Special Edition

Using

Visual Basic® 6

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Brian Siler and Jeff Spotts

Special Edition Using Visual Basic® 6

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To Julia, Larry, Ben, and Brent for all of your loyal support.
- Brian Siler

To my lovely wife Tina and our beautiful daughter Lauren, for making me smile every single day. You make me better at everything I do.
- Jeff Spotts

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Brian Siler works as a senior programmer analyst for a major hotel corporation, developing its executive information system in Visual Basic. Brian is a graduate of the University of Memphis with a B.S. in Computer Science. He has developed applications using Visual Basic, C, HTML, and SQL on a variety of platforms including PCs, AS/400, UNIX, and Vax. He was the co-author of Que's *Special Edition Using Visual Basic 5, Second Edition*, and Que's *Platinum Edition Using Visual Basic 5*. Brian may be contacted via e-mail at `bsiler@bigfoot.com`.

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Introduction

In this chapter

Fundamental Visual Basic Programming 2
Working with Visual Basic Components 3
Creating Application Interfaces 4
Advanced Visual Basic Programming 4
Database Programming Techniques 5
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Conventions and Special Elements Used in This Book 6

Congratulations! You have decided to embark on learning Visual Basic.

This is an exciting time; there never has been a better time for Visual Basic programmers. While Visual Basic has always made it easy to develop Windows programs, through the years it has matured into a true professional development language and environment. You still can quickly create Windows programs with Visual Basic, but now you also can write enterprise-level client/server programs and robust database applications. In fact, the newest version contains several enhancements that greatly increase the power and flexibility that programmers have to write database-enabled applications. While this is enough to get you hyped up about programming in Visual Basic, there's even more available in Visual Basic version 6.

As you know, the Internet is revolutionizing computing. You also may have seen enough of Internet programming to think that it is reserved for only a select group of programmers. Visual Basic version 5 introduced several tools that let you work more easily with the Internet. Now, in version 6, these Internet tools are even more powerful and easy to use. There are tools that let you easily connect your programs to the Internet and include browser capabilities in your programs. In addition, over the past year or so, certain Web servers and browsers have added support for a special flavor of Visual Basic known as VBScript. The Visual Basic knowledge that you acquire will translate easily into the ability to create VBScript code as well.

With VBScript, you can create ActiveX documents and ActiveX controls from Visual Basic. Because ActiveX is a critically important part of Microsoft's Internet strategy, this puts you right in the middle of the action. And the really good news is that all of your ActiveX pieces can be used in non-Internet programs as well, extending the usefulness of any ActiveX components you create. The ActiveX components you create can even be used by programmers working with other languages, such as C++.

Microsoft also has integrated a special version of Visual Basic known as Visual Basic for Applications (VBA) into all the components of the Microsoft Office suite, Microsoft Project, and several other programs. Because VBA is the core language component of Visual Basic, this means that all your knowledge of Visual Basic can be applied to writing applications and macros for other products. And because Microsoft has licensed VBA to dozens of companies, you will soon be able to write applications and macros for those programs, as well. All this benefit comes from your Visual Basic knowledge.

Okay, so now you are excited about learning Visual Basic. Your next question is, "What will this book do for me?"

Fundamental Visual Basic Programming

Although this book presents a lot of material on advanced Visual Basic programming, you can't just jump into these topics and expect to understand them. You need a good foundation from which to work.

In Part I of the book, "Getting Started with Visual Basic," you are introduced to what Visual Basic can do and how to work in the development environment.

Chapter 1, “Starting Out with Visual Basic,” discusses how Visual Basic works to create Windows-based computer programs and starts you out designing your first program.

In Chapter 2, “Creating Your First Program,” you work step-by-step through the process of building a fully functional application in Visual Basic.

Chapter 3, “Visual Basic Building Blocks,” takes you on a tour of forms and controls, which are the fundamental components of every program you will create in Visual Basic. You will see how you can manipulate forms and controls by modifying their properties and how you can perform tasks with their methods.

In Chapter 4, “Using Visual Basic’s Default Controls,” you learn how to work with the group of controls that is most commonly used when designing your applications.

Part II, “Programming with Visual Basic,” covers the basics to get you started on your programming adventure.

Chapter 5, “Responding to the User with Event Procedures,” discusses how Visual Basic programs become interactive. You’ll learn how to make your programs react to the various actions your users can initiate.

In Chapter 6, “Giving More Control to the User: Menus and Toolbars,” and Chapter 7, “Using Dialog Boxes to Get Information,” you look at how you can enhance your programs by using menus, toolbars, and dialog boxes. These program components give your users an interface that is familiar because of their experience with other Windows programs. The proper use of menus, toolbars, and dialog boxes makes your programs more intuitive to the user. You also examine the Event model, which is the cornerstone of programming in a Windows environment.

In Chapter 8, “Using Variables to Store Information,” and Chapter 9, “Visual Basic Programming Fundamentals,” you are led into the world of programming commands, structures, and variables. Visual Basic is built upon the solid foundation of the BASIC language. The Visual Basic language is rich in features and functions that let you write programs to handle practically any task. You learn how to create and use variables, and how to perform math and string operations. Chapter 10, “Controlling the Flow of Your Program Code,” explains how to control your program through the use of decisions and loops and through error handling.

Chapter 11, “Managing Your Project: Sub Procedures, Functions, and Multiple Forms,” takes you even further into the programming concepts that will help you enhance your program code.

Working with Visual Basic Components

Part III, “Visual Basic Program Components,” expands the fundamental knowledge that you have gained so far by exploring various types of components you can use to enhance your applications. Think of these components as building blocks that are more advanced than the basic ones you learned about in preceding chapters.

Chapter 12, “Microsoft Common Controls,” introduces you to even more of the controls that Visual Basic provides for you to use when you build your programs.

In Chapter 13, “Working with Control Arrays,” you learn more advanced techniques for using groups of variables to make your programs more efficient.

You learn much about ActiveX components in Chapter 14, “Creating ActiveX Controls,” and Chapter 15, “Extending ActiveX Controls.” These components can be used in Visual Basic programs, Internet applications, or other ActiveX-enabled programs. These chapters walk you through the process of creating, and then enhancing, your own ActiveX controls.

Chapter 16, “Classes: Reusable Components,” teaches you how to create classes, which allow you to take advantage of a very powerful programming feature that simplifies your work when you have many programs that perform similar tasks.

Creating Application Interfaces

In Part IV, “Visual Basic Interfaces,” you are introduced to some concepts of designing your programs’ interfaces, which is what your users will interact with.

In Chapter 17, “Multiple Document Interface Applications,” you learn how to create a Multiple Document Interface (MDI) program. This type of program enables your users to work with multiple windows contained within one main window. You’ll see how MDI applications differ from those created with single forms.

Chapter 18, “Proper Interface Design,” and Chapter 19, “Using Visual Design Elements,” discuss reasons why it is important to design your program before you start writing code. You will also see some of the things that make a bad user interface and learn how to avoid some of the common design mistakes.

Advanced Visual Basic Programming

Part V, “Advanced Programming Topics,” consists of several topics that that go beyond the concepts you have already learned to focus on some very specific programming techniques.

Chapter 20, “Accessing the Windows API,” shows you how to access the multitude of predefined programming routines available in Windows’ Applications Programming Interface. You will see how your programs can take advantage of a vast library of code that is available to any Windows application.

Chapter 21, “Working with Files,” discusses how your programs can use different types of files for information storage and retrieval purposes.

Chapter 22, “Using OLE to Control Other Applications,” shows you how to use OLE to have your programs interact with other programs, taking full advantage of the power of OLE.

Chapter 23, “Master’s Toolbox,” demonstrates several standalone Visual Basic applications that perform a variety of interesting tasks.

Database Programming Techniques

Database programs make up a large percentage of all programs in use in the business world today. These programs range in complexity from simple programs for managing mailing lists to complex programs handling reservations and billing for major corporations. Part VI, "Visual Basic and Databases," takes you through the process of building database applications to meet a variety of needs.

Chapter 24, "Database Basics," discusses how to create and manipulate a database. You continue in Chapter 25, "The Data Control and Data-Bound Controls," by learning how to quickly create applications using the Data control in conjunction with the controls that can be bound to it.

Chapter 26, "Using Data Access Objects (DAO)," and Chapter 27, "Using Remote Data Objects (RDO)," show you how to harness the programming power that is available for creating database applications.

Chapter 28, "Using ActiveX Data Objects (ADO)," introduces you to Microsoft's latest model for working with databases.

Finally, Chapter 29, "Creating Reports," shows you how to output data from your database applications using the new Data Report Designer and Crystal Reports, a third-party reporting tool.

Internet Programming

In Part VII, "Visual Basic and the Internet," you are exposed to the growing world of using variations of Visual Basic for Web-based applications.

Chapter 30, "Using VBScript," teaches you about this up-and-coming cousin of Visual Basic. You will apply much of this knowledge in Chapter 31, "Active Server Pages," where you learn how VBScript is processed by Web servers to provide flexibility in the information that is presented on the Internet.

Chapter 32, "ActiveX Documents," extends the ActiveX concepts that you learned earlier into the ability to create ActiveX components that can be shared in an advanced way.

Chapter 33, "Visual Basic and Other Uses of the Internet," shows you how to Web-enable your Visual Basic applications. Among other topics, you learn how to add Internet-browsing and e-mail capabilities to your programs.

Additional References

You can use Part VIII, "Appendixes," as a guide to some of the things you'll need to know as you develop your Visual Basic applications.

Appendix A, "Introduction to the Development Environment," gives you a tour of Visual Basic's interface. You can use this appendix as a guide while you explore the Visual Basic environment.

Appendix B, "Packaging Your Applications," shows you how to prepare the Visual Basic programs that you write for distribution.

Appendix C, "SQL Summary," presents the fundamentals of Structured Query Language (SQL), which is used to perform operations such as data retrieval on databases. This information will be of value to you as you read the chapters that deal with accessing databases from your Visual Basic programs.

Source Code and Programs Used in This Book

All the source code from the listings and programs included in this book is available via download from the Que—Macmillan Computer Publishing Web site. You can download the listings code to save typing time and errors as you follow examples in the book. You also can obtain all the programs built in the book and additional sample programs we've included.

To access this material, follow these steps:

1. Point your browser to the following URL:

   `www.mcp.com/info`

2. Enter the book's ISBN as directed:

   `0-7897-1542-2`

3. Follow the instructions to access and download the specific code or program you are looking for.

Conventions and Special Elements Used in This Book

This book includes various conventions and special elements to highlight specific things and make using the book easier. Familiarize yourself with these conventions and elements, and allow them to enhance your reading experience.

Conventions

The following list details conventions used in the book:

- *Italic type* is used to emphasize the author's points or to introduce new terms.
- Screen messages, code listings, and command samples appear in `monospace type`.
- URLs, newsgroups, Internet addresses, and anything you are asked to type also appear in `monospace type`.
- Keyboard hotkeys are indicated with <u>underlining</u>. For example, if you see the command <u>T</u>ools, <u>O</u>ptions, pressing Alt and T causes the Tools menu to open. You can then press O to select the Options menu item.

- Occasionally, a code sample or listing will show a portion of program code with certain lines set in **`bold monospace`** type. In such cases, the bold type signifies code you are to add to existing code. This approach enables you to see what you are supposed to add or change in context.
- Because of the space limitations of this book's pages, a few code lines in this book's examples cannot be printed exactly as you must enter them. In cases where breaking such a line is necessary to fit within the book's margins, the Visual Basic continuation character (_) will be used at the end of the line that is broken. You can leave these characters out and enter the code on a single line, or just enter the characters as they appear. Visual Basic will understand the code either way.

Special Elements

Certain types of information is set off in special book elements. The following explanations and examples indicate the kinds of elements you will encounter in the book.

Each chapter begins with a "road map," or list of the key topics covered in the chapter, along with a page number so you can easily find the relevant material. Then at the end of each chapter, a "From Here…" section summarizes briefly the topics discussed in the chapter and refers you to other chapters that cover related material or extend the topic you just read about.

▶ **See** cross-references within each chapter for directions to more information on a particular topic.

TIP Tips present short advice on a quick or often overlooked procedure.

NOTE Notes provide additional information that might help you avoid problems, or offer advice that relates to the topic. ■

CAUTION

Cautions warn you about potential problems that a procedure might cause, unexpected results, and mistakes to avoid.

Sidebar

Longer discussions not integral to the flow of the chapter are set aside as sidebars. Look for these sidebars to find out even more information.

PART I

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CHAPTER 1

Starting Out with Visual Basic

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Computer Programs and Programming Languages **13**

Visual Basic Is a Smart Language **14**

The Importance of Designing Your Program **14**

When people find out I know something about Visual Basic, I am often asked questions such as the following:

- What is Visual Basic?
- Is Visual Basic a program?
- What can you do with Visual Basic?
- Why should I learn Visual Basic?

Microsoft's Visual Basic product is defined as a *programming system*. Simply put this programming system is used to write Windows-based computer programs; it includes the Visual Basic language as well as a number of tools that help you write these programs. You don't use Visual Basic as a productivity tool; you use it to create customized productivity tools. By using Visual Basic to create your own customized programs, you (or your company) are not bound by the limitations of a particular "off-the shelf" computer program; rather, you can design applications to meet your own specific needs. A good computer program should be flexible enough to fit the task at hand, rather than having to modify your needs to fit the program.

This chapter introduces you to the concept of a computer program and discusses programming languages as they pertain to creating your own programs. The chapter concludes with some important considerations related to planning and designing a program. This material provides a bit of context for Chapter 2, "Creating Your First Program."

What Is a Computer Program?

With Visual Basic, you can design programs, also known as *applications*, to accomplish just about any task you can imagine. Computer programs generally fall into two very broad categories—packaged and custom.

Packaged programs are those that you can purchase in a software store, via mail order, direct from a manufacturer, and so on. Packaged programs are predesigned to accomplish some specific task. For example, you may purchase Microsoft Word to meet your word processing needs, Symantec's WinFax Pro to enable your computer to send and receive faxes, or McAfee's VirusScan to help prevent viruses from attacking your system. You may also be interested in game programs such as Broderbund's Myst or Microsoft Flight Simulator. All these programs are among the thousands upon thousands of software packages that are available for Windows-based PCs.

Custom programs are usually designed for a specific purpose within a particular organization. For example, a company may need an application that tracks product orders from the time they are placed until they are actually shipped. If there is no packaged program available that meets the company's specific needs, a custom program could be developed. One advantage of a custom program in this case is that the program can be continually modified as the company's needs change—packaged programs generally can't be modified by the user.

NOTE Some computer programs fall in between our characterization of packaged and custom programs. A number of software developers offer customized versions of their programs that start off as packaged programs. This is quite common among *vertical-market* software developers—those who create programs that are used in a specific industry. For example, I have spent a number of years developing a software system that is used by exposition managers to manage flea markets, antique fairs, trade shows, and so on. All my clients use the same basic system, but many of them have asked for special customization features that apply to a specific situation.

Another of these types of "hybrid" programs is actually meant to work as a customized interface to a packaged program, in effect enabling a user to customize a program that wasn't designed as customizable!

One thing that all computer programs have in common, however, is that they are developed using one or more programming languages such as Visual Basic.

Computer Programs and Programming Languages

A computer program is nothing more than a set of instructions that a computer follows to accomplish a specific task. A programming language such as Visual Basic is used to translate instructions as we humans understand them into the steps that the computer can comprehend and follow.

When you get down to a computer's most basic level, the microprocessor that is at the core of the computer's functionality doesn't understand anything other than numeric instructions. To make matters worse, the only instructions that the processor can understand are incredibly simplistic commands, most of which have to do with moving numbers around between memory locations. These commands that the processor understands are known as *machine language*, or the most basic language that the machine (the PC) can use.

Machine language is known as a *low-level* language, because it's all the way down at the processor's level of understanding. As you might imagine, writing programs in machine language is an incredibly daunting task. Fortunately, you don't have to get down to that level to create computer programs. Several higher-level programming languages have been developed to enable us to write programs. These programming languages allow programmers to write instructions in something resembling English; the instructions are then converted into a program containing machine-language instructions that the processor can understand.

Some examples of programming languages that have developed over the years include Fortran and COBOL, which are generally used with mainframe computers, as well as BASIC, Pascal, C, and C++, which are commonly used to write programs at the personal computer level.

Visual Basic is a descendant of BASIC, which has been around for a number of years. BASIC (Beginner's All-Purpose Symbolic Instruction Code) was originally developed, as the name implies, as a language for beginners. BASIC was often the first language that programmers learned in order to become familiar with programming basics before moving on to more powerful languages.

With the advent of Windows, Microsoft developed Visual Basic, which is a *visual* (graphical) version of BASIC. Since its introduction, Visual Basic has developed into an extremely powerful application development tool, leaving its reputation as a beginners' language far behind.

One very nice feature of Visual Basic is the fact that you can use it to create a solid application very quickly. As you'll see throughout this book, Visual Basic makes short work of what would normally be very time-consuming programming tasks. This frees up the programmer to spend his time developing the application's functionality, rather than spending time on mundane, repetitive programming tasks. Visual Basic is often referred to as a Rapid Application Development (RAD) tool.

Visual Basic Is a Smart Language

The main reason why Visual Basic is so popular and powerful is the same reason behind the success of Windows. Microsoft took a complex technology (writing computer programs) and made it easier to use through a graphical interface. Suppose you have to write a program for your company. In a visual programming environment, you can quickly design the windows that the user sees by drawing and arranging them just as you would lay out elements for a newspaper. In a text-based programming system, you control the user interface through program language commands. Common sense tells you that the visual programming method is easier for newcomers to learn and requires less time to maintain. In this case, the old adage "a picture is worth a thousand words" truly applies.

However, do not let me give you the impression that Visual Basic is just another pretty interface. Another key concept of Visual Basic is the ability to create and use self-contained components, or *objects*. One type of object that you learn about very shortly is a Visual Basic control.

Controls are elements you can use when designing a user interface, just like the real-life controls on a car dashboard. These controls can be used to display information (like a speedometer) or take action (like the ignition switch). The underlying operations of the car, such as the relationship between ignition, starter, and engine, are hidden from the driver; he "communicates" with the car through a clearly defined interface. In the same way, Visual Basic controls enable you to add features to your programs without you having to be involved in the details of how these features work. For example, receiving input from a user of your program is as simple as drawing a control that accepts input. This is a great advantage of visual programming languages—you can concentrate on what you want your program to do, not how to get the programming language to do it.

The Importance of Designing Your Program

A college English professor of mine was once describing different types of novelists: "A traditionalist author usually orders his story beginning-middle-end, a modernist might reverse that order, and a post-modernist would only include two of the three parts."

Unfortunately, authors of computer programs don't have that luxury. Due to the structured nature of computing, it's critically important to design your programs *before* beginning to code them. Many programmers tend to want to dive in and start coding right off the bat, but you should get into the habit of planning, even with small programs. If you do nothing else, sit down with a blank sheet of paper, make some notes about what you want the program to accomplish, and sketch out what the user interface should look like.

NOTE Please keep in mind that the strategy presented in this chapter is by no means the only approach to programming, but rather one set of general guidelines. Your technique, of course, may be totally different.

How Design Fits into the Programming Process

When creating a computer program, it's important to take a structured approach. Certain steps need to be accomplished in a certain order, and you might as well get used to doing things the right way. It's always tempting to fire up Visual Basic and dive right in to designing and coding the program, but a little time spent with proper planning can save you a lot of headaches later in the process.

The key steps in creating a computer program are as follows:

1. Plan the program's tasks (how it should work).
2. Design the user interface (how it should look).
3. Write the program's code (implement steps 1 and 2).
4. Test and debug the program (including beta testing with users outside of the development team, if appropriate).
5. Document and distribute the program (put it in use).

These steps are very generalized and definitely not all-inclusive. As I discuss the sample program in this chapter, I'll list some steps specific to Visual Basic programming.

The first two steps listed define the core process of actually building the program. The sample program in Chapter 2 provides a context for explaining some of the specifics in designing and building a Visual Basic program. Although you run the sample program in Chapter 2, the last two steps aren't covered until later in the book.

NOTE If you are tackling a large project, breaking it down into smaller pieces will make it much more manageable. Many of Visual Basic's features can be used to divide up a large project among members of a development team.

Program Design in a Nutshell

When starting a new project, it is tempting to just sit down and start hacking out code. After all, drawing the interface and writing the program code is the most fun and creative aspect of programming. However, a good program starts with a solid design. An in-depth flowchart

might not be necessary for very small-scale projects, but on the other hand it is always a good idea to start with a plan.

The design process should produce the following results:

- A concise list of tasks to be performed by the program.
- Deadlines for when particular tasks need to be completed.
- Clarification of the dependence of one part of the program on another.
- The criteria for testing the program.

For a program like the example in Chapter 2, the design can be a simple statement of what the program should accomplish. For more complex programs, the design might include written criteria, data diagrams, flowcharts, a milestone document, and a test and acceptance plan. It is up to you and your client (the program's user) to determine the right level of documentation that is necessary for a given project. However, you should always make sure that the design is clearly spelled out, and you should always write it down.

From Here...

This chapter has exposed you to the fundamentals of writing Visual Basic programs. The following chapters will get you started in developing your own applications:

- To step through the process of developing a Visual Basic program, see Chapter 2, "Creating Your First Program."
- For an explanation of the fundamental pieces that comprise Visual Basic programs, see Chapter 3, "Visual Basic Building Blocks."
- For a more in-depth discussion of writing Visual Basic applications, see Chapter 9, "Visual Basic Programming Fundamentals."

CHAPTER 2

Creating Your First Program

In this chapter

Creating Your Program's User Interface 18

Getting Information From the User 23

Changing a Form's Properties 30

Coding Your Program's Actions 31

Running Your Program 36

It's common among programming texts to have the reader begin by creating a very basic first program along the lines of the classic `Hello, World` application. In this extremely simple example, the user is asked to initiate some action such as clicking a button or pressing a key, and the computer responds with a message such as "Hello, World!" A slightly more advanced variation asks for the user's name and responds with a customized greeting like "Hello, Lauren!"

Although these examples might be sufficient for demonstrating that you can indeed use a programming language to create a program, the resulting application isn't very useful. Our approach is to begin with a sample program that not only demonstrates the fundamentals of creating a Visual Basic application, but can also be used in the real world.

In this chapter, you'll create a Loan Calculator program that calculates the periodic payment needed to repay a loan, based on various factors such as the loan term and interest rate. Your users will be able to input and modify values for these and other variable factors, perform the calculation, and view the results. In addition, they will be able to view an amortization schedule for the entire life of the loan.

As you can see, the preceding paragraph specified what the program would do and what information was required to perform the task, and provided some information about how the interface should be designed. That wasn't so bad, was it?

NOTE The application you'll be creating was adapted from a shareware program I wrote named My Amortizer. With proper planning and design, Visual Basic can be used to create commercial-quality software applications.

Creating Your Program's User Interface

A program's *user interface* refers to the part(s) of the program that the user sees and interacts with. As you develop this application's interface, you'll see how to use some of the many tools provided in Visual Basic's Integrated Development Environment (IDE). As discussed in Chapter 1, "Starting out with Visual Basic," the Visual Basic IDE makes short work of interface design, which was once a daunting task at best.

Before you begin, take a look at what the final product will look like. Figure 2.1 shows the Loan Calculator's main screen as it's being used.

Getting Started

Let's begin by creating a new project. A *project* is simply a set of files that store information about the components that make up an application (program). To create a Visual Basic program, you customize your project's various components.

To get started with the Loan Calculator program, start Visual Basic; you will see the New Project dialog box shown in Figure 2.2. If Visual basic is already running, or if you don't see the New Project dialog, choose File, New Project (see Figure 2.3).

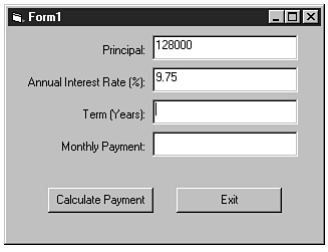


FIGURE 2.1
The Loan Calculator program offers the user a variety of options.

FIGURE 2.2
When Visual Basic starts, this version of the New Project dialog box is shown.

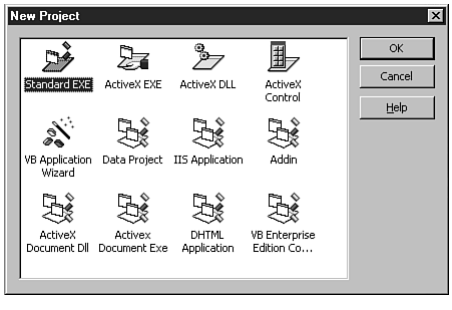


FIGURE 2.3
This version of the New Project dialog box is presented when a new project is begun after Visual Basic is already running.

The New Project dialog box enables you to specify the type of project you want to create. For the Loan Calculator project, select the Standard EXE option and click OK. You will then be placed in Visual Basic's design environment, as illustrated in Figure 2.4.

NOTE Due to Visual Basic's many customization features, your screen may not look exactly like the one shown in Figure 2.4.

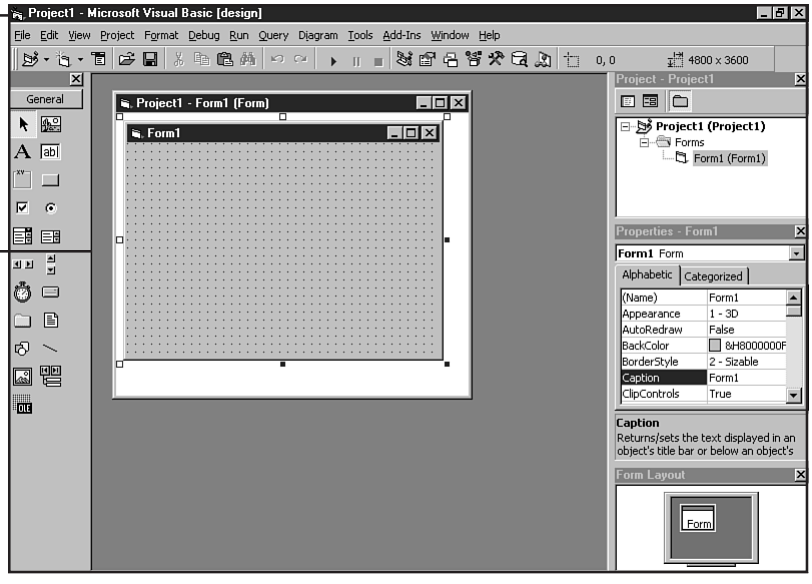


FIGURE 2.4
Visual Basic's design environment is the canvas for creating your application.

First off, notice Visual Basic's title bar—specifically, the word *design*. This means that you are in *Design mode*, also known as *designtime*, a name for the time you spend designing your program. Later, when you run your program, Visual Basic will be in *Run mode*.

As you see, a new Standard EXE project consists of one *form*, or window, which will usually be your program's main user interface. Visual Basic applications are comprised of one or more components, such as forms, code modules and classes, along with controls and other components.

Look at the *Project Explorer* (illustrated in Figure 2.5). It consists of a list of the contents of the current project. Because you've just begun this project, it only contains a single form named `Form1`, which is located in the `Forms` folder of the project (named `Project1` by default). A project can grow to include many components; the Project Explorer helps keep them organized.

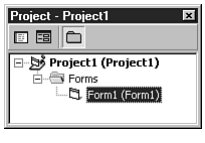


FIGURE 2.5
The Project Explorer lists all the components that make up a project.

Saving Your Work

It's bound to happen eventually—your system crashes, the electricity goes out, or Fido kicks out your computer's power cord, and all your hard work is gone. To minimize your losses when something like this (inevitably) happens, you should get in the habit of saving your work to your hard disk as soon as you begin a new project, and then save it frequently as your application grows. At the very least, you should always save your application before running it. That

way, if running your program causes the system to crash (yes, it can—and does—happen to the best of us), you won't lose your work.

Saving Visual Basic Projects The process of saving a project is a little more complex than you might expect; however, with a little practice you'll have no problem. To save a project, you must save each component of your project (each form, code module, and so on) into its own file, and then save the project itself into its project file. Think of the project file as a list of the names and locations of the components that make up the project.

TIP It's a good idea to create a folder on your hard drive for each project that you work on. This makes it easy to keep all the files that make up a particular project organized in one place. If you follow this practice, you can also store non–Visual Basic files, such as documentation, project cost analysis spreadsheets, customized graphics, and so on, in the same folder.

To save a project, choose File, Save Project from the Visual Basic menu system, or simply click the Save Project button on the toolbar. The first time you save the project, (or after you subsequently add any files to the project) you'll be led through one or more of the Save File As dialog boxes (see Figure 2.6), one for each of the project components, and then a Save Project As dialog box for the project file. You specify the name and location of each file where the components (and project) are to be saved. Subsequent Save Project operations simply resave the components using the same filenames as before. Then you can easily execute frequent, quick saves of a previously saved project by clicking the Save Project button. If one or more components have been added to the project since it was last saved, the Save File As dialog box will be presented for each new component.

NOTE Visual Basic has an option that assists you in making sure your project is properly saved. Choose Tools, Options from Visual Basic's main menu, and then click the Options dialog's Environment tab. In the When a Program Starts frame, you can tell Visual Basic to automatically save any changes to your project when you run it, or to prompt you to decide if changes should be saved before running.

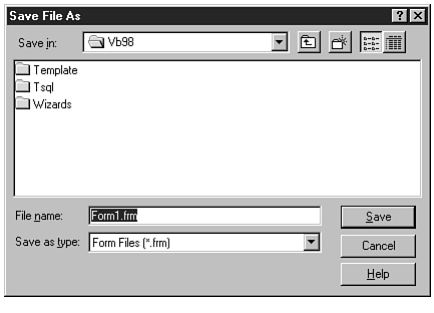


FIGURE 2.6
The Save File As dialog box enables you to specify the name and location of the files that store your application's components.

TIP You can save a single project component individually by selecting the component in the Project Explorer and choosing File, Save *(component name)* in the menu system, or by right-clicking the component in the Project Explorer and choosing Save *(component name)* from the context menu that appears. You can also save a component with a different filename than it was originally saved under by using one of these methods and selecting the Save *(component name)* As option.

Saving the Loan Calculator Project Now let's save the sample Loan Calculator project. Choose File, Save Project, or click the Save Project button on the toolbar. You will first be prompted to save your application's one form (`Form1`). This displays the Save File As dialog box so you can specify the name and location of your application's files:

- The *File Name* text box is used to name the file where the component will be stored. In the example, the default filename of Form1.frm is presented. Change the filename to the more descriptive `LoanCalcMain`. You don't need to add the file extension .FRM; it will be automatically appended to the filename you enter.
- The *Save In* drop-down list box at the top of the dialog box enables you to specify the *location* where the component should be stored. If nothing has been saved during this Visual Basic session, a default folder (usually the folder where Visual Basic resides) will be presented. Use the Save In drop-down list box to navigate to the folder where you want to store the files that make up this application. If necessary, you can use the Create New Folder button to make a new folder for the project.

CAUTION

Never save your application's component files in the same folder as Visual Basic's program files. It's usually good practice for an application to have its own folder.

For the purposes of this example, navigate to the root of your hard drive, use the Create New Folder button to make a new folder, and change the folder's name from `New Folder` to `LoanCalc`. Then double-click the `LoanCalc` folder to make it current, and click Save to complete the operation.

After you've saved the form, you'll be presented with the Save Project As dialog box, where you can specify the name and location of the project file. The default location should now be the same location where you saved the form file. Change the suggested filename Project1.vbp to Loan Calculator (the extension .VBP, for Visual Basic Project, will be added for you). Click Save to finish.

Now that you've laid out the application's infrastructure and named and saved its files, you're ready to begin true development. Of course, in order for your program to process data, you need to plan how to get the necessary data from the user.

NOTE Depending upon the options that were chosen when Visual Studio was installed, you may be presented with a dialog box asking if you want to add the project to SourceSafe.

SourceSafe is a system that helps ensure that project source files are properly protected and backed up, and it helps organize different versions of source files. For now, just answer No to this question.

Getting Information from the User

Most computer programs are interactive—they need to receive information from the user as well as provide information to the user. A Visual Basic program interacts with its user through controls that are placed on the program's form(s). A *control* is an object you place on a form that interacts with the user or the program. Many of Visual Basic's controls can be used to obtain input from the user.

The user interface for the Loan Calculator program will be responsible for accepting input, displaying output, and initiating the loan calculations. You use three of Visual Basic's most commonly used controls:

- *TextBox* controls to accept textual information needed from the user, and to display certain information back to the user.

- *Label* controls to act as captions, displaying information to the user. Labels are similar to TextBoxes, except that the user can't edit the information presented in them.

- *CommandButton* controls, which the user can click to initiate program actions.

All these controls are part of the basic set of controls found in Visual Basic's Toolbox (see Figure 2.7).

FIGURE 2.7
Visual Basic's Toolbox contains the controls needed to build applications.

Adding a TextBox Control

The TextBox control, also known simply as a *text box*, is (as its name implies) a *box* that displays and accepts *text*. In a way, it's similar to a text box you might find on a survey form. It can accept input (from a pen or pencil) as well as display information. The TextBox control is one example of how far programming languages have advanced. Earlier programming environments required a lot of work to exchange information with the user. Visual Basic works in

conjunction with Windows to take care of the mundane details of where the text is positioned on the screen, how it's retrieved from the user, and so on. Your Visual Basic program simply needs to be concerned with the text in the text box; the control itself takes care of the rest.

Adding a Control to a Form In order for a Visual Basic program to use a control, that control must be placed on a form. For your Loan Calculator program, you begin by placing a TextBox control on the main form:

1. Click the tool for the TextBox control in the Toolbox. If you aren't sure which is the TextBox control, let your mouse pointer pause over each in turn to see a ToolTip.
2. Move the mouse pointer to the form. Note that the pointer changes to a crosshair, indicating that you're about to draw a control.
3. Move the pointer to one corner of the area where you want to draw the control.
4. Click and hold the left mouse button.
5. Drag the mouse to where you want the diagonally opposite corner of the control. As you drag the mouse, notice that a sizing box appears from the first corner of the control's location (where you first clicked the mouse button) to the current mouse pointer location. This box indicates where the control will eventually be (see Figure 2.8).

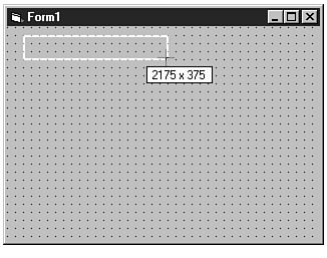


FIGURE 2.8
A ToolTip-type box appears showing the actual dimensions of the control in twips (a special unit of measurement that will be covered later in the book).

6. When you're satisfied with the size and shape of your control, release the mouse button. The control will be drawn on the form (see Figure 2.9).

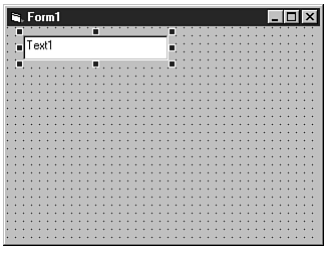


FIGURE 2.9
The completed text box appears on the form and is selected (notice the sizing handles).

TIP You can also add a control to a form by double-clicking the control's Toolbox icon. This places a control of a default size in the center of the form. You can then move and resize the control as desired with the sizing handles, as described in the upcoming section, "Moving and Resizing a Control."

The procedures used to draw the TextBox control are the same as those for drawing most controls on a form.

Setting a Control's Properties After you have added a control to a form, you will usually want to set one or more of the control's properties. *Properties* are settings that control the appearance and behavior of an object. For the text box you just added, you want to set the `Name` and `Text` properties.

The `Name` property is very important. It is used in program code to identify the control. Because a program will likely have many controls of the same type, you can use the control's name property to identify the particular control for which a particular code statement is written.

Every control must have a name, which is represented by the value of its `Name` property. In addition, every control on a particular form must have a *unique* name, unless it's part of a control array. (*Control arrays* are covered in detail in Chapter 13, "Working with Control Arrays;" for now, just make sure all your controls on a given form have unique names.)

Visual Basic assigns a default name to every control placed on a form. Because this is the first text box you've placed on this form, its default name is `Text1`. Subsequently placed text boxes would be named `Text2`, `Text3`, and so on. It's very good programming practice to change the default control names to be more descriptive. Assume, for example, you have three text boxes on a form that are used to accept a customer's last name, first name, and address. If you change the default names of `Text1`, `Text2`, and `Text3` to something more descriptive, such as `txtLName`, `txtFName`, and `txtAddress`, it will be much easier to remember what each control's purpose is when you (inevitably) must modify your program's code at some future date.

TIP Note that the control names suggested begin with the prefix `txt`. It's common to begin a control name with a three-character lowercase prefix denoting the type of control; the rest of the name describes the control's purpose. Thus, when debugging program code, it is immediately clear that `txtLName` refers to a TextBox control that contains last name information. Other commonly used prefixes include `lbl` for Label controls and `cmd` for CommandButton controls.

To change the name of the first text box you placed on the form for the Loan Calculator project, you must first make sure the control is selected. The *selected* control is the one for which properties will be changed in the Properties window. As you'll see a little later, multiple controls can be selected at the same time. You can tell if a control is selected if it has a series of eight sizing handles around its borders. The selected control's name also appears in the Properties window's Object box, which is the drop-down list just below the Properties window's title bar. If the desired control isn't selected, simply click it one time to select it.

Now that the control is selected, look at the Properties window. The left column of the Properties window is a list of properties that apply to the selected object at design time. Each

property's current value is denoted in the right side of the Properties window. Look for the `Name` property in the left column, which appears at the top of the list (because the `Name` property is so important, it appears before all the other properties, which are presented alphabetically. You can also sort the properties by Category by clicking the Categorized tab). Click the `Name` property, making it the current property (note that the property name is highlighted). Note the default value—`Text1`—of the `Name` property on the right side. At this point, you can simply type a new value for the `Name` property, or edit the existing value. Change the value of your TextBox control's `Name` property by typing a more descriptive name—let's use `txtPrincipal`—and pressing Enter. Figure 2.10 shows the Properties window after making this change.

A TextBox control's `Text` property represents the text that's entered in the box—that is, what is displayed inside the box on the screen. As the user types in a text box, Visual Basic constantly modifies the text box's `Text` property to reflect the current contents of the box. By default, a new text box contains its own name; your new text box contains `Text1` in its `Text` property (recall that `Text1` was the control's name when it was created). You don't want anything in the `Text` property when the program starts; in other words, you want the box to start off empty. To accomplish this, locate the TextBox control's `Text` property in the Properties window. Select the current value (`Text1`), and press the Delete key.

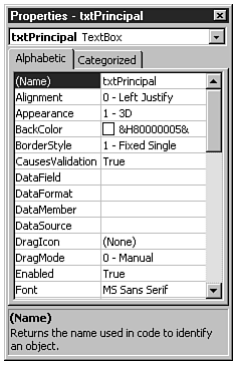


FIGURE 2.10
Use the Properties window to set values for your controls' properties.

Adding the Remaining Text Boxes Now that you've added one TextBox control to the form, it should be a simple matter to add the other text boxes that you need for your Loan Calculator program. Add three more text boxes to the form; name them `txtIntRate`, `txtTerm`, and `txtPayment`. Clear their `Text` properties as well. When you're done, your form should look similar to the one in Figure 2.11.

If your form doesn't look exactly like the one in Figure 2.11, don't worry. One nice thing about a visual design environment is that you can change the appearance of objects quite easily.

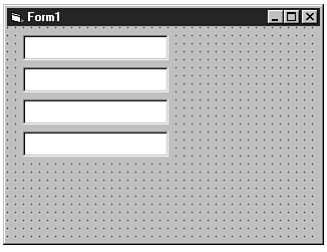


FIGURE 2.11
The interface of the Loan Calculator program has four text boxes.

TIP To draw multiple controls of the same type, hold down the Ctrl key when you select the control's tool in the Toolbox. That tool will remain selected in the Toolbox even after you've finished drawing a control. You can keep drawing multiple instances of that control without having to reselect the tool. When you're through drawing that control, select the Toolbox's pointer tool to return the mouse pointer to its normal state.

Moving and Resizing a Control If you don't like where a control is positioned, use the mouse to drag it to a new location. If you pause while dragging it, note that the control's current position (relative to the form's top-left corner) is displayed as a ToolTip.

If you want to change the size of a control, you must first select it, which causes the sizing handles to appear. You can then use the mouse to change the control's size by dragging the sizing handles. The handles on the control's top and bottom edges change its height. The handles on the control's left and right edges change its width. The handles on the control's corners change its height and width simultaneously. Note how the sizing box described earlier appears as you're resizing the control to help you visualize the control's final size.

Now that you have created text boxes for the user's input, you should label them so that the user knows what to enter in each box. To make room for the labels, move the text boxes to the right. You could drag each text box individually; however, it is quicker to move them all together at the same time. You can easily select them all and move the entire group. To do this, click one of the text boxes to select it, and then hold down Ctrl while you click each of the others. Notice that each text box that you select in this manner gets its own set of sizing handles. After you've got them all selected, begin dragging one of them. As you drag, the entire group is dragged at once. Drop the controls on the right side of the form; when you're done, your form should look like Figure 2.12.

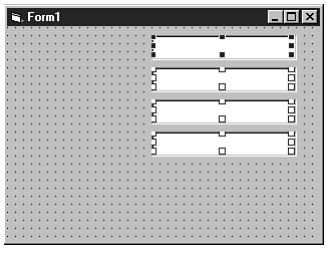


FIGURE 2.12
Selecting multiple controls enables you to move them together as a group.

TIP Instead of Ctrl+clicking multiple controls, you can select a group of controls by drawing a rectangle around them. Click and hold down the left mouse button in an empty area of the form. Note that a "rubber-band" box stretches as you move the mouse. Draw the box around all the controls you want to select.

Labeling Your Program's Controls

Obviously, the user needs to know which values are to be entered into each of the text boxes. The easiest way to do this is to add a Label control next to each text box. The label will then act as a caption for the text box, containing a brief description of what data is to be entered there.

Although the user perceives Label controls and TextBox controls to be quite different, they are very similar from a programmer's perspective. They can both contain the same types of text, although the text in a Label control can't be modified by the user. However, by setting various properties of a Label control, the *appearance* of the text contained in it can be altered in many ways. Figure 2.13 illustrates several Label controls demonstrating a variety of looks.

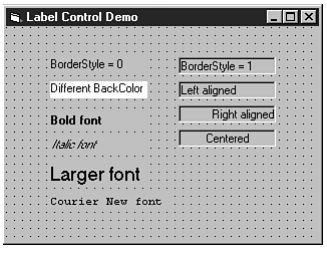


FIGURE 2.13
Labels can take on many different sizes and appearances.

To continue your earlier analogy of a survey form, Label controls are like the words that are pre-printed on the form to identify the purpose of the text boxes. The key difference between a Label control and a TextBox control is that a Label control contains text that the user cannot change. The text contained in a Label control is stored in its `Caption` property (as opposed to a TextBox control's `Text` property).

To add a Label control to a form, follow these steps:

1. Select the Label control's tool in the Toolbox.
2. Draw a Label control to the left of the first TextBox control.
3. In the Properties window, change the Label control's `Name` property to `lblPrincipal`.
4. Change the Label control's `Caption` property to `Principal:`.
5. Change the Label control's `Alignment` property to `1 - Right Justify`, using the drop-down arrow next to the property setting (see Figure 2.14). This makes the label align its caption along the right side, next to its corresponding text box, as is common with caption labels.

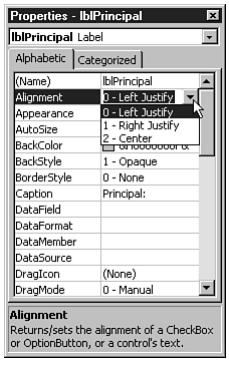


FIGURE 2.14
Clicking the drop-down arrow for the Alignment property allows you to select from predefined settings.

You should now be able to see how the Label control will aid the user in determining what to type in the first text box. Create three more Label controls, one for each of the remaining text boxes. Use the recommended values for the `Name` and `Caption` properties outlined in Table 2.1 (don't forget to set the `Alignment` property as well). When you're finished, your form should look like the one shown in Figure 2.15.

Table 2.1 Name and Caption Properties for the Loan Calculator Program's Label Controls

Name Property	Caption Property
`lblPrincipal`	`Principal:`
`lblIntRate`	`Annual Interest Rate (%):`
`lblTerm`	`Term (Years):`
`lblPayment`	`Monthly Payment:`

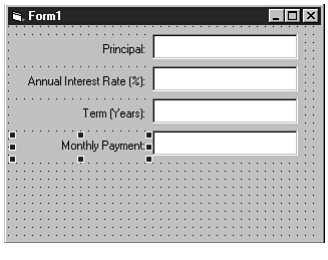


FIGURE 2.15
The Loan Calculator program's labels show the user what to enter in the text boxes.

Adding a Command Button

So far, your sample application's form has a set of text boxes to accept the user's input, and a set of labels to identify those text boxes. You also need some way for the user to initiate actions—this is the purpose of CommandButton controls. A user can click a CommandButton

control, also commonly known as a *command button* (or simply a *button*), to cause something to happen. You can add a command button to a form just like you add other controls—by using the mouse to draw it.

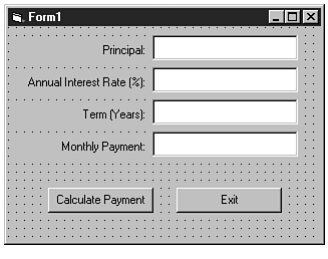
Like labels, command buttons have a `Caption` property that enables you to determine what text will appear on the button's face, so the user will know what the button does.

To complete the interface of the Loan Calculator program, add two command buttons near the bottom of the form. Set their `Name` and `Caption` properties according to Table 2.2. Figure 2.16 shows the completed Loan Calculator interface.

Table 2.2 Name and Caption Properties for the Loan Calculator Program's CommandButton Controls

Name Property	Caption Property
`cmdCalculate`	`Calculate Payment`
`cmdExit`	`Exit`

FIGURE 2.16
After you have added the CommandButton controls, the Loan Calculator's interface is complete.



Changing a Form's Properties

Just as you define a control's appearance and behavior by setting its properties, you can also set a form's properties to govern its appearance and behavior.

Just like controls, forms have a `Name` property. The default name for a project's first form is `Form1`; subsequently added forms are named `Form2`, `Form3`, and so on. As with controls, it's a good idea to give forms a more descriptive name. Use the Properties window to change the `Name` property of the Loan Calculator project's one and only form to `frmMain`.

Follow these steps to change the form's `Width` property:

1. Click an empty area of the form to deselect any control(s) that may be selected. This has the effect of selecting the form itself. Note that the form's name appears in the Properties window's Object box.
2. Now that the form itself is selected, the properties presented in the Properties window are the *form's* properties. Scroll the Properties window until you find the `Width` property near the bottom of the list and note its value.

3. Change the form's width by using the mouse to click and drag the sizing handle in the center of the form's right edge (if you've changed your setup so that VB is running in SDI mode, you resize a form by simply dragging an edge or corner). Note that the value of the `Width` property in the Properties window has changed.
4. To change the `Width` property back to its original value, select the new value in the right side of the Properties window and replace it with its original value. When you press Enter, the form's width is changed.

Saving Your Work—Again...

Now that you've completed designing the Loan Calculator's interface, this would be an excellent time to save your work so far. Because you already saved your nearly empty project just as you started it, resaving it is very easy—and highly recommended. In fact, it makes sense to save your work at several stages of the interface development process. You never know when you'll have problems; a quick save only takes a few seconds, and could save you a lot of work when those problems do happen.

To resave your project, choose File, Save Project from the menu system, or simply click the Save Project button on the toolbar. Because you've already told Visual Basic where to save the files that make up your project, they're automatically saved in the same location, using the same filenames. If you have added new components (forms, modules, and so on) since the last save, you will be prompted for a filename and location for each of the newly added components.

Coding Your Program's Actions

As mentioned earlier, the user interface of the Loan Calculator program is now complete. However, it doesn't actually do anything at this point. In order for your program to become functional, you need to write some code. The term *code*—as it is used in this book—refers to one or more lines of programming commands, written in a particular programming language (Visual Basic, in your case).

Responding to Events

Visual Basic is an object-oriented, event-driven language. This means that a program's interface is comprised of *objects* (controls, forms, and so forth); the program is "taught" what actions to perform when *events* happen to those objects.

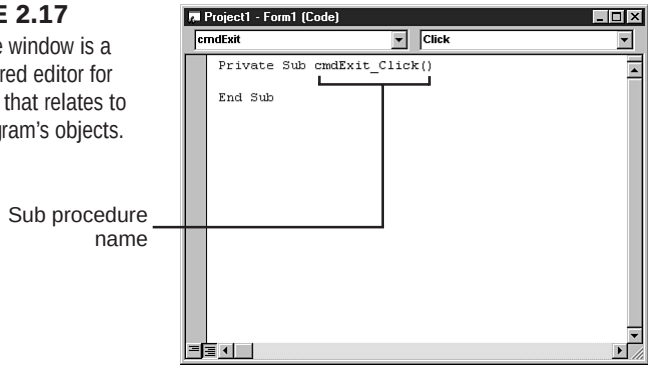
An event is usually initiated by the user. By anticipating the possible events that can (and should) occur to the various objects in your program, you can write code to respond to those events appropriately. For example, in the case of a command button labeled Exit, your code should respond to that button's `Click` event by ending the program. This code should execute whenever the Exit button's `Click` event occurs.

You cause a program to respond to events by placing code in *event procedures*. An event procedure is a segment of code that is executed when a particular event occurs to a particular object.

In the case of a user clicking an Exit button, you need to add code to the Exit button's `Click` event procedure. Let's illustrate this by writing code for the `Click` event procedure of your Loan Calculator program's `Exit button`.

Double-click the Exit button that you placed on the sample application's form. You'll see a new window called a Code window (see Figure 2.17). You can open a separate code window for each form (or other kind of module) in your project, and this is where you place code that relates to that form and the objects contained in it. Notice that the Code window contains a template, or shell, of a sub procedure, beginning with the words `Private Sub` and ending with the words `End Sub`. A *sub procedure* (also known simply as a *procedure*) is a discrete sequence of code statements that has a name and is executed as a unit.

FIGURE 2.17
The Code window is a full-featured editor for the code that relates to your program's objects.



The part after the words `Private Sub` denotes the sub procedure's name. This particular sub procedure is named `cmdExit_Click`, a predefined name that denotes the `Click` event procedure for the control named `cmdExit`. Visual Basic will execute any code located within this sub procedure whenever the `Click` event occurs to this command button.

NOTE Most controls can react to one of several different events; each type of control has a default event, which is the event that usually occurs to that type of control most often. For example, the `Click` event is the one that occurs most often to a CommandButton control. The default event is the one that is opened in the Code window when you double-click a new control.

To cause the program to end when the user clicks the Exit button, you simply need to add one line of code—Visual Basic's `End` statement—to the `cmdExit_Click` procedure. Your cursor should already be on the blank line between the `Private Sub cmdExit_Click()` and `End Sub` statements; if it's not, simply click there. Press Tab to indent the code (that makes it easier to read), and then type the word `End`. Press Enter to insert a new blank line into the procedure (this isn't necessary, but the extra blank line improves readability). When you're done, your complete sub procedure should look like this code:

```
Private Sub cmdExit_Click()
    End

End Sub
```

Congratulations! You just wrote your first Visual Basic code.

Specifying Event Procedures

Look at the two drop-down list boxes near the top of the Code window, as shown in Figure 2.18. The *Object box* (the one on the left) lists all the objects that have been placed on the current form, as well as the form itself. The *Procedure box* (on the right) lists all the events that apply to whichever object is currently selected in the Object box. Using these two drop-down list boxes enables you to navigate to any portion of the Code window. Think of the code for a particular form as one long text file; the Code window is a navigation tool that helps you quickly display a specific object/event combination.

FIGURE 2.18
The Exit button's `Click` event procedure will cause the program to end when the button is clicked.

When you double-click a control at design time, the Code window automatically opens to the default event for the control you clicked, unless some event other than the default already has code in its event procedure. In that case, the event procedure that contains code is selected, in case you want to edit that code. Of course, you can use the Object and Procedure boxes at any time to quickly locate the desired object/event combination.

TIP In addition to double-clicking an object, you can also open the Code window by pressing F7, by clicking the View Code button in the Project window, or by selecting View, Code from the menu.

Now that you've properly coded the Exit button to end the application, all that remains is to code the Calculate Payment button. Its function is to calculate the monthly payment amount, based on the information the user has supplied. This code will be written as the `Click` event procedure for the command button `cmdCalculate`. You could display the `cmdCalculate` button's `Click` event procedure by bringing the form designer to the front and double-clicking `cmdCalculate`; however, because the Code window is already open, it would be more efficient to drop down the Code window's Object box and select `cmdCalculate`. This displays the procedure `cmdCalculate_Click` in the Code window.

Writing Program Code

The procedure that calculates the loan payment will be more complex than the `Exit` procedure. Obviously, the code that performs the payment calculation will be more involved than a simple `End` statement. In addition, you must do some additional housekeeping in this procedure, as you will be using variables.

A *variable* is a temporary storage location for information. Very often, your programs will need to remember information—such as calculation results, the user's name, order totals, and so on—as the program is running. Think of a variable like a white board that the program can use to remember information. Within certain guidelines, the program can write information on the white board, modify that information, even erase it completely. One important consideration is that when the program finishes, the white board is erased completely.

▶ **See** "Working with Variables," **p. 159**

Variable Declarations The first part of the Calculate sub procedure will be used to declare the variables you'll need. That means that you will tell Visual Basic the *names* of the variables that the procedure will be using, as well as what *type* of information each variable may contain. Although Visual Basic doesn't require you to declare your variables (by default), it's always good practice to do so.

TIP *Always declare your variables!* In the Tools, Options menu, under the Editor tab, make sure Require Variable Declaration is checked. This causes Visual Basic to report an error if you attempt to run a program that uses a variable that hasn't been declared (for example, if you inadvertently misspell the variable's name).

Your `Calculate` procedure uses four variables—one each to hold the principal amount, the interest rate, the loan term, and the calculated monthly payment. Make sure the cursor is on the blank line between `Private Sub cmdCalculate_Click()` and `End Sub`. Press Tab to indent the code, and then type the following line of code:

```
Dim cPrincipal As Currency
```

Notice that when you press Enter after typing this code, the cursor doesn't go back to the left margin of the code window. Visual Basic assumes that you want to indent the next line of code to the same level as the preceding line. This aids in your code's readability. You can increase the level of indent by pressing Tab; Backspace will decrease the indent.

As you can tell from this code, the general format for declaring variables is the word `Dim`, followed by a variable name, the word `As`, and the variable's type. As with object names, you should follow a naming standard. Throughout this book, you'll use a very common variable naming standard that uses the first (lowercase) character of the variable name as a prefix designating its type; the remaining portion of the variable's name describes its purpose. The variable named `cPrincipal`, for example, is a Currency type variable that stores the principal amount. Some variable types and their common prefixes are outlined in Table 2.3.

Table 2.3 Prefixes Used in a Common Variable Naming Convention

Prefix	Variable Type
s	String
n	Integer
l	Long Integer
f	Single-precision Floating Point
d	Double-precision Floating Point
c	Currency
b	Boolean (True/False)
v	Variant

Add the following line of code for the next declaration:

```
Dim fIntRate As Single
```

This would be a good time to point out that multiple variables can be declared on the same line of code. If you do so, each variable must have its own type listed. Add the following line of code to declare two more variables:

```
Dim nTerm As Integer, cPayment As Currency
```

CAUTION

A common beginner mistake is to attempt to include multiple variable declarations in a statement like `Dim x, y, z As Integer`. Remember, however, that each variable must have its type explicitly mentioned. In this case, only `z` would be an Integer; `x` and `y` would be initialized as Variants. The Variant data type is a special type discussed later in the book. The correct syntax would be to place the words `As Integer` after each variable name.

Procedure Code The procedure code is the remaining part of the procedure that does the actual work. In your Loan Calculator program, this part of the procedure will be responsible for retrieving the input values from the first three text boxes, calculating the monthly payment, and displaying the payment in the fourth text box.

Enter the following two lines into the Code window (after the variable declaration statements):

```
'Store the principal in the variable cPrincipal
cPrincipal = Val(txtPrincipal.Text)
```

The first line is a comment explaining what's going on. A comment is denoted by a single quotation mark (`'`), usually at the beginning of a line. When Visual Basic encounters a single quote on a line, the remainder of the line is ignored. Visual Basic then looks to the next line for the next instruction.

The second line in this code retrieves the information that the user entered into the `txtPrincipal` text box, placing the value into the variable `cPrincipal`. This is done with an assignment statement, much like an assignment statement in algebra—a variable appears on the left side of the equal sign, and the value to be placed in that variable appears on the right side. The `Val()` function is used to convert whatever is between the parentheses to a numeric type for subsequent calculation purposes. The actual value in the text box is retrieved by accessing its `Text` property (you refer to properties of an object in code using the notation *`object.property`*). Think of `txtPrincipal.Text` as being equivalent to the current value of the `Text` property of `txtPrincipal` (recall that the `Text` property of a TextBox control contains the current contents of the box on the screen).

TIP As you enter the remaining code, you'll notice several more comments within the code statements. Again, a *comment* is a line of code that isn't executed; rather, it's used to explain the purpose or functionality of the executable portions of the code. Comments, which are a form of documentation, help a programmer to quickly understand the purpose of a section of code when she must edit it at some point in the future. It's usually a very good idea to include a lot of comments in your code. You may think you'll remember why you solved a problem a certain way, but when you look at code that you (or someone else) wrote a year earlier, comments will make the code's purpose much clearer.

Enter the remaining code presented in Listing 2.1 in the Code window. The comments should help you understand how the code works. Figure 2.19 shows the completed sub procedure in the Code window.

Listing 2.1 Code to Calculate the Monthly Payment

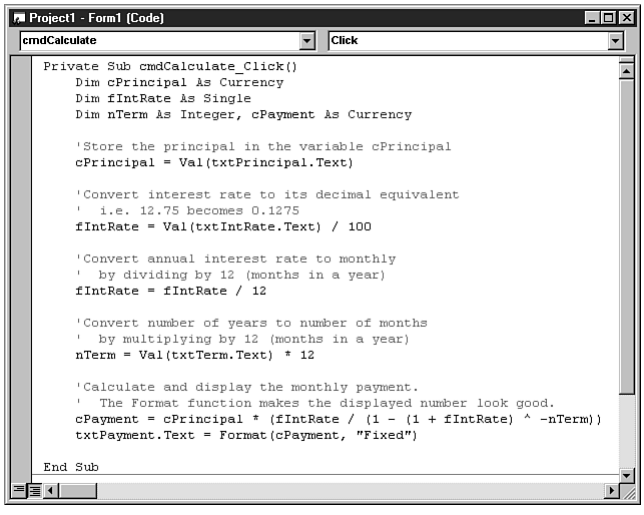
```
'Convert interest rate to its decimal equivalent
'  i.e. 12.75 becomes 0.1275
fIntrate = Val(txtIntRate.Text) / 100

'Convert annual interest rate to monthly
'  by dividing by 12 (months in a year)
fIntrate = fIntrate / 12

'Convert number of years to number of months
'  by multiplying by 12 (months in a year)
nTerm = Val(txtTerm.Text) * 12

'Calculate and display the monthly payment.
'  The Format function makes the displayed number look good.
cPayment = cPrincipal * (fIntrate / (1 - (1 + fIntrate) ^ -nTerm))
txtPayment.Text = Format(cPayment, "Fixed")
```

Running Your Program

I'll bet you're anxious to see your program in action! Before running it, however, make sure you save your work so far. To run the program, you need to execute Visual Basic's Start command using any of these methods:

- Click the Start button on the Visual Basic toolbar.
- Choose Run, Start.
- Press F5.

FIGURE 2.19
Entering the code to calculate the monthly payment completes the `Click` event procedure for `cmdCalculate`.



When you execute the Start command, Visual Basic compiles your program to check for certain types of errors. If none are found, the program will begin executing, and you'll see the main form. Notice in Visual Basic's title bar that you've gone from Design mode to Run mode, meaning that the program is actually running. Because the application is object-oriented and event-driven, it's waiting for you (the user) to cause an event to occur to an object, such as typing in a text box or clicking a button.

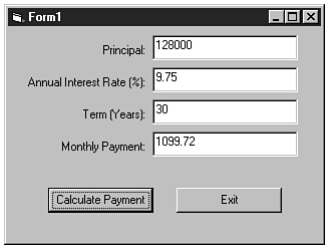
Test your program by entering values for the principal, term, and interest rate. Use these values for your first test:

Principal	128000
Interest Rate	9.75
Term	30

After entering these values, click the Calculate Payment button. The monthly payment displayed should be 1099.72 (see Figure 2.20).

NOTE Because this program is a demonstration of basic programming techniques, its interface is quite simple, and very little effort has gone into making it error-proof. Numbers must be typed without thousands separators or dollar signs in order for the calculations to work properly. As you develop your programming skills later in the book, you'll see how to overcome these types of limitations.

FIGURE 2.20
The Loan Calculator program is now fully functional and can calculate loan payments.



Test the program with other combinations of numbers. When you're through, end the program by clicking the Exit button, or by clicking the End button on Visual Basic's toolbar. This will return you to the design environment.

ON THE WEB

The completed Loan Calculator program is contained in the file LOANCALC.ZIP, which can be downloaded from `www.mcp.com/info`.

From Here...

The loan calculator program has enabled us to dive right in to writing a Visual Basic program from scratch. In this chapter, you learned how to do the following:

- Start Visual Basic
- Begin a new project
- Add controls to a form
- Set properties of your project's objects
- Write code to bring the program to life

Believe it or not, these steps comprise the core of Visual Basic programming. You've seen simple examples of all these steps, but most Visual Basic programming involves repetition of these steps over and over until the desired results are obtained.

As you start working with more complex applications, you'll see many ways to practice and enhance these fundamental Visual Basic programming skills. Refer to the following chapters for additional related information:

- To see how to use Visual Basic's fundamental components to create your own applications, see Chapter 3, "Visual Basic Building Blocks."
- To learn about the various controls that you can use when building programs, see Chapter 4, "Using Visual Basic's Default Controls."
- To learn more about writing Visual Basic code to interact with your program's users, see Chapter 5, "Responding to the User with Event Procedures."

CHAPTER 3

Visual Basic Building Blocks

In this chapter

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Using Controls 41

Exploring Properties 42

A First Look at Methods and Events 50

Form Properties Revisited 52

You've already learned that objects such as forms and controls are the parts of a Visual Basic program with which users interact. Collectively, these objects that users see and use are known as a program's *visual component*. Compare this to a program's *code component*, which refers to the program code that the programmer has created.

In this chapter, you'll examine some of the fundamentals necessary to build a program's visual component. You'll see how you can define the appearance and behavior of an object by working with its *properties*, *methods*, and *events*. By knowing how to manage these components of your program's objects, you'll be well on your way to creating professional quality user interfaces.

NOTE The term *object* in this chapter refers to visual objects such as forms and controls. In later chapters, I'll further discuss these types of objects as well as some other objects and how they relate to Visual Basic program code.

Forms

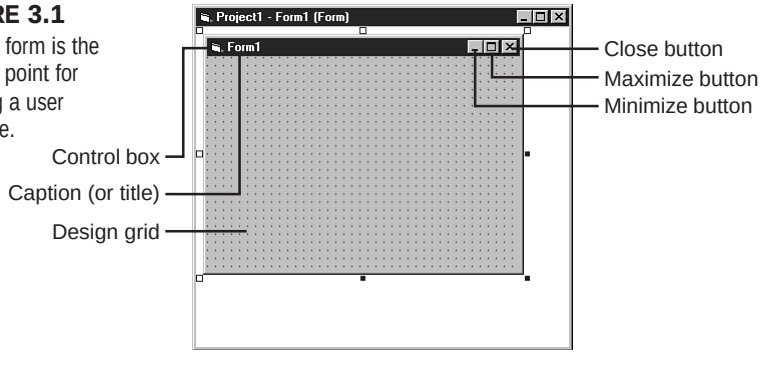
So far, most of the examples have used the Form object. A form is a container that holds all the other controls (such as labels, text boxes, and pictures) that make up part of a program's user interface. Most of your programs will use a number of forms.

NOTE If you want, you can create a Visual Basic program that contains no forms at all! One example might be a command-line program that processes files and requires no user interface.

Parts of a Form

When you start a new Standard EXE project, you are presented with the default Visual Basic project, which normally includes a single standard form (see Figure 3.1). Because this form is the place where you start work on your user interface, take a brief look at the different parts of it now.

FIGURE 3.1
A blank form is the starting point for building a user interface.



As you can see in Figure 3.1, a Visual Basic form contains all the elements you would expect to find as part of a window in a program. It contains a title bar, a control menu, and a set of Minimize, Maximize/Restore, and Close buttons. Note that many of these elements, such as the Close button, are always present at design time even if the properties are set in such a way that they are not visible at runtime.

Another design-time feature is a grid of dots that allows you to line up controls easily as you are designing your interface. You can control the behavior of the design grid through the Options dialog box, which you can access by choosing Tools, Options from the menu system. In this dialog box, you can change the size of the grid or even turn it off completely. You can also choose whether controls are automatically aligned to the grid. If this option is on (the default setting), the upper-left corner of each control is aligned with the grid point that's closest to the corner. Using the default setting enables you to line up controls easily. In fact, I set the grid to be smaller than the default, which allows more precise control alignment.

What Do Forms Do?

As I mentioned earlier, forms represent your program's user interface. That is, forms are what your users see and interact with. All the controls that users work with, such as text boxes, command buttons, and so forth, are contained on one or more forms.

In addition to serving as containers for controls, forms act as a sort of overall "traffic cop" overseeing the use of the objects that make up the interface. You'll see many examples of using program code to respond to events that occur to various objects. All the program code that relates to the objects on a particular form is stored (and edited) as a part of the form itself. In other words, the form contains not only the objects the users *can* see, but it also contains the program code that the users *can't* see.

Using Controls

Although forms are an important part of your programs, you can't do very much without adding controls to them. Visual Basic controls let you perform a wide variety of tasks including editing text, displaying pictures, and interfacing with a database. The liberal use of controls has always been one of Visual Basic's strongest features.

What Are Controls?

In Visual Basic, controls are objects designed to perform specific tasks. Like form objects, controls have associated properties, events, and methods. For example, if you use a TextBox control, you can set properties to determine the size of the text box, the font for the text that it displays, and the color of the text and background.

Because of Visual Basic's design, you are not limited to using only the controls provided by Microsoft. The design allows easy integration of third-party controls—which has led to a thriving market for these custom controls. With this amount of third-party involvement, chances are that you can find a control to perform almost any task you want, from data acquisition to custom reporting to specialized graphics processing to game play, and everything in between.

Although controls have been around since the beginning of Visual Basic, the capability to create your own controls did not exist until version 5. Visual Basic now allows you to create your own ActiveX controls for use in your programs and in any other program that adheres to ActiveX standards.

Control Functions

You can think of a control as a miniature program in itself that performs certain tasks for you. For example, the text box correctly sizes and displays the text based on the property values that you assign. Also, a text box contains internal code that allows it to process keystrokes so that it knows, for example, to erase a character when you press the Backspace key. If you wrote programs in earlier languages, particularly in the DOS and mainframe environments, you know that you might have had to write a significant amount of code just to accept and process keystrokes that allowed the users to enter input. Now you can just drop a control on your form, and the rest is done for you. In other words, controls are prepackaged objects that perform specific tasks.

Visual Basic 6 comes with a standard set of controls that are available in all editions and that let you perform many types of programming tasks. These controls are illustrated in the Toolbox shown in Figure 3.2. The use and purpose of these standard controls are discussed in Chapter 4, "Using Visual Basic's Default Controls."

FIGURE 3.2
Visual Basic's Toolbox contains a standard set of controls.

NOTE The standard controls that automatically appear in the Toolbox shown in Figure 3.2 are not the only ones included with Visual Basic. To add other controls, such as the TreeView control or ImageList control, use the Components dialog box by choosing Components from the Project menu.

▶ **See** "Using the `TreeView` Control," **p. 258**

Exploring Properties

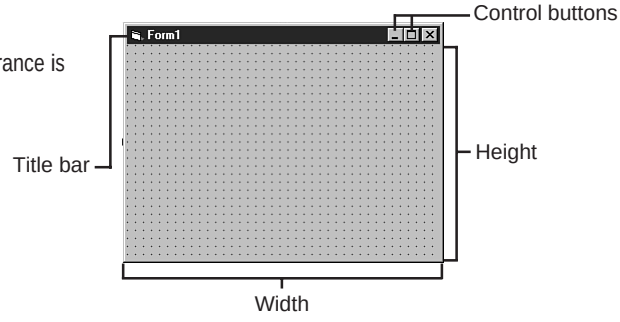
In Chapter 2, "Creating Your First Program," you saw how to set an object's properties to modify its appearance when your program runs. Think of a property as an adjective that describes one specific thing about an object. By changing the value of one or more properties,

you can easily customize an object's appearance to the task at hand. In the following sections, you learn about properties as they relate to a form object; the same concepts apply to properties of controls as well.

Property Basics

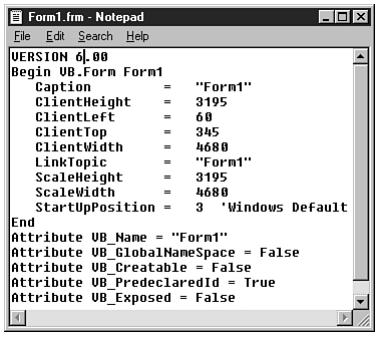
When you look at a form, you see a rectangular window on the screen, like the one shown in Figure 3.3. This window's appearance is defined by a set of properties. For example, the position of the form on the screen is denoted by its `Left` and `Top` properties, and its size is denoted by its `Width` and `Height` properties. The form's `Caption` property dictates what is shown in its title bar. You can even specify which (if any) control buttons appear on the form's title bar by setting a couple of properties.

FIGURE 3.3
A form's appearance is defined by its properties.



When you save a form as part of a project, Visual Basic creates a text file with an .FRM extension. This file stores information about the form, its properties, the objects contained in the form, and the objects' properties, as well as any program code that may have been created for that form. Figure 3.4 shows part of the .FRM file for the form illustrated in Figure 3.3.

FIGURE 3.4
A form's .FRM file contains information about the properties that define the form and its objects.



CAUTION

For some forms, Visual Basic also creates a file with an .FRX extension. This file stores graphics and other binary elements that cannot be defined in a text file. If you copy a form from one folder to another, copying the associated .FRX file as well is very important.

Common Properties

All objects in Visual Basic do not have the same set of properties. However, several properties are common to many objects. Important common properties include the following:

- `Name`
- `Index`
- `Left`
- `Top`
- `Height`
- `Width`
- `Enabled`
- `Visible`

Using Properties to Control an Object's Size

The size of an object in Visual Basic is governed by its `Height` and `Width` properties. As you've seen, you can modify an object's size by selecting it and dragging a sizing handle at design-time, or by changing the values of its `Height` and `Width` properties at either design time or runtime. If you resize an object at design time, you see a corresponding change in the `Height` and `Width` properties in the Properties window, as you discovered in Chapter 2.

During program execution (in other words, at runtime), you can use code to initiate a change in an object's size. In some cases, the size of an object (such as a form) can be changed by the users, as when they drag the edge of the form. In the "Changing Properties at Runtime" section, you'll see an example that demonstrates this concept.

Figure 3.5 illustrates how a form's `Height` and `Width` properties relate to its size.

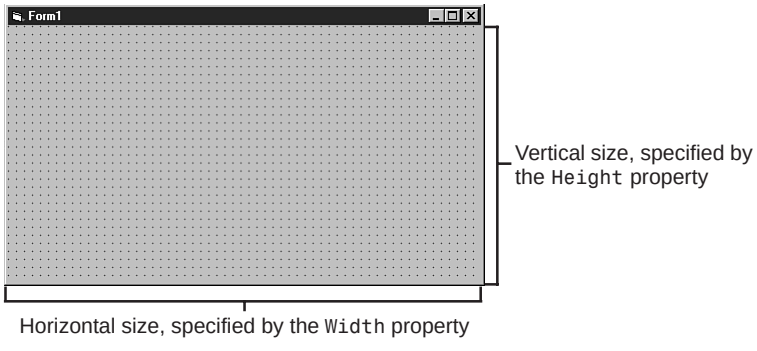


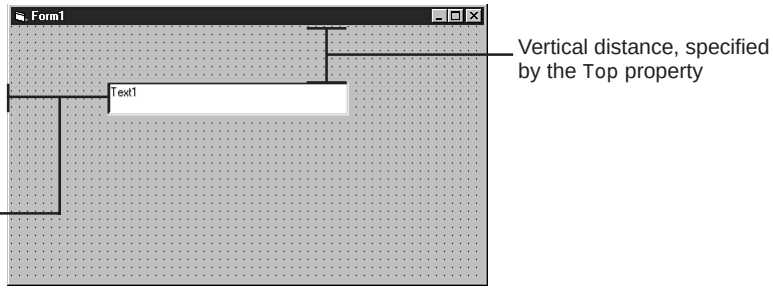
FIGURE 3.5
A form's size is determined by its `Height` and `Width` properties.

Using Properties to Adjust an Object's Position

In addition to controlling an object's *size*, you can also control its *position* with the `Left` and `Top` properties (see Figure 3.6). The `Left` property specifies the distance of the left side of an

object from the left side of the object's container. The `Top` property specifies the distance of the top edge of an object from the top edge of its container. In the case of a standard form, the container is the entire screen. If you draw a control on a form, the form is the control's container. I should also mention that some controls themselves, such as the PictureBox and Frame controls, can act as containers for other controls.

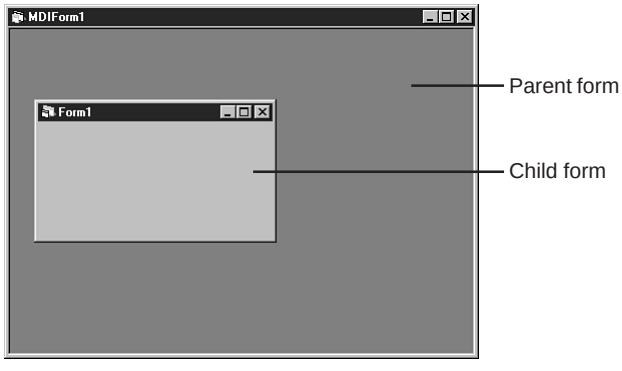
FIGURE 3.6
This TextBox control's position is measured relative to the form, which is its container.



NOTE An object's `Top` and `Left` properties can actually have a negative value. For example, a Label control whose `Left` property value is –1440 is positioned so that its left edge is approximately one inch to the left of its container; therefore, some (or all) of it can't be seen.

Whereas the position of most forms is measured in relation to the upper-left corner of the screen, a form that is part of a Multiple Document Interface (MDI) application is positioned relative to the upper-left corner of the client area of the parent form (see Figure 3.7).

FIGURE 3.7
An MDI child form is positioned relative to its parent form.



Changing Properties at Runtime

As you've learned, objects' properties can be changed at runtime, either through user action or program code. At this point, you can work through an exercise that illustrates this concept. This sample project presents the users with a standard form. They can modify the form's size or position simply by using the mouse to drag the form or one of its edges. The form also has a command button that *programmatically* increases the form's width and another that

programmatically lowers the form's position. Finally, a set of Label controls reports the form's `Height`, `Width`, `Left`, and `Top` properties.

Creating the Form Resize Program When program code refers to properties of various objects, *dot notation* is used. As an example, the `Caption` property for a Label control named `lblAddress` on a particular form is referred to in code as `lblAddress.Caption`.

If you don't remember how to add objects to a form and set the objects' properties, you might want to review Chapter 2.

Figure 3.8 shows my completed sample form; you may want to refer to it as you build the project.

▶ **See** "Creating Your Program's User Interface," **p. 18**

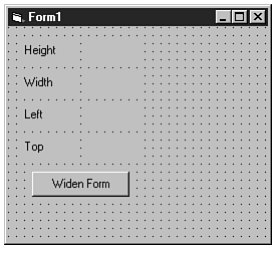


FIGURE 3.8
This sample project demonstrates the use of code to set various properties of a form.

Perform the following steps to create your own version of this project:

1. Create a new Standard EXE project.
2. Add four Label controls to the form, aligned in a column at the left side of the form. These labels will be used as captions for other information; you generally don't need to modify the `Name` properties for labels used in this manner, as they won't be referred to in code. Change the four Label controls' `Caption` properties to `Height`, `Width`, `Left`, and `Top` (working from top to bottom).
3. Add another column of four Label controls just to the right of the first set. Change their `Name` properties to `lblHeight`, `lblWidth`, `lblLeft`, and `lblTop`. Change their `Caption` properties to nothing (clear out the default captions).
4. Add a CommandButton control near the bottom of the form. Change its `Name` property to `cmdWiden`, and change its `Caption` property to `Widen Form`.
5. Select the form and change its `Width` property to 4000 twips. (See the sidebar "Measurements in Visual Basic" for a definition of the term *twip*.)
6. Double-click the command button to bring up the Code window. You should see an empty `cmdWiden_Click` sub procedure.
7. Press the Tab button, and then type the code `Form1.Width = Form1.Width + 100`. This line of code causes the value of `Form1`'s `Width` property to increase by 100 twips each time the command button is clicked.

8. Drop down the Code window's Object box and select Form. Drop down the Code window's Event box and select Resize. You are presented with the shell of the `Form_Resize` event procedure. The `Resize` event occurs whenever the width and/or height of the form is changed, either through user actions or program code.
9. Add the following lines of code to the `Form_Resize` event procedure:

```
lblWidth.Caption = Form1.Width
lblHeight.Caption = Form1.Height
lblLeft.Caption = Form1.Left
lblTop.Caption = Form1.Top
```

   This code causes the current values of the form's `Width`, `Height`, `Left`, and `Top` properties to be displayed in the appropriate Label controls. Because this code is in the form's `Resize` event procedure, the labels will be updated whenever the size of the form changes, whether programmatically or by user action.
10. Save the form and project if you want; however, you probably don't need to bother because this is just a simple demonstration.

TIP Visual Basic provides a useful tool called *Auto List Members* that helps with properties. When you type the name of an object followed by a dot (period), Visual Basic attempts to help you complete the dot notation by providing a pop-up list of all properties that apply to that object (along with other things that apply, such as methods and events). Just type enough characters of the desired property name to highlight it in the pop-up list. You can then press Enter or Ctrl+Enter, and the dot notation is completed for you.

Measurements in Visual Basic

By default, all distances are measured in twips. A *twip* is a device-independent unit of measure equivalent to 1/20th of a printer's point, which means that there are 1440 twips per inch. The actual physical size of a twip varies depending on screen resolution. You can specify another unit of measure for positioning and sizing objects within a container using the container's `ScaleMode` property. However, the screen's scale mode cannot be changed, so a form's `Left`, `Top`, `Height`, and `Width` properties are always measured in twips.

Testing the Form Resize Program After you've completed this project, run it. Change the form's width and/or height by dragging its edges; notice how the form's labels report the modified `Width` and `Height` properties. This action illustrates how an object's properties can be changed at runtime by user action.

Next, click the Widen Form command button to cause the form's width to increase. The `Width` label is updated with the new property value. This example illustrates a programmatic modification of a property (even though a user initiated the action that led to the width change, the actual property change was performed by a code statement).

Finally, try moving the form (by dragging the form's title bar). By doing so, you (the user in this case) are modifying the form's `Top` and `Left` properties. One problem with this example is

that the revised `Top` and `Left` properties aren't automatically displayed in the Label controls. This result is due to the fact that the code to update the labels is contained in the form's `Resize` event procedure, and the form wasn't resized when you moved it. Unfortunately, no event is similar to a `Resize` event that occurs when a form is repositioned. This problem can be overcome, of course; however, the solution is beyond the scope of this chapter. For now, you can "manually" update the labels by resizing the form just after you've moved it, allowing you to see the updated `Top` and `Left` properties.

Using Properties to Control User Interaction

Even if your application includes many forms and controls, you probably don't want the users to have access to all of them at the same time. For example, suppose you are writing a program that allows users to enter expense reports. You might have a command to allow the users to print the expense reports, but you would not want the command to be available unless the reports balance. Two properties, the `Visible` property and the `Enabled` property, help you to manage this process.

The `Visible` property determines whether an object can be seen on the screen. The `Enabled` property determines whether the users can interact with an object. You can set both properties to either `True` or `False`.

If the `Visible` property is set to `False`, the object is not shown, and the users will not know that the object is even there. If the `Enabled` property is set to `False`, the object is visible (provided that the `Visible` property is `True`), but the users cannot use it. Typically, if an object is disabled, it is shown on the screen in a grayed-out, or dimmed, mode. This mode provides a visual indication that the object is unavailable.

A good example of objects that are variably available and unavailable occurs in the wizard interface in some Windows programs. A wizard organizes a task into several logical steps, with three navigation buttons (typically labeled Back, Next, and Finish), which are used to move between steps. Depending on which step a user is currently working on, all these buttons may not be enabled, as in Figure 3.9.

FIGURE 3.9
Because the user of this wizard is on step 1, the `Enabled` property of the Back button is set to `False`, causing it to be grayed out.

TIP If you are implementing a wizard interface in Visual Basic, one option is to draw the controls for each step in a frame. Visual Basic's `Frame` control acts as a container, so setting its own `Visible` property relevant to the user's current step affects all the controls within it.

Referencing Forms and Controls from Your Code

One other key property of every Visual Basic object is the `Name` property. The `Name` property defines a unique identifier by which you can refer to the object in code. Each form, text box, label, and so on must have a unique name.

NOTE All forms in a project must have different names. However, control names have to be unique only for the form on which they are located. That is, you can have a `Text1` control on each form in your project, but you can't have two forms called `Form1` in your project.

Visual Basic provides a default name when an object is first created. For example, `Form1` is the name given to the first form created for your project, and `Text1` is the name given to the first text box that you place on a form. However, the first thing you should usually do after drawing a control or form is to provide it with a name that has some meaning. For example, I often use `frmMain` as the name of the main interface form in my applications.

As mentioned in Chapter 2, following a standard when naming forms and other objects is good programming practice. It's common to use a three-letter contraction of the control's type as a lowercase prefix to identify the type of object to which the name refers; the remainder of the name describes the purpose of the object. In the `frmMain` form just discussed, the prefix `frm` indicates that the object is a form, and the suffix `Main` indicates that it's the main form in the program. Table 3.1 lists suggested prefixes for many of Visual Basic's objects (forms and controls).

Table 3.1 Visual Basic Object Types and Common Name Prefixes

Object Type	Name Prefix	Object Type	Name Prefix
CheckBox	`chk`	Horizontal ScrollBar	`hsb`
ComboBox	`cbo`	Image	`img`
Command Button	`cmd`	Label	`lbl`
Common Dialog	`cdl`	Line	`lin`
Data Control	`dat`	ListBox	`lst`
Data Bound ComboBox	`dbc`	Menu	`mnu`
Data Bound Grid	`dbg`	OLE Container	`ole`
Data Bound ListBox	`dbl`	Option Button	`opt`
Directory ListBox	`dir`	Picture Box	`pic`
Drive ListBox	`drv`	Shape	`shp`
File ListBox	`fil`	TextBox	`txt`
Form	`frm`	Timer	`tmr`
Frame	`fra`	Vertical ScrollBar	`vsb`
Grid	`grd`		

Remember that the names you assign will be used in code, so avoid carpal tunnel syndrome by keeping them short!

To set the `Name` property for an object, select the object, view the Properties window (by clicking the Properties button; by selecting View, Properties Window; or by pressing the F4 key), and click the `Name` property. You can then type a new value. Figure 3.10 shows the `Name` property in the Properties window.

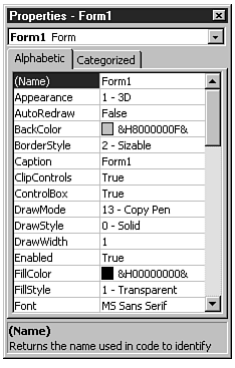


FIGURE 3.10
The `Name` property is located at the top of the list on the Alphabetic page and is the first property listed under the Misc group on the Categorized page.

NOTE The Properties window displays in Visual Basic 6 by default, so you won't need to open it unless you have previously closed it.

A First Look at Methods and Events

So far, this chapter has concentrated on properties, showing how they can control an object's appearance. In addition to properties, an object can have *methods*, which define tasks that it can perform. The tasks can be simple, such as moving the object to another location, or they can be more complex, such as updating information in a database.

Taking Action with Methods

A method is really just a program function that is built into the object. Using its embedded methods, the object knows how to perform the task; you don't have to provide any additional instructions. For example, forms have a `PrintForm` method that prints an image of the form on the current printer. The statement `Form1.PrintForm` prints an exact duplicate of `Form1`. Because the low-level details for the `PrintForm` method are encapsulated within the form object, a Visual Basic programmer does not have to be concerned with them.

As you may have guessed, methods, like properties, are referenced using dot notation. Visual Basic uses the *Auto List Members* feature described earlier to list an object's methods, properties, and events when you type the object's name followed by a period. Although different objects have different methods, many objects have the following methods in common:

- **Drag**. Handles the operation of the users' dragging and dropping the object within its container
- **Move**. Changes the position of an object
- **SetFocus**. Gives focus to the specified control
- **Zorder**. Determines whether an object appears in front of or behind other objects in its container

NOTE Focus refers to the current control that receives keystrokes. Only one control on any form can have the focus at any given time. Focus is usually indicated by the position of the edit cursor (for text boxes) or a dotted rectangle around the control (for check boxes, option buttons, and command buttons).

Responding to Actions with Events

In addition to performing tasks, the objects in your program can respond to actions, whether generated by the users or externally. Responses to actions are handled through the use of events. For example, when users click a command button, the button raises a `Click` event. Part of the definition of an object is the set of events it can raise and the user actions that trigger them.

Examples of user actions that trigger events are clicking a command button, selecting an item in a list box, or changing the contents of a text box. Events also occur when users exit a form or switch to another form. When an object raises an event, the object executes an event procedure for that specific event. To respond to events, you need to place program code in the appropriate event procedures. For example, in the Loan Calculator example in Chapter 2, you placed code in the `Click` event procedure of a command button.

Chapter 5, "Responding to the User with Event Procedures," delves into all the intricacies of events. In that chapter, you will learn how to write code to handle events and how multiple events are related.

How Properties and Methods Are Related

By now, you know that objects have properties to define their appearance, methods that let them perform tasks, and events that let them respond to user actions. You might think that all these things happen independently of one another, but that is not always the case. Sometimes, the properties and methods of an object are related. That is, as you invoke a method of an object, the properties of the object may be changed. Also, most times that you use the methods of an object or change its properties with code, you do so in response to an event.

NOTE Some property changes can trigger events. For example, changing the `Height` or `Width` property of a form in code triggers the form's `Resize` event.

You can see one example of the interdependence of methods and properties of an object when the `Move` method is used and the `Left` and `Top` properties are set. You can cause an object to

change position either by using the `Move` method or by setting the `Left` and `Top` properties to new values. For example, the following two code segments accomplish the same task of changing a TextBox control's position to 100 twips from the left and 200 twips from the top of its container:

```
'CODE SEGMENT 1 - Move the text box by setting its properties
txtName.Left = 100
txtName.Top = 200

'CODE SEGMENT 2 - Move the text box using the Move method
txtName.Move 100, 200
```

To see an example of the difference between using properties and methods, add code to move the command button in the previous example. With that project open, follow these steps:

1. Open the Code window to the `Form_Resize` event.
2. Add the following two lines of code to the end of the event procedure:

   ```
   cmdWiden.Left = 100
   cmdWiden.Top = Form1.ScaleHeight - cmdWiden.Height
   ```

3. Run the program and resize the form. The code repositions the command button near the bottom of the form as you resize it, always 100 twips from the left.
4. Stop the program and replace the two statements you just added with the following line of code:

   ```
   cmdWiden.Move 100, Form1.ScaleHeight - cmdWiden.Height
   ```

5. Run the program again. Notice that the code statements in both cases are slightly different, but they have the same end result. No matter whether you use the `Left` and `Top` properties or the `Move` method, the control itself handles the actual change in position for you.

If you type these code segments, you may notice that the `Move` method has two additional arguments available. These optional arguments can change the size of the object. Using this method has the same effect as setting the `Height` and `Width` properties to new values.

Similarly, the `Show` and `Hide` methods of a form have the same effect as changing the form's `Visible` property. When you invoke the form's `Hide` method, the effect is the same as setting its `Visible` property to `False`. (The effect, of course, is that the form disappears from the screen.) Likewise, the form's `Show` method produces the same effect as setting its `Visible` property to `True`.

Form Properties Revisited

Forms, like most of the objects used in Visual Basic, have a series of properties that control their behavior and appearance. In the earlier section "Exploring Properties," you learned about some of the properties that apply to forms. In this section, you'll learn several additional key properties of forms. You'll see how these properties can be controlled during program design and execution. Table 3.2 lists several of the key properties of a form and provides a brief

description of each. The table also identifies whether the value of the property can be changed while the program is running.

Table 3.2 Key Form Properties

Property Name	Description	Changeable at Runtime
`BorderStyle`	Sets the type of border that is used for the form	No
`ControlBox`	Determines whether the control box (containing the Move and Close menus) is visible when the program is running	No
`Font`	Determines the font used to display text on the form	Yes
`Icon`	Determines the icon that is shown in the form's title bar and that appears when the form is minimized	Yes
`MaxButton`	Determines whether the Maximize button is displayed on the form when the program is running	No
`MDIChild`	Determines whether the form is a child form for an MDI application	No
`MinButton`	Determines whether the Minimize button is displayed on the form when the program is running	No
`StartUpPosition`	Determines the initial position of a form when it is first shown	No
`WindowState`	Determines whether the form is shown maximized, minimized, or in its normal state	Yes

Now you can take a closer look at some of these properties. The `BorderStyle` property has six possible settings that control the type of border displayed for the form (see Table 3.3). These settings control whether the form is sizable by clicking and dragging the border, they control the buttons that are shown on the form, and they even control the height of the form's title bar (see Figure 3.11).

Table 3.3 *BorderStyle* Property Settings

Setting	Effect
0 - None	No border is displayed for the form. The form also does not display the title bar or any control buttons.
1 - Fixed Single	A single-line border is used. The title bar and control buttons are displayed for the form. The user cannot resize the form.

continues

Table 3.3 Continued

Setting	Effect
2 - Sizable	The border appearance indicates that the form can be resized. The title bar and control buttons are displayed. The user can resize the form by clicking and dragging the border. This setting is the default.
3 - Fixed Dialog	The form shows a fixed border. The title bar, control box, and Close button are shown on the form. Minimize and Maximize buttons are not displayed. The form cannot be resized.
4 - Fixed ToolWindow	The form has a single-line border and displays only the title bar and Close button. They are shown in a reduced font size (approximately half height).
5 - Sizable ToolWindow	This is the same as the Fixed ToolWindow, except that the form has a sizable border.

FIGURE 3.11
Changing the `BorderStyle` property can give a form many different appearances.

NOTE Setting the `BorderStyle` property to prevent resizing does not affect the form's appearance in the design environment; it does so only at runtime.

The default `BorderStyle` property setting provides a border that allows the users to resize the form while the program is running. You can find this type of form in a typical Windows application. However, you can change the `BorderStyle` setting to make the form look like almost any type of window that you would see in a program, including Toolboxes and dialog boxes. You can even remove the form's border altogether.

In Table 3.3, several of the `BorderStyle` definitions indicate that a control box and the Close, Minimize, and Maximize buttons would be displayed in the title bar of the form. This behavior

is the default. But even with these border styles, you can individually control whether these elements appear on the form. The `ControlBox`, `MaxButton`, and `MinButton` properties each have a `True` or `False` setting that determines whether the particular element appears on the form. The default setting for each of these properties is `True`. If you set a property to `False`, the corresponding element is not displayed on the form. These properties can be changed only at design time.

The `Font` property lets you set the base font and font characteristics for any text displayed directly on the form by using the form's `Print` method.

NOTE The `Font` property of a form is actually an object itself with its own properties. For example, to change the size of a form's font, you enter `Form1.Font.Size = 10` in a Code window (or the Immediate window, for that matter) to change the size to 10 points.

In addition, setting the form's `Font` property sets the font for all controls subsequently added to the form.

One final form property of note is the `StartupPosition` property. As you might guess, this property controls where the form is located when it is first displayed. The `StartupPosition` property has four possible settings, which are summarized in Table 3.4.

Table 3.4 *StartupPosition* Property Settings

Setting	Effect
0 - Manual	The initial position is set by the `Top` and `Left` properties of the form.
1 - CenterOwner	The form is centered in the Windows desktop unless it is an MDI child form, in which case it is centered within its parent window.
2 - CenterScreen	The form is centered in the Windows desktop.
3 - Windows Default	The form is placed in a position determined by Windows based on the number and position of other windows open at that time.

Although the `StartupPosition` property can center your form for you when the form first loads, it does not keep the form centered. For example, if you resize the form, it does not remain centered.

Displaying a Form

If you write a program with just a single form, you needn't worry about displaying the form or hiding it. This process is performed automatically for you as the program starts and exits. This single form is known as the Startup Object or Startup Form. When you run your program, Visual Basic loads your Startup Form into memory and displays it. As long as this form remains loaded, your program keeps running and responding to events. When you click the Close button on the form (or execute the `End` statement), the program stops.

NOTE You can select a Startup Form in the Project Properties dialog box. You also can have a program start from a sub procedure named `Main` in a code module rather than from a form.

However, if you have multiple forms—as most programs do—you need to understand how to manage them. The state of a form is controlled by Visual Basic's `Load` and `Unload` statements as well as the form's `Show` and `Hide` methods.

The `Load` statement places a form in memory but does not display it. The following line of code shows how the statement is used:

```
Load frmApplication
```

By using this statement, you are explicitly loading the form. However, the form is loaded automatically if you access a property, method, or control on it. Because the load operation is performed automatically, using the `Load` statement with a form is not really necessary. However, being aware when a form is being loaded is important because the code in the `Form_Load` event will be executed at that time.

To display a form other than the Startup Form, you must use the `Show` method. The `Show` method works whether or not the form was loaded previously into memory. If the form was not loaded, the `Show` method implicitly loads the form and then displays it. The `Show` method is used as follows:

```
frmApplication.Show
```

The `Show` method also has an optional argument that determines whether the form is shown as a *modal* or *modeless* form. If a form is shown modally (a *modal* form), then program control doesn't return to the procedure that called the `Show` method until the modal form is closed. Think of the program code as being paused as long as a modal form is displayed. An example of a modal form is the Windows 95 Shutdown screen. You cannot put the focus on another window while the Shut Down Windows form is displayed.

If a form is shown *modeless*, your program's users can move at will between the current form and other forms in the program. The preceding statement displayed a form as modeless. To create a modal form, you simply set the optional argument of the `Show` method to `vbModal`, as shown here:

```
frmApplication.Show vbModal
```

NOTE A modal form is typically used when you want the users to complete the actions on the form before working on any other part of the program. For example, if a critical error occurs, you do not want the users to switch to another form and ignore it.

After a form is displayed, you have two choices for getting rid of it programmatically. The `Hide` method removes the form from the screen but does not remove it from memory. Use `Hide` when you need to remove the form from view temporarily but still need information in it:

```
frmApplication.Hide
sUserName = frmApplication.txtUserName.Text
```

In this example, the second line of code is able to access information in a control on `frmApplication`, even though that form is not visible on the screen. The `Hide` method leaves a form in memory.

If you are finished with a form and the information contained on it, you can remove it from both the screen and memory by using the `Unload` statement. The `Unload` statement uses basically the same syntax as the `Load` statement, as shown here:

```
Unload frmApplication
```

TIP If you are using the `Unload` statement from within the form you are removing, you can use the keyword `Me` to specify the form. By using this approach, you can prevent errors if you later rename your form. In this case, the statement would be the following:

```
Unload Me
```


Using *Load* to Enhance Program Performance

Because the `Show` method automatically loads a form into memory, you typically do not need to use the `Load` statement in your program at all. However, some forms with a very large number of controls display slowly when they are shown. One way around this problem is to load the form into memory by using the `Load` statement when the program begins to run. With the form already in memory, subsequent `Hide` and `Show` methods appear to perform much more quickly. If you use this trick, be careful of two things. First, don't forget to unload the form at the end of your program. Second, be aware of possible memory limitations. If you load too many forms in memory at once, you might see a decline in the overall performance of your program.

Loading forms into memory does increase the amount of time required for your program to start, but you will save time whenever the form is shown. If you show a form only once during the program, no net time savings is gained by loading it at the beginning. However, if the form is shown more than once, usually an overall time savings is experienced. Also, users are typically more tolerant of time delays when a program loads (especially if they're busy looking at a splash screen) than later when they are performing a task.

From Here...

This chapter introduced you to the world of forms and controls. You began to see how to use forms and controls as the basic building blocks of user interface design. You learned how to manage the appearance of forms and controls by manipulating their properties, both at design-time and runtime. The basic concepts discussed here will carry over into the upcoming discussions of many of the controls that are available for you to use in designing your Visual Basic applications.

- Learn more about the standard controls by reading Chapter 4, "Using Visual Basic's Default Controls."

- To explore program events in more detail, see Chapter 5, “Responding to the User with Event Procedures.”
- To discover more about the Visual Basic language, see Chapter 8, “Using Variables to Store Information,” and Chapter 11, “Managing Your Project: Sub Procedures, Functions, and Multiple Forms.”

CHAPTER 4

Using Visual Basic's Default Controls

In this chapter

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Controls for Making Choices 66

Special-Purpose Controls 78

Working with Multiple Controls at Designtime 85

Working with the Controls Collection 90

By now, you are familiar with what a control is and how controls are used in a Visual Basic program. A great way to learn more about Visual Basic is to explore each of the available controls. Controls are discussed in almost every chapter in this book. The next three chapters focus on how to use specific controls.

In this chapter, you learn about the controls that are included by default with a new Visual Basic project. While there are very many controls that you can add to your projects—including controls provided by Microsoft as well as third-party companies—the controls discussed here are always available to use with no extra effort on your part.

Introduction to the Intrinsic Controls

Visual Basic comes with controls that let you perform many types of programming tasks. Some of these controls appear in the Toolbox automatically when you start Visual Basic. These standard controls are called the *intrinsic* controls. These controls, pictured in Figure 4.1, include some very general controls likely to be used by almost every VB programmer. They are summarized in Table 4.1.

FIGURE 4.1
The Toolbox contains tools that represent Visual Basic's intrinsic controls.

Table 4.1 Controls Contained in Visual Basic's Toolbox

Control Name	Function
PictureBox	Displays graphics. Can also serve as a container for other controls.
Label	Displays text that the users cannot edit.
TextBox	Displays text. Allows the users to enter and edit the text.
Frame	Serves as a container for other controls. Provides grouping of controls.
CommandButton	Allows the users to initiate actions by clicking the button.

Control Name	Function
CheckBox	Lets the users make a true/false choice.
OptionButton	Lets the users choose one option from a group of items.
ComboBox	Lets the users choose from a list of items or enter a new value.
ListBox	Lets the users choose from a list of items.
Horizontal ScrollBar	Lets the users choose a ScrollBar value based on the position of the button in the bar.
Vertical ScrollBar	Same as Horizontal ScrollBar.
Timer	Lets the program perform functions on a timed basis.
Drive List Box	Lets the users select a disk drive.
Directory List	Lets the users select a Box directory or folder.
File List Box	Lets the users select a file.
Shape	Displays a shape on the form.
Line	Displays a line on the form.
Image	Similar to a PictureBox control. Uses fewer system resources but doesn't support as many properties, events, and methods.
Data Control	Provides an interface between the program and a data source.
OLE	Provides a connection between the program and an OLE server.
Common Dialog	Allows use of Windows standard dialog boxes to retrieve information such as filenames, fonts, and colors.

NOTE The controls shown in Figure 4.1 and described in Table 4.1 are not the only ones included with Visual Basic. To add other controls such as the Microsoft CommonDialog control or Microsoft FlexGrid control to the Toolbox, use the Components dialog box by choosing Project, Components, or right-clicking an empty area of the Toolbox and selecting Components from the context menu.

Many of the controls listed in Table 4.1 are discussed in the following sections. Others are described in chapters more closely associated with their purposes. The controls covered in other chapters are as follows:

- The PictureBox, Image, Shape, and Line controls are covered in Chapter 19, "Using Visual Design Elements."
- The Data control is covered in Chapter 25, "The Data Control and Data-Bound Controls."
- The OLE control is covered in Chapter 22, "Using OLE to Control Other Applications."

Working with Text

In Chapter 2, "Creating Your First Program," you built a simple program that used the TextBox and Label controls. If you have not read that chapter, you may want to review it before continuing. From the examples, you learned that the TextBox and Label controls are designed to work with text. The term *text* here does not just mean paragraphs and sentences like those you handle with a word processor. When you deal with text in a program, you also might want to display or retrieve a single word, a number, or even a date. You also may have noticed the major difference between the text box and label: the text box can be used both to display and accept text input, whereas the label control is designed for display-only use. Figure 4.2 shows various examples of TextBox and Label controls in use.

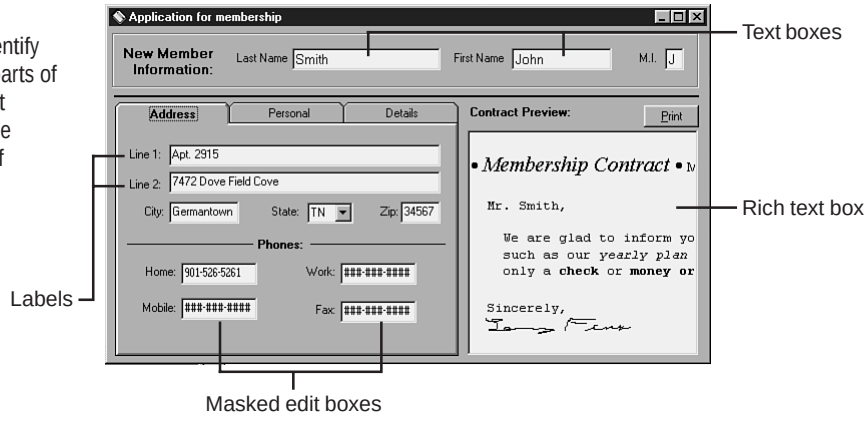


FIGURE 4.2
Label controls identify the purposes of parts of this form, and text boxes allow for the input or display of different types of information.

Displaying Text with a Label Control

The purpose of the Label control is to display text. It is most often used to identify items on a form to the users. The simplest way to use the Label control is to place it next to an input field and set its `Caption` property. Refer to Figure 4.2 and notice that the Label controls are used to inform the users what type of information is to be entered in the text boxes.

Although the Label control does not allow the users to enter text directly, it contains events and properties that allow the programmer to manipulate the text directly from code. To test this feature, create a new Standard EXE project and place a Label control on the form. Place the following code in the label's `Click` event:

```
Private Sub Label1_Click()
    Label1 = "The time is: " & Time$
End Sub
```

Run the program. Each time you click in the label using the mouse, the label displays the current time. Also, in the preceding code, notice that you do not specifically mention the `Caption` property because it is the default property of the Label control. As you may recall, to specify a property of an object, you use dot notation, as in the following line of code:

```
Label1.Caption = "The time is: " & Time$
```

However, you are not limited to using the label control to display small amounts of text. In fact, you can use the Label control to display multiple lines or even paragraphs of information. If you want to display a large amount of information in a label control, you need to pay particular attention to the `AutoSize` and `WordWrap` properties.

The *AutoSize* Property If you know in advance what text is going to be displayed in a label's `Caption` property, you can set the size of the label to accommodate the text. However, if different text will be displayed in the label at different times (for example, in a database application), you may want the label to adjust to the length of its current contents. The `AutoSize` property of the Label control determines whether the size of the control automatically adjusts to fit the text being displayed. When `AutoSize` is `False` (the default), the label's size remains unchanged regardless of the length of its caption. If a caption is too long for the label, some of the caption is not visible because it's wider than the label, and it does not wrap to another line.

The *WordWrap* Property Setting `AutoSize` to `True` causes a label to adjust its size automatically to fit its caption. If the caption is longer than the label's original size allows, the method of resizing depends on the value of the `WordWrap` property. If the `WordWrap` property is `False` (the default), the label expands horizontally to allow the caption to fit, even if the label grows so large that it runs past the right edge of the screen. If the `WordWrap` property is set to `True`, the label expands vertically to allow enough lines of text to accommodate the caption, even if the label runs off the bottom edge of the screen. (The words wrap to new lines—hence, the property name `WordWrap`.) In either case, the `Caption` property contains the entire caption, even if some of the text isn't visible on the form. The effects of the different settings of the `AutoSize` and `WordWrap` properties are shown in Figure 4.3.

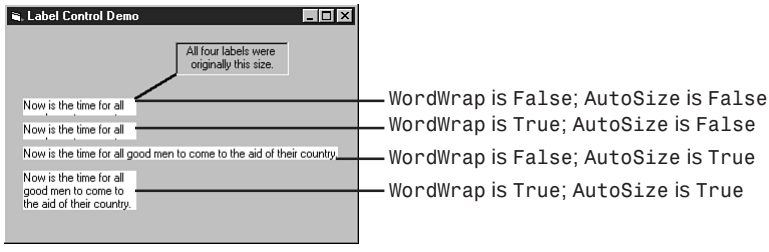


FIGURE 4.3
These four labels have the same long caption; their `AutoSize` and `WordWrap` properties determine whether and how they resize to fit the caption.

CAUTION

To preserve the original width of your label control, you must set the `WordWrap` property to `True` before setting the `AutoSize` property. Otherwise, when you set the `AutoSize` property to `True`, the label control adjusts horizontally to fit the current contents of the `Caption` property.

TIP When assigning a label's `Caption` property, you can force a new line by including a carriage return and line feed combination. This technique, as well as its nomenclature, is a throwback to the ancient days of manual typewriters. When a manual typewriter user reached the end of a line, he or she had to move the paper up manually to the next line (a line feed) and return the carriage to the beginning of that line (a carriage return). In Visual Basic, you can insert a carriage return/line feed combination by inserting ASCII characters 13 and 10 into the caption at the point where the line should break. Visual Basic supplies a predefined constant, `vbCrLf`, to help you accomplish this task:

```
Label1.caption = "First Line" & vbCrLf & "Second Line"
```

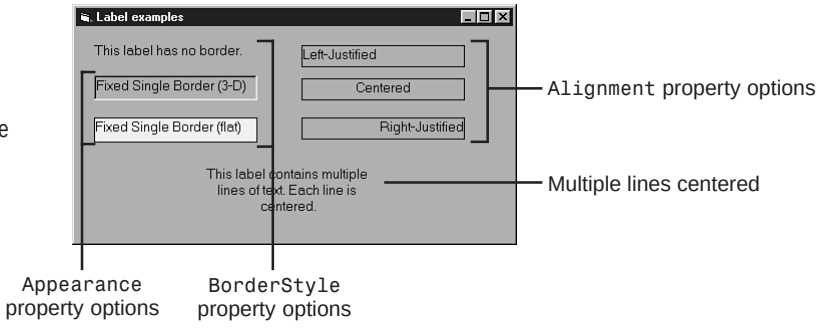
Controlling the Appearance of Text The `Caption` property contains the text to be displayed, but other properties control the appearance of the text. You have already looked at `AutoSize` and `WordWrap`; other properties are listed here:

- `Alignment`—Controls text justification (left, right, or centered)
- `Appearance`—Causes the label to look flat or three-dimensional
- `BorderStyle`—Determines whether the label control has a border
- `Font`—Makes the text boldface, underlined, italic, or changes the typeface
- `ForeColor` and `BackColor`—Control the color of the text and the label background
- `UseMnemonic`—Controls whether an ampersand (`&`) in the `Caption` property is treated like an access key indicator

NOTE With `BorderStyle` set to `Fixed Single`, the label control takes on the appearance of a noneditable text box.

You can set these properties to provide any different number of visual effects to emphasize text in the label and other controls. The effects of setting some of these properties are shown in Figure 4.4.

FIGURE 4.4
The `Alignment`, `Appearance`, and `BorderStyle` properties can change the look of a label control.



NOTE The `Alignment` property also affects the text when the label is used to display multiple lines. The control aligns each line according to the setting of the `Alignment` property (refer to Figure 4.4).

Entering Text with a Text Box

Because much of what programs do is to retrieve, process, and display text, you might guess (and you would be correct) that the major workhorse of many programs is the TextBox control. The text box allows you to display text; more important, however, it also provides an easy way for your users to enter and edit text and for your program to retrieve the information that was entered.

Handling Multiple Lines of Text In most cases, you use the text box to handle a single piece of information, such as a name or address. But the text box can handle thousands of characters of text. A TextBox control's contents are stored in its `Text` property—the main property with which your programs interact. You can also limit the number of characters users can enter by using the `MaxLength` property.

By default, the text box is set up to handle a single line of information. This amount of information is adequate for most purposes, but occasionally your program needs to handle a larger amount of text. The text box has two properties that are useful for handling larger amounts of text: the `MultiLine` and `ScrollBar` properties.

The `MultiLine` property determines whether the information in a text box is displayed on a single line or wraps and scrolls to multiple lines. If the `MultiLine` property is set to `True`, information is displayed on multiple lines, and word wrapping is handled automatically. Users can press Enter to force a new line. The `ScrollBar` property determines whether scrollbars are displayed in a text box, and if so, what types of scrollbars (`None`, `Horizontal`, `Vertical`, or `Both`). The scrollbars are useful if more text is stored in the `Text` property than fits in the text box. The `ScrollBar` property has an effect on the text box only if its `MultiLine` property is set to `True`. Figure 4.5 shows the effects of the `MultiLine` and `ScrollBar` properties.

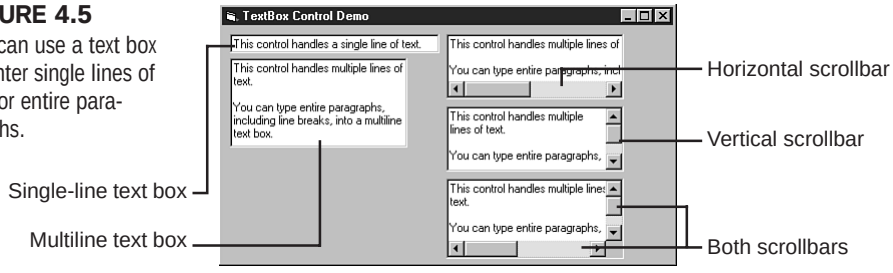


FIGURE 4.5
You can use a text box to enter single lines of text or entire paragraphs.

TIP When a text box is activated (known as *receiving the focus*) by the user tabbing to it or clicking in it, a common practice is for the contents to be selected (or highlighted). Although this feat cannot be accomplished automatically, it can be done pretty easily. Enter these lines of code in the text box's event procedure, replacing `Text1` with the text box's actual name:

```
Text1.SelStart = 0
Text1.SelLength = Len(Text1.Text)
```

The `SendKeys` statement sends a string of characters to the active form at runtime just as if the users had typed them at the keyboard. In this case, you're acting as if the users had pressed the Home key and then a shifted End key (the plus sign before `{End}` represents Shift). This action causes the text to be highlighted, so the users can begin entering new text without having to delete what is already there.

Validating Input When accepting free-form text input from the users, you often need to perform some data validation before proceeding. For example, if you have a text box for Phone Number, you can use code to check the length of the phone number or even to verify that the users entered any information at all.

A new feature in Visual Basic 6 is the `Validate` event of a text box. This event procedure can contain code that validates the information in the associated control. It is triggered by another control whose `CausesValidation` property is set to `True`. For example, the following line of code displays a message box if a text box does not contain numeric data:

```
If Not IsNumeric(Text1) Then MsgBox "please enter a number"
```

To test this event, create a new Standard EXE project. Place a command button and a text box on the form, and enter the preceding line of code in the text box's `Validate` event. As you use the Tab key to move away from the text box, the message is displayed unless you enter a number. Setting the `CausesValidation` property of the command button to `False` turns off the `Validate` event.

Controls for Making Choices

Previously, you learned how to acquire input from users through the use of a text box. This approach works well for a number of data-gathering needs. But what if you just want a simple piece of information, such as "Do you own a car?" or "What is your marital status?" In these cases, the choice of answers you want to provide is limited to two or, at most, a few fixed

choices. If you set up a program to handle only the words *yes* and *no*, your program will have a problem if users type `Maybe` or if they mistype a word.

You can eliminate this problem, however, and make your programs easier to use by employing controls to display and accept choices. In the following sections, you will examine several controls used for making choices. You can offer these choices through the use of check boxes, option buttons, lists, and combo boxes:

- **Check Box**. Switches one or more options on or off
- **Option Button**. Selects a single choice from a group
- **List Box**. Displays a list of user-defined items
- **Combo Box**. Like a list box, but also displays selected item

The Command Button

A control important to practically every application that you will develop is the `CommandButton` control. Typically, this control lets users initiate actions by clicking the button. You can set up a `CommandButton` control by drawing the button on the form and then setting its `Caption` property to the text that you want displayed on the button's face. To activate the button, just place code in the button's `Click` event procedure. Like any other event procedure, this code can consist of any number of valid Visual Basic programming statements.

Although users most often use command buttons by clicking them, some users prefer accessing commands through the keyboard versus using the mouse. This is often the case for data-entry intensive programs. To accommodate these users, you can make your program trigger command button events when certain keys are pressed. You do so by assigning an access key to the command button. When an access key is defined, the user holds down the Alt key and presses the access key to trigger the `CommandButton` control's `Click` event.

You assign an access key when you set the `CommandButton` control's `Caption` property. Simply place an ampersand (`&`) in front of the letter of the key you want to use. For example, if you want the users to be able to press Alt+P to run a print command button, you set the `Caption` property to `&Print`. The ampersand does not show up on the button, but the letter for the access key is underlined. The caption `Print` then appears on the command button.

NOTE If, for some reason, you need to display an ampersand in a command button caption, simply use two of them in a row in the `Caption` property; for example, `Save && Exit` produces the caption `Save & Exit`.

One command button on a form can be designated as the *default button*. Therefore, the user can simply press Enter while the focus is on any control (except another command button or a text box whose `MultiLine` property is `True`) to trigger the default button. This action triggers the default button's `Click` event, just as if the users had clicked it with the mouse. To set up a button as the default button, set its `Default` property to `True`. Only one button on a form can be the default button.

You can also designate one button as the *cancel button*, which is similar to the default button but works with the Esc key. To make a command button into a cancel button, set its `Cancel` property to `True`. As with default buttons, only one button on a form can be a cancel button. As you set the value of the `Default` or `Cancel` property of one button to `True`, the same property of all other buttons on the form is set to `False`.

Check Boxes

You use Visual Basic's CheckBox control to get an answer of either "yes" or "no" from the user. This control works like a light switch. Either it is on or it is off; there is no in between. When a check box is on, a check mark (✓) is displayed in the box. It indicates that the answer to the check box's corresponding question is "yes." When the check box is off, or unchecked, the box is empty, indicating an answer of "no." Check boxes also have a third state, *grayed*, which is represented by a check mark with a gray background. This is usually used to indicate that a partial choice (some, but not all, of a number of sub-choices) has been made. A user can uncheck a grayed check box; if he rechecks it, it becomes fully checked. Figure 4.6 shows check boxes exhibiting all three possible states.

NOTE The check mark or empty box format is characteristic of the standard-form check box. If you set the check box's `Style` property to `1 - Graphical`, pictures are used to indicate checked and unchecked. Graphical check boxes are illustrated in Figure 4.6 as well.

FIGURE 4.6
A check box can indicate a "yes" or "no" response to a question.

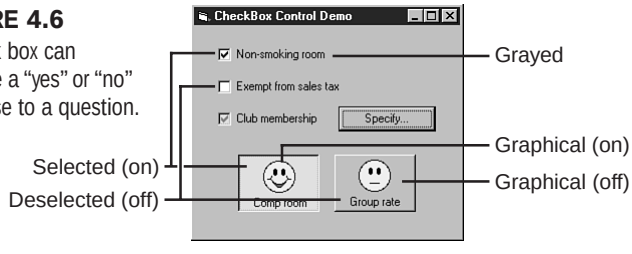


Figure 4.6 shows graphical check boxes as well as standard check boxes. Two properties, `Picture` and `DownPicture`, determine the pictures displayed by a graphical check box.

Option Buttons

Option buttons, also called *radio buttons*, are like the buttons on a car radio; they exist in a group, and only one of them can be "selected" at a time. They are useful for presenting a fixed list of mutually exclusive choices. Try it yourself: Draw several option buttons on a form. Initially, each option button has the default value of `False`. However, notice that if you set the value of any one of them to `True`, and then subsequently set the value of a different button in the group to `True`, the one that was `True` will automatically become `False`, as shown in Figure 4.7.

You can use option buttons in two basic ways in code:

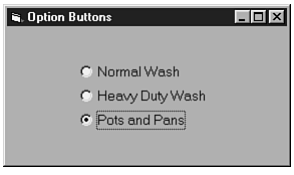


FIGURE 4.7
Option buttons can be used to provide a list of fixed choices.

- Use the `Click` event if you want to take an action when users select an option. This method is useful when you are using option buttons that are in a control array, as in the following example:

```
Private Sub optWash_Click(Index As Integer)
    Select Case Index
        Case 0
            MsgBox "You selected: Normal"
        Case 1
            MsgBox "You selected: Heavy Duty"
        Case 2
            MsgBox "You selected: Pots and Pans"
    End Select
End Sub
```

- Do not write any code in the option button events. Instead, use an `if` statement to check their state, as shown here:

```
Private Sub cmdStartWash_Click()

    If optHeavy = True Then
        DoHeavyWash
    Else
        DoNormalWash
    End If

End Sub
```

  This second method is useful if you do not want something to happen immediately when users select options.

You may be wondering whether it is ever possible to have multiple option buttons on a form selected at the same time. The answer is yes, but you have to separate the option buttons into groups by using container controls. Using a container, such as the `Frame` control discussed later in this chapter, allows you to group option buttons, as shown in Figure 4.8.

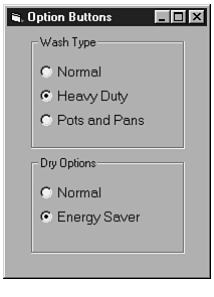
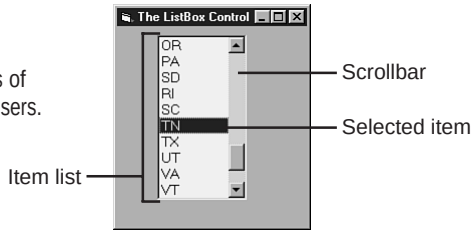


FIGURE 4.8
To create multiple groups of option buttons, place them in a container such as a frame or picture box.

The List Box

You can use the ListBox control to present a list of choices. Figure 4.9 shows a simple list used to pick a state abbreviation for use on a mailing label. This list shows all the components that make up the list box.

FIGURE 4.9
A simple list box contains a series of choices for the users.



The key parts of the list box are the following:

- **Item list**. This is the list of items from which the users can select. These items are added to the list in the design environment or by your program as it is running.
- **Selected item**. This item is chosen by the users. Depending on the style of list you choose, a selected item is indicated by a highlight bar or by a check in the box next to the item.
- **Scrollbar**. This part indicates that more items are available on the list than will fit in the box and provides the users with an easy way to view the additional items.

To the users, using the list box is similar to choosing channels on a TV. The cable company decides which channels to put on the selection list. The customers then can pick any of these channels but can't add one to the list if they don't like any of the choices provided. With the list box, the choices are set up by you, the programmer; the users can select only from the items you decide should be available.

When you first draw a list box on the form, it shows only the border of the box and the text `List1` (the name of the list box). No scrollbar is present and, of course, no list items are available. A vertical scrollbar is added to the list box automatically when you list more items than fit in the box. Note that the list box doesn't have a horizontal scrollbar if the choices are too wide for the control, so you should make sure that the list box is wide enough to display all of its entries.

Basic Use of the List Box The simplest way to control the choices available in a list box is to use the `AddItem` method to add items to the list box. The only thing you need to specify is the text that you want to be placed in the list box. To try it out, start a new Standard EXE project, draw a list box on the form, and add the following lines of code to the form's `Load` event:

```
Private Sub Form_Load()
    Dim i As Integer

    For i = 1 To 100
        List1.AddItem "This is item " & i
    Next i

End Sub
```

NOTE Although this example uses code to add items, you can also create the list at designtime by typing the text that you want to appear in the `List` property of a list box. Each line in the property corresponds to a selection that is presented to the users. After you add an item to the list, press Ctrl+Enter to move to the next line of the list.

Run the project, and you'll notice that 100 lines of text appear in the list box. To clear all the items in a list box, use the `Clear` method, as in the following example:

```
List1.Clear
```

The items in a list box are stored in an array, which is accessible via the `List` property of the list box. The list array starts with a zero index, so to print the first item in the list, you can use the following statement:

```
Print List1.List(0)
```

You can test this statement by putting the sample program in break mode (press Ctrl+Break) and entering the `Print` statement in the Immediate window.

Two other properties are critical for using a list box: `ListCount` and `ListIndex`. `ListCount` represents the number of items in a list box. `ListIndex` represents the selected item.

CAUTION

When you are using `ListCount` in a loop to examine the contents of an unknown number of items, remember that the `List` array starts with zero, so your code should look like this:

```
For i = 0 To List1.ListCount - 1
        'Process List1.List(i)
Next i
```

NOTE `Listindex` is –1 if no item is selected.

To illustrate the `ListIndex` property in action, stop the sample program and add the following code to the `Click` event of the list box:

```
Msgbox List1.List(List1.ListIndex)
```

Run the program again, and when you click an item, it is displayed in a message box.

Another way to retrieve the value of the list box item selected by the user is to check the list box's `Text` property. The `Text` property contains the item from whichever line of the list box has the focus. If it's a simple list box, the line that the user clicked is returned in the `Text` property. If no list box item has yet been clicked, the `Text` property contains an empty string (`""`).

To remove items from the list box, use the `RemoveItem` method, specifying the array index of the item you want removed from the list. To demonstrate, add the following line of code to the `KeyDown` event of the list box:

```
Private Sub List1_KeyDown(KeyCode As Integer, Shift As Integer)

If KeyCode = vbKeyDelete And List1.ListIndex <> -1 Then
    List1.RemoveItem List1.ListIndex
End If

End Sub
```

Run the program with the new modification, and you should be able to remove a specific item from the list by selecting it and pressing the Delete key.

Using the List Array You already know how to use the `AddItem` method to add an item to the end of the list. An optional parameter, `Index`, can be used with the `AddItem` method. This parameter specifies the location within the list where you want the new item to appear. You specify the index value of the item in front of which you want to add your item. For example, if the list contains five items, and you want your item to appear ahead of the third item, you use code like the following:

```
lstAvailable.AddItem "Corvette", 2
```

Sorting Items In the preceding section, you saw how to modify the list by adding and removing items. You also saw that you can add an item to a specific location by specifying an index. But what do you do if you want your entire list sorted in alphabetic order?

Fortunately, this task is simple. To sort the list, you simply set the `Sorted` property to `True`. Then, no matter in which order you enter your items, they appear in alphabetic order to the users. The indexes of the list items are adjusted as they are added so that they remain in order.

NOTE Remember, in alphabetic order, *2* is listed after *11*.

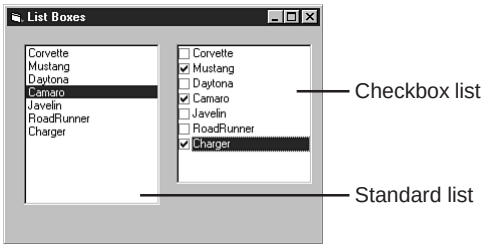
This built-in sorting capability is a nice feature of the list box because you can use it to sort data quickly. However, you have to specify the `Sorted` property at designtime. If you want to have the users turn sorting on or off at runtime, you can use two list box controls and use the `Visible` properties so that only one is displayed at a time.

Setting the Appearance of a List Box In addition to the "plain" list box in Figure 4.9, several additional styles are available. You can make your list look like a series of check boxes or include multiple columns of items.

You handle the selection of the list type by setting the `Style` property. The two settings of the property are `0 - Standard` and `1 - Checkbox`, as illustrated in Figure 4.10. You also can change this property at runtime by setting its value to one of the intrinsic constants `vbListBoxStandard` or `vbListBoxCheckBox`, respectively.

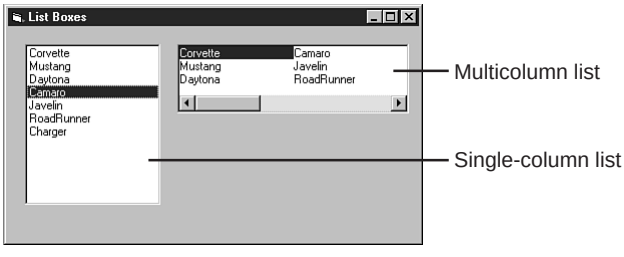
Another way to change the list's appearance is to use the `Columns` property. The default value of the property is 0. This value results in the standard list box previously discussed. Setting the property to 1 causes the list to be presented one column at a time, but to scroll horizontally instead of vertically. Setting the property to greater than 1 causes the list to display in the number of columns specified by the property (for example, a value of 2 displays the list in two col-

FIGURE 4.10
Checkbox-style list boxes provide the users with an intuitive way to select multiple items.



umns). When the list is displayed in multiple columns, the list scrolls horizontally. You can use the `Columns` property with either the Standard or Checkbox styles of lists. Figure 4.11 shows single-column and multicolumn lists. The list works the same way no matter how many columns you use.

FIGURE 4.11
You also can create multicolumn lists.



Working with Multiple Selections Sometimes you need to let the users select more than one item from a list. The list box supports this capability with the `MultiSelect` property. This property has three possible settings: `0 - None`, `1 - Simple`, and `2 - Extended`:

- The default setting, `0 - None`, means that multiple selections are not permitted, and the list box can accept only one selection at a time. The other two settings both permit multiple selections; the difference is in how they let the users make selections.
- With a setting of `1 - Simple`, users can click an item with the mouse to select it or click a selected item to deselect it. If they use the keyboard to make the selection, they can use the cursor keys to move the focus (the dotted line border) to an item and then press the Spacebar to select or deselect it.
- The other setting of the `MultiSelect` property, `2 - Extended`, is more complex. In this mode, users can use standard Windows techniques to quickly select multiple items. They can select a range of items by clicking the first item in the range and then, while holding down the Shift key, clicking the last item in the range; all items in between the first and last item are selected. To add or delete a single item to or from this selection, users hold down the Ctrl key while clicking the item.

Getting the selections from a multiple-selection list box is a little different than getting them for a single selection. Because the `ListIndex` property works only for a single selection, you can't use it. Instead, you have to examine each item in the list to determine whether it is selected.

Whether an item is selected is indicated by the list box's `Selected` property. Like the `List` property mentioned earlier, the `Selected` property is an array that has an element for each item in the list. The value of the `Selected` property for each item is either `True` (the item is selected) or `False` (the item is not selected).

You also need to know how many items are in the list so that you can set up the loop to check all the selections. This information is contained in the `ListCount` property. The following code prints onto the form the name of each list item that is selected:

```
numitm = Fruits.ListCount
For I = 0 to numitm - 1
   If Fruits.Selected(I) Then Form1.Print Fruits.List(I)
Next I
```

Keeping Other Data in the List What if you want the users to see a meaningful list, such as a list of names, but you also want to have the list remember a number that's associated with each name? The `ItemData` property of a list box is, in essence, an array of long integers, one for each item that has been added to the list box. No matter what position an item occupies in the list box, the `ItemData` array remembers the number associated with that particular element. This happens even if the list box's `Sorted` property is `True`, meaning that items aren't necessarily listed in the order that they're added. For example, the `ItemData` array element associated with the first item in a list box named `List1` can be accessed as `List1.ItemData(0)`. The array element for the currently selected list box entry can be accessed with `List1.ItemData(List1.ListIndex)` (recall that the `ListIndex` property reports which item is currently selected).

As items are added to a list box, an associated element is created in the `ItemData` array. Of course, it's your job to place the appropriate value into the proper position of the `ItemData` array. So how can your program know into which list box position a newly added item went, especially if the list box is sorted? Visual Basic makes this task easy. A list box's `NewIndex` property contains the index number of the most recently added item in the list. The following code adds a new customer to a sorted list box and then adds that customer's account number to the correct element of the associated `ItemData` array:

```
    lstCustomers.AddItem "Thomas, June"
    lstCustomers.ItemData(lstCustomers.NewIndex) = 21472301
```

Now, your programs can allow the users to select from a list box containing meaningful elements (names), but the background processing can be done with an associated number, which is easier for the computer. This approach is illustrated in the following `Click` event procedure of the list box:

```
Private Sub lstCustomers_Click()
    Dim lgThisCust As Long
    lgThisCust = lstCustomers.ItemData(lstCustomers.ListIndex)
    Call LookUpAccount(lgThisCust)
End Sub
```

The Combo Box

Another control that enables you to present lists to the users is the ComboBox control. The combo box can be used in three different forms:

- **The drop-down combo box.** Presents the users with a text box combined with a drop-down list (see Figure 4.12). The users can either select an item from the list portion or type an item in the text box portion.
- **The simple combo box.** Displays a text box and a list that doesn't drop down (see Figure 4.13). As with the drop-down combo box, the users can either select an item from the list portion or type an item in the text box portion.
- **The drop-down list.** Displays a drop-down list box from which the users can make a choice (see Figure 4.14). The users cannot enter items that are not in the list.

NOTE A new type of combo box, the ImageCombo, was added in Visual Basic version 6.0. This control is discussed in Chapter 12, "Microsoft Common Controls."

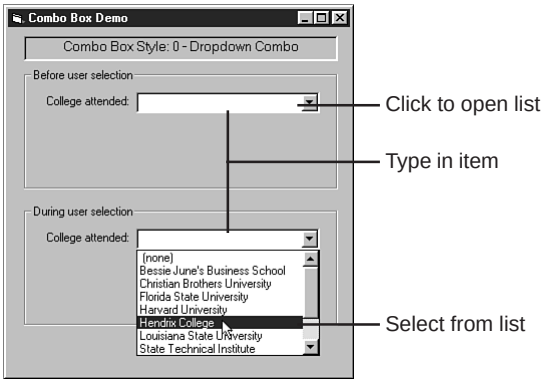


FIGURE 4.12
With the drop-down combo box, you can select an item from the drop-down list or type an alternative item in the text box.

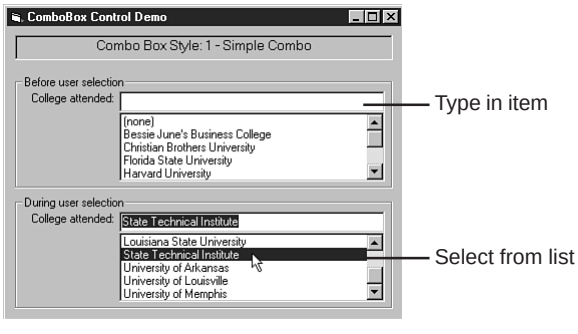


FIGURE 4.13
This simple combo box works like the drop-down combo box, except the list is always displayed.

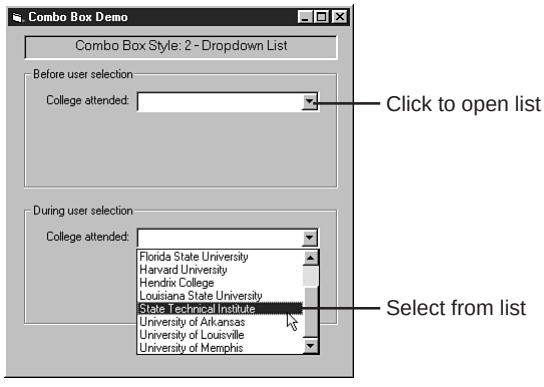


FIGURE 4.14
With the drop-down list, you cannot type an alternative item.

The combo box has much in common with the list box. Both use the `AddItem`, `RemoveItem`, and `Clear` methods to modify the contents of the list. Both can present a sorted or an unsorted list. Both support the `ItemData` array and `NewIndex` property. However, one box can do some things that the other cannot.

The combo box mainly lacks support for multiple selections. The key advantage of the combo box, though, is that it allows the users to enter choices that are not on the list. This feature works like an election ballot, in which you can choose a candidate from the list of those running or write in your own.

NOTE The drop-down list does not support the users' entering choices that are not on the list. Its chief advantage over a simple list box is that it occupies less space.

The following sections explain how to use the different forms of the combo box. The drop-down list is examined first because it is the simplest of the combo box styles.

Creating a Drop-Down List A drop-down list functions exactly like a list box. The key difference is that the drop-down list takes up less room on your form. When users want to select an item from the list, they click the down arrow, located to the right of the box, to extend the list. After the drop-down list appears, they then make a selection by clicking the item they want to choose. After the selection is made, the list retracts like a window shade, and the selection appears in the box.

You create a drop-down list by drawing a combo box on the form and then setting the `Style` property to `2 - Dropdown List`. You then can begin adding items to the list by using the `List` property, just like you did for the list box. However, keep in mind that the users can't add items that are not in the list.

Setting the Initial Choice Depending on your application, you might want to set the initial item for a combo box. For example, you can set the choice in a program that needs to know your citizenship. You can provide a list of choices but set the initial value to "U.S. Citizen" because that would be the selection of most people in this country.

You set the initial value by using the `ListIndex` property. For example, if "U.S. Citizen" is the fourth entry in the list, you can use the following code to cause that item to be pre-selected (recall that `ListIndex` begins its counting with zero):

```
Fruits.ListIndex = 3
```

This statement causes the fourth item in the list to be displayed when the combo box is first shown. (Remember, the list indexes start at 0.) You can set the initial choice with any of the three combo box styles. You also can set the initial choice of the combo box by setting the `Text` property to the value you want. If you do not set an initial choice by setting the index, the text contained in the `Text` property is displayed.

CAUTION

The initial value of the `Text` property is the name of the combo box. If you do not want this name to appear in your combo box on startup, set either the `ListIndex` property or the `Text` property in code.

TIP If you want your combo box to be blank when the form is first shown, simply delete the contents of the `Text` property while you are in the design environment.

Working with Choices Not on the List The drop-down list is useful for presenting several choices in a small amount of space. However, the real power of the combo box is its capability to allow users to enter choices other than those on the list. This capability is available with the other two styles of combo boxes—the simple combo box and the drop-down combo box. Both styles provide a list of items from which you can select, and both allow you to enter other values. The difference between the two styles is the way in which you access items already in the list.

You set up a simple combo box by drawing the control on the form and then setting the `Style` property to `1 - Simple Combo`. With the simple combo box, the users can access the items in the list using the mouse or the arrow keys. If the users don't find what they want on the list, they can type new choices.

The drop-down combo box works like a combination of the drop-down list and the simple combo box. You select an item from the list the same way you would for a drop-down list, but you also can enter a value that is not on the list. You create the drop-down combo box by setting the `Style` property to `0 - Dropdown Combo`. The drop-down combo box is the default setting of the `Style` property.

As with the list box and the drop-down list, you can use the `List` property to add items to the list of selections. You also can modify the list for any of the combo box styles while your program is running. As with the list box control, you modify the list by using the `AddItem`, `RemoveItem`, and `Clear` methods.

Special-Purpose Controls

The last group of intrinsic controls is labeled "special purpose" because they really do not fit into a group with other controls. However, you will probably find that they still get a lot of use.

The following are the types of controls covered in this section:

- ScrollBar controls
- Timer control
- Frame control

Scrollbars

If you have used Windows, then you are already familiar with scrollbars. Scrollbars provide a graphical way for you to perform tasks such as control your position within a document or make adjustments to your sound card volume.

Scrollbars work just like the real-world volume control on your stereo system, which can be set to any point between certain maximum and minimum values. From the programmer's point of view, the Visual Basic scrollbar controls return a numeric value; it is the programmer's responsibility to use this value appropriately in an application.

Visual Basic provides two types of scrollbars for entering numerical data: the vertical scrollbar and the horizontal scrollbar. These two controls are shown in Figure 4.15. The two scrollbars are referred to in the documentation as the VScrollBar and HScrollBar controls, respectively.

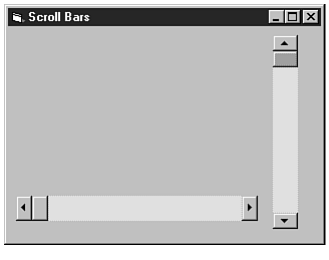


FIGURE 4.15
The VScrollBar and HScrollBar controls can be used to enter and display a numeric value graphically.

The only difference between the two controls is the orientation of the bar on the form. The following section examines the HScrollBar control, but it applies equally to the VScrollBar control.

Setting Up the Scrollbar To use a scrollbar, you simply use properties to set and retrieve the range and value. The three most important properties, available at designtime and runtime, are as follows:

- `Value`—Retrieves or sets the current numeric value
- `Min`—Controls the minimum value of the `Value` property
- `Max`—Controls the maximum value of the `Value` property

To use these properties, set the `Min` and `Max` properties to values representing the range you want and then access the `Value` property to find the result. One typical range is from 0 to 100, where the users would enter a number as a percentage.

NOTE The scrollbar can accept whole numbers (integers) anywhere in the range of –32,768 to 32,767. However, the valid values for the `Value` property depend on the values of the `Min` and `Max` properties. Remember this point when you are setting a scrollbar value from code, because a value outside the current range causes an error.

The `Change` event of the scrollbar fires when the `Value` property changes. To test a scrollbar, start a new Standard EXE project. Place a horizontal scrollbar and a text box on the form. Then enter the following code in the `Form_Load` event and `HScroll1_Change` events:

```
Private Sub Form_Load()
    HScroll1.Min = Me.Left
    HScroll1.Max = Me.ScaleWidth
End Sub
Private Sub HScroll1_Change()
    Text1.Left = HScroll1.Value
End Sub
```

Run the program and set the scrollbar to different values by dragging, clicking, and using the arrow, Home, and End keys. The text box should change positions on the form to match the current setting of the scrollbar.

Controlling the Size of the Value Changes If you have used a scrollbar in a word processor or other program, you know that clicking the arrow at either end of the bar moves you a short distance, and clicking between an arrow and the position button moves you a larger distance. The scrollbar controls work the same way, and you get to set how much the numbers change with each kind of move. The number entered in a scrollbar is contained in the `Value` property. This property changes every time you click the scrollbar or drag the position button, as indicated in Figure 4.16.

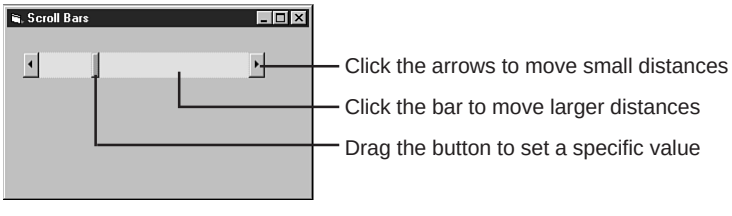


FIGURE 4.16
Clicking various parts of the scrollbar changes its value by different amounts.

The amount that the `Value` property increases or decreases when an arrow is clicked is controlled by the `SmallChange` property, unless such a change would exceed the bounds of the `Min` and `Max` properties. This property gives you very fine control over the numbers being entered. Its default value is `1`, which is probably a good number to use for most purposes.

When you click between the arrow and the position button, the `Value` property can change by a different amount than if you click an arrow. The amount of this change is set by the

`LargeChange` property. The default setting of the `LargeChange` property is `1`. The setting you use depends on your application. For example, a value of `10` is a good number if you are setting percentages.

TIP A good rule of thumb is to set the `LargeChange` property to a number about five to ten percent of the total range (for example, a value of 50 for a 0 to 1000 range.)

Showing the User the Numbers Although the visual representation is nice, users cannot tell what the range is or the exact numeric value. Sometimes you may need to write code to provide more detailed feedback. For example, suppose you are using a scrollbar to browse the letters of the alphabet for a database search. As users move the mouse, you can display the value they are scrolling through and then, when they release the mouse, perform the actual database search (see Figure 4.17).

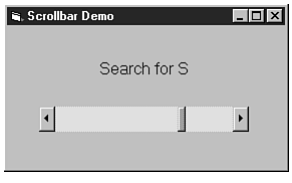


FIGURE 4.17 Associating labels or text boxes with the scrollbar shows the users the range and actual value.

The tricky part is knowing where to put the code statements. To show the value at all times, you actually have to place this statement in three events:

- `Form_Load`—Use this event to display the initial value of the scrollbar after setting up the range.
- `Change`—The `Change` event is triggered when you release the mouse button after dragging the position button to a new location. The `Change` event is also triggered each time the user clicks one of the arrows or clicks the scrollbar.
- `Scroll`—The `Scroll` event fires while the scrollbar position button is being dragged. This event allows you to display the value or take action as the `Value` property changes but before the `Change` event fires.

To test this alphabet example, create a new Standard EXE project. Place a scrollbar and label on the form. Then enter the code in Listing 4.1.

Listing 4.1 SCRLDEMO.ZIP—Using the Scrollbar

```
Private Sub Form_Load()
    'Set Max, then Min properties to numeric values
    HScroll1.Max = Asc("Z")
    HScroll1.Min = Asc("A")

    'Display the Initial Value
    Label1.Caption = Chr$(HScroll1.Value)
End Sub
```

```
Private Sub HScroll1_Change()
    Label1.Caption = "Search for " & Chr$(HScroll1.Value)
    'Insert code here to actually perform the db search
End Sub
Private Sub HScroll1_Scroll()
    Label1.Caption = "Release to select " & Chr$(HScroll1.Value)
End Sub
```

Run the program and watch the text in the label change as you manipulate the scrollbar. By putting code in the appropriate events, as in the example in Listing 4.1, you can have your program always display the exact value of the scrollbar but take action only when appropriate.

The Timer Control

As you may guess from looking at its icon, the Timer control works like a stopwatch or an alarm clock. However, three major differences exist between a timer in the real world and one in Visual Basic:

- Instead of making a noise or beeping, the Timer control executes code (in its `Timer` event) when the interval is complete.
- The Timer control counts down repeatedly, as long as the `Enabled` property is set to `True`.
- The Timer control is designed to work with very small amounts of time; the maximum setting is just a little longer than a minute.

The Timer control has many uses, including scheduling and performing repeated operations.

Setting Up the Timer You set up a Timer control by first drawing it on the form, as shown in Figure 4.18. The Timer control always shows up as an icon at designtime, but it does not show up at all while your program is running.

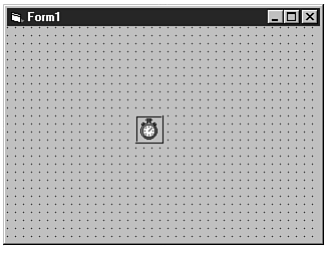


FIGURE 4.18
The Timer control appears as an icon, no matter what size you draw it.

To make the control work, you must first place code in the `Timer` event and then set the following properties, either at designtime or runtime:

1. Set the `Interval` property.
2. Set the `Enabled` property to `True`.

The `Enabled` property acts like a switch that turns your timer on and off. If the Timer control is enabled, the code in the `Timer` event is executed at the end of the time specified in the `Inter-`

`val` property. The `Interval` property can be set to any value between zero and 65,535. Setting the `Interval` property to zero disables the Timer control. Otherwise, the `Interval` property specifies the amount of time in milliseconds between firings of the `Timer` event. In other words, if you want 10 seconds to elapse, set the value to 10,000.

NOTE If the `Enabled` property is set to `True` at designtime, the timer begins countdown as soon as the form containing it is loaded.

Because the maximum value of the `Interval` corresponds to about a minute, how can you set up longer time intervals? You set up code within the `Timer` event that uses the system time to determine whether your interval has elapsed, as shown in Listing 4.2. The code in this listing causes the current time to be printed in the Immediate window every five minutes.

Listing 4.2 TIMEREX.ZIP—Using a Timer Control for Long Intervals

```
Option Explicit
Dim dtNextTime As Date

Private Sub Form_Load()
    'Set up the timer
    Timer1.Interval = 500
    Timer1.Enabled = True

    'We want to do something every 5 minutes
    dtNextTime = DateAdd("n", 5, Now)

End Sub

Private Sub Timer1_Timer()
    If Now >= dtNextTime Then
        Timer1.Enabled = False

        'Do what you want here then update dtNextTime
        Debug.Print "Timer Event at " & Now
        dtNextTime = DateAdd("n", 5, Now)

        Timer1.Enabled = True
    End If
End Sub
```

The code in Listing 4.2 does not use the Timer control to execute an event; instead, it uses the Timer control to check the system date to see whether it needs to execute an event. The key to this listing is the `DateAdd` function, which is used to compute a date five minutes in the future.

NOTE A code-only alternative to using the Timer control is the `Timer` function, which returns the number of seconds elapsed since midnight. You can subtract the current return value of this function from a stored value to find the number of elapsed seconds, as in the following example:

```
Dim sngStart As Single
sngStart = Timer
' (perform some action)
Debug.Print "Elasped time was " & CInt(Timer - sngStart) & " seconds."
```

Creating a Simple Animation To see how easily you can use the Timer control, create a simple animation now:

1. Start a new Standard EXE project in Visual Basic.
2. Place a Timer control and an Image control on the form.
3. From the Properties window on the Image control, select the ellipsis button next to the `Picture` property.
4. When the Load Picture dialog box appears, select an icon file from your Visual Basic \Graphics\Icons directory. For example, select the file FACE03.ICO from the Misc directory. The Image control should now contain an image of some type.
5. Enter the following code in the `Timer` event, `Form Load` event, and declarations section:

```
Dim xChange As Integer
Dim yChange As Integer

Private Sub Form_Load()

  xChange = 100
  yChange = 100

End Sub

Private Sub Timer1_Timer()

    Image1.Left = Image1.Left + xChange
    Image1.Top = Image1.Top + yChange

    If Image1.Left > Me.ScaleWidth Then xChange = xChange * -1
    If Image1.Left < 0 Then xChange = xChange * -1
    If Image1.Top > Me.ScaleHeight Then yChange = yChange * -1
    If Image1.Top < 0 Then yChange = yChange * -1
End Sub
```

6. Open the Properties window for the Timer control.
7. Set the `Interval` property to `200` and the `Enabled` property to `True`.

When you run the program, the image should move around your form, changing direction when it "hits" the side of the form.

Frames

The Frame control is special because it is a type of control called a *container*. Containers are controls in which you can draw other controls, much like a real picture frame visually encloses (or contains) an artist's picture. When you hide a container control (using the `Visible` property) or change its position on a form, the controls it contains are also affected. This feature is useful for creating multiple "pages" of controls on a single form.

NOTE Container controls create a different visual relationship between the form and the controls they contain. The code events and scope of variables on the form remain unaffected.

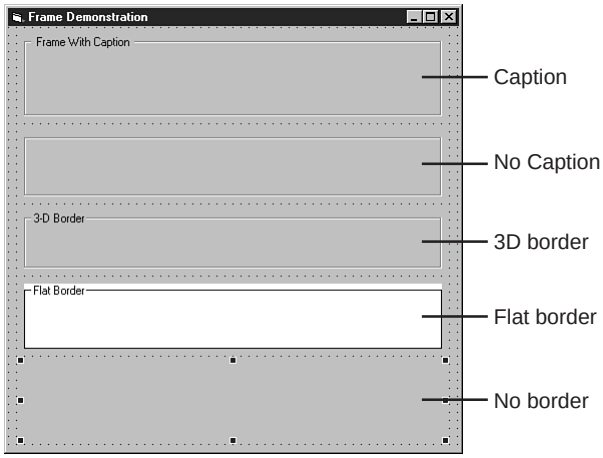
As with all other controls, the first step in setting up the frame control is to draw it on your form in the size that you want. Then, of course, you need to set the `Name` property to a unique

name. At this point, you can set several properties that control the appearance of the frame, the effects of which are shown in Figure 4.19:

- `Caption`—If you enter a value in the `Caption` property, the text you enter appears in the upper-left corner of the frame. This caption can be used to identify the contents of the frame or provide other descriptive information. If you don't want a caption and simply want an unbroken border around the frame, delete the text in the `Caption` property.
- `Appearance`—This property controls whether the border is shown as a single-line, single-color border, which gives the control a flat look, or is shown using lines that give the control a 3D effect.
- `BorderStyle`—This property determines whether the border around the frame is displayed. If the `BorderStyle` property is set to `None` (using a value of 0), no border is displayed, and the caption is not displayed because it is also part of the border.

TIP To avoid having the lines of the border touch the text of the caption, insert a space before and after the text when you set the `Caption` property.

FIGURE 4.19
You control the frame's appearance through the `Appearance`, `BorderStyle`, and `Caption` properties.



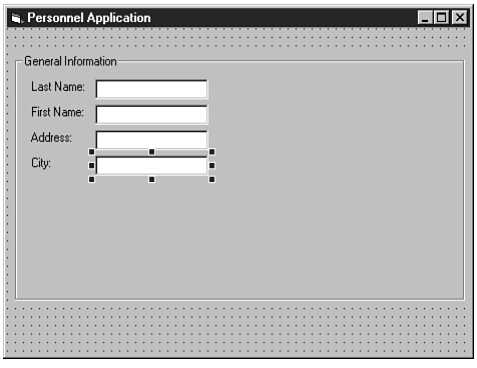
TIP If you want the frame to appear without a border, leave the border turned on while you are in design mode and then set the `BorderStyle` property to `0` when your form loads. Having the border displayed in the design environment makes it easier to see the boundaries of the frame.

Working with Controls in the Frame After you draw a Frame control, you are ready to start placing other controls in it. You can place any controls you like in the frame (or any other container). You can even place containers within containers.

To place controls in a frame, simply draw them directly in the frame just like you would draw them on the form. (If you double-click a Toolbox tool to add a control, it's important that the frame is selected before adding the control.) Then draw controls in the frame just like you

would draw them on the form. You need to make sure that the cursor is inside the frame when you start drawing the control. Otherwise, the control is not contained by the frame. Figure 4.20 shows several controls for a personnel application drawn on a frame.

FIGURE 4.20
Make sure your cursor is inside the frame before you start to draw a control.



Here are a couple of points about controls and frames:

- First, if you already have controls on the form, they are not contained by the frame, even if you draw the frame over the control.
- Second, when you are moving a control on a frame, unlike moving controls around on a form, you cannot move a control into or out of the frame by dragging and dropping the control.

You can drag a control over the frame, and the control will look like it is contained within the frame, but it really isn't. The only way to move a control from other parts of the form into the frame is to cut and paste. Cut the control from the form, select the frame, and then paste the control in the frame. (You can also copy a control from another part of the form and paste it into the frame.) The control is initially placed in the upper-left corner of the frame, but after the control is in the frame, you can drag and drop the control within the frame. You can use the same technique to move a control out of the frame. You can, of course, move multiple controls at the same time.

TIP If you want to make sure a control is in the frame, try moving the frame. If the control moves with it, the control is part of the frame. If the control does not move with the frame, you can cut and paste to move it into the frame.

Working with Multiple Controls at Designtime

So far, you have seen how to add controls to your forms and how to set the properties of a single control at a time. Sometimes, though, you need to be able to work with multiple controls at the same time. For example, if you have a bunch of Label controls on a form and decide to

change their font, you don't want to have to select and change each Label control individually. Fortunately, you don't have to handle controls one at a time; you can work with them in groups.

Selecting Multiple Controls

The first step in working with multiple controls is to select all the controls that you need to move or modify. You can select a group of controls by clicking the mouse on your form and dragging it. As you drag the mouse, a dashed-line box appears on the form, as shown in Figure 4.21 (the designtime Form Grid has been disabled for clarity). Use this box to enclose the controls you want to select.

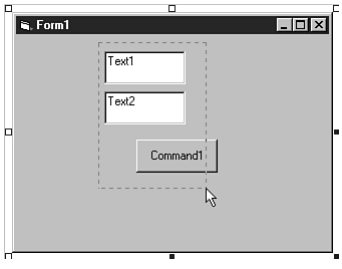


FIGURE 4.21
You can easily select multiple controls by using the mouse.

When you release the mouse button, any controls that are inside the box or touching it are selected. The selected controls are indicated by sizing handles at each corner and in the center of each side of the control, as you can see in Figure 4.22.

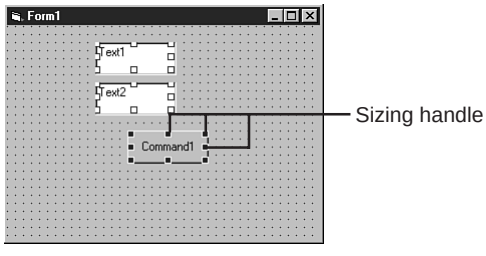


FIGURE 4.22
Sizing handles indicate that one or more controls are selected.

NOTE You can also select multiple controls by holding down the Ctrl key while you click them individually. If you need to select a group of controls that are contained within a frame or picture box, you must Ctrl+click them because the dashed-line box technique doesn't work.

You can add controls to a group or remove them by clicking the control while holding down the Shift or Ctrl key. You can even use this approach after making an initial selection with a mouse drag, so you can refine your selection to exactly the group of controls you want to work with.

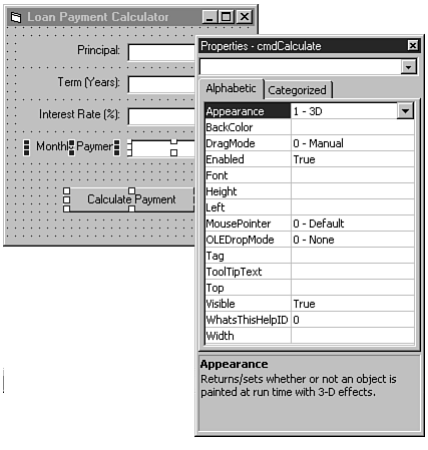
After the group of controls has been selected, you can move the group as a whole by clicking one of the controls in the group and dragging the group to a new location. The controls retain their relative positions within the group as you move them. You can also use editing operations such as Delete, Cut, Copy, and Paste on the group as a whole.

Using the Properties Window

In addition to the ability to move, cut, copy, paste, and delete a group of controls, you can also work with their properties as a group. For example, if you want to change the font of a group of Label controls, simply select the group of controls and access the `Font` property in the Properties window. When you change the property, all the selected controls are affected. This technique is great for making changes to many controls at once.

Although this method obviously works for a group of controls of the same type (such as a group of labels or a group of text boxes), you might be wondering what happens when your group includes controls of several different types. In this case, Visual Basic displays the properties that are common to all the controls in the group. These properties typically include `Top`, `Left`, `Height`, `Width`, `Font`, `ForeColor`, `Visible`, and `Enabled`. You can edit only the properties that are common to all the controls. However, this capability is useful if you want to align the left or top edges of a group of controls. To do so, simply select the group and set the `Left` property of the group (or the `Top` property). Figure 4.23 shows a selected group of different controls and the Properties window containing their common properties.

FIGURE 4.23
Common properties of different controls can be modified as a group.



Using the Form Editor Toolbar

Editing common properties is not the only way to work with a group of controls. You can also use the *Form Editor toolbar* (see Figure 4.24). You access it by selecting View, Toolbars, Form Editor. Table 4.2 shows and explains each of the toolbar buttons.

FIGURE 4.24
The Form Editor toolbar makes aligning and sizing multiple controls easy.

Table 4.2 Form Editor Toolbar Buttons

Name	Function
Bring to Front	Moves the selected control in front of other controls on the form
Send to Back	Moves the selected control behind other controls on the form
Align	Lines up a group of controls
Center	Centers a group of controls
Make Same Size	Resizes a group of controls to match
Lock Controls Toggle	Prevents movement or resizing of controls with the mouse (however, the controls can still be modified with the Properties window)

Using the Form Editor toolbar, you can manipulate the position and size of a group of controls. The Align button allows you to align the left, right, top, or bottom edges of a group of controls. Although you can align the left and top edges of a group by setting the `Left` and `Top` properties directly, you cannot align the right or bottom edges directly. The Align button also allows you to line up the vertical or horizontal centers of the controls. You cannot make this change directly with the properties. To choose which type of alignment to use, click the arrow button to the right of the Align button. This action displays a menu from which you can pick the alignment. You can also choose to align all the selected controls to the grid. Aligning the controls this way causes the upper-left corner of each control to be moved so that it is touching the grid point nearest its current location.

Another task that was tedious in earlier versions of Visual Basic was centering controls on the form. This task has also been made easy using the Form Editor toolbar. Next to the Align button is the Center button. This button allows you to center the group of controls horizontally or vertically within the form. The entire group is centered as if it were a single control; the relative position of each control in the group remains the same. As with the alignment options, you select the type of centering you want from a pop-up menu that appears when you click the arrow button next to the Center button.

The Make Same Size button allows you to make the height and/or width of all the controls in the group the same. Although you can do so by setting the appropriate properties, the Form Editor makes this task much more convenient. Figure 4.25 shows a group of controls made the same size as well as centered horizontally within the form.

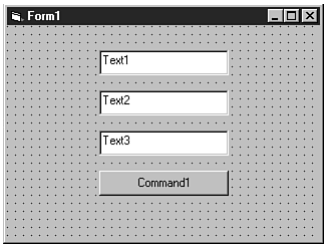


FIGURE 4.25
When you use the Form Editor toolbar, centering and resizing controls is a snap.

TIP If you click the wrong button on the Form Editor toolbar, you can undo the changes by clicking the Standard toolbar's Undo button or by pressing Ctrl+Z.

Using the Format Menu

Visual Basic's Format menu is also useful when you are working with controls. The Format menu contains all the same functions as the Form Editor toolbar, but it also has three other options for working with multiple controls: Horizontal Spacing, Vertical Spacing, and Size to Grid (see Figure 4.26).

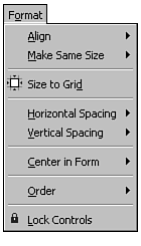


FIGURE 4.26
The Format menu offers a number of tools for fine-tuning the appearance of controls on your forms.

Using the Horizontal Spacing option, you can make the spacing between controls equal. Equal spacing gives you a clean look for groups of controls such as command buttons. If you think the controls are too close together, you can increase the spacing. The spacing is increased by one grid point. You can also decrease the spacing between controls or remove the spacing altogether. By choosing Vertical Spacing, you can perform the same tasks in the vertical direction. Figure 4.27 shows a "before" and "after" look at a group of command buttons. The "after" portion shows the effect of setting the horizontal spacing equal.

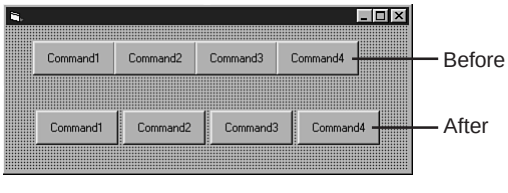


FIGURE 4.27
Equal horizontal spacing makes this group of buttons look orderly.

The final item on the Format menu is the Size to Grid item. Selecting this option sets the `Height` and `Width` properties of each selected control so that it exactly matches the grid spacing.

Multiple Controls in a Frame

Now you know how to select multiple controls on a form to work with their common properties or to handle alignment and sizing tasks. You can use the same approach with controls inside a frame. The only difference is in the way that you select the controls. To select a group of controls, you first need to click the form so that no controls are selected. Then hold down the Shift or Ctrl key while you click, and drag the mouse around the controls in the frame. This action selects the group of controls. You can still select or deselect other controls by holding down the Ctrl key while you click the controls.

NOTE When you are selecting a group of controls, all the controls must be inside or outside a container. Also, control selection cannot span containers.

After you select the multiple controls, you can work with their common properties or use the commands of the Format menu to position and size the controls.

CAUTION

The Center in Form command of the Format menu still centers the controls in the form, not within the frame. This result may be undesirable.

Working with the Controls Collection

By now, you're probably thinking, "All this is great when I am in the design environment, but what about while my program is running?" Well, as you know, you can change the properties of any single control by specifying the control name, the property name, and the new property value. But does this mean that you have to set each control individually? No way!

Each form contains a *collection* called the `Controls` collection. This collection identifies each control on the form. Using this collection and a special form of the `For` loop, you can change a specific property of every control on your form.

Changing All Controls

As an example of changing controls, you might want to give your users a way to select the font they want to use for the controls on the form. Trying to set each form in code would be a real pain. But, with the `For Each` loop, you can set the font of every control on the form with just three lines of code:

```
For Each Control In Form1.Controls
    Control.Font = "Times New Roman"
Next Control
```

CAUTION

This code will only work if all controls on the form support the `Font` property. A few controls, such as the Timer control, don't have that property.

You can use the same approach with any other properties that are supported by all the controls on the form.

Changing Selected Controls

What if you want to set a property that is not supported by all the form's controls? For example, if you want to change the text color of your controls, the command button doesn't have a `ForeColor` property, although other types of controls do. For this problem, you use another code statement: the `TypeOf` statement. This statement allows you to determine the type of any object. This way, you can set up a routine that changes the `ForeColor` property of all controls that are not command buttons:

```
For Each Control In Form1.Controls
    If Not TypeOf Control Is CommandButton Then
        Control.ForeColor = &HFF
    End If
Next Control
```


From Here...

This chapter introduced you to the world of forms and controls. You learned how to control the appearance of forms and controls through their properties and how you can use the methods of forms to perform tasks. You also saw how to work with multiple controls in both the design environment and in your programs.

For more information on topics discussed in this chapter, see the following:

- To learn about some controls other than the standard controls, see Chapter 6, "Giving More Control to the User: Menus and Toolbars," and Chapter 12, "Microsoft Common Controls."
- To learn about using controls in an array, see Chapter 13, "Working with Control Arrays."
- To find out how to arrange controls in a manner that is visually pleasing, as well as learn about some graphics-related controls, see Chapter 19, "Using Visual Design Elements."

PART II

Programming with Visual Basic

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CHAPTER 5

Responding to the User with Event Procedures

In this chapter

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With the advent of graphical, object-based operating systems such as Microsoft Windows and its successors, the way that users interact with programs has changed forever. Gone are the days when a character-based program ran from beginning to end with few user interactions. With Windows, you now have tremendous control over what functions a program performs, as well as the order in which these functions are performed. Although this concept made programs much easier to use, they can be much more difficult to develop. A program's developer is no longer in control of the entire program experience. Programmers of event-driven programs must plan for many possible user activities and, in many cases, must protect the users from themselves.

Windows applications are inherently *event-driven*, meaning that the flow of program execution is controlled by the events that occur as the program is running. As you'll see, most of these events are the direct result of actions initiated by the users; however, some events are invoked by other objects, including the program itself.

NOTE Although event-driven programs were around before Windows arrived on the scene (Macintosh programs and even a few DOS programs were event-driven), it was Windows that started the groundswell that has defined desktop computing today.

Introducing Events

The concept of an event-driven program might be fairly new to you, but the idea of responding to events should not be. Most of the world could be called *event-driven*. For example, consider your TV. You can change the channel whenever you feel like it, and with today's remote controls, you can go directly to your favorite channel instead of having to switch through all the channels on the TV. By the same token, you can change the volume of the TV whenever you want by as much as you want. You can probably also cut out the sound altogether by pressing the mute button. This type of control over how and when things happen correlates to event-driven programming. You (the user of your TV) initiate an event (by pressing a button) that causes the TV to take an action appropriate to the event that occurred. You also control when these events happen.

Windows programs work in a similar manner. In Microsoft Word, for example, you can easily change the font or style of a piece of text. You can also highlight a section of text and drag it to a new location. Each of these actions is made possible by the program's capability to take actions in response to user-initiated events.

As you create your own Windows programs, you will seek to model the program after the real-world tasks that the program is supposed to handle. Therefore, you should give the users command buttons or menu selections so that they can perform tasks when they want. Figure 5.1 shows an example of the interface for an event-driven program.

FIGURE 5.1
Graphical user interfaces go hand in hand with event-driven programming.

Another advantage of event-driven programming is that you can use the events to provide immediate feedback to the user. For example, you can program an event to verify a user's entry as soon as the user finishes typing. Then, if a problem occurs with what the user entered, he or she knows immediately and can fix it. This type of feedback is handled by code, such as that shown in Listing 5.1, which ensures that the user has entered required information in the text box.

Listing 5.1 EVENTS.FRM—Code to Verify Entry of a Last Name

```
Private Sub txtLastName_LostFocus()
    If Trim(txtLastName.Text) = "" Then
        smsg = "You must enter your Last Name."
        MsgBox smsg, vbExclamation, "Warning"
        txtLastName.SetFocus
    End If

End Sub
```


Handling Events in Your Programs

In a typical program, many events can occur and many user actions can trigger these events. Program events can be triggered by actions such as the user clicking a mouse button, pressing a key, moving the mouse, changing the value of the information in a control, or switching to another window in the program. The program itself can cause events to occur. Windows events can also be triggered by system functions such as a timer, or even by external factors such as receiving an e-mail message. Hundreds—if not thousands—of events can occur in any given program. Your program should be able to isolate the events that are relative to the program's function. Visual Basic makes this task easy.

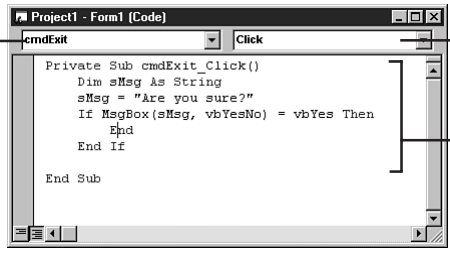
Determining When an Event Has Occurred

When Windows detects a user action destined for your program, it sends your program a message. The Visual Basic runtime kernel embedded in your program interprets the message and, if appropriate, raises a corresponding event. If you've written code to handle this event, Visual Basic invokes your code.

Each object in a Visual Basic program can raise a specific group of events, depending on the object's type (text box, form, command button, and so on). However, the key to handling events is to determine exactly which object/event combinations are appropriate to your program and then write code for those object/event combinations. You do so by creating an *event procedure* in a *Code window*. For example, if you want to write some code that will be executed whenever a command button named `cmdExit` is clicked, you write the `Click` event procedure for `cmdExit`. You can edit this procedure by opening a Code window on the form that contains `cmdExit`.

Recall from Chapter 2, "Creating Your First Program," that you use the drop-down boxes at the top of the Code window to select an event procedure. The object is selected in the Code window's upper-left drop-down list box (the *Object* box); the appropriate event procedure is selected in the upper-right drop-down list box (the *Procedure* box). When that object/event combination occurs at runtime, if code has been written for that combination, Visual Basic executes the code. If no code has been written for the combination, Visual Basic ignores the event. Figure 5.2 shows an example of an event procedure written for a specific control and event.

FIGURE 5.2
Visual Basic responds to an event only if you write code for it.



Types of Events

Two basic types of events can occur in your Visual Basic program: user-initiated events and system-initiated events. Most often, you will write code for user-initiated events, which let your users control the flow of the program. That is, your users can take a specific action whenever they want (within the constraints imposed by the program), which gives them almost complete control.

NOTE You can, of course, limit the actions that users can take by hiding or disabling controls when you don't want users to have access to them. This technique is discussed in Chapter 3, "Visual Basic Building Blocks."

▶ **See** "Using Properties to Control User Interaction," p. 48

User-Initiated Events User-initiated events are those that occur because of an action taken by the user. As you might guess, these events include keystrokes and mouse clicks, but other events are also caused by the user, either directly or indirectly. For example, when the user clicks a text box to start editing the information in the box, a `Click` event is fired for the text box. What you might not realize is that several other events are also fired.

One of these events is the `GotFocus` event for the text box. This event occurs every time the user moves to the text box, either by clicking the mouse or using the Tab key. Also, when the text box gets the program's focus, another control must lose the focus. This action causes a `LostFocus` event to fire for the other control. The `GotFocus` and `LostFocus` events are caused by the user's action, just as the `Click` event is. As you will see in the upcoming section "Understanding Event Sequences," multiple events can occur for each action a user takes. The order in which the events occur can be important.

The following are some of the main user actions that trigger events in a program:

- Starting the program
- Pressing a key
- Clicking the mouse
- Moving the mouse
- Closing the program

System Events Although forms and controls can respond to many different events, many controls have several events in common, as you can see in Table 5.1.

Table 5.1 Events Common to Many Controls

Event	Occurs When
`Change`	The user modifies the text in a text box or combo box.
`Click`	The user clicks an object with the primary mouse button (usually the left button).
`DblClick`	The user double-clicks an object with the primary mouse button.
`DragDrop`	The user drags a control to another location.
`DragOver`	An object is dragged over a control.
`GotFocus`	An object receives the focus.
`KeyDown`	A key is pressed while an object has the focus.
`KeyPress`	A key is pressed and released while an object has the focus.
`KeyUp`	A key is released while an object has the focus.
`LostFocus`	The focus has left an object.
`MouseDown`	A mouse button is pressed while the mouse pointer is over an object.
`MouseMove`	The mouse cursor is moved over an object.
`MouseUp`	A mouse button is released whilethe mouse pointer is over an object.

You might have noticed that several of the events seem to correspond to the same user action. For example, the `Click`, `MouseDown`, and `MouseUp` events all occur when the user clicks the

mouse button. Although some of the differences between the events are obvious—for example, the `MouseDown` event occurs when you press the mouse button—other differences between the events do exist. In the case of pressing a mouse button, the `Click` event is fired only if the left mouse button is pressed; it does not respond to the click of any other mouse button. The `MouseDown` and `MouseUp` events not only respond to any mouse button, but the event also can report which button was pressed, so your program can take appropriate action.

The `KeyDown`, `KeyPress`, and `KeyUp` events work in a similar manner. The `KeyPress` event tells you only which key was pressed, not whether a Shift or Ctrl key was held down when the key was pressed. If you need that information, you need to use the `KeyDown` or `KeyUp` events.

Writing Event Procedures

With all these events going on, how do you make your code respond to them? And how do you filter out the events that you don't want? The answer to both questions is the same. To respond to any event for any object, you write program code specifically for that event happening to that object. Any object/event combination that has no code written for it is ignored. So the next question is, how do you write code for an event?

To write code, you first need to access a *Code window*. Do so by double-clicking a control on your form (or the form itself), by clicking the View Code button in the project window, by selecting Code from the View menu, or by pressing F7. Any of these actions presents you with the Code window for the current form (see Figure 5.3).

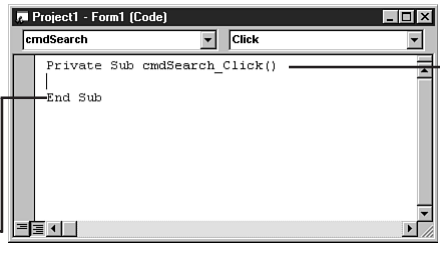


FIGURE 5.3
Double-clicking a form or control at designtime presents a Code window, opened to an event procedure.

Follow these steps to write a simple example:

1. Start Visual Basic and choose a Standard EXE project.
2. Double-click the form to open the Code window. By default, if no other code exists for the form, you are placed in the form's `Load` event procedure.
3. From the Object box, select the Form object.
4. From the Procedure box, select the `MouseMove` event.

NOTE Notice that when you make a selection, Visual Basic automatically sets up the skeleton of a procedure with the procedure's name and the `End Sub` statement (which denotes the end of the procedure).

The procedure name for an event procedure contains the name of the object and the name of the event. In this example, `Form` is the object and `MouseMove` is the event. Notice that the `MouseMove` event procedure also contains several parameters; for example, the parameters `X` and `Y` represent the coordinates of the mouse.

5. At this point, you can write program statements to take whatever action(s) should happen in response to an occurrence of the event. Add the following line of code to the event procedure:

```
Me.Caption = "Mouse Coordinates are (" & X & "," & Y & ")"
```

Your event procedure should now look like this:

```
Private Sub Form_MouseMove(Button As Integer,
Shift As Integer, X As Single, Y As Single)
    Me.Caption = "Mouse Coordinates are (" & X & "," & Y & ")"
End Sub
```

The preceding code displays the values of the `X` and `Y` parameters in the form's title bar by setting the `Caption` property of the form. Press Visual Basic's Start button, or F5, and move the mouse pointer over the form. You should see the form's caption (title) change as the mouse pointer moves.

TIP If you enter a Code window by double-clicking an object, the Code window automatically selects that object's most commonly used event procedure. For example, if you double-click a command button at designtime, the Code window is opened to that command button's `Click` event procedure.

Calling an Event Procedure from Code

As you learn Visual Basic, you will be writing and calling many procedures. Event procedures are kind of special in that they are called by Visual Basic itself. In the `MouseMove` example in the preceding section, Visual Basic executed the code you wrote in response to an event. However, it is noteworthy to mention that you can execute event procedures yourself, just like any other procedure you would write. You might do so when you have written code in an event procedure that needs to be executed in multiple places.

Let me demonstrate this by example. If you still have the Standard EXE project open from the previous example, return to Design mode and draw a CommandButton control on the form. Double-click the command button and change the event procedure to display the current date and time, as follows:

```
Private Sub Command1_Click()
    MsgBox "The system time is " & Now
End Sub
```

The preceding code is easy to understand. It just displays a message box when the button `Command1` is clicked. However, you can call the `Command1_Click` procedure from other parts of your code, including another event. Double-click the form itself, and from the Procedure box, select the `Click` event. Change the `Form_Click` event procedure to call the `Command1_Click` procedure:

```
Private Sub Form_Click()
    Command1_Click
End Sub
```

Run the program, and you will notice that whether you click the form or the command button, the same `MsgBox` statement is executed, just as if the user had clicked the command button itself.

NOTE If the event procedure you are calling has parameters, such as the `MouseMove` event, you have to supply them when calling the event procedure.

Understanding Event Sequences

By now, you should have an understanding of what events are and how Visual Basic handles them. You have seen how to write code to take action when an event occurs. But you need to dive just a little deeper into the world of events.

As you learned earlier, a single user action or system event can trigger multiple events. This result can be good because you can use these different events to handle different situations, as in the case of the `MouseDown` and `Click` events. However, there is a flip side. (Isn't there always?) If you write code for multiple events that can occur, these procedures can interact in ways that you don't want. In the worst case, a sequence of events—each with its own event procedure—can put your system into an infinite loop. The following are several keys to avoiding these problems:

- Recognize that multiple events can occur.
- Determine which events occur for a user action.
- Understand the sequence in which the events occur.
- Test the interactions between multiple events in your code.

In the following sections, you examine some issues to be aware of when writing event procedures in Visual Basic.

Multiple Events for Each Action

One of the problems of handling multiple events is that the user can interact with your program in a very large number of ways. For example, did the user move to the text box with a mouse or with the Tab key? Prior to the move, was the focus on another text box or was it on a command button? And what happens when you move from one form to another? As you can see, the possibilities can be almost overwhelming.

The good news, though, is that you will not write code for most object/event combinations. Therefore, even though these events might occur, your program ignores them—and they do not cause you any problems.

Even though not writing this extra code simplifies the task of handling multiple events, it does not eliminate the task. To get a handle on this situation, take a look at some simple sets of events that occur when a user performs an action.

Consider, for example, the Logon dialog box that appears when you start Windows. If you imagine that this dialog box had been written in Visual Basic, as you enter your username and password, several events occur.

First, look at the simple keystroke. For each character that you type in your username, three events are fired: `KeyDown`, `KeyPress`, and `KeyUp` (in that order). When you move from the username field to the password field, you change the focus from one control to another, so two additional events are triggered: `LostFocus` for the current control and `GotFocus` for the new control.

Finally, as you click the OK button, the simple mouse click fires three events: `MouseDown`, `MouseUp`, and `Click`. If you double-click another object such as the form, two more events occur after the `Click` event: the `DblClick` event and another `MouseUp` event. That's five events for what would seem like a single user action. In addition, if the mouse click causes the focus to move from one control to another, `LostFocus` and `GotFocus` events would be triggered, for a total of seven events.

Another problem is that different actions to achieve the same purpose cause different event sequences. For example, consider the OK button on the Windows Logon dialog box. Did you know that you can either click it with the mouse or tab over to it and press the spacebar? Using the mouse triggers the `MouseDown`, `MouseUp`, and `Click` events. Using the spacebar triggers the `KeyDown`, `KeyPress`, `KeyUp`, and then the `Click` events. This process can be confusing, can't it?

However, you can determine what events will occur in your program and in what order they will occur.

Determining the Order of Events

The key to understanding the purposes of these events is knowing *when* they occur. If this information is still a bit unclear, try the simple tutorial that follows. In the tutorial, you create a program to monitor form events and then trigger those events to determine the firing order. You also preview the type of code you might want to put in each of these event procedures.

Creating a Sample Form Events Program Five special events occur to each form, and you can place code in the associated event procedure for any of them:

- **`Load`**. Occurs when the form is loaded into memory
- **`Activate`**. Occurs when the form is displayed initially or when the user returns to the form from another form
- **`Deactivate`**. Occurs when the user moves to another form or the form is hidden
- **`Unload`**. Occurs when the form is unloaded from memory
- **`Initialize`**. Occurs when an instance of the form object is created
- **`Terminate`**. Occurs when an instance of the form object is destroyed

This sample program is very simple; it has only two forms with no controls. To create it, follow these steps:

1. Open Visual Basic and create a new Standard EXE project.
2. Double-click `Form1` to bring up its Code window.
3. Make sure the `Load` event is selected in the drop-down Event box at the upper-right of the Code window.
4. Type the statement `MsgBox "The Form Load Event occurred"` into the event procedure so that the code looks like this:

```
Private Sub Form_Load()
    MsgBox "The Form Load Event occurred "
End Sub
```

5. Repeat steps 3 and 4 to place similar `MsgBox` statements in the `Initialize` and `Unload` event procedures.
6. Add a second form, `Form2`, to the project by choosing Project, Add Form.

Now that you have created the project, press F5 to run it. Notice that the `Initialize` event comes first, followed by the `Load` event. Click the form's Close button, and you should notice that the `Unload` and `Terminate` events occur before the program stops.

Testing Program Events Now start the program again and press Ctrl+Break to pause execution. Press Ctrl+G to bring up the Immediate window. Put the cursor in the Immediate window, and enter the following lines (pressing Enter after each), observing the messages that appear:

```
Load Form2
Unload Form1
Load Form1
```

(You load `Form2` to prevent the program from ending when you unload `Form1`.) You should have noticed that the `Initialize` event did not occur when `Form1` was loaded the second time. Now enter the following lines:

```
Unload Form1
Set Form1 = Nothing
```

Setting an instance of a form to `Nothing` when you're done with it is good practice. This way, you can ensure that all resources that were allocated to the form are properly released.

Now enter this line:

```
Load Form1
```

The `Initialize` event occurs again because the instance of `Form1` that you created before was destroyed when it was set to `Nothing`.

Using Form Events You can use program code in these events to set the properties of the form or any of its controls, set up databases or recordsets needed for the form, or run any other code that you might find necessary. The `Load` and `Unload` events each occur only once in the life of a form—when the form is loaded and unloaded from memory, respectively. On the other hand, the `Activate` and `Deactivate` events can occur many times. Therefore, you need to be careful which code is placed in which event.

The following code segment shows you a couple of simple but useful things that you can do with code in the `Load` event procedure. One very common use of the Load event procedure is to "preset" the value of one or more properties of controls on your form (or the form itself). Listing 5.2 illustrates how to set the form's `Caption` property as the form loads to reflect the current user's name (which you can assume has been previously determined elsewhere in the program and stored in the string variable `sUserName`). You also see how to set the `Text` property of a text box to contain the current date.

Listing 5.2 TESTLOAD.FRM—Using the *Load Event* Procedure to Set Properties

```
Private Sub Form_Load()
    Me.Caption = "Expense Summary for " & sUserName
    txtDate.Text = Date
End Sub
```

Other common uses of the `Load` event include setting up connections to data stored in databases, initializing variables, and positioning the form relative to other forms that may be open.

Another form event that you will use often is the `Resize` event. This event is triggered any time the size of the form is changed, either by the user or by your program. It also occurs after the form's `Load` event, before the `Activate` event occurs. Typically, you use the `Resize` event to change the size of one or more controls on your form. Doing so gives the user more room to work when the size of the form is increased and prevents information from being hidden when the size of the form is decreased. Listing 5.3 shows how the size of a data-bound `Grid` control changes when the form's size is changed. The code also checks the `WindowState` property of the form and does not perform the operation when the form is minimized.

Listing 5.3 RESIZE.FRM—Changing the Size and Position of Objects When the Form's Size Changes

```
If Me.WindowState <> vbMinimized And AllowResize Then
    dbgResults.Width = Me.ScaleWidth - 180
    dbgResults.Height = Me.ScaleHeight - dbgResults.Top - 60
End If
```

The first step in determining the event interaction is to map the order of events in a program. You can easily write a simple program to familiarize yourself with when events occur. First, create a new standard EXE project and place a `TextBox` control and a command button on it. You can then place code in the control and form event procedures to notify you when an event occurs. The easiest way to do so is to use the `Debug.Print` statement, which causes text to be displayed in the Immediate window. Simply add `Debug.Print` statements to the event procedures, such as the following ones for the text box:

```
Private Sub Text1_Click()
    Debug.Print "Text1 Click Event"
End Sub

Private Sub Text1_GotFocus()
    Debug.Print "Text1 Got Focus Event"
End Sub

Private Sub Text1_KeyPress(KeyAscii As Integer)
    Debug.Print "Text1 Keypress Event"
End Sub
```

Whether you use a tool like this program, or some other method, understanding the sequence of events is critically important. Once you realize that one user action can lead to several events, you can use that information to plan for which events you want to write code. For example, you can use a text box's `KeyDown` event, which is the first event that occurs when the user presses a key while the text box has the focus, to determine whether the user has pressed Ctrl. That may be an indication within your program of some special action, such as opening a new record or saving initialization information. Whatever the case, you should test your applications thoroughly, using a variety of sequences of actions to your objects, to make sure that unexpected event sequences won't cause undesired results.

From Here...

This chapter focused on how Visual Basic handles events. However, events are useful only in the context of forms and controls because they are the objects capable of receiving events. Also, events can cause an action in your program only if some code has been written for the event. You can learn more about these related topics in the following chapters:

- See Chapter 3, "Visual Basic Building Blocks," for introductions to forms, controls, properties, methods, and events.
- For further fundamental information on using Visual Basic controls, see Chapter 4, "Using Visual Basic's Default Controls."
- Chapter 6, "Giving More Control to the User: Menus and Toolbars," covers menus and toolbars in Visual Basic programs.
- For information on the Common Dialog control, see Chapter 7, "Using Dialog Boxes to Get Information."
- To find out more about writing your own procedures, see Chapter 11, "Managing Your Project: Sub Procedures, Functions, and Multiple Forms."
- To learn about the many different events available in the custom controls, see Chapter 12, "Microsoft Common Controls."

CHAPTER 6

Giving More Control to the User: Menus and Toolbars

In this chapter

Creating a Menu Bar **108**

Creating Pop-Up Menus **122**

Using Toolbars in Visual Basic **124**

Using the Coolbar Control **136**

Many computer programs are interactive; that is, they perform functions in response to user actions. In Chapter 5, "Responding to the User with Event Procedures," you learned how to make the objects in your program react to user actions. In this chapter, you explore how to give more control to your users. You learn how to add menu structures to your programs, giving your users the capability to select from a number of program commands. You will then see how to add toolbars to give your users a shortcut to commonly-used program functions.

Creating a Menu Bar

One of the most important aspects in designing any program is providing the users with easy access to all the program's functions. Users are accustomed to accessing most functions with a mouse click or two. In addition, they want all the functions located conveniently in one place. To help facilitate this strategy, Visual Basic lets you quickly and easily create a menu system with the Menu Editor. You can use this editor to create a menu bar for each of your application's forms, as well as context-sensitive "pop-up" menus (see the section "Creating Pop-Up Menus" later in this chapter).

The menu bar for the main form of a custom-designed exposition management program is shown in Figure 6.1.

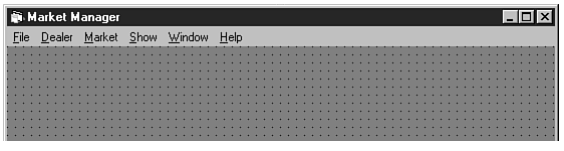


FIGURE 6.1
A well-designed menu system enables a program's users to locate and execute its functions easily.

The first step in creating a menu is determining what program commands need to be on the menu and how these commands should be organized. Figure 6.2 shows Visual Basic's own main menu. As you can see, the commands are organized into functional groups (File, Edit, View, and so forth).

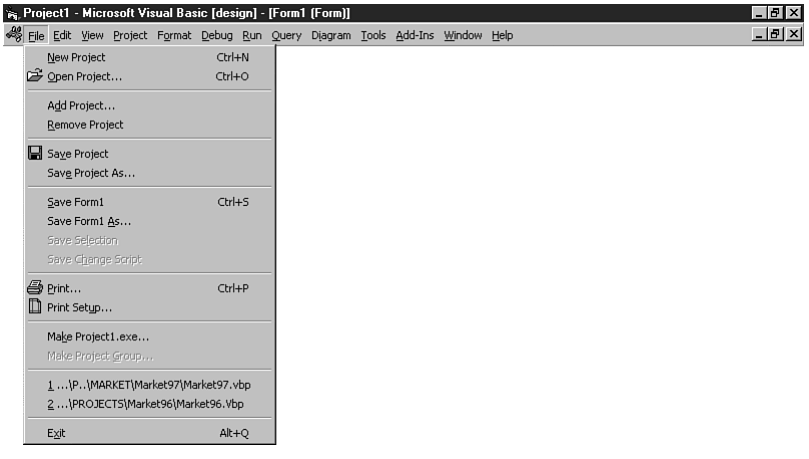


FIGURE 6.2
Visual Basic's main menu, shown here with its File menu opened, provides a convenient and intuitive way for users to select the various program functions.

The following sections provide the details about menus and building and coding them.

Common Menus

When you create your program's menu, you should group similar items. In fact, if possible, you should use groups with which your users are already familiar. This way, users have some idea where to find particular menu items, even if they've never used your program. The following list describes some standard menus you will find on many menu bars:

- **File.** This menu contains any functions related to whole files used by your program. Some of the typical menu items are New, Open, Close, Save, Save As, and Print. If your program works extensively with different files, you might also want to include a quick access list of the most recently used files. If you include a File menu, the program's Exit command is usually located near the bottom of this menu.
- **Edit.** The Edit menu contains the functions related to editing of text and using the Windows Clipboard. Some typical Edit menu items are Undo, Cut, Copy, Paste, Clear, Find, and Replace.
- **View.** The View menu might be included if your program supports different looks for the same document. A word processor, for example, might include a normal view for editing text and a page-layout view for positioning document elements, as well as a variety of zoom options. Another use of the View menu is to allow the users to display or hide special forms in your program, like the Visual Basic View, Toolbox option.
- **Tools.** This menu is a catchall for your program's utilities or "helper" functions. For example, a spelling checker, grammar checker, or equation editor might be included for a word processor.
- **Window.** This menu typically is included if your program uses a Multiple Document Interface (MDI). MDI programs, like Microsoft Word, support the simultaneous editing of different documents, databases, or files. The Window menu lets users arrange open documents or switch rapidly between them.
- **Help.** The Help menu contains access to your program's Help system. Typically, it includes menu items for a Help Index (a table of contents for help), a Search option (to let the users quickly find a particular topic), and an About option (providing summary, authoring, and copyright information regarding your program).

You can use these six "standard" menus as a basis for creating your own menu system. Include any or all of them as needed by your program, and add other menu groups as needed. Plan well before adding a lot of new groups, though. Make sure your users can easily access all your program's functions through the menu system.

Setting Up the Main Items

After deciding what functions to include in your menu and how to group these functions, you can then build the menu. To create a menu, first open the form on which you want the menu located, and then start the Menu Editor in any of three ways: click the Menu Editor button on the toolbar; choose Tools, Menu Editor; or press Ctrl+E. The Menu Editor then appears, as shown in Figure 6.3.

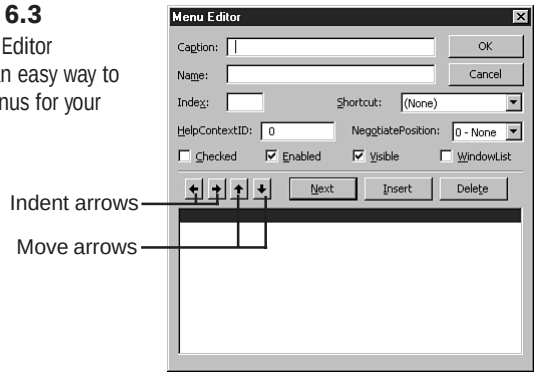


FIGURE 6.3
The Menu Editor provides an easy way to create menus for your program.

Menu Controls Each line of text (menu item) in a menu is a *Menu control*, just as each command button that you place on a form is a `CommandButton` control. You use the Menu Editor to create Menu controls and to set the following properties for each control:

- **Caption.** The caption is the actual text that is displayed in the menu item. You can specify an access key, which allows the users to select the menu item with the keyboard instead of a mouse, by placing an ampersand (`&`) before the appropriate letter of the caption. For example, if a particular menu item's `Caption` property is set to `F&ormat`, the "o" is underlined, and the users can select that item by pressing *O* when the menu is active. The `Caption` property is required for all menu items.
- **Name.** This property is used to identify the menu item in code. The `Name` property is required for all menu items. Like all other controls, each Menu control must have a name that will be used to refer to it in code. With these controls, unlike other controls, however, Visual Basic does not give menu items a default name; therefore, you must set the `Name` property of all menu items before leaving the Menu Editor.
- **Index.** If this menu item is part ofcontrol array, the `Index` property uniquely identifies the particular control array element.
- **Shortcut.** With this property, you can define shortcut key combinations that allow your users to select a menu item with one keystroke, bypassing the menu system entirely. For example, many programs use Ctrl+P as a shortcut key, eliminating the need to choose File, Print from the menu system.

- **HelpContextID.** This property sets a context ID that can be used in conjunction with a custom help file to provide context-sensitive help for your application.
- **NegotiatePosition.** If your application has linked or embedded objects, this property determines if and how this menu item is displayed while the linked or embedded object is active.
- **Checked.** If this property is `True`, a check mark appears to the left of the menu item's caption to indicate, for example, that a user has selected a particular option. If this property is `False`, no check mark appears.
- **Enabled.** This property can be set to `False` if its associated action isn't appropriate at a particular time. For example, if no text is selected, an Edit menu's Copy command can be disabled by setting its `Enabled` property to `False`.
- **Visible.** This property determines whether the menu item can be seen. Your application may have menu items that should not be seen at certain times; for example, you may not want the users to be able to see the Window menu item if no windows are open.
- **WindowList.** If your menu is on an MDI (Multiple Document Interface) form, , setting this property for a top-level menu control appends a dynamically-updated list of any active MDI child windows to the menu automatically.

Creating a Simple Menu System To illustrate the process of designing menus, you actually create a simple menu system now. You'll create a menu structure that includes some standard menu items. First, create a sample File menu:

1. Start Visual Basic, if necessary, and begin a Standard EXE project.
2. Make sure that the form for which you want to create the menu system is selected. `Form1` should already be selected; if not, click it.
3. Start the Menu Editor by selecting Tools, Menu Editor, or clicking the Menu Editor button on the toolbar.

   The cursor should be in the Caption field. In this field, you enter the text to be displayed by the menu item.
4. Type `&File` (remember, the ampersand indicates that the next character—*F*, in this case—is to be the access key). As you type, notice that the caption you are typing automatically appears in the box at the bottom of the Menu Editor. In this area, you can preview the layout of your menu. Note also that the top line of this box is highlighted.
5. Tab to the Name field and type `mnuFile`.

   The two properties you just set—`Caption` and `Name`—are all you need to set for now. The default values of the other properties work fine.
6. Click Next or press Enter to accept the properties you've set up for this Menu control. The property boxes are then cleared to prepare for a new control. Note that the highlight in the box at the bottom moves down to a new (blank) line.
7. Repeat steps 4 through 6 to create a second menu item. Use `&New` for the caption and `mnuFileNew` for the name.

8. Click OK to close the Menu Editor.

After following these steps, your form should have a menu bar like the one illustrated in Figure 6.4.

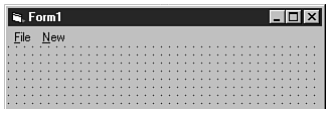


FIGURE 6.4
This menu bar, shown at designtime, was created with the Menu Editor.

You may have expected the menu to look different than this, with the New menu being a subitem within the File menu. Instead, both File and New are top-level menus. To fix this problem, you need to learn about the different levels that a menu can have. You learn more information about this topic in the following section, "Multiple-Level Menus."

You may also have tried clicking one of the menu items in the design environment. If you did, you were presented with a Code window. What you've done here is the equivalent of double-clicking an object on a form at designtime: You've opened the `Click` event procedure associated with the menu item that you clicked. Here, you can write code to be executed when that menu item is chosen at runtime. You learn about writing code for menu items later in the chapter in the section "Writing Code for the Menu Items"; for now, just close the Code window.

Multiple-Level Menus

Typical menus in Windows-based applications contain multiple levels of commands. Top-level menu items are the ones that are visible in the program's menu bar. Normally, clicking a top-level menu item opens that item's submenu. Each item in a submenu can represent either a program command or another submenu. In Visual Basic, your menus can have up to six levels of submenus.

TIP Although Visual Basic allows menus to have up to six levels, you should usually limit your program's menus to two or three levels. Too many levels can make navigating the menu system more difficult for your users.

Follow these steps to continue creating the File menu you started in the preceding section and to add the Edit and Options menus:

1. While Form1 is selected, open the Menu Editor.
2. In the box at the bottom of the Menu Editor, click the New item to select it.
3. Locate the four arrow buttons in the left-center area of the Menu Editor. Then click the right-facing arrow once. This action moves the selected menu item down a level. Notice in the box that the caption for this item becomes indented as a visual cue that it is a lower-level item. Clicking the left-facing arrow moves the item up a level.

4. Click Next to prepare the Menu Editor for another new item. Notice that in addition to clearing the property boxes, the new (blank) item in the Menu Editor's box is automatically indented to the level of the item preceding it.
5. Add new (indented) menu items with the following captions and names:

Caption	Name
`&Open...`	`mnuFileOpen`
`&Print...`	`mnuFilePrint`
`&Save`	`mnuFileSave`
`Sen&d To`	`mnuFileSendTo`

6. The Send To menu item will itself be a submenu. After you create it, indent the next blank menu item to another level by clicking the right-facing arrow, and add new (twice-indented) menu items with these captions and names:

Caption	Name
`&Mail Recipient`	`mnuFileSendToMail`
`&Fax Recipient`	`mnuFileSendToFax`

NOTE When you create multiple menu levels, as in the Send To option of the sample menu, Windows automatically provides the arrow-like indicator that lets users know a submenu exists.

7. Click the left-facing arrow once to unindent the next blank menu item by one level. Set this item's caption to `E&xit` and its name to `mnuFileExit`.
8. Click Next or press Enter to create a new menu item.
9. Click the left-facing arrow to make this a top-level menu item (not indented at all). Set this new item's caption to `&Edit` and its name to `mnuEdit`.
10. Indent the next menu item so that it is subordinate to the Edit menu. Add new menu items with these captions and names:

Caption	Name
`Cu&t`	`mnuEditCut`
`&Copy`	`mnuEditCopy`
`&Paste`	`mnuEditPaste`

11. On your own, add a top-level menu item. Set its `Caption` property to `&Options` and its `Name` property to `mnuOptions`.
12. Add these indented (second-level) menu items under the Options menu:

Caption	Name
`&Text Only`	`mnuOptionsText`
`&Uppercase`	`mnuOptionsUppercase`

The Menu Editor should look like the one in Figure 6.5.

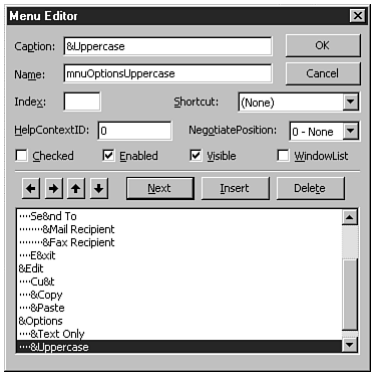


FIGURE 6.5
The Menu Editor enables you to create hierarchical menu systems quickly and easily.

13. Click OK to close the Menu Editor.

TIP I typically use a hierarchical structure to assign the `Name` property of my menu items. Each menu item's name begins with the prefix `mnu-`, followed by words that describe the portion of the menu in which the item is located. For example, `mnuFileSendToFax` is used to represent the menu item with the caption `Fax Recipient`; I can tell from the name that this item is in the Send To submenu of the File menu.

NOTE Occasionally, a menu item's caption ends with an ellipsis (...), as in the Open and Print items in the example. This ellipsis signifies to the users that more information, such as a filename and location, are needed to complete the requested command. After users select such a command, your program requests the appropriate information via a dialog box. ■

Now that you're back in the Visual Basic design environment, you can click Form1's File menu to see what it looks like. At this point, you may decide that you would like to group the commands that work with managing files—New, Open, and Save—together, as well as the Print and Send To commands. To do so, you need to move the Print menu down so that the file functions are together. You can then insert *separator bars* to group the related functions.

Grouping Menu Items

In addition to using menu levels to organize the items in your menu, you might want to further separate items in a particular level. Placing *separator bars* in the menu breaks up a long list of items and further groups the items, without your having to create a separate level. To place a separator bar in your menu, enter a hyphen (-) as the menu item's `Caption` property. It creates a separator bar that is the full width of the drop-down menu in which it appears. Remember, you must give each separator bar a unique value for its `Name` property, just as with any other menu item. I typically use incrementing numbers as part of the names of my separator menu items—`mnuHyphen1`, `mnuHyphen2`, and so on.

CAUTION

You cannot use a separator bar in the top level of the menu (the menu bar); separator bars must be part of a submenu. If you attempt to use a separator in the menu bar, Visual Basic informs you of the error as you try to save the menu.

Modifying the Menu

After creating your menu, you will probably find that you need to make some changes to the menu's structure. This task also is easily accomplished with the Menu Editor. Table 6.1 lists some common editing needs and how they are accomplished.

Table 6.1 Modifying Your Menu

Editing Function	How to Do It
Move an item	Select the item, and then click one of the Move arrows to move the item up or down in the list. The indentation level of the menu does not change as you move the item.
Add an item to the middle of the list	Select the item that should appear below the new item in the list, and then click the Insert button. A blank item appears; you can then enter the `Caption` and `Name` properties for the item. The new item is indented at the same level as the item below it.
Remove an item	Select the item, and then click the Delete button. The item is immediately deleted, without any confirmation. (There is no Undo feature available in the Menu Editor; whatever you delete is gone. However, if you wrote any program code for the menu control, that code is still present in the Code window.)

Now you can use these menu modification techniques to regroup the items and to insert the separator bars mentioned in the preceding section. To do so, follow these steps:

1. While Form1 is selected, open the Menu Editor.
2. Click the Print menu item once to select it.
3. Click the downward-facing arrow twice to move the item just above the Send To menu item. (If you need to move an item up, click the upward-facing arrow.)
4. With the Print menu item still selected, click the Insert button to create a blank menu item above the Print item.
5. Click in the Caption field, and type a single hyphen (`-`).
6. Tab to the Name field and type `mnuHyphen1`.

7. To insert another blank item before the Exit menu item, select the Exit item and then click Insert.
8. Enter a hyphen as the new item's `Caption` property and `mnuHyphen2` as its `Name` property.
9. Click OK to close the Menu Editor.

Figure 6.6 depicts the Menu Editor after creating and modifying the sample File menu.

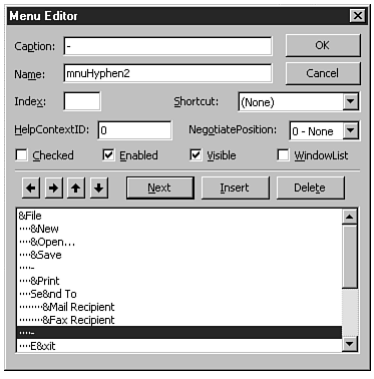


FIGURE 6.6
Multiple menu levels help organize your program's functions.

Adding Access Keys and Shortcut Keys for Quick Access

Many menu items in Windows programs can be accessed by using keystroke combinations. You can let users access your menu items in the same way. Two types of key combinations can be used this way: *access keys* and *shortcut keys*.

Access Keys Access keys offer users a way to navigate a menu system by using the keyboard instead of a mouse. If a menu item has an access key defined, the access key is indicated by an underscore beneath the letter in the item's caption (for example, the *F* in File). You create an access key by placing an ampersand (`&`) in front of the appropriate letter in the `Caption` property. For the File menu, the `Caption` property would be `&File`. You can create an access key for any or all of the items in your menu.

TIP Where possible, use the first letter of the menu item as the access key, because typically the users expect it. On the other hand, you shouldn't use the first letter if that letter is already in use in that menu. For example, Visual Basic's Format menu uses the second letter as the access key to avoid conflict with the File menu. You can assign the same access key to multiple menu items. If you do so, Visual Basic just cycles through the items with each press of the access key. However, this approach is not standard practice because having to press an access key multiple times defeats its purpose. In addition, many users don't know that they can cycle through the items in this manner and become frustrated when they see no apparent way to select the desired choice.

When you have access keys defined for your menu items, the users can select a top-level menu item (in the menu bar) by holding down the Alt key and then pressing the access key. This action causes the submenu for that item to drop down, showing the items for that group. The users can then start the desired task by pressing the access key defined for the menu item. For example, for the New item of the File menu, users could press Alt+F and then press N.

To create an effective set of access keys, you must specify a different key for each of the top-level menu items. Then you need to specify a different key for each of the items in the submenu. Conceivably, you can have up to 36 access keys on the same menu, one for each letter of the alphabet and one for each of the 10 digits, but you may run out of screen space for the choices before running out of letters.

Shortcut Keys In addition to the access keys just discussed, you can assign shortcut keys to some of the more commonly used functions in your program. Shortcut keys provide direct access to a function through a single key (such as Delete) or key combination (such as Ctrl+S), bypassing the menu system entirely. Users can take advantage of shortcut keys to perform tasks quickly.

To assign a shortcut key to one of your functions, enter the Menu Editor, select the menu item for which you want a shortcut key, and then select the desired key from the Shortcut list. The key is assigned to that function, and the shortcut key information appears next to the menu item in the menu.

To illustrate this use, assign Ctrl+P as the shortcut key for the sample menu's File, Print function, as follows:

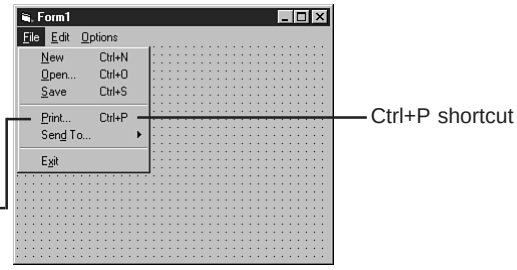
1. Make sure Form1 is selected, and then open the Menu Editor.
2. Click the Print menu item to select it.
3. Click the drop-down arrow next to the Shortcut list, and select Ctrl+P from the list.
4. On your own, assign the following shortcut keys:

Menu Item	Shortcut Key
File, New	Ctrl+N
File, Open	Ctrl+O
File, Save	Ctrl+S
Edit, Cut	Ctrl+X
Edit, Copy	Ctrl+C
Edit, Paste	Ctrl+V

5. Click OK to close the Menu Editor.

Now that you're back in the design environment, click the File menu to see how the shortcut key combinations are displayed. Figure 6.7 illustrates the results.

FIGURE 6.7
Shortcut keys have been assigned to several of the File menu's functions.



You can assign any unused shortcut key to any menu item, but you should try to make your program use the same "standard" keys that are used in many Windows programs. Some of these keys are listed in Table 6.2. As examples, the "Description" column explains what these keys do when you're working within Visual Basic itself.

Table 6.2 Commonly Used Shortcut Keys Speed Access to Program Tasks

Menu Item	Shortcut Key	Description
Edit, Cut	Ctrl+X	Removes selected text from its current location and copies it to the Clipboard.
Edit, Copy	Ctrl+C	Makes a copy of the selected text in the Clipboard.
Edit, Paste	Ctrl+V	Pastes the contents of the Clipboard to the active document.
Edit, Undo	Ctrl+Z	Undoes the last change.
Edit, Find	Ctrl+F	Opens the Find dialog box to allow the users to search for something (text, for example).
File, New	Ctrl+N	Creates a new document.
File, Open	Ctrl+O	Opens a dialog box to allow the users to select a document to open.
File, Save	Ctrl+S	Saves the current document.
File, Print	Ctrl+P	Opens the Print dialog box to allow selection of items to be printed.

TIP As with access keys, you should try to make the shortcut key correspond to the first letter of the item name—for example, Ctrl+P for Print. Users can remember the shortcuts more easily this way. To avoid confusing your users, you should use the standard shortcut keys listed in Table 6.2 whenever possible.

Writing Code for the Menu Items

After creating the menu's structure, you need to write code to let the menu items actually perform tasks. As with a form or other controls, you do so by writing code in an event procedure. A menu item handles only one event: the `Click` event. This event is triggered when a user clicks the menu item, or when the user selects the item and presses Enter. Think of the user's action of selecting a menu item as being similar to clicking a command button.

NOTE A menu item's `Click` event is also triggered when a user uses an access key or shortcut key to access an item.

To add code to a menu item's `Click` event procedure, first select the menu item on the form by clicking the item. This action opens a Code window and sets up the `Event` procedure for the selected item, in the same manner as if you had double-clicked some other object on your form. Then simply type in the code to handle the task.

Now you can enhance the menu example by coding the File, Exit function, as shown in the following steps:

1. In the design environment, click Form1's File menu to open it; then click Exit. You are presented with the Code window for the `Click` event procedure for your `mnuFileExit` menu item.
2. Type the following code into the event procedure:

```
Dim nTemp As Integer, sTemp As String
sTemp = "Are you sure you want to exit?"
nTemp = MsgBox(sTemp, vbYesNo, "Menu Sample Program")
If nTemp = vbYes Then
      End
End if
```

3. Close the Code window.

Save and run your test application. When you choose File, Exit from the menu system, you should be presented with a message box asking you to verify your decision to exit the program. If you click the Yes button, your program ends.

Optional Settings

In addition to the required `Caption` and `Name` properties, each menu item has several optional properties that you can set either to control the behavior of the menu or to indicate the status of a program option. The most commonly used of these properties are the `Visible`, `Enabled`, and `Checked` properties.

The *Visible* and *Enabled* Properties The menu item's `Visible` and `Enabled` properties work just like they do with any other object. When the `Visible` property is set to `True`, the menu item is visible to the users. If the `Visible` property is set to `False`, the item (and any associated submenus) are hidden from the users. You have probably seen the `Enabled` and `Visible` properties used in a word processing program (though you might not have been aware of how it

was accomplished), where only the File and Help menus are visible until a document is selected for editing. After a document is open, the other menu items are shown.

Changing the setting of the `Visible` property allows you to control what menu items are available to the users at a given point in your program. Controlling the menu this way lets you restrict the users' access to menu items that might cause errors if certain conditions are not met. (You wouldn't want the users to access edit functions if no document was open to edit, right?)

The `Enabled` property serves a function similar to that of the `Visible` property. The key difference is that when the `Enabled` property is set to `False`, the menu item is *grayed out*. This means that the menu item still can be seen by the users but cannot be accessed. For example, the standard Edit, Cut and Edit, Copy functions should not be available if no text or object is selected, but nothing is wrong with letting the users see that these functions exist (see Figure 6.8).

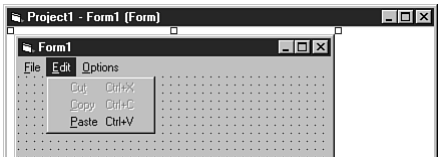


FIGURE 6.8
Disabled menu items are visible to the users but are shown in gray tones, indicating that the items are currently unavailable.

Although the `Visible` and `Enabled` properties of menu items can be set at designtime using the Menu Editor, they are typically set using code at runtime in response to changes in your program's status. Just as with other objects, you can set the value of a Menu control property in code by specifying the menu item's `Name` property, the name of the property to be changed, and the new value.

To continue with the running example, you can enhance the simple menu system. When the program starts, no document will be open. Therefore, the File menu's Save, Send To, and Print options should not be enabled. Also, you don't want the Edit menu to be visible at all unless a document has been opened. Follow these steps to ensure that the menu system is properly set up when the program starts:

1. Make sure Form1 is selected, and then open the Menu Editor.
2. Click the Save menu item to select it.
3. Click the check box next to the `Enabled` property to uncheck it. This action has the effect of setting the Enabled property to `False`.
4. Set the `Enabled` property for the Send To and Print menu items to `False` as well.
5. Click the Edit menu item to select it.
6. Click the check box next to the `Visible` property to uncheck it. This action has the effect of setting the Visible property to `False`.
7. Close the Menu Editor.

TIP Notice that the Edit menu is no longer visible, even in the design environment. You can still access the menu item's `Click` event procedure by entering the form's Code window and selecting the appropriate menu item from the object box. If you prefer, you can also leave the menu item's `Visible` property set to `True` and use the form's `Load` event procedure to set it to `False`.

Follow these steps to enable the appropriate portions of the File menu and to make the Edit menu visible whenever a document is opened:

1. In the design environment, click the File menu, and then click the Open menu item. You are presented with `mnuFileOpen`'s `Click` event procedure.
2. In a fully functional application, your code for opening a file would be placed here. You can use a comment line to represent that portion of the code. Enter these lines of code into the `mnuFileOpen_Click` procedure:

```
'Code for opening a file goes here
mnuFileSave.Enabled = True
mnuFileSendTo.Enabled = True
mnuFilePrint.Enabled = True
mnuEdit.Visible = True
```

3. Close the Menu Editor.
4. Save and run your application. Notice that the Edit menu can't be seen. Notice also that when you click the File menu, some of the items are grayed out.
5. Choose File, Open, which causes the Open menu item's `Click` event procedure to be executed. Choose the File menu again, and notice that all File menu items are now available. Notice also that the Edit menu is now visible.
6. Click the End button on the toolbar to end the program.

The *Checked* Property The `Checked` property of the menu item determines whether a check mark is displayed to the left of the item in the menu, as shown in Figure 6.9. The `Checked` property is typically used to indicate the status of a program option; for example, if a user has selected a particular option, a check mark appears next to that item in the menu. The menu item is then used to toggle back and forth between two program states.

FIGURE 6.9
The `Checked` property determines whether a check mark is placed to the left of a submenu item.

Enter the following code into the `Click` event procedure of the `mnuOptionsText` menu item in the sample menu:

```
mnuOptionsText.Checked = Not mnuOptionsText.Checked
```

Because the `Checked` property can only be `True` or `False`, the preceding code makes nice use of some Boolean logic with the `Not` keyword. `Not` represents the opposite of a Boolean value, so `Not mnuOptionsText.Checked` returns the opposite of the current value of the `Checked` property of `mnuOptions`. This process is known as "toggling" a Boolean value. At any point in the program code, the state of the `Checked` property indicates whether the user wants the document to be composed of plain text.

Of course, you can set a menu item's `Checked` property at designtime if you want that item to be checked when the program begins.

CAUTION

You cannot set the `Checked` property to `True` for an item on the menu bar (top menu level). Doing so results in an error.

Other Properties You might have noticed two other items in the Menu Editor. These items specify the value of the `NegotiatePosition` and `WindowList` properties of the menu item. The `NegotiatePosition` property specifies whether and where the menu item of your application is displayed when an embedded object on a form is active and its menu is shown (for example, if your application has an instance of Word embedded for modifying a document). If the `NegotiatePosition` property is 0, your menu is not displayed while the object is active. If the property is not 0, your menu item is displayed to the left of, in the middle of, or to the right of the object's menu (property settings of 1, 2, or 3, respectively). The `WindowList` property specifies whether the current menu should maintain a list of active MDI child forms. When this property is `True`, items are automatically appended to the menu as child forms are opened, and removed when the corresponding child forms are closed. You learn about this topic in more detail in Chapter 17, "Multiple Document Interface Applications."

Creating Pop-Up Menus

So far, the discussion of menus has looked at the menu bar that appears along the top of the form. Visual Basic also supports *pop-up menus* in your programs. A pop-up menu is a small menu that appears somewhere on your form in response to a program event.

Pop-up menus often are used to handle operations or options related to a specific area of the form (see Figure 6.10)—for example, a format pop-up menu for a text field that lets you change the font or font attributes of the field. You can find such context-sensitive menus in many of the latest generation of Windows programs, including Visual Basic itself.

When a pop-up menu is invoked, usually by right-clicking an object with the mouse, the menu appears onscreen near the current mouse pointer location. The user then makes a selection from the menu. After the selection is made, the menu disappears from the screen.

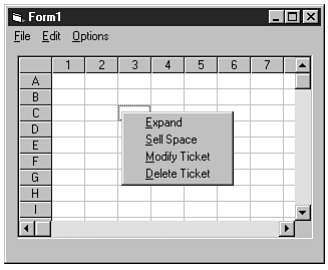


FIGURE 6.10
This grid's pop-up menu provides a convenient way to initiate program functions specifically related to the grid.

Creating the Menu to Be Displayed

You create a pop-up menu in the same way that you created the main menu for your program—with the Menu Editor. There is, however, one extra step. The pop-up menu should be hidden so that it does not appear on the menu bar. To hide the menu, you set the `Visible` property of the top-level menu item to `False`.

NOTE Typically, you hide the menu item that is used as a pop-up menu, but you can use any of the top-level items of a menu bar as a pop-up menu. That is, a particular menu can appear both as a pop-up menu and as a part of the main menu of a form.

To illustrate the concept of a pop-up menu, add a simple one to the sample menu system, as follows:

1. Using the Menu Editor, add a new top-level menu item at the end of the list of menu items. Set its `Caption` property to `Format`, and its `Name` property to `mnuFormat`.
2. Set `mnuFormat`'s `Visible` property to `False`.
3. Create these indented menu items under the Format menu:

Caption	Name
`&Bold`	`mnuFormatBold`
`&Italic`	`mnuFormatItalic`
`&Underline`	`mnuFormatUnderline`

4. Close the Menu Editor.

Notice that the Format menu does not appear on your form's menu bar. However, the menu is present and can be modified in the Menu Editor.

The technique you must use to add code to the `Click` event of the items in a pop-up menu is also a little different. Because the menu is not visible on the form, you cannot just click the item to bring up the Code window. Instead, you bring up the Code window by selecting the View Code button in the Project window or double-clicking the form. Then you can select the desired menu item in the Code window's Object list at the upper-left corner. This way, you can enter code for the hidden items.

Activating a Pop-Up Menu

To have the pop-up menu appear on your screen, you must invoke the form's `PopUpMenu` method. You do so by specifying the name of the form where the menu will be displayed, the `PopUpMenu` method, and the name of the menu to be shown. Although you can use this method from anywhere in your code, pop-up menus are used most often in response to mouse clicks, usually those using the right mouse button.

To illustrate this use, make the sample pop-up menu appear when the user right-clicks the form. Of course, in a fully coded application that formats text, the user would probably be right-clicking selected text; however, the following steps illustrate the concept:

1. Open the form's Code window by double-clicking the form.
2. Drop down the Code window's Object box, and select the `mnuFormatBold` menu item.
3. In `mnuFormatBold`'s `Click` event procedure, enter the following line of code, which simply causes a message box to appear and report that the procedure was indeed executed:

   ```
   MsgBox "You just bolded some text!"
   ```

4. Drop down the Code window's Object box, and select Form.
5. Drop down the Code window's Procedure box, and select the `MouseUp` event.
6. Enter the following code into the form's `MouseUp` event procedure:

   ```
   If Button = vbRightButton Then
       Form1.PopupMenu mnuFormat
   End If
   ```

7. Save and run the program. Right-click the form to open the Format menu. Choose the Bold item.

In the code segment you just entered, the `MouseUp` event is used to take an action whenever a mouse button is pressed. The event passes a parameter, the `Button` parameter, that tells you which of the mouse buttons was pressed. Because you want the menu to appear in response to only a right button click, you check for the value of the `Button` parameter. If it is equal to `vbRightButton` (an intrinsic constant for the right mouse button), the pop-up menu is displayed.

NOTE You can create multiple pop-up menus and have them displayed in response to different mouse buttons or in different areas of the screen. The `X` and `Y` parameters passed to the `MouseUp` event procedure report the location of the mouse cursor at the time the event occurred.

Using Toolbars in Visual Basic

You have probably noticed that many Windows programs now have one or more toolbars in addition to the menu system. These toolbars provide the users with an easy way to access the most commonly used functions of the program. Some programs also use toolbars to help with

specific tasks, such as the Drawing toolbar that is in Microsoft Word. Because toolbars are becoming so common, users have come to expect them in all programs.

Fortunately, you can easily set up a toolbar in Visual Basic. In fact, Visual Basic Version 6 now has two different styles of toolbars: the standard toolbar and the newer CoolBar control.

Toolbar Basics

Although these two types of toolbars (pictured in Figure 6.11) appear different to the user, they both are used for the same purpose: to provide a set of graphical buttons to access common program functions.

The ToolBar control enables you to create six different types of buttons:

- Pushbuttons that work like command buttons
- Check buttons that work in an on-off mode, like a check box
- Button groups that work like option buttons
- Separator buttons that create spaces in the toolbar
- Placeholder buttons that create empty space, allowing you to place other controls, such as combo boxes, on the toolbar
- Drop-down buttons that, when clicked, offer the user a drop-down menu of choices

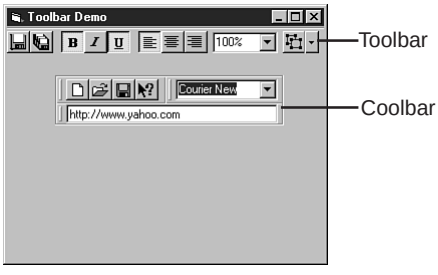


FIGURE 6.11
The sleek-looking coolbar was first introduced in Microsoft Internet Explorer.

To create a toolbar, you need to use multiple controls: one or more of the ToolBar controls and the ImageList control. The ImageList control contains a collection of bitmaps for use by other controls. In this case, the ToolBar control displays images from the ImageList control on its buttons. The ImageList control is part of the Microsoft Windows Common Controls 6.0 Group, discussed in Chapter 12, "Microsoft Common Controls."

▶ **See** "The ImageList: A Fundamental Common Control," **p. 248**

To draw a ToolBar control on a form, you first need to add it to the Toolbox. To begin, right-click in an empty area of the Toolbox, and choose Components from the pop-up menu. When the Components dialog box appears, select the first group of Common controls—Microsoft Windows Common Controls 6.0—as shown in Figure 6.12. This group of controls contains the standard toolbar and the ImageList control. The CoolBar control is in the third group (Microsoft Windows Common Controls–3 6.0); select this group to add the coolbar to the Toolbox.

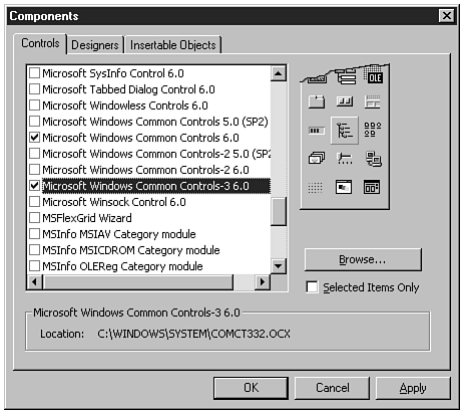


FIGURE 6.12
The CoolBar control is in a new group called Microsoft Windows Common Controls – 36.0.

In the following sections, you discover how to include both types of toolbars in your program.

Getting the Images for Your Toolbar

The first step in creating any toolbar is adding the images that will be displayed on the toolbar to an ImageList control. Follow these steps to get those images:

1. Draw an ImageList control on your form, and give it a unique name. Because the ImageList control is not visible to the users, its size is set by Visual Basic. No matter what size you draw it on the form, it always appears as a little icon at designtime.
2. To add bitmap images to the control, open its Property Pages dialog box either by pressing the ellipsis (…) button of the `Custom` property in the Properties window, or by right-clicking the ImageList control and selecting Properties.

   From this dialog box, shown in Figure 6.13, you can add images from graphics files (icons and bitmaps) stored on your hard drive.

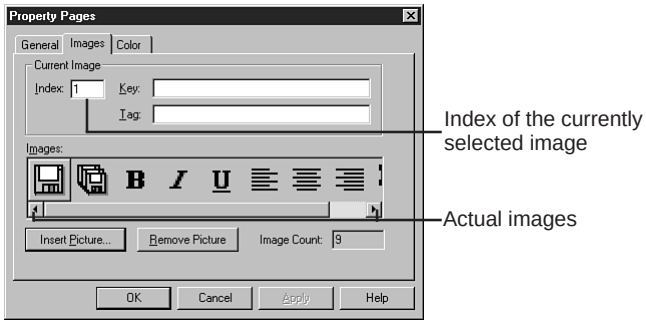


FIGURE 6.13
At designtime, you can add images to the ImageList control by using the Images tab of the Property Pages dialog box.

3. To add an image to the ImageList control, click the Insert Picture button. This action presents you with the Select Picture dialog box, from which you can choose the bitmap or icon you want. As you select the picture, it is added to the control and displayed in the Images area.
4. After you add all the pictures you might need, click the OK button to close the dialog box.

NOTE Many sample icons and bitmaps are included with Visual Basic. If you installed them, they are located in a subdirectory called Graphics (the location of this directory depends on which installation options you chose, and whether you installed just Visual Basic or the entire Visual Studio suite).

After you complete these steps, your ImageList control is ready to use for supplying images to your toolbar.

Creating a Standard Toolbar

To use the standard ToolBar control, you first need to position it on a form. To do so, follow these steps:

1. Draw the ToolBar control on your form. Visual Basic positions the toolbar at the top of the form, and the control spans the width of the form.
2. Set the toolbar's alignment. A toolbar can be aligned along any of the four edges of its form or float freely:
   - To position the toolbar along the top of your form, leave the `Align` property set at its `1 – vbAlignTop` default setting.
   - To position it along the bottom of your form, set its `Align` property `to 2 - vbAlignBottom`.
   - To align it to the left or right edge of the form, set the `Align` property to `3 - vbAlignLeft` or `4 - vbAlignRight`, respectively. In these cases, you should adjust the `Width` property to keep it from filling the form completely.
   - To use a free-floating toolbar, set its `Align` property to `0 – vbAlignNone`. You can adjust the toolbar's position and size by setting the `Left`, `Top`, `Width`, and `Height` properties.
3. Open the ToolBar control's Property Pages dialog box by right-clicking the control and choosing Properties. Figure 6.14 shows the first page of the ToolBar control's Property Pages.
4. Set the ToolBar control's `ImageList` property to the name of the ImageList control that you already set up to provide images. Clicking the arrow to the right of the `ImageList` property provides you with a list of all ImageList controls on the current form.

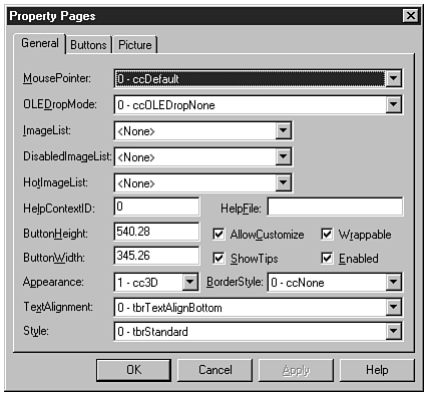


FIGURE 6.14
You can assign an ImageList control to your toolbar in the General tab of the toolbar's Property Pages dialog box.

Several other properties on the Property Pages' General tab control the appearance and behavior of the toolbar. These properties are summarized in Table 6.3.

Table 6.3 Toolbar Properties That Control Its Appearance and Behavior

Property Name	Description
`BorderStyle`	Determines whether a single-line border is displayed around the toolbar or no border is used.
`ButtonHeight`	Specifies the height (in twips) of the buttons in the toolbar.
`ButtonWidth`	Specifies the width (in twips) of the buttons in the toolbar.
`AllowCustomize`	Determines whether the user is allowed to customize the toolbar by adding, deleting, or moving buttons.
`ShowTips`	Determines whether ToolTips are shown if the mouse pointer is rested on one of the buttons.
`Wrappable`	Determines whether the toolbar wraps around to a second row of buttons if the toolbar has more buttons than fit on a single row.
`HotImageList`	Specifies a different ImageList control to provide images for drop-down and check-style buttons when they are activated. An alternate image will also be displayed when the mouse pointer hovers over any button if the toolbar's `Style` property is set to `1 - tbrFlat`. To use this property, make sure the desired image in the ImageList control referenced by this property has the same index as the image in the primary image list.
`DisabledImageList`	Specifies a different ImageList control to provide images for toolbar buttons whose `Enabled` property is set to `False`. To use this property, make sure the desired image in the ImageList control referenced by this property has the same index as the image in the primary image list.
`Style`	Determines whether the toolbar is drawn with a three-dimensional effect or whether it appears flat on the form.

Creating the Toolbar's Buttons

The next step in creating your toolbar is to create the buttons that will be placed on the toolbar. For this task, you move to the Buttons tab of the Property Pages (see Figure 6.15).

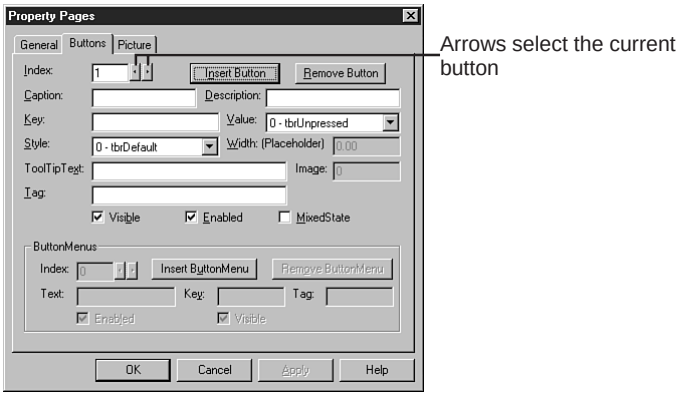


FIGURE 6.15
You can assign images, captions, identifiers, and even menus to toolbar buttons in the Buttons tab.

Adding a Standard Button to the Toolbar To add a button to the toolbar, click Insert Button. If other buttons already exist on the toolbar, a new button appears after the currently selected button. For each button that you add, you should specify several properties—the `Key` property, the `Style` property, and the `Image` property.

The `Key` property specifies a string that is used to identify the button in code. You will see how it is used in the upcoming section "Enabling the Buttons with Code." The `Key` property for each button must be unique, and you should assign a string that is meaningful to you. This way, you can remember it more easily when you are writing your code.

The `Image` property specifies the index of the picture that you want to appear on the face of the button. The index corresponds to the index of the picture in the ImageList control. You can specify a value of zero for the `Image` property if you do not want a picture to appear on the button.

The `Style` property determines the type of button that you create. Table 6.4 summarizes the various settings of the `Style` property. Each of the button styles is shown in Figure 6.16.

Table 6.4 *Style* Property Settings That Control the Behavior of Toolbar Buttons

Setting Example	VB Constant	Description of Behavior
`0- tbrDefault`	The button is a standard pushbutton.	The Save Project button in Visual Basic

continues

Table 6.4 Continued

Setting Example	VB Constant	Description of Behavior
1- `tbrCheck`	The button indicates that an option is on or off by its state.	The Bold button in Word
2- `tbrButtonGroup`	The button is part of a group. Only one button of the group can be pressed at a time.	The alignment buttons in Word
3- `tbrSeparator`	The button is used to provide space between other buttons. The button has a width of eight pixels.	N/A
4- `tbrPlaceHolder`	This button is used to hold a space in the toolbar for other controls such as a combo box.	The font combo box in Word
5- `tbrDropDown`	Used with a `ButtonMenu` to create a drop-down menu on the toolbar button.	The Add Form button in Visual Basic

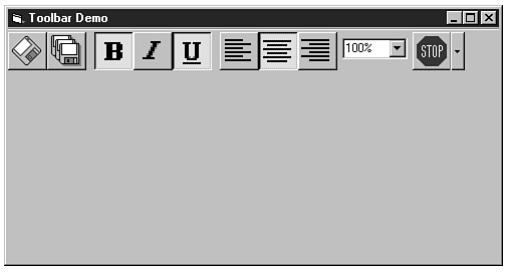


FIGURE 6.16
Examples of the different toolbar button styles are shown here. Note that the place-holder and separators are not really buttons.

In addition to these three key properties, you can set several other properties for each button on the toolbar (see Table 6.5).

Table 6.5 Optional Properties That Provide Further Control over Toolbar Buttons

Property	Description
`Caption`	This text is displayed beneath the picture on a button.
`Description`	This text describes the button to the users when they invoke the Customize Toolbar dialog box.
`ToolTipText`	This text appears when the mouse pointer rests on the button. This text is displayed only if the `ShowTips` property of the toolbar is set to `True` (which is the default).
`Value`	This property sets or returns the current state of the button. A value of 0 indicates that the button is not pressed. A value of 1 indicates that the button is pressed. This property is typically used to pre-select a check-style button, or one button in a group.

TIP Unless the images on your buttons are self-explanatory, you should include ToolTips. A *ToolTip* is a text message describing a button that appears when the users move the mouse pointer over the button. Depending on your application, you may be able to include ToolTips instead of captions to save some screen real estate. Without some text indication the users cannot know what the button does unless they click it. ToolTips give your program a professional appearance and are easy to add.

After setting up the buttons on the toolbar, you can exit the Property Pages dialog box by clicking the OK button.

Adding a Drop-Down Toolbar Button A new feature in Visual Basic 6 is the `tbrDropDown` style button. This button combines a normal toolbar button with a drop-down menu for an effect that is similar to a combo box. The following example illustrates how to create such a button and program its events.

Starting a Toolbar Example

To illustrate the use of toolbars, this section walks you through the creation of a sample program containing a standard toolbar button and a drop-down toolbar button, with a separator button providing blank space between them. Follow these steps:

1. Create a new Standard EXE project. Add a ToolBar control and an ImageList control to the form as described in the preceding sections.
2. Set the toolbar's `Name` property to `tbrDemo`. Leave the ImageList control's `Name` property set to the default of `ImageList1`.
3. On the Images tab of the Property Pages dialog box for `ImageList1`, add two appropriate icons to the ImageList control (click the Insert Picture button and browse to the picture files). These icons will eventually be the pictures displayed on two toolbar buttons.

4. Right-click the ToolBar control and choose Properties. In the toolbar's Property Pages dialog box, set the `ImageList` property of the toolbar to `ImageList1`, the name of your image list.
5. On the Buttons tab, click Insert button. The `Style` property should already be set to the default, `0 – tbrNormal`. Set the button's `Key` value to `newfile`.
6. Set the `Image` property of the button to the index of the appropriate icon in the ImageList control (which should be `1` if you've followed these steps).
7. Click the Insert button again to add a second button. Set the `Style` property of this button to `3 - tbrSeparator`. This separator button will be seen as blank space between the first and third buttons.
8. Click the Insert button again to add a third button. Set the `Style` property of this button to `5 - tbrDropdown`. Set its `Key` value to `report` and its `Image` property to the index of the other icon from the ImageList control (2). Set its `Caption` property to `REGION`.
6. To add items to the button menu for this drop-down button, click the Insert Buttonmenu button. Enter `East` for the button menu item's `Text` property.
7. Repeat step 6 for West, South, and Central regions.
8. Click OK to close the Property Pages dialog box. Your drop-down button should now appear on the toolbar.

Enabling the Buttons with Code

You have seen how to set up the toolbar, but until you add code to the toolbar's events, it cannot perform any functions. The buttons of the toolbar do not have events of their own. Instead, you actually write your code for the `ButtonClick` and `ButtonMenuClick` events of the toolbar itself. These events pass a `Button` or `ButtonMenu` object reference as a parameter to the event procedure. In your code, you use the value of the `Button` object's `Key` property to determine which button was actually pressed.

By completing the steps outlined in the preceding sections, you have created a toolbar with buttons that look good and can be clicked, but that don't actually do anything. You need to add code to make them functional. Writing an event procedure for a button on a toolbar is a little different than writing a procedure for a standard command button. Rather than have a separate event procedure for each button and menu, your code must look at object properties to determine which button or button menu item was selected.

Enter the code presented in Listing 6.1 into the form's Code window.

Listing 6.1 TBRDEMO.TXT—Using Code to Activate a Toolbar

```
Option Explicit
Dim sCurrentRegion As String

Private Sub tbrDemo_ButtonClick(ByVal Button As ComctlLib.Button)
    Select Case UCase(Button.Key)
        Case "NEWFILE"
```

```
            'Code to create a new file goes here
            MsgBox "Creating a new file..."
        Case "REPORT"
            'Create a report with the current region
            Call MakeReport
    End Select

End Sub

Private Sub tbrDemo_ButtonMenuClick(ByVal ButtonMenu As ComctlLib.ButtonMenu)
    'Create a report using the newly selected region
    sCurrentRegion = UCase(ButtonMenu.Text)
    ButtonMenu.Parent.Caption = sCurrentRegion
    Call MakeReport

End Sub

Sub MakeReport()
    Dim sTemp As String
    'If no region selected, use WEST as default
    If Trim(sCurrentRegion) = "" Then
        sCurrentRegion = "WEST"
    End If
    sTemp = "Creating report for " & sCurrentRegion
    sTemp = sTemp & " Region..."
    MsgBox sTemp
    'Actual report-creating lines go here...

End Sub
```

Once you have entered this code, run the program and examine the behavior of the toolbar buttons.

The procedures being called are actually the `Click` event procedures of menu items. With these procedures being called, you can code an action once and then call it from either the menu or the toolbar. Doing so makes it easier to maintain your code because changes or corrections have to be made in only a single location. Also, note the introduction of the `Select Case` statement, which is more readable than a nested `If` statement. You learn about it in more detail in a later chapter.

▶ **See** "Using `Select Case`," **p. 207**

Creating a Toolbar with Code

Although you can set up a toolbar in the design environment, you can also set up and change a toolbar at runtime with program code. To use the Toolbar and other common controls successfully, you need to understand the concept of *collections*.

Understanding Collections A collection is a group of objects. In the case of the ImageList control, you will find a collection called `ListImages`. The objects stored in this particular collection are the images in the ImageList control. By manipulating the `ListImages` collection from code, you can add, remove, and change images.

Think of a collection as being similar to, but not exactly like, an array. You can access it like an array, as in the following line of code, which sets a form's picture to the first image in an ImageList control:

```
Set form1.Picture = ImageList1.ListImages(1).Picture
```

Notice that a specific object is referred to with its *index*—in this case, `1`. Remember, a collection stores objects, unlike an array, which stores values. These objects have their own set of properties.

Objects in a `Buttons` collection have a special property: the `Key` property. A `Button` object's key is a text string that can be used in the same manner as an index:

```
Set form1.Picture = ImageList1.ListImages("Smiley Face").Picture
```

Generally, the `Button` object's `Key` property is set when the object is added to the `Buttons` collection through the key parameter of the `Buttons` collection's `Add` method.

Setting Up the Toolbar To set up a ToolBar control in code, you have to first set up an ImageList control (either in design mode or with code), including populating it with images. Then you can assign the ImageList control to the toolbar with a statement like the following:

```
Set tbrMain.ImageList = ImageList1
```

Next, you manipulate the toolbar's `Buttons` collection to create toolbar buttons. In the following example, a separator and standard button are added to a toolbar control, `tbrMain`:

```
tbrMain.Buttons.Add 1, "Sep1",, tbrSeparator, 0
tbrMain.Buttons.Add 2, "open","Open File" , tbrDefault, 1
```

In this example, two additional `Button` objects are created in the `Buttons` collection by using the `Add` method. The first two parameters are the button's index and key, each of which must be unique. The third parameter is the button caption. The fourth parameter (`tbrSeparator` and `tbrDefault`) is a constant representing the type of button. Finally, an index value from the associated image list tells the toolbar which picture to use.

The `Add` method can also work as a function. If used in this manner, it returns a reference to the `Button` object just created. You could rewrite the preceding code like this:

```
Dim btn As Button

Set btn = tbrMain.Buttons.Add(, "Sep1", , tbrSeparator, 0)

Set btn = tbrMain.Buttons.Add(,"open", , tbrDefault)
btn.ToolTipText = "Click to open a file"
btn.Caption = "Open File"
btn.Image = 1
```

Note that the `ToolTipText` property must be added to the `Button` object because it is not in the `Add` method's parameters. Also, in the preceding example, the `Index` properties are defined automatically because they are not specified. This approach is generally the preferred way of coding because, as objects are added and deleted from a collection, the index of a particular object will change. The `Key`, however, is always associated with a specific object.

Your code can use the button parameter's `Key` property to determine which button was pressed. For example, consider the following code in the toolbar's `ButtonClick` event:

```
Private Sub Toolbar1_ButtonClick(ByVal Button As ComctlLib.Button)

    Select Case Button.Key
        Case "open"
            'Insert open file code here
        Case "save"
            'Insert save file code here
        Case "exit"
            'Insert code to end the program
    End Select

End Sub
```

The preceding code works great for buttons of type `tbrDefault`. However, if you have any `tbrCheck` buttons, you should have your code also check the `Value` property to see what the state of the button is:

```
        Case "boldface"
            If Button.value = tbrUnpressed then
                'Button is "Up" - Turn bold off
            Else
                 'Button is "down" – Turn bold on
        End If
```

If you set the `MixedState` property of a button to `True`, it always looks grayed out—no matter what the value.

Allowing the User to Customize the Toolbar

One of the really great features of the ToolBar control is that you can allow your users to customize the toolbar to their liking. When the `AllowCustomize` property of the toolbar is set to `True`, users can access the Customize Toolbar dialog box by double-clicking the toolbar. This dialog box, shown in Figure 6.17, allows the user to add buttons to the toolbar, remove buttons, or move the buttons to a different location.

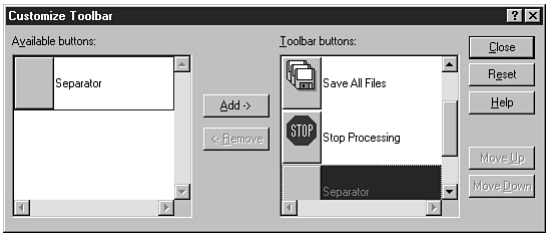


FIGURE 6.17
The `AllowCustomize` property lets users customize the toolbar to their liking, without the need for additional code.

Using the CoolBar Control

The CoolBar control, pictured earlier in Figure 6.11, is a special control that acts as a container for other controls but looks like a toolbar. The CoolBar control itself does not have "built-in" Button objects like a toolbar does. However, since the coolbar is a container control, it can contain objects such as command buttons and even toolbars.

The CoolBar control contains a collection of Band objects, each of which is a mini-container that the user can resize at runtime.

To illustrate how the CoolBar control can contain other controls, let's extend the example from the earlier part of the chapter. Follow these steps:

1. If you haven't done so already, add the CoolBar control to the Toolbox by selecting Microsoft Windows Common Controls – 3 6.0 from the Components dialog box.
2. Change the `Align` property of the toolbar you created earlier to `0 – vbAlignNone`. Drag it to an open area of the form and adjust its width so it is just wide enough to display the buttons you added earlier.
3. Double-click the coolbar icon in the Toolbox to add a CoolBar control to your form.
4. Click the CoolBar control to select it. Click the CommandButton icon and draw a command button directly on the coolbar.
5. Create a simple `Click` event procedure for the command button, adding a line of code like `MsgBox "You clicked Command1"`.
6. Right-click the toolbar and select Cut to remove it from the form, placing it on the Windows Clipboard.
7. Right-click the CoolBar control and select Paste. The toolbar from the Clipboard is pasted into the coolbar container.
8. Right-click a blank area of the CoolBar control (don't click the contained toolbar or command button). Select Properties to display the coolbar's Property Pages dialog box.
9. The Bands tab of the Property Pages dialog box contains properties for each of the CoolBar control's bands. Band 1 should be selected in the Index box at the top. Drop down the Child list and select `tbrDemo`. This action instructs the coolbar to display `tbrDemo` in the Band 1 mini-container.
10. Change the index to `2` to select the second band. Set its Child property to `Command1` (the command button you added earlier).
11. Click OK to close the Property Pages dialog box. While the CoolBar control is still selected, go to the Properties window and change its `Align` property to `1 – vbAlignTop`.

When you have completed these steps, run the program and observe the behavior of the objects on the CoolBar control. You can experiment with placing different types of objects on a CoolBar control in your applications.

From Here...

This chapter showed you the advantages of creating menus and toolbars for your programs. Hopefully, you have seen how easy it is to create these items. You were also exposed to several other topics in this chapter. To learn more about them, refer to the following chapters:

- To review using forms to build your applications, see Chapter 3, "Visual Basic Building Blocks."
- To learn about another way that your programs interact with your users, see Chapter 7, "Using Dialog Boxes to Get Information."
- For more information about using variables to remember information throughout your programs, see Chapter 8, "Using Variables to Store Information."

CHAPTER 7

Using Dialog Boxes to Get Information

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A dialog box is a window used to display and/or accept information. Its name comes from the fact that it is, in essence, a *dialog* (or conversation) with the user. A dialog box is usually shown *modally*, which means the user must close it (or "answer the dialog") before continuing with any other part of the program. In this chapter, you'll look at two dialog boxes built in to Visual Basic: the message box and the input box. Next, you'll use the CommonDialog custom control, which allows you to place four types of standard dialog boxes in your program. Finally, you'll review some guidelines for creating your own form-based dialog box.

Keeping the User Informed

A big part of any programming project is providing information to the users about the program's progress and status. Although the forms and controls of your program provide the main interface to the users, they are not necessarily the best vehicles for providing bits of information that require immediate attention, such as warnings or error messages. For providing this type of information, the message box is the way to go.

Understanding the Message Box

The *message box* is a simple form that displays a message and at least one command button. The button is used to acknowledge the message and close the form. Because message boxes are built in to the Visual Basic language, you do not have to worry about creating or showing a form. To see a simple message box, type the following line of code into Visual Basic's Immediate window (choose View, Immediate Window to open the window) and press Enter:

```
MsgBox "I love Visual Basic!"
```

Optionally, the message box can display an icon or use multiple buttons to let the user make a decision. This is done with the use of optional parameters. For example, the following code line produces the message box shown in Figure 7.1:

```
MsgBox "Delete record?", vbYesNo + vbExclamation, "Confirm Delete"
```

NOTE You can try this example yourself. Just type the code in the Immediate window and press Enter. This action has the same effect as if the statement were executed at runtime.

FIGURE 7.1
A message box communicates with the user.

Message boxes can be used in either of two ways, depending on your needs. You can use the message box to simply display information, or you can use it to get a decision from the user. In either case, you will use some form of the `MsgBox` function.

NOTE Although this chapter refers to functions and statements interchangeably, a conceptual difference does exist between using `MsgBox` as a function and as a statement. By definition, a *function* returns a value, whereas a *statement* does not. Also, the syntax for parameters is slightly different; a function's parameters must be enclosed in parentheses. For example, if you want to see the return value from the `MsgBox` function, you could type the following line in the Immediate window:

```
Print MsgBox ("Delete record?", vbYesNo + vbExclamation, "Confirm Delete")
```

Although the message box is useful, it does have a few limitations:

- The message box cannot accept text input from the user. It can only display information and handle the selection of a limited number of choices.
- You can use only one of four predefined icons and one of six predefined command button sets in the message box. You cannot define your own icons or buttons.
- By design, the message box requires a user to respond to a message before any part of the program can continue. This means that the message box cannot be used to provide continuous status monitoring of the program because no other part of the program can be executing while the message box is waiting for the user's response.

Displaying a Message

The simplest way to create a message box in your program is to use the `MsgBox` function as if it were a statement, without returning a value. Using the `MsgBox` function this way, you simply specify the message text that you want to appear in the message box and then call the function. The message box displays an OK button to allow the user to acknowledge the message.

```
MsgBox "Record processing is complete."
```

When you specify the message text, you can use a *string constant* (a string of text enclosed in quotation marks, as shown in the preceding line) or a string *variable*, as in this example:

```
Dim sMyText as String

sMyText = "Hello," & vbCrLf & "World"
MsgBox sMyText
```

Note the use of the intrinsic (predefined) constant `vbCrLf`, representing a carriage return/line feed combination, to make `"Hello"` and `"World"` appear on separate lines.

The default message box uses the project's title (which can be set in the Project, Properties dialog) for its caption and only has an OK button. You can dress up your messages somewhat by using two optional parameters: the `buttons` argument and the `title` argument. The `buttons` argument is an integer number that can specify the icon to display in the message box, the command button set to display, and which of the command buttons is the default. The `title` argument is a text string that specifies custom text to be shown in the title bar of the message box. The full syntax of the `MsgBox` function is as follows:

```
MsgBox(prompt[, buttons] [, title] [, helpfile, context])
```

If you choose to display an icon in the message box, you have a choice of four icons. These icons and their purposes are summarized in Table 7.1.

Table 7.1 Icons Indicate the Type of Message Being Shown

Icon Name	Typical Purpose
Critical Message	Indicates that a severe error has occurred. Often a program is shut down after this message.
Warning Message	Indicates that a program error has occurred; this error may require user correction or may lead to undesirable results.
Query	Indicates that the program requires additional information from the user before processing can continue.
Information Message	Informs the user of the status of the program. This message is often used to notify the users of the completion of a task.

To tell Visual Basic that you want to use a particular icon in the message box, you set a value for the `buttons` argument of the `MsgBox` function. The `buttons` argument can be set to one of four values, as defined in the following table. You can use either the numerical value or the constant from the following table:

Message Type	Argument Value	Constant
Critical	16	`vbCritical`
Query	32	`vbQuestion`
Warning	48	`vbExclamation`
Information	64	`vbInformation`

TIP Good programming practice dictates that you use the appropriate constant to represent the integer value. Using the correct constant makes your programs more readable and will not require any conversion should Microsoft change the arguments' values.

NOTE The constants listed in the preceding table not only affect the icon that is displayed, but also the sound produced by Windows when a message appears. You can set sounds for different message types in the Windows Control Panel.

To illustrate how icons and titles can be used in your message boxes, enter the following code, which produces the message box shown in Figure 7.2:

```
MsgBox "This message box contains an icon.", vbInformation, "Icon Demo"
```

FIGURE 7.2
Use titles and icons to give the user visual cues to the nature of the message.

Returning a Value from the *MsgBox* Function

The `MsgBox` function, as described previously, works fine for informing users of a problem or prompting them to take an action. However, to get a decision from the users, you need to use the `MsgBox` function's return value. There are two key differences to using the `MsgBox` function this way—you must deal with the function's return value, possibly by assigning it to a variable, and you must enclose the arguments of the function in parentheses. This value reports which command button a user clicked. The following line of code shows how the value returned by the function can be assigned to a variable for further processing:

```
nResult = MsgBox("The printer is not responding", _
    vbRetryCancel,"Printer Error!")
```

Additional statements after the preceding code could check the value of the variable `nResult` with, for example, an `If` statement and take appropriate action.

Choosing Among the Command Button Sets The following six sets of command buttons can be used in the `MsgBox` function:

- **OK.** Displays a single button with the caption `OK`. This button simply directs the user to acknowledge receipt of the message before continuing.
- **OK, Cancel.** Displays two buttons in the message box, letting the user choose between accepting the message and requesting a cancellation of the operation.
- **Abort, Retry, Ignore.** Displays three buttons, usually along with an error message. The user can choose to abort the operation, retry it, or ignore the error and attempt to continue with program execution.
- **Yes, No, Cancel.** Displays three buttons, typically with a question. The user can answer yes or no to the question, or choose to cancel the operation.
- **Yes, No.** Displays two buttons for a simple yes or no choice.
- **Retry, Cancel.** Displays the two buttons that allow the user to retry the operation or cancel it. A typical use is reporting that the printer is not responding. The user can either retry after fixing the printer or cancel the printout.

To specify the command buttons you want to appear in the message box, you need to specify a value for the `buttons` argument of the `MsgBox` function. The values for each of the command button sets are listed in Table 7.2.

Table 7.2 Set the *buttons* Argument to One of the Following Values to Specify Which Set of Buttons to Use

Button Set	Value	Constant
OK	0	`vbOKOnly`
OK, Cancel	1	`vbOKCancel`
Abort, Retry, Ignore	2	`VBAbortRetryIgnore`
Yes, No, Cancel	3	`vbYesNoCancel`
Yes, No	4	`vbYesNo`
Retry, Cancel	5	`vbRetryCancel`

Because the `buttons` argument controls both the icon and the command button(s) used for a message box, you might wonder how you can specify both at the same time. You do so by adding the values of the constants together. The `MsgBox` function is designed so that any combination of the icon constant and the command button constant creates a unique value. This value is then broken down by the function, to specify the individual pieces. The following code combines an icon constant and command button constant to create a warning message that allows the user to choose an action. The results of the code are illustrated in Figure 7.3:

```
nOptVal = vbExclamation + vbAbortRetryIgnore
nRetVal = MsgBox("File does not exist.", nOptVal, "My Application")
```

NOTE If you want your message box to display a Help button, add the constant `vbMsgBoxHelpButton`, which has a value of 16384, to whichever button set constant you choose.

FIGURE 7.3
The `buttons` argument controls both the icon and the command buttons displayed by the `MsgBox` function.

Setting the Default Button If you are using more than one command button in the message box, you can also specify which button is the default. The *default button* is the one that has focus when the message box is displayed. This button is the one that the user is most likely to choose so that he or she can just press the Enter key. For example, if you display a message box to have the user confirm the deletion of the record, you probably should set up the default button so that the record would not be deleted. This way, the user must make a conscious choice to delete the record.

To specify which button is the default, you need to add another constant to the `buttons` argument of the `MsgBox` function. You can choose from four possible default button values, which are identified in the following table:

Default Button	Value	Constant
First	0	`vbDefaultButton1`
Second	256	`vbDefaultButton2`
Third	512	`vbDefaultButton3`
Fourth	768	`vbDefaultButton4`

A user might choose from seven buttons, with the selection depending on the button set used in the message box. Each of these buttons returns a different value to identify the button to your program (see Table 8.3).

Table 7.3 Return Values Indicate the User's Choice

Button	Value	Constant
OK	1	`vbOK`
Cancel	2	`vbCancel`
Abort	3	`vbAbort`
Retry	4	`vbRetry`
Ignore	5	`vbIgnore`
Yes	6	`vbYes`
No	7	`vbNo`

As always, using the constant in your code rather than the actual integer value is preferable. After you know which button the user selected, you can use that information in your program.

Making a Message Box Modal For completeness, you can apply one final setting to the `buttons` argument of the `MsgBox` function. You can choose to have the message box be modal for your application or for the entire system. Remember from earlier chapters that when a *modal* window is shown, it must be closed before continuing with the program. If you specify that the message box is modal to the system, the user must respond to the message box before he or she can do any further work on the computer at all. The system modal option should be used with extreme care. The default behavior is application modal, which means the users can continue to work in other applications.

To use the default, application modal, you do not have to add anything to the `buttons` argument, or you can add the `vbApplicationModal` constant, which has a value of 0. To make the message box system modal, you need to add the constant `vbSystemModal`, which has a value of 4096, to the `buttons` argument.

Demonstrating the *MsgBox* Function

To see the message box in action, create a simple program that utilizes it. You'll use a message box to confirm that a user who is attempting to exit the program is sure he or she wants to exit. Follow these steps:

1. Start Visual Basic, if necessary, and begin a new Standard EXE project.
2. Add a single command button to Form1. Set the command button's `Name` property to `cmdExit` and its `Caption` property to `Exit`.
3. Enter the following code into `cmdExit's Click` event procedure:

```
Dim sMsg As String
Dim nButtons As Integer
Dim nResult As Integer
sMsg = "Are you sure you want to exit?"
nButtons = vbYesNo + vbQuestion
nResult = MsgBox(sMsg, nButtons, "My Program")
If nResult = vbYes Then
    End
End If
```

4. Run the program and click the Exit button. You are asked whether you are sure you want to exit the program. Click the No button, and notice that the program does not close.

Getting Information from the User

Many times in a program, you need to get a single piece of information from the user. You might need the user to enter a name, the name of a file, or a number for various purposes. Although the message box lets your user make choices, it does not allow him or her to enter any information in response to the message. Therefore, you have to use some other means to get the information. Visual Basic provides a built-in dialog box for exactly this purpose: the *input box.*

The input box displays a message to tell the user what to enter, a text box where the user can enter the requested information, and two command buttons—OK and Cancel—that can be used to either accept or abort the input data. A sample input box is shown in Figure 7.4.

FIGURE 7.4
An input box lets the user enter a single piece of data in response to a message.

Setting Up the *InputBox* Function

Programmatically, the input box works very much like the message box with a return value. You can specify a variable to receive the information returned from the input box and then

supply the input box's message (prompt) and, optionally, a title and default value. An example of the `InputBox` function is the following:

```
Dim sMsg as String, sUserName As String
sMsg = "Please type your name below:"
sUserName = InputBox(sMsg, "Enter user name", "Anonymous")
```

In this statement, the information returned by the `InputBox` function is stored in the variable `sUserName`. The first argument, the `prompt` parameter, represents the message that is displayed to the user to indicate what should be entered in the box. Like the message in the message box, the prompt can display up to approximately 1,024 characters before it is truncated. Word-wrapping is automatically performed on the text in the prompt so that it fits inside the box. Also, as with the message box, you can insert a carriage return/line feed combination (`vbCrLf`) to force the prompt to show multiple lines or to separate lines for emphasis.

After the prompt comes the `title` argument, which specifies the text in the input box's title bar. The other argument in the preceding example is the `default` argument. If included, it appears as an initial value in the input box. The user can accept this value, modify it, or erase it and enter a completely new value.

The minimum requirement for the `InputBox` function is a prompt parameter, as in this statement:

```
sReturnVal = InputBox("How's the weather?")
```

In addition to the input box's optional parameters to specify a window title and default value, other optional parameters allow you to set its initial screen position, as well as the help file to be used if the user needs assistance. Refer to the complete syntax of the `InputBox` function in Visual Basic's help system.

NOTE Unlike the `MsgBox` function, no option in the `InputBox` function specifies any command buttons other than the defaults of OK and Cancel.

Values Returned by *InputBox*

When the input box is used, the user can enter up to 255 characters of text in the input box's entry area, which resembles a text box. If the user types more text than will fit in the displayed entry area, the text he or she has already typed scrolls to the left. After the user is done, he or she can choose the OK or Cancel button. If the user chooses the OK button, the input box returns whatever is in the text box, whether it is new text or the default text. If the user chooses the Cancel button, the input box returns an empty string, regardless of what is in the text box.

To be able to use the information entered by the user, you must determine if the data meets your needs. First, you probably should make sure that the user actually entered some information and chose the OK button. You can do so by using the `Len` function to determine the length of the returned string. If the length is zero, the user clicked the Cancel button or left the input field blank. If the length of the string is greater than zero, you know that the user entered

something. To see how the `Len` function works, enter each of these lines in the Immediate window and note the different results:

```
Print Len("Hello")
```

```
Print Len("")
```

You may also need to check the returned value to make sure it is of the proper type. If you are expecting a number that will subsequently be compared to another number in an `If` statement, your program should present an error message if the user enters letters. To make sure that you have a numerical value with which to work, you can use the `Val` function. The `Val` function's purpose is to return the numerical value of a string. If the string contains or starts with numbers, the function returns the number. If the string does not start with a number, the function returns zero. To understand the `Val` function, enter these lines in the Immediate window to see what each returns:

```
Print Val("Hello")
```

```
Print Val("50 ways to leave your lover")
```

```
Print Val("100 and 1 make 101")
```

The following code illustrates additional processing of the returned value of the input box with `Val` and `Len`:

```
Dim stInputVal As String
stInputVal = InputBox("Enter your age")
If Len(stInputVal) = 0 Then
    MsgBox "No age was selected"
Else
   If Val(stInputVal) = 0 Then
        MsgBox "You entered an invalid age."
   Else
        MsgBox "Congratulations for surviving this long!"
   End If
End If
```

Using Built-In Dialog Boxes

In earlier sections, you learned what a dialog box is and how to use two simple dialog boxes. In the following sections, you'll learn about the Microsoft CommonDialog control, which allows you to use standard Windows dialog boxes to specify filenames, select fonts and colors, and control the printer. And although the ease of setup is a great benefit, an even bigger bonus is that these dialog boxes are already familiar to the user because they are the same dialog boxes used by Windows itself.

General Usage of the CommonDialog Control

Using a single CommonDialog control, you have access to the following standard Windows dialog boxes:

- **Open.** Lets the user select the name and location of a file to open.

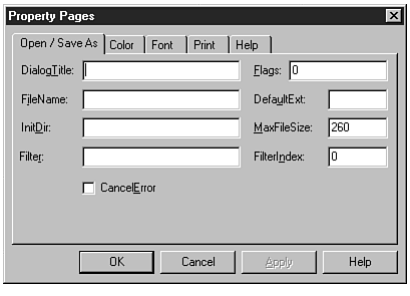
- **Save As.** Lets the user specify a filename and location in which to save information.
- **Font.** Lets the user choose a base font and set any font attributes that are desired.
- **Color.** Lets the user choose from a standard color or create a custom color for use in the program.
- **Print.** Lets the user select a printer and set some of the printer parameters.
- **Help.** Takes the user into the Windows Help system.

Although the CommonDialog control is included with Visual Basic, it's not one of the controls included in the Toolbox by default. To access the CommonDialog control, you might first have to add it to your project (and to the Toolbox) by selecting it from the Components dialog box. You can access this dialog box by choosing Project, Components. From there, select Microsoft Common Dialog Control 6.0 in the Controls list and click OK.

After you add the CommonDialog control to the Toolbox, you can add the control to a form by clicking the control and drawing it on the form just like any other control. The CommonDialog control appears on your form as an icon, as the control itself is not visible when your application is running.

The following sections describe each type of dialog box that can be created with the CommonDialog control. For each of these dialog boxes, you need to set some of the control's properties. You can do so through the Properties window, or you can use the CommonDialog control's Property Pages dialog box. The Property Pages dialog box provides you with easy access to the specific properties that are necessary for each of the common dialog box types (see Figure 7.5). You can access the Property Pages dialog box by clicking the ellipsis (...) button in the Custom property of the CommonDialog control, or by right-clicking the control and selecting Properties.

FIGURE 7.5
The Property Pages dialog box enables you to set up the `CommonDialog` control easily.



Testing the CommonDialog Control

Throughout this section, you'll want to try each of the styles of common dialog boxes. To get ready to test them, follow these steps:

1. Start Visual Basic, if necessary, and begin a new Standard EXE project.
2. Select Project, Components from the menu system.

3. Click the check box next to the control named *Microsoft Common Dialog Control 6.0*, making sure a check mark appears in the box.
4. Click OK to close the Components dialog box.
5. When you see the CommonDialog tool in the Toolbox, double-click it to add a common dialog control to `Form1`.
6. Set the CommonDialog control's `Name` property to `cdlTest`.
7. Add a command button to Form1. Set its `Name` property to `cmdTest` and its `Caption` property to `Test Common Dialog`.

You'll use this shell program to see how the various flavors of the CommonDialog control work. When instructed, enter code into `cmdTest`'s `Click` event procedure.

The File Dialog Boxes

One of the key uses of the CommonDialog control is to obtain file names from the user. The CommonDialog control's File dialog box can be used in either of two modes: `Open` and `Save As`. `Open` mode lets the user specify the name and location of a file to be retrieved and used by your program. Save As mode lets the user specify the name and location of a file to be saved.

Open and Save As Dialog Boxes The dialog boxes for the `Open` and `Save As` functions are similar. Figure 7.6 shows the Open dialog box.

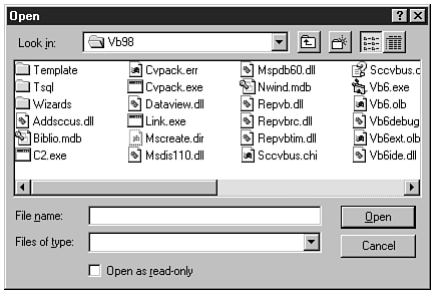


FIGURE 7.6
The Open and Save dialog boxes share many components.

The dialog box's major components are as follows:

- **Drive/Folder list.** The current folder is listed here. If the current folder is the root (`\`), the current drive is listed here. You can use the combo box and navigation buttons to move up folder levels, similar to the way you would in the Windows Explorer.
- **File/Folder selection list.** The names indicated in this area are the folders and files one level beneath the item in the Drive/Folder list. An item in this area can be opened either by double-clicking it, or by highlighting it and pressing Enter. If the item you open is a folder, the display is updated to show the contents of the new current folder. If the item you open is a file, the dialog box closes.
- **File Name text box.** The user can use this text box for manual filename entry and folder navigation. If the user enters a filename, the dialog box closes. If he or she enters

a path such as C:\Data\Word and presses Enter, the dialog box is updated to show that folder. Also, if the user single-clicks a filename in the file/folder selection area, it appears here.

- **File Type list box.** Here, the user selects the types of files to display. These types are determined by the extension portion of the filename; the available types are controlled by the `Filter` property of the CommonDialog control.
- **Toolbar buttons and Command buttons.** The buttons in the upper-right corner let the user move up one folder level, create a new folder, or switch the file display area between the list mode and the file details mode. The buttons at the lower-right corner let the user process the selection or cancel the dialog box.

Opening and Saving Files To open an existing file, use the `ShowOpen` method of the CommonDialog control. (This method displays the dialog box in Figure 7.6.) You use this method by specifying the name of the CommonDialog control and the method name. To try it, type this code into the `Click` event procedure of the command button `cmdTest` in the sample project:

```
cdlTest.ShowOpen
Msgbox "You Selected " & cdlTest.FileName & " to be opened."
```

After the preceding code is executed, the name of the file selected is available to your code through the CommonDialog control's `FileName` property.

Using the CommonDialog control for saving and opening involves essentially the same steps. The name of the method used to invoke the Save As dialog box is `ShowSave`. You will find a few subtle differences between the dialog boxes shown for the `Open` and `Save` functions, such as the title of the dialog box and the captions on the command buttons.

To test the CommonDialog control's `ShowSave` method, replace the code in the sample project's `cmdTest_Click` procedure with these lines:

```
cdlTest.ShowSave
Msgbox "You Selected " & cdlTest.FileName & " to be saved."
```

NOTE The Open and Save As dialog boxes don't actually open or save files; they simply get information from the user as to the names and locations of the files to be opened or saved. Your program must take whatever steps are necessary to complete the operation.

Specifying File Types with the *Filter* Property When using the CommonDialog control, you might need to specify that only certain file types are listed. If your program reads Microsoft Excel (.XLS) files, for example, you would not want the user to attempt to open batch (.BAT) files. You can restrict (or "filter") the files shown in the dialog box by using the `Filter` property.

You set the `Filter` property at designtime from either the Properties window or the Property Pages dialog box, or at runtime with an assignment statement in code. The `Filter` property is a string value that includes a file type description followed by the file extension. It requires a special format, as shown here:

```
cldTest.Filter = "Word Documents (*.doc)¦*.doc"
```

The vertical line in the preceding code line is known as the *pipe symbol*. This symbol must be present in the filter. Preceding the pipe symbol is a short description of the file type, in this case `Word Documents (*.doc)`. Following the pipe symbol is the actual filter for the files. You typically express the filter as an asterisk followed by a period and the extension of the files that you want to display. Some examples are `*.txt`, `*.doc`, and `*.*`.

If you specify the `Filter` property with an assignment statement, you must enclose the filter in double quotation marks, as with any string. The quotes are omitted if you specify the filter from the Properties dialog box.

You can specify multiple `description¦filter` pairs within the `Filter` property. Each pair must be separated from the other pairs by the pipe symbol, as shown in the following example:

```
cdlTest.Filter = "Text Files¦*.txt¦All Files¦*.*"
```

To see the `Filter` property in action, replace the code in the test project's `cmdTest_Click` event procedure with these lines, and then run the program:

```
cdlTest.Filter = "Text Files (*.txt)¦*.txt¦All Files (*.*)¦*.*"
cdlTest.ShowOpen
```

When you test this code, note that the CommonDialog control's `Filter` property causes only text files to be displayed, unless the user selects another filter by dropping down the Files of type drop-down list.

Customizing the File Dialog Boxes with the *Flags* Property Another important property is the `Flags` property. The `Flags` property is set using a constant or combination of constants, similar to the `MsgBox` function's `Options` parameter. A complete list of constants is listed in Visual Basic's Help system. For example, if the Open as Read Only check box doesn't make any sense in your program, you can set a flag to hide it, like this:

```
cdlTest.Flags = cdlOFNHideReadOnly
cdlTest.InitDir = "C:\Windows"
cdlTest.ShowOpen
```

Note also the use of the `InitDir` property, which starts the dialog box in a specific folder.

CAUTION

`Flags`, `Filters`, and other properties that affect the CommonDialog control must be set before displaying it.

The Font Dialog Box

Setting up the CommonDialog control to show the Font dialog box is just as easy as setting it up for file functions. In fact, you can use the same CommonDialog control on a form to handle file, font, color, and printer functions, just by resetting the properties and invoking the appropriate method.

The first step in using the CommonDialog control to handle font selection is to set a value for the `Flags` property. Among other things, this property tells the CommonDialog control whether you want to show screen fonts, printer fonts, or both. This setting is required; the constants are listed in the following table:

Font Set	Constant	Value
Screen fonts	`cdlCFScreenFonts`	1
Printer fonts	`cdlCFPrinterFonts`	2
Both sets	`cdlCFBoth`	3

CAUTION

If you do not set a value for the `Flags` property, you get an error message stating that no fonts are installed.

You can set the value of the `Flags` property from the design environment by using the Properties window or the Property Pages dialog box, or you can set it from your program by using an assignment statement. After the `Flags` property has been set, you can invoke the Font dialog box from your code, using the CommonDialog's `ShowFont` method. After the dialog box is closed, information about the font that the user selected is contained in the CommonDialog's properties.

To see this process in action, follow these steps to modify the sample program you created earlier in this chapter:

1. If the program is still running from an earlier test, stop it.
2. Add a `Label` control to Form1. Set the `Label` control's `Name` property to `lblTest` and its `Caption` property to `This is a test`.
3. Set `lblTest`'s `AutoSize` property to `True`.
4. Replace the code in `cmdTest`'s `Click` event procedure with the following:

```
cdlTest.Flags = cdlCFBoth + cdlCFEffects
cdlTest.ShowFont
lblTest.Font.Name = cdlTest.FontName
lblTest.Font.Size = cdlTest.FontSize
lblTest.Font.Bold = cdlTest.FontBold
```

5. Run the application. When you click `cmdTest`, a Font dialog box should appear. Change the font to something totally different than the default. When you click OK, `lblTest`'s font should match what you selected in the dialog box.

Note two things in the preceding code. First, an extra flag, `cdlCFEffects`, allows the user to select additional font "effects" such as bold, color, and underline. Second, note the slight difference in syntax between the Label control's `Font` properties and the CommonDialog's `Font` properties. The `Font` property of a Label control (or of other objects, such as a `TextBox` control) is an object itself (a `Font` object), and the CommonDialog box stores each attribute about a font (`Name`, `Size`, `Bold`, and so on) in a separate property. The text box has the older, separate

properties for compatibility, but you should avoid them. If you have to set the font for two text boxes, for example, you can set one directly from the CommonDialog control's properties and the other one simply by assigning the first text box's `Font` property:

```
Set txtAddress.Font = txtName.Font
```

Figure 7.7 shows the Font dialog box that is presented to the user. This particular dialog box contains both screen and printer fonts.

FIGURE 7.7
The Font dialog box can be programmed to display screen fonts, printer fonts, or both.

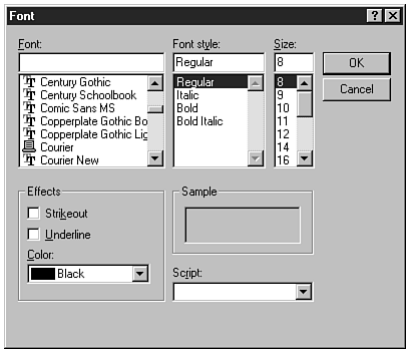


Table 7.4 shows the control's properties and the font attributes that each manipulates.

Table 7.4 CommonDialog Control Properties That Store Font Attributes

Property	Attribute
`FontName`	The name of the base font
`FontSize`	The height of the font in points
`FontBold`	Whether boldface is selected
`FontItalic`	Whether italic is selected
`FontUnderline`	Whether the font is underlined
`FontStrikethru`	Whether the font has a line through it

The font information can be used to set the font of any object in your program or even to set the font for the `Printer` object. Be sure to peruse the Help system for a complete list of `Flags` property constants.

The Color Dialog Box

The CommonDialog control's Color dialog box lets the user select colors that can be used for the foreground or background colors of your forms or controls (see Figure 7.8). The user has the option of choosing one of the standard colors, or creating and selecting a custom color.

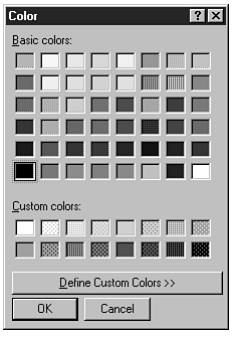


FIGURE 7.8
The Color dialog box lets the user select a color graphically and then returns it to your program as a hex value.

Setting up the CommonDialog control for colors is basically the same as for fonts. You set the `Flags` property to the constant `cdlCCRGBInit` and then invoke the control's `ShowColor` method.

When the user selects a color from the dialog box, a hexadecimal number representing that color is stored in the `Color` property of the control. To see how the Color dialog box works, replace the code in the test project's `cmdTest_Click` event procedure with the following:

```
cdlTest.Flags = cdlCCRGBInit
cdlTest.ShowColor
Form1.BackColor = cdlTest.Color
```

As with the other dialog boxes, you can alter the behavior of the Color dialog box by using the `Flags` property. For example, if you want only default colors available, use the `cdlCCPreventFullOpen` flag so that the user cannot open the Define Custom Colors window. Check the Color Dialog Box/Flags Property (Color dialog) topic in the Visual Basic Help system for a full listing of the flags and properties that affect the Color dialog box.

The Print Dialog Box

Another type of dialog box that the CommonDialog control can display is the Print dialog box. A Print dialog box is usually displayed just before your application initiates a printing process. It lets the user select which printer to use and specify options for the print process (see Figure 7.9). These options include specifying which pages to print and the number of copies, as well as an option of printing to a file.

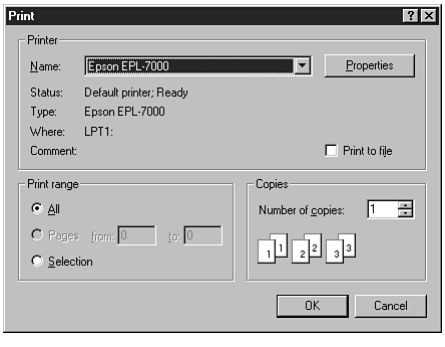


FIGURE 7.9
The Print dialog box provides a consistent way for your users to set printer options.

To invoke the Print dialog box, just call the CommonDialog control's `ShowPrinter` method. There are no required flags to set prior to the call.

After the Print dialog box is displayed, the user can select the printer from the Name list at the top of the dialog box. This list contains all the printers installed in the user's operating system. Just below the Name list is the Status line, which tells you the current status of the selected printer.

If a user wants to change any printer-specific parameters (such as paper size and margins), he or she can click the Properties button on the Print dialog box. This action brings up the Properties dialog box for the selected printer, as shown in Figure 7.10. This dialog box lets the user control all the settings of the printer, just as with the Windows Control Panel.

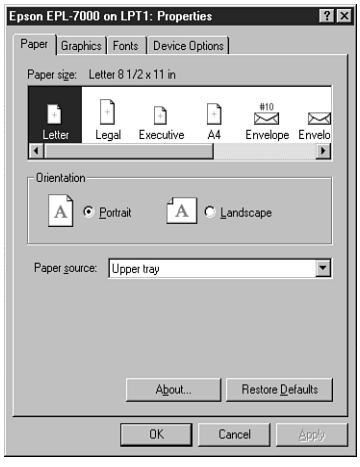


FIGURE 7.10
The Properties dialog box for the printer lets you control paper size, margins, and other printer attributes.

The Print dialog box returns the information provided by the user in the dialog box's properties. The `FromPage` and `ToPage` properties tell you the starting and ending pages of the printout as selected by the user. The `Copies` property tells you how many copies the user wants printed. These details are provided only as information. The Print dialog box does not automatically create the desired printout.

To see how the Printer dialog box works, replace the code in the test project's `cmdTest_Click` event procedure with the following:

```
cdlTest.Flags = cdlPDDisablePrintToFile
cdlTest.Copies = 3
cdlTest.PrinterDefault = True
cdlTest.ShowPrinter
MsgBox "The default printer is:" & Printer.DeviceName
```

In this sample code, properties and flags are used to disable the Print to File option and set the default number of copies to `3`. In addition, the `PrinterDefault` property means that the dialog box will use the control's properties to modify the default system printer. The Printer dialog box has quite a few useful options that are detailed in the Visual Basic help system.

The Help Dialog Box

This use of the CommonDialog control invokes the Windows Help engine by running WINHLP32.EXE. To use the Help dialog box, you must set the CommonDialog control's `HelpFile` property to the name and location of a properly formatted Windows help (.HLP) file and set the `HelpCommand` property to tell the Help engine what type of help to offer. After you set these properties, use the CommonDialog control's `ShowHelp` method to initiate the Help system. The user can then navigate the Help system using your program's Help file.

Creating Your Own Dialog Boxes

Although the CommonDialog control provides you with several types of dialog boxes to use in your programs, sometimes you just can't accomplish some tasks with these built-in tools. For example, if you want to set your own captions for the command buttons in a dialog box, you can't use the message box; nor can the message box handle more than three buttons (not including the Help button). Also, consider the built-in input box. This dialog box cannot display an icon, nor can it handle more than one input item. If your program needs dialog box capabilities that the CommonDialog control can't offer, you can simply use a standard Visual Basic form to create your own custom dialog box.

Creating a Custom Dialog Box

You need only follow a few simple guidelines if you decide to create a custom dialog box:

- Set the form's `BorderStyle` property to `3 - Fixed Dialog`. Standard dialog boxes can't be resized. This property setting also removes the form's Maximize/Restore and Minimize buttons.
- Remove the form's icon by deleting the setting for its `Icon` property.
- Set the form's `StartUpPosition` property to `1 - CenterOwner` so that the dialog box is centered on the parent application.
- Add controls as necessary to obtain the required information from the user. Use Label controls as captions for text boxes.
- Use Frame controls to group other controls where appropriate (see the Print range area of the Printer dialog control for an example).
- Include an OK button that accepts the user's choices.
- Include a Cancel button that allows the user to abort the action.
- When you show the dialog box, show it modally (`frmDialog.Show vbModal`).

Feel free to look to some of the standard Windows dialog boxes or to other programs' custom dialog boxes for design ideas.

Using Form Templates for Other Dialog Boxes

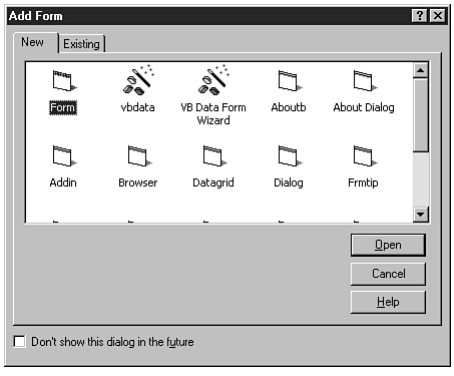
Microsoft has included several form templates with Visual Basic representing custom dialog boxes that can be handy to use in your programs. You can quickly add one of these form

templates to your project by selecting the appropriate type when you add a new form; you can then customize it to suit your needs. The available templates include the following:

- **About Dialog.** Used to provide the user with information about your program.
- **Log In Dialog.** Allows the user to enter a user ID and password.
- **Options Dialog.** Creates a dialog box similar to Property Pages or the Options dialog box of Visual Basic.
- **Tip Dialog.** Can provide a Tip of the Day function for your program.

You can add these forms based on these dialog box templates to your program by choosing Project, Add Form, or by clicking the Add Form button. You then see the Add Form dialog box shown in Figure 7.11. You can choose the desired dialog box from the templates available and then customize it to suit your needs.

FIGURE 7.11
Several custom dialog boxes are available as form templates.



From Here...

In this chapter, you learned how dialog boxes can be used to help the user select files, printers, and fonts in your programs. You also learned how the message box and input box are used to inform the user and to get decisions or single pieces of information. You even saw how to design your own dialog boxes when the built-in ones are insufficient for the task. To learn more about using some of the concepts presented here, take a look at the following chapters:

- To learn more about desigining the forms you use in your applications, see Chapter 3, “Visual Basic Building Blocks.”
- For an introduction to writing the code that enables your forms to react to your users’ actions, see Chapter 5, “Responding to the User with Event Procedures.”
- For a more complete discussion of writing Visual Basic code, see Chapter 9, “Visual Basic Programming Fundamentals.”

CHAPTER 8

Using Variables to Store Information

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To make Visual Basic programs truly functional, they must be able to store information temporarily. With Visual Basic, as with any programming language, there is a need to remember information as the program runs. Visual Basic allows you to store information using variables and constants.

This chapter examines the types of variables and constants available to Visual Basic programmers and explores how to use them to allow the necessary retention of information.

Introduction to Variables

Simply stated, you use variables to store information in the computer's memory while your programs are running. Three components define a variable:

- The variable's name (which correlates to its location in memory)
- The type of information being stored
- The actual information itself

Suppose you are given this assignment: "Go count all the cars in the parking lot." As you count each car, you are storing information in a variable. Your location in memory is either a notepad or your brain. The type of information being stored is a number. And the actual information you are storing is the current number of cars.

As the name *variable* suggests, the information stored in a variable can change (vary) over time. In the example of counting cars, the count will be increased periodically. With any variable, there are two basic functions you can perform: storing information (writing on the notepad) and retrieving information (reading what is written on the notepad).

Naming Variables

A variable must have a name for you to be able to assign values to it. You might have noticed statements like the following in earlier examples:

```
Dim X As Integer
```

This example illustrates a `Dim`, or *Dimension*, statement, used for *dimensioning* (or *declaring)* variables (see the section "Variable Declarations" later in this chapter). When your program declares a variable, it is, in essence, telling Visual Basic, "Set aside a memory location that will be used to store variable information; call it *X*." The last two words in the `Dim` statement tell Visual Basic what type of information you plan to store—in this case, integer numbers. This information helps determine how much memory is to be set aside for the variable.

In naming a variable, you have a tremendous amount of flexibility. Variable names can be simple, or they can be descriptive of the information they contain. In the preceding example, `X` is a perfectly legal name but not very descriptive to the readers. Although you are allowed great latitude in naming variables, you must adhere to a few restrictions:

- The name must start with a letter, not a number or other character.

- The remainder of the name can contain letters, numbers, and/or underscore characters. No spaces, periods, or other punctuation characters are allowed.
- The name must be unique within the variable's scope. (Scope refers to the context in which the variable is defined, as we will see shortly.)
- The name can be no longer than 255 characters.
- The name cannot be one of Visual Basic's reserved words.

Make your variable names descriptive of the task to make your code easy to read, but also keep the names as short as possible to make the code easy to type. Many programmers also use prefixes in their variable names to indicate the type of data stored; usually, these conventions are variations of the Hungarian Naming Convention. These prefixes usually consist of one or two lowercase characters at the beginning of the variable; the next letter is usually capitalized.

For example, a prefix of `s`, as in `sCity`, indicates a variable that stores a String value. Table 8.1 lists some of the common prefixes that you should use when naming variables. This convention, which is recommended in a Microsoft Knowledge Base article, is used for many of the original code samples in this book. You might prefer a two-character prefix or some other convention altogether.

Table 8.1 Variable Naming Prefixes

Variable Type	Prefix	Example
String	`s`	`sFirstName`
Integer	`n`	`nAge`
Long Integer	`l`	`lPopulation`
Single (Floating Point)	`f`	`fAverageGrade`
Double	`d`	`dThrustRatio`
Currency	`c`	`cPayRate`
Boolean	`b`	`bTaxable`

For integers, the prefix `n` is used rather than the seemingly more obvious `i` because the prefix `i` is used to represent indexes.

Types of Variables

Okay, you know what a variable does and how to name it. But what can you store in a variable? The simple answer is: *almost anything*. A variable can hold a number; a string of text; or a reference to an object, such as a form, control, or database. This chapter looks specifically at using variables to store numbers, strings, and logical values. Using variables to represent objects and databases is covered later in Chapters 16, "Classes: Reusable Components," and 26, "Using Data Access Objects (DAO)," respectively.

Each type of variable has its own memory requirements and is designed to work efficiently with different types of information. Therefore, you cannot store a string like `"Hello"` in a variable that you declare as an integer.

Table 8.2 shows some of the standard variable types that are available in Visual Basic. The table also shows the range of values that the variable can hold and the amount of memory required. Variables with smaller memory requirements should be used wherever possible to conserve system resources.

Table 8.2 Variables Store Many Types of Information

Type	Stores	Memory Requirement	Range of Values
Integer	Whole numbers	Two bytes	–32,768 to +32,767
Long	Whole numbers	Four bytes	(approximately) +/– 2 billion
Single	Decimal numbers	Four bytes	+/– 1E-45 to 3E38
Double	Decimal numbers	Eight bytes	+/– 5E-324 to 1.8E308
Currency	Numbers with up to 15 digits left of the decimal and four digits right of the decimal	Eight bytes	+/– 9E14
String	Text information	One byte per character	Up to 65,400 characters for fixed-length string and up to 2 billion characters for dynamic strings
Byte	Whole numbers	One byte	0 to 255
Boolean	Logical values	Two bytes	`True` or `False`
Date	Date and time information	Eight bytes	1/1/100 to 12/31/9999
Object	Instances of classes; OLE objects	Four bytes	N/A
Variant	Any of the preceding data types	16 bytes + 1 byte per character	N/A

In addition to the preceding variable types, you also can create *user-defined types* to meet your needs. Consider the following code segment, which demonstrates the declaration and use of a user-defined type:

```
Private Type Point
         x As Integer
         y As Integer
```

```
End Type

Private Sub Command1_Click()
        Dim MyPoint As Point
        MyPoint.x = 3
        MyPoint.y = 5
End Sub
```

As you can see from the sample, you declare a new type by using the `Type` statement. Note that types must be defined in the general declarations section; in this case, we have defined a private type called `Point` within a form. To create a variable of the new type, you use the `Dim` statement just as you would with any other type. The parts of a type are accessed via dot notation.

As you know, there are some specialized types to deal with databases (such as `Database`, `Field`, and `Recordset`). Visual Basic knows about these other data types when you add a reference to a *type library*. A type library is a DLL or other file that makes these types available to your program. A good example of using a type library is discussed in Chapter 22, "Using OLE to Control Other Applications."

▶ **See** "The Microsoft Word Object Library" **p. 489**

Variable Declarations

Earlier, in the section "Naming Variables," you saw an example of the `Dim` statement, which is used to tell Visual Basic the name and type of your variable. However, Visual Basic does not require you to specifically declare a variable before it is used. If a variable is not declared, Visual Basic creates the variable by using a default data type – usually a *variant*. A variant can contain any type of information. Using a variant for general information has two major drawbacks—it can waste memory resources, and the variable type might be invalid for use with functions that expect a specific variable type.

Always declaring your variables before they are used is good programming practice. Therefore, you should now take a look at the two ways to declare a variable in Visual Basic—*explicit* and *implicit* declarations—and the special case of *fixed-length strings*.

Explicit Declaration

Explicit declaration means that you use statements to define the names and types of your program's variables. These statements do not assign values to the variables but merely tell Visual Basic what the variables should be called and what type of data they can contain.

You can use each of the following statements to explicitly declare a variable's type:

```
Dim varname [As vartype][, varname2 [As vartype2]]

Private varname [As vartype][, varname2 [As vartype2]]

Static varname [As vartype][, varname2 [As vartype2]]

Public varname [As vartype][, varname2 [As vartype2]]
```

`Dim`, `Private`, `Static`, and `Public` are Visual Basic keywords that define how and where the variable can be used. (You learn more about where these keywords can be used in upcoming sections.) *`varname`* and *`varname2`* represent the names of two variables that you want to declare. As indicated in the syntax, you can specify multiple variables in the same statement as long as you separate the variables with commas. Note that the syntax shows only two variables on one line, but you can specify several. In fact, over a thousand characters can fit on one line in the Code window. From a practical standpoint, however, you should refrain from writing lines of code that are wider than the displayed Code window. This way, you make your code much easier to read because you don't have to scroll left and right when looking at it.

`vartype` and *`vartype2`* represent the data types of the respective variables. A *data type* is a keyword that tells Visual Basic what kind of information is stored in the variable. As indicated, the variable type is an optional property. If you include the variable type, you must include the keyword `As`. If you do not include a variable type, the default type (usually Variant type) is used.

The following code shows the use of these declaration statements for actual variables:

```
Private nNumVal As Integer
Private nAvgVal As Integer, vInptVal As Variant
Static fClcAverage As Single
Dim sFirstName As String
```

Implicit Declaration

Declaring your variables using the `Dim` or other statements shown in the preceding section is best, but in many cases you can also assign a type to a variable using an *implicit declaration*. With this type of declaration, a special character is used at the end of the variable name when the variable is first assigned a value. The characters for each variable type are shown in Table 8.3.

Table 8.3 Special Variable Type Characters

Variable Type	Character
Integer	`%`
Long	`&`
Single	`!`
Double	`#`
Currency	`@`
String	`$`
Byte	None
Boolean	None
Date	None
Object	None
Variant	None

Visual Basic automatically sets aside space for implicitly declared variables the first time each variable is encountered. The variables that were declared using the code in the preceding section could have been used as implicitly declared variables, as follows:

```
nNumVal% = 0
nAvgVal% = 1
vInptVal = 5
fClcAverage! = 10.1
sFirstName$ = "Lauren"
```

Notice that the variable `vInptVal` doesn't have a declaration character. This means that `vInptVal` will be of the Variant type.

Fixed-Length Strings

Most strings that you use in your programs will be of the type known as *variable-length strings*. These strings can contain any amount of text, up to approximately 2 billion characters. As information is stored in the variable, the size of the variable adjusts to accommodate the length of the string. Both the implicit and explicit declarations shown earlier created variable-length strings. Visual Basic, however, does have a second type of string: the *fixed-length string*.

As the name implies, a fixed-length string remains the same size, regardless of the information assigned to it. If a fixed-length string variable is assigned an expression shorter than the defined length of the variable, the remaining length of the variable is filled with spaces. If the expression is longer than the variable, only as many characters as will fit in the variable are stored; the rest are truncated.

A fixed-length string variable can only be declared using an explicit declaration like the following:

```
Dim varname As String * strlength
```

Notice that this declaration is slightly different from the previous declaration of a string variable. The declaration of a fixed-length string variable contains an asterisk (`*`) to tell Visual Basic that the string will be of a fixed length. The final parameter, *`strlength`*, tells the program the maximum number of characters that the variable can contain.

One example of a fixed-length string is to aid in building a column-delimited text file. Suppose 25 characters of the file are used to represent a person's name. The following code would automatically cut the string off at 25 characters:

```
Dim sName As String * 25
sName = "This text is too long for the string variable."
```

Assigning a value less than 25 characters in length to `sName` would make the remaining characters spaces.

NOTE Another common use of fixed-length strings is to receive information from a Windows API function, as discussed in Chapter 20, "Accessing the Windows API."

Variable Arrays

All the variables discussed so far have been single-instance variables. Often, however, you may find it very useful to work with *arrays*. An array is a group of variables of the same type, sharing the same name. In this way, processing groups of related areas is easy. For example, you might want to have a group of variables that tracks the sales in each of your company's four regions. You can declare a currency variable for each region, plus one for the total sales across all regions, like this:

```
Dim cRegSales1 As Currency, cRegSales2 As Currency
Dim cRegSales3 As Currency, cRegSales4 As Currency
Dim cTotalSales As Currency
```

Then, if you want to calculate the total sales for all regions, you might use this code:

```
cTotalSales = cRegSales1 + cRegSales2 + cRegSales3 + cRegSales4
```

This approach isn't all that cumbersome. However, what if you have 20 regions? Or several hundred? You can see how working with large numbers of related variables could get messy very quickly.

You can greatly simplify this example by using an array. Here, create an array of variables named `cRegSales`; the array can contain as many elements (instances of variables) as you have regions. You can rewrite the previous example for 20 regions like this:

```
Dim cRegSales(1 To 20) As Currency
Dim cTotalSales As Currency
Dim nCounter As Integer
Dim sTemp As String

    cTotalSales = 0
    For nCounter = 1 To 20
        cTotalSales = cTotalSales + cRegSales(nCounter)
    Next nCounter
    sTemp = "Total sales for all regions = "
    sTemp = sTemp & Format(cTotalSales, "currency")
MsgBox sTemp, vbInformation, "Sales Analysis"
```

Note this example's use of a *loop*. The block of code beginning with the `For` instruction and ending with the `Next` instruction defines a group of program statements that will be repeated a certain number of times (in this case 20). Using loops makes short work of processing variable arrays.

As you progress through this book, you'll see several cases in which arrays can make your coding much simpler.

Determining Where a Variable Can Be Used

In addition to telling Visual Basic what you want to be able to store in a variable, a declaration statement tells Visual Basic where the variable can be used. This area of usage is called the *scope* of the variable. This is analogous to the coverage area of a paging system. When you

purchase a pager, you make a decision whether you want local service, regional service, or nationwide service. This information is then programmed into your pager when you buy it. If you go outside the service area, your pager does not work. In a similar manner, you can declare variables to work in only one procedure, work in any procedure of a form, or work throughout your program.

By default, a variable that is implicitly declared is local to the procedure in which it is created. If you don't specify any kind of declaration, explicit or implicit, you create a local variable. Therefore, to create variables that have a scope other than local, you must use a declaration statement.

NOTE The scope of a variable is determined not only by the type of declaration, but also by the location of the declaration. For example, the `Dim` and `Private` keywords assume different meanings in different parts of a form's code.

Creating Variables That Are Available Everywhere

In most programs, unless you have only one form and no code modules, you will find that you need some variables that can be accessed from anywhere in the code. These variables are called `Public` variables. (Other languages, as well as earlier versions of Visual Basic, might refer to them as `Global` variables. In fact, Visual Basic still recognizes the `Global` keyword.) These variables are typically used to hold information such as the name of the program's user, or to reference a database that is used throughout the program. They might also be used as flags to indicate various conditions in the program.

To create a `Public` variable, you simply place a declaration statement with the `Public` keyword in the General Declarations section of a module (.BAS file) of your program. The following line shows the `Public` declaration of a variable used for storing the program user's name:

```
Public sUserName As String
```

In a form or a class module, the `Public` keyword has a special meaning. Variables defined as `Public` act like a property of the form or class that is available anywhere in the program. These properties are referenced like the built-in properties of a form or control instead of like a variable. The `Public` properties are used to pass information between forms and other parts of your program. For example, suppose the previous declaration for `sUserName` existed in a form. The following lines of code could be used to set and retrieve the user name from the form:

```
frmLogin.sUserName = "CKRAMER"
frmLogin.Show vbModal
MsgBox "The name entered was " & frmLogin.sUserName
```

The first line of code sets the contents of the public variable (and loads `frmLogin` if it is not already loaded) as if it were a property of the form. The second line of code shows the form modally, so that the third line of code is not executed until the form is hidden. If a user of the form changes the value of `sUserName` from within the form itself and then hides the form, the third line of code displays a message box with the new value.

Keeping a Variable Local

If you do not need to access a variable from everywhere in your program, you should not use the `Public` keyword in a declaration. Instead, you should use the `Dim` or `Private` keywords, which tell Visual Basic to define the variable within the scope of the current procedure or form, respectively. With these declarations, the location of the statement determines the actual scope of the variable. If the variable is defined in the General Declarations section of a form or module, the variable is available to every procedure in that form or module. This type is known as a *form-level* or *module-level variable*. If the variable is declared inside a procedure, it can be used only within that procedure. This type is typically known as a *local variable*.

You may be wondering the reasons behind wanting to keep a variable as local as possible. The answer is two-fold:

- **Good Programming Practice**. Having code that relies on a public variable is harder to debug and maintain. For example, consider the following implementations of a simple procedure, `CalcArea`:

  ```
  Sub CalcArea()
                MsgBox "The Answer is " & nHeight * nWidth
  End Sub
  ```

  ```
  Sub CalcArea(nHeight As Integer, nWidth As Integer)
                MsgBox "The Answer is " & nHeight * nWidth
  End Sub
  ```

  If you are tasked with debugging the `CalcArea` procedure, the first example is the most difficult. The calculation depends on two public variables (`nHeight` and `nWidth`) being set correctly. The second implementation improves on this problem slightly by making `nHeight` and `nWidth` function parameters, allowing the programmer to easily call the function from the Immediate window without having to preset many variables. Of course, to make `CalcArea` as modular and reusable as possible, you would probably want to turn it into a function.

- **Use of Resources**. The second reason for keeping variables as local as possible should be almost common sense. If you declare a variable as `Public`, Visual Basic has to make that variable available to all forms and modules in your application. The limited scope of local variables does not require as many resources and will make your programs more efficient.

Using Static Variables

Most variables that are created inside a procedure are discarded by Visual Basic when the procedure is finished. Sometimes, however, you might want to preserve the value of a variable even after the procedure has run. This is often the case when you call the procedure multiple times, and the value of a variable for one call to the procedure is dependent on the value left over from previous calls. As an example, you may have a procedure that prints a header at the top of each page of a report, and the procedure needs to remember the page number from the previous time it was called so that it can be incremented.

To create a variable that retains its value, you use the `Static` keyword in the variable declaration. It tells Visual Basic that the variable can be referenced only within the procedure but to remember the value because it might be needed again. Here's an example of a variable declared using the `Static` keyword:

```
Static nPageNumber As Integer
```

NOTE If you use the `Static` keyword in front of a Function or Sub header (such as `Static Sub MySub()`, all variables in that procedure are treated as static. The following example subroutine demonstrates this concept:

```
Static Sub Test()
       Dim x As Integer
       Debug.Print "Value of x before assignment statement = " & x
       x = 1234
       Debug.Print "Value of x after assignment statement = " & x
End Sub
```

In this example, the variable `x` would be treated as a static variable. The first time you called the `Test` function, the output would be `0` and `1234`. The next call would print `1234` for both the before and after values. ■

Using the *Option Explicit* Statement

Earlier, in the section "Variable Declarations," you learned that declaring your program's variables before they are used is good programming practice. You can have Visual Basic "force" you to declare variables by setting one of its environment options. To do so, access Visual Basic's Options dialog box by choosing Tools, Options. On this dialog box's Editor tab is the Require Variable Declaration option (see Figure 8.1). Selecting this box requires you to declare each variable before you use it.

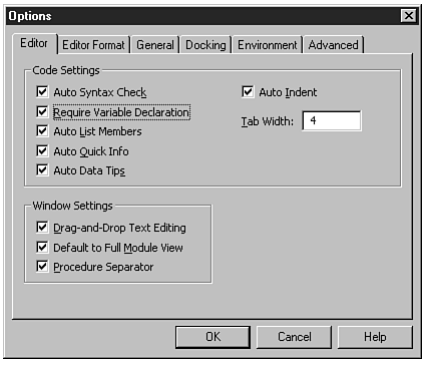


FIGURE 8.1
The Require Variable Declaration option helps prevent you from mistyping variable names.

Setting the Require Variable Declaration option causes the `Option Explicit` statement to be placed in the General Declarations section of all new modules and forms that are added to your project, as shown in Figure 8.2.

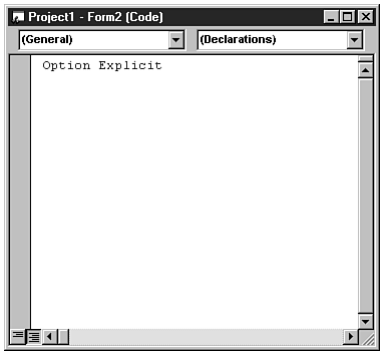


FIGURE 8.2
The `Option Explicit` statement is added to your program.

If a form or module contains the `Option Explicit` statement and you fail to declare a variable, you receive the error message `Variable not defined` when you try to run your code. The integrated debugger highlights the offending variable and aborts the compilation of your program. The benefit of this message is that it helps you avoid errors in your code that might be caused by typographical errors. For example, you might declare a variable using the following statement:

```
Dim sMyName As String
```

If, in a later statement, you mistype the variable name, Visual Basic catches the error for you rather than continues with unpredictable results. For example, the following statement causes an error if `Option Explicit` is used; otherwise, the program continues without having set the value of the intended variable:

```
sMyNme = "Tina Marie"
```

Without the `Option Explicit` statement, the previous line of code would create an additional variable. In other words, you would have two string variables: `sMyName` and `sMyNme`.

CAUTION

If you set the Require Variable Declaration option after starting to create a program, the option has no effect on any forms or modules that have already been created. In this case, you can add the `Option Explicit` statement as the first line of code in the General Declarations section of any existing forms or modules.

TIP

If you use some capital letters in your variable declarations, enter your code in all lowercase letters. Visual Basic automatically sets the capitalization of your variables to match the declarations. This convention gives you an immediate visual indication that you typed the name correctly.

What's Different About Constants

Using variables is just one way of storing information in the memory of a computer. Another way is to use *constants*. Constants in a program are treated a special way. After you define them (or they are defined for you by Visual Basic), you cannot modify them later in the program. If you try, Visual Basic generates an error when you run your program. It may help you to think of a constant as a variable whose value cannot change.

How to Use Constants

Constants are most often used to replace a value that is hard to remember or to type, such as the color value for the Windows title bar. Remembering the constant `vbActiveTitleBar` is easier than remembering the value `-2147483646`. You can also use a constant to avoid typing long strings if they are used in a number of places. For example, you can set a constant such as `FileErrMsg` containing the string "`The requested file was not found.`"

Constants are also used frequently for conversion factors, such as 12 inches per foot or 3.3 feet per meter. The following code example shows how constants and variables are used:

```
Const MetersToFeet = 3.3
nDistMeters = InputBox("Enter a distance in meters")
nDistFeet = nDistMeters * MetersToFeet
MsgBox "The distance in feet is: " &  CStr(nDistFeet)
```

Another common use for constants is to minimize changes to your code for reasons such as changing your program's name, version number, and so forth. You can define constants at the beginning of your program and use the predefined constants throughout the program. Then, when a version number changes, all you need to do is change the declaration of the constant. The following example illustrates this technique:

```
Public Const ProgTitle = "My Application Name"
Public Const ProgVersion = "3.1"
```

Note the use of the `Public` keyword, which makes these constants available throughout the application (assuming that their declaration is in a module).

Constants That Visual Basic Supplies

Visual Basic supplies a number of built-in constants for various activities. They are known as *intrinsic constants*. Color-definition constants, data-access constants, keycode constants, and shape constants, among many others, are available. Especially useful are constants correlating to a command's parameter information, such as the `vbExclamation` constant used for a `MessageBox` statement in previous chapters.

The constants that you need for most functions are described in the help system's topic for the function. If you want to know the value of a particular constant, you can use the Object Browser (see Figure 8.3). Access the Object Browser by clicking its icon in the Visual Basic toolbar, by selecting View, Object Browser from the menu system, or simply by pressingF2. You can use the list to find the constant that you want. When you select it, its value and function are displayed in the text area at the bottom of the dialog box.

Creating Your Own Constants

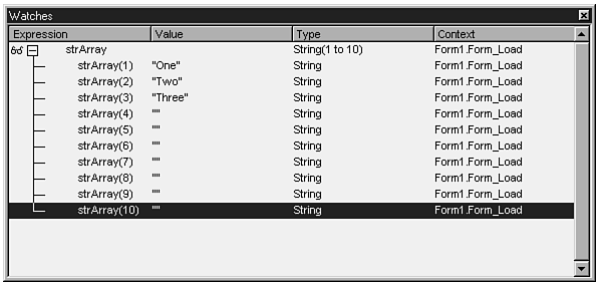
Although Visual Basic defines a large number of constants for many activities, sometimes you need to define your own constants. Constants are defined using the `Const` statement to give the constant a name and a value, as illustrated in the following syntax:

```
[Public ¦ Private] Const constantname [As constanttype] =
```

Tracking Variable Values

While you are in break mode, printing out variable values in the Immediate window is common practice. However, Visual Basic includes two special features for keeping track of variables during program execution. One of them is simple; just hover the mouse pointer over the variable name, and the value appears in a ToolTip. The other, more advanced method is to use the Watches window, as shown in Figure 10.4.

FIGURE 10.4
In the Watches window, you can watch and change variable values.



To monitor a variable in the Watches window, simply right-click the variable, and choose Add Watch from the context menu. Try it now: Start a new Standard EXE project, and enter the following code in the `Form_Load` event:

```
Private Sub Form_Load()

        Dim strArray(1 To 10) As String

        strArray(1) = "One"
        strArray(2) = "Two"
        strArray(3) = "Three"

End Sub
```

While you are still in design mode, right-click `strArray` and select Add Watch. The Add Watch dialog box appears, as shown in Figure 10.5. Click the OK button, and the Watches window includes an entry for `strArray`. Notice that the Value column displays `<Out of context>`, because the program has not started yet, and the array doesn't exist. Press F8 once to start the program, and make sure that the Watches window is visible. If it is not, choose View, Watch Window. Press F8 several times, each time stopping to inspect the Watches window. The values for each element of `strArray` should be displayed in the window. You can even double-click a variable and enter a new value (which is just like entering an assignment statement in the Immediate window). Also note that variables with multiple dimensions (such as arrays or objects) are displayed in a tree-like hierarchy. This feature can be handy when you are dealing with complex objects such as an ADO recordset.

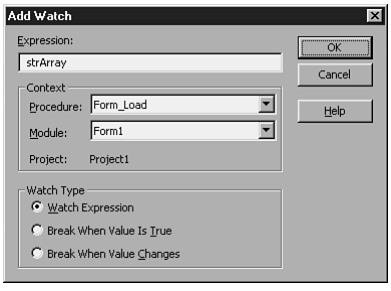


FIGURE 10.5
You set up watches in the Add Watch dialog box.

Error Trapping

As you are writing code, Visual Basic informs you of syntactical errors. However, once the program is running, you may encounter unexpected runtime errors in many circumstances. For example, suppose you try to open a text file that the user has deleted. When a compiled program has an error like this, an error message is displayed, as shown in Figure 10.6, and the program ends.

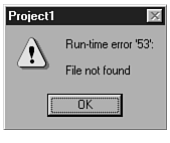


FIGURE 10.6
You can avoid cryptic error messages and ungraceful exits by adding error handling to your application.

Although you cannot predict and write code for every possible type of error, `File Not Found` errors, such as the one in Figure 10.6, are fairly easy to handle. If you do not write code to work around the error, you can at least provide a message that makes more sense before ending the program.

Using the *On Error* Statement

The most common way to handle error conditions is to use Visual Basic's `On Error` statement. The `On Error` statement interrupts the normal flow of your program when an error occurs and begins executing your error handling code. A typical use is as follows:

```
On Error Goto FileOpenError
```

When this statement is executed, any errors that occur in subsequent statements cause Visual Basic to stop the normal line-by-line execution and jump to the statement labeled as `FileOpenError`.

Labeling Code Lines

This discussion brings up another new concept: line labels. If you have used an early version of BASIC, you may remember statements with line numbers, like this:

```
10 Print "hello"
20 Goto 10
```

Line labels in Visual Basic are similar to the line numbers of early BASIC. In Visual Basic, line labels can include text if you want, but each label must be unique. They are followed by a colon (`:`), as in the following example:

```
Private Sub Form_Load()
On Error GoTo FileOpenError
    Open "C:\NOFILE.TXT" For Input As #1
    Line Input #1, sData
    Exit Sub

FileOpenError:
    MsgBox "There was a problem opening the file. Call the Help Desk!"
    End

End Sub
```

In the preceding sample code, if the `Open` or `Line Input` statements cause an error, the statements starting at the label `FileOpenError` are executed, causing the message to be displayed and ending the program.

You should note a few points about the sample code. First, note the location and style of the error handling routine. It is usually placed near the end of the subroutine, with the label not indented to indicate a special section of code. Second, and more important, notice the `Exit Sub` statement after the `Open` statement. It is necessary to prevent the error handling routine from executing even when the `Open` statement is successful.

Controlling Program Flow After an Error

In the preceding code example, you simply end the program if an error occurs. However, you can handle the error in several (better) ways:

- Exit the subroutine after informing the user of the error, and allow the program to continue running with limited functionality.
- Resume execution with the next statement following the error.
- Provide a way for the user to correct the error and retry the offending statement.

You can also have multiple labels within a procedure and set the current error handler multiple times. For example, you can add a line to the code sample after the `Open` statement that specifies a new label, `FileInputError`. You can also turn off error handling with the following statement:

```
On Error Goto 0
```

The `On Error` statement goes hand in hand with the `Resume` statement. For example, this statement causes errors to be ignored and the program to proceed through each line of code anyway:

```
On Error Resume Next
```

You should use the preceding line of code sparingly because it really just ignores errors rather than handles them. A better use of `Resume` is to go to another section of code, as in the following example:

```
Private Sub Form_Load()

    On Error GoTo FileOpenError
RetryHere:
    Open "C:\NOFILE.TXT" For Input As #1
    Line Input #1, sData
    Exit Sub

FileOpenError:
    Dim sMessage As String

    sMessage = "There was a problem opening the file. " & vbCrLf
    sMessage = sMessage & "Press Retry to try again, or Cancel to quit."

    If MsgBox(sMessage, vbRetryCancel + vbCritical, "Error!") = vbRetry Then
        Resume RetryHere
    Else
        End
    End If

End Sub
```

The preceding example displays a message box with Retry and Cancel buttons. If the user clicks Retry, the code resumes executing at the label `RetryHere`, causing the `Open` statement to be executed again.

Determining the Type of Error

After an error has occurred, your code can find out more information about the error in several ways:

- `Err`—Contains a number that represents the error.
- `Error`—Contains a string describing the error.
- `Err Object`—Contains error number, description, and additional information. Also used to raise your own custom errors.

If you know how to recover from certain errors that may occur, you can use these objects to respond intelligently to a specific error. In the previous example, you received a `File Not Found` error, which is number 53. You can easily add code in the error handler to take appropriate action (that is, check another file) if the value of `Err` is equal to 53.

TIP When you are writing an error handling routine with a message box, display the error number and description in your message box to make troubleshooting easier.

From Here...

This chapter provided you with an overview of programming in Visual Basic. You learned how to handle string manipulations, decisions, and loops in your code. For some more material on programming, refer to the following chapters:

- For more information about the Visual Basic language, see Chapter 9, "Visual Basic Programming Fundamentals."
- To learn how to create your own functions, see Chapter 11, "Managing Your Project: Sub Procedures, Functions, and Multiple Forms."
- To find out how to write a sharp-looking interface, see Chapter 18, "Proper Interface Design."

CHAPTER 11

Managing Your Project: Sub Procedures, Functions, and Multiple Forms

In this chapter

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Working with Multiple Forms **235**

Managing Components in Your Project **237**

Controlling How Your Program Starts **241**

In Chapter 9, "Visual Basic Programming Fundamentals," you learned about writing code to make your computer programs accomplish various tasks. You saw how you can manipulate data and how control statements allow you to execute repetitive tasks and to execute statements selectively. However, creating a good, maintainable program involves more details than just writing code.

One of the tasks you need to be able to perform is to create reusable pieces of code and reusable program pieces so that you are not constantly reinventing the wheel (or the program, in this case). Another important skill is the ability to manage those various pieces of code and forms effectively. This chapter deals with both of these aspects of project management. First, you learn how you can use *procedures* to eliminate repetitive code in your programs. Then you learn how those procedures and other program components are added to your project. Finally, this chapter gives you a brief look at compiling and distributing your programs for others to use.

Using Procedures and Functions

As you create more and larger programs, you will often find yourself using the same block of code over and over in several places throughout your program and in multiple programs. Surely, there must be a better way to handle repetitive code than to just place it in multiple locations in your program, right? Of course, there is. The solution is to use *procedures* and *functions*. Procedures and functions are segments of code that perform a particular task and then return processing to the area of the code from which they were called. This means that a single procedure (or function) can be called from multiple places in your code and, if managed properly, can be used with multiple programs.

You have already been exposed to working with procedures even if you didn't know it. Each time you entered code to be executed by a command button (or other control) in response to an event, you were building an event procedure. Event procedures are called by the program when an event is triggered. As you might already know, you can also create your own procedures and call them when you need them. The procedures that you build are referred to as user-defined sub procedures (or subroutines). Although the code in earlier examples was entirely contained in event procedures, a "real" program might contain more code in user-defined sub procedures.

Working with Procedures

The key idea behind working with procedures is to break down your program into a series of smaller tasks. Each of these tasks can then be encapsulated in a procedure, function, or possibly a class. (Classes are discussed in Chapter 16, "Classes: Reusable Components.") Programming in this manner presents several advantages:

- You can test each task individually. The smaller amount of code in a procedure makes debugging easier and makes working on the same project with other developers easier.
- You can eliminate redundant code by calling a procedure each time a task needs to be performed instead of repeating the program code.

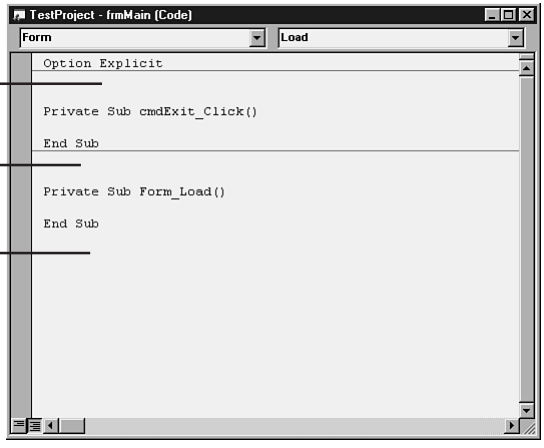
- You can create a library of procedures that can be used in more than one program, saving yourself development time in new projects.
- Program maintenance is easier for a couple of reasons. First, if code is not repeated, you have to edit it only once. In addition, separating key components (for example, the user interface and the database functions) allows you to make major changes in one part of the program without recoding the whole thing.

TIP To make your code reusable, use comments often. This extra detail allows another programmer (or yourself after a long period of time) to see quickly the purpose of each procedure and how it accomplishes its task.

Creating the Procedure As with your program as a whole, the process of creating a procedure starts with design. You need to determine the task to be performed , what information will be needed by the procedure, and what information will be returned by the procedure. After you complete this task, you can start the actual coding of the procedure. You can start building a procedure in Visual Basic in two ways: starting from scratch or using the Add Procedure dialog box. Both methods are relatively easy, and the one you use is a matter of personal preference. Also, both methods require you to be in the Code window before you can build a procedure.

To create a procedure from scratch, place your cursor in the Code window in a location that is not within a currently defined function or procedure. For example, you might place the cursor after the `End Sub` statement of a procedure, before the `Sub` statement of another procedure, or at the top of the Code window. Figure 11.1 shows where you can start.

FIGURE 11.1
Start a procedure in the Code window by using a `Sub` statement.



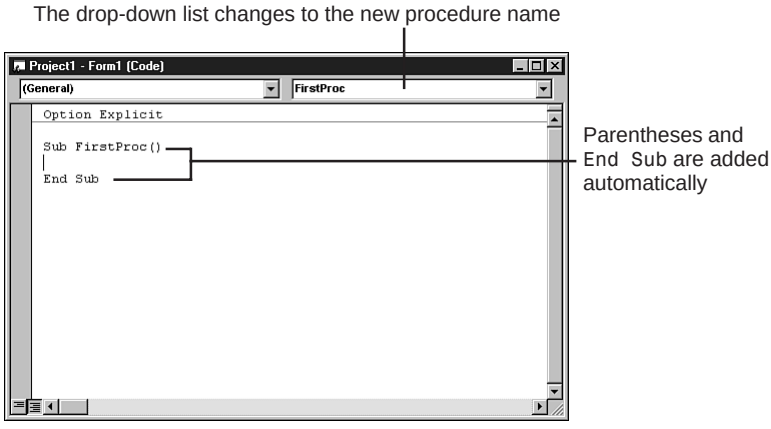
TIP Placing your procedures in alphabetical order makes finding them easier when you page through the Code window. However, they will always be in alphabetical order in the Code window's drop-down Procedure box.

You can create a new procedure in the Code window by following these steps:

1. Open the code for Form1 by clicking the View Code button.
2. Type the keyword `Sub`, followed by a space.
3. Type the name of your new procedure—`FirstProc` in this example.
4. Press the Enter key to create the procedure.

When you press Enter, three things happen: a set of parentheses is added at the end of the `Sub` statement, an `End Sub` statement is placed in the Code window, and the current object in the Procedure drop-down list of the code editing window becomes your new procedure name. Figure 11.2 shows these changes for a procedure named `FirstProc`.

FIGURE 11.2
The `End Sub` statement is automatically added when you define a new procedure.



You are now ready to enter any commands that you want to run when the procedure is called.

The full syntax of a `Sub` procedure includes the `Sub` statement, the `End Sub` statement, and the procedure commands:

```
[Public ¦ Private] [Static] Sub procname([arguments])
statements_to_be_run
End Sub
```

The `Public`, `Private`, and `Static` keywords in the `Sub` statement are optional and affect the locations from which the procedure might be called. These keywords indicate the scope of the procedure in the same way that they indicate the scope of a variable.

▶ **See** "Determining Where a Variable Can Be Used," **p. 166**

The other method of creating a procedure is to use the Add Procedure dialog box (see Figure 11.3). You access this dialog box by choosing Tools, Add Procedure.

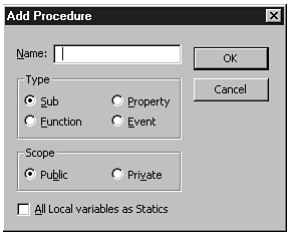


FIGURE 11.3
Although typing a procedure by hand is faster, you can also create a new procedure in the current module or form by using the Add Procedure dialog box.

In the Add Procedure dialog box, perform the following steps to create the shell of your procedure:

1. Enter the name of the procedure in the Name text box.
2. Choose the type of procedure (Sub, Function, Property, or Event).
3. Choose the scope of the procedure (Public or Private).
4. Check the All Local Variables as Statics check box if necessary.

To create a procedure, you need to choose the sub procedure type. You are presented with four choices. A *function type of procedure* returns a specific value. These procedures are covered later in this chapter. A *property procedure* sets or retrieves the value of a property in a form or class module. An *event procedure* responds to an event in a form or class module; choosing Event in this dialog box inserts a forward declaration to a user-defined event that you will create. The `Property` and `Event` procedures are described in Chapter 16, "Classes: Reusable Components."

▶ **See** "Property Procedures," **p. 359**

After you enter the necessary information, click OK. Visual Basic then creates the framework of a procedure in the Code window.

Running the Procedure After you develop a procedure, you need a way to run it from other parts of your program. You can choose from two methods for running a procedure: use the `Call` statement or use just the procedure name. With either method, you simply specify the procedure name and any arguments that are required by the procedure. (The arguments are the ones specified in the `Sub` statement when you defined the procedure.)

The syntax for running a procedure is as follows:

```
Call procname([arguments])
```

or

```
procname arguments
```

In either syntax, *`procname`* refers to the name of the procedure. This name is specified in the `Sub` statement that defined the procedure. *`Arguments`* refers to the parameters passed to the procedure. In the calling statement, the arguments can be literal values, variables, or functions that return the proper data type. This is different from the `Sub` statement in which all the arguments have to be variable names. Parameters, if present, must be separated by commas.

Now look at a brief example of a procedure that uses parameters. Suppose your program needs to log all its operations and errors to a text file. A procedure that handles writing messages to the log file, along with a date and time, could be very useful:

```
Sub LogPrint(sMessage As String)
    Dim nFileNum As Integer
    nFileNum = FreeFile
    Open "C:\EVENTLOG.TXT" for append as #nFileNum
    Print #nFileNum, Now & " - " & sMessage
    Close #nFileNum
End Sub
```

The following line of code calls the procedure. When calling a procedure, you can supply values for its arguments using either a variable, a literal string, or a combination of the two:

```
LogPrint "Error Opening file " & sUserFile
```

The `LogPrint` procedure is simple, yet it saves a lot of time in the long run. It makes the calling code shorter and more readable. In addition, if you ever want to change the format of the output file or change the destination of the log information from a text file to a database, printer, or pager, you have to modify only the `LogPrint` function itself.

CAUTION

Typically, you must include the same number of parameters in the calling statement as are present in the definition of the procedure. Also, the values supplied by the calling statement must match the data types expected by the procedure. Violating either of these conditions results in an error when you run your program.

At the start of this section, I listed two methods of calling a procedure. The following line of code calls the `LogPrint` procedure using the other syntax:

```
Call LogPrint ("The server was rebooted")
```

As you can see, the `Call` keyword itself is optional when calling the procedure. If you use the `Call` keyword, you must include the parameters in a set of parentheses. I recommend using the syntax that does not use `Call`. As you will see after looking at the examples in the next section, this approach makes distinguishing between procedure calls and function calls easier.

Passing Data to a Procedure You can get information into a procedure for processing in two ways: you can define the variables as public variables that are available everywhere in your program, or you can pass the variables directly to the procedure in the calling statement.

For example, you could add a second argument to the `LogPrint` procedure that allows it to work with multiple files:

```
Sub LogPrint(sLogFile As String, sMessage As String)
    Dim nFileNum As Integer
    nFileNum = FreeFile
    Open sLogFile for Append as #nFileNum
    Print #nFileNum, Now & " - " & sMessage
    Close #nFileNum
End Sub
```

However, this approach means that if your program uses only one log file, you still have to pass the filename to the procedure each time you call it:

```
LogPrint "C:\LOGFILE.TXT", "Error Opening the file " & sUserFile
```

For this particular procedure, the `sLogFile` argument probably does not change much throughout the program. However, hard-coding it into the `LogPrint` procedure does not make much sense either, so a public variable would be the logical choice:

```
Public sLogFileName As String

Sub LogPrint(sMessage As String)
    Dim nFileNum As Integer
    nFileNum = FreeFile
    Open sLogFileName for Append as #nFileNum
    Print #nFileNum, Now & " - " & sMessage
    Close #nFileNum
End Sub
```

Before calling the procedure, your program needs to set the value of `sLogFileName`. The `Public` keyword makes it visible to all the other procedures in your program. The variable `nFileNum`, on the other hand, can be used only within the `LogPrint` procedure, as it should be.

If you are going to use the variables in a number of procedures and the procedure is specific to the current program, setting up the variables as public variables is the better approach. However, for the sake of reusability among projects, keeping procedures as independent as possible is a good idea. To do so, you should define all the necessary parameters to be passed to the procedure in the `Sub` statement and pass the parameters in the calling statement. Additionally, all variables used by the procedure should be `Private` (local) variables that are declared within the procedure itself.

The parameters used by a procedure can provide two-way communication between the procedure and the calling program. The procedure can use information in the parameters to perform a calculation and then pass the results back to the calling program in another parameter.

For example, the following procedure gets the height and width of a rectangle from the parameters list and then calculates the area and perimeter of the rectangle. These values are returned through the parameters list:

```
Sub CalcRectangle(nWidth as Integer, nHeight as Integer, _
                  nArea as Integer, nPerimeter as Integer)
    nArea = nWidth * nHeight
    nPerimeter = 2 * (nWidth + nHeight)
End Sub
```

The procedure can be called by using variables for both the input and output parameters, as follows:

```
nWid = 5
nHgt = 5
nArea = 0
nPerm = 0
CalcRectangle nWid, nHgt, nArea, nPerm
```

It can also be called by using literal values for the input parameters and variables for the output parameters:

```
nArea = 0
nPerm = 0
CalcRectangle 4, 10, nArea, nPerm
```

Passing parameters to a procedure in this way is known as *passing by reference*. In this case, the variable name passed to the procedure and the variable name used in the procedure both refer to (reference) the same location in memory. When entering a function or procedure declaration, you can explicitly indicate "by reference" parameters with the `ByRef` keyword, as in the following example:

```
Sub ChangeString(ByRef AnyString As String)
    AnyString = "After"
End Sub

Dim sSampleString As String
sSampleString = "Before"
ChangeString sSampleString
```

The first three lines of code define a simple subroutine that changes the contents of a string passed as a parameter. The `ByRef` keyword indicates that any changes made to the parameter will be reflected in the variable passed to the procedure. In other words, changing the value of `AnyString` within the procedure causes the value of `sSampleString` to be changed as well. This capability enables the procedure to modify the value that is then passed back to the calling code.

You can also pass a parameter to a procedure *by value*. This approach causes the procedure to use a *copy* of the information that was passed to it, which prevents the procedure code from modifying the value used by the calling program. By default, when you declare a parameter for a procedure, the passing by reference approach is used. To modify this behavior, you must explicitly tell Visual Basic to pass the parameter by value. Do so by placing the `ByVal` keyword in the parameter list before each variable that is to be passed by value, as illustrated in the following code:

```
Sub CalcRectangle(ByVal nWidth As Integer, ByVal nHeight As Integer, _
                 _nArea, nPerimeter As Integer)
```

CAUTION

If you are passing parameters by reference, you need to explicitly declare the variable in the calling program and in the procedure, and you need to be sure that the variable types are the same.

Exiting a Procedure Early As your programs, and therefore your procedures, grow in complexity, sometimes you might not need to execute all the commands in the procedure. If you need to exit the procedure before all the commands have been executed, you can use the `Exit Sub` statement.

One way to use the `Exit Sub` statement is in the beginning of the procedure in a routine that checks parameters for proper values. If any of the parameters passed to procedure are the wrong type or have values that could cause a problem for the procedure, use `Exit Sub` to terminate the procedure before the error occurs. Using the statement this way is a type of *data validation*. The following code modifies the previous area calculation code to perform this check:

```
Sub CalcRectangle(nWidth as Integer, nHeight as Integer, nArea as Integer, _
                  nPerimeter as Integer)
If nWidth <= 0 Or nHeight <= 0 Then
     Exit Sub
   End If
   nArea = nWidth * nHeight
   nPerimeter = 2 * (nWidth + nHeight)
End Sub
```

Working with Functions

Functions are similar to procedures, with one key difference: they return a value. This value can be assigned to a variable or used in expressions. Visual Basic offers a number of built-in functions that you can use, such as `Abs`, which returns the absolute value of a number, or `Left`, which returns a specified number of characters from the left end of a string. You can build your own functions as well.

To build a function, you have the same two choices you had in building a procedure—starting from scratch or using the Add Procedure dialog box. To start from scratch, select the place in the Code window where you want the function to start and then enter the keyword `Function` followed by the name of the function. The naming conventions for functions are the same as those for procedures. To use the Add Procedure dialog box, just select the Function Type option button in the dialog box. Either method creates the shell of a function just as it does for a procedure. An example of this shell is shown in the following lines of code:

```
Public Function NumAverage()

End Function
```

Although the first line is an acceptable function declaration, most of the time you will define the type of value that will be returned by the function. You define this function type like you define variable types in a `Dim` statement—by using the `As` keyword followed by the variable type. This function type declaration follows the parentheses that enclose the parameter declaration. In addition, you will typically declare the parameters that are passed to the function in the declaration statement. A more complete declaration statement is shown in the following line:

```
Public Function NumAverage(inpt1 As Single, inpt2 As Single) As Single
```

The other key difference between building a function and a procedure is that you assign a value to the function name somewhere within the code of the function. This value must be of the same type as specified in the function declaration. This is shown in the second line of the following code:

```
Public Function NumAverage(inpt1 As Single, inpt2 As Single) As Single
   NumAverage = (inpt1 + inpt2) / 2
End Function
```

NOTE Although your function code can assign a value to the function multiple times, only the last value assigned before the end (or exit) of the function is returned.

When you call a function, you typically assign its return value to a variable in your program, or use the value in a conditional statement as shown here:

```
'Assigning a function to a variable
fAvgNum = NumAverage(25, 15)

'Using a function in a conditional expression
If NumAverage(num1, num2) > 20 Then MsgBox "What an average!"
```

NOTE If you need your function to simply perform a task (opening a database, for example), you can call the function the same way that you would call a procedure, throwing away the return value.

ON THE WEB

There are a number of functions built and demonstrated in the FUNCDEMO.VBP project, which you can download from www.mcp.com/info.

Determining the Scope of Procedures and Functions

When you create a procedure (or function), you might want to limit where it can be used and how resources are allocated to make its code available to other parts of your program. Where a procedure can be called from is referred to as the *scope* of the procedure.

Procedures can be defined in either of two ways: as *public procedures* or as *private procedures*. Which of these keywords you use in the `Sub` statement determines which other procedures or programs have access to your procedure.

NOTE The scope of procedures and functions is related to the scope of variables, which is discussed in the section titled "Determining Where a Variable Can Be Used" in Chapter 9, "Using Variables to Store Information."

▶ **See** "Determining Where a Variable Can Be Used," **p. 166**

Going Public If you want to have your procedure or function available throughout your program, you need to use the `Public` keyword when you define the procedure. Using the `Public` keyword allows a procedure defined in one form or module to be called from another form or module. However, you have to be careful with the names of public procedures because each public procedure must have a name that is unique throughout the current scope.

If you omit the keywords `Public` and `Private` from the `Sub` statement, the procedure is set up by default as a public procedure.

Keeping the Procedure Private Using the `Private` keyword in the `Sub` statement lets the procedure be accessed from only the form or module in which it is defined. This approach, of course, poses advantages and disadvantages. One advantage is that a private procedure is resident in memory only while the module in which it is stored is loaded, conserving system resources. A disadvantage is that the procedure is not accessible from other modules.

When working with event procedures in other chapters, you might have noticed that they are, by default, private procedures. They are private because, typically, controls are not accessed outside the form on which they reside. This is an example of *information hiding*, or *encapsulation*, a technique used in object-oriented programming. If you are sharing a module with a team of developers, you could define the functions they call as public, while the internal procedures they don't need to know about remain private.

Preserving Variables Typically, when a procedure is executed, the variables it uses are created, used in the procedure, and then destroyed when the procedure is terminated. However, sometimes you might want to preserve the values of the variables for future calls to the procedure. You can handle this task by using the `Static` keyword. This keyword can be applied to the declaration of the variables in the procedure or in the declaration of the procedure itself.

When `Static` is used in a variable declaration, only the variables included in the `Static` statement are preserved. If you use the `Static` keyword in the procedure declaration, all the variables in the procedure are preserved. For example, a procedure that prints a report header on the printer may keep track of the current page number. In the following code example, the value of the static variable `nPageNum` is retained each time the procedure is run:

```
Public Sub PrintHeader()
    Static nPageNum As Integer
    nPageNum = nPageNum + 1
    Printer.Print "FORTNER MASONRY ANNUAL EARNINGS REPORT"
    Printer.Print Date
    Printer.Print "Page " & nPageNum
    Printer.Print
End Sub
```


TIP For efficiency's sake, it's important to place your procedures in the appropriate scope. Giving a procedure a scope that is too broad (for example, making a procedure public when it only needs to be private) wastes valuable system resources. If you create a public procedure, Visual Basic must allocate appropriate resources to make it available to all parts of your program. Using the `Static` keyword to force a procedure to "remember" its local variables causes an extra allocation of resources as well. In general, you should make procedures private if possible, and avoid the use of static variables as well. If you use this approach, Visual Basic can manage memory more efficiently because it is free to unload the various sections of code as needed.

Reusing Functions and Procedures

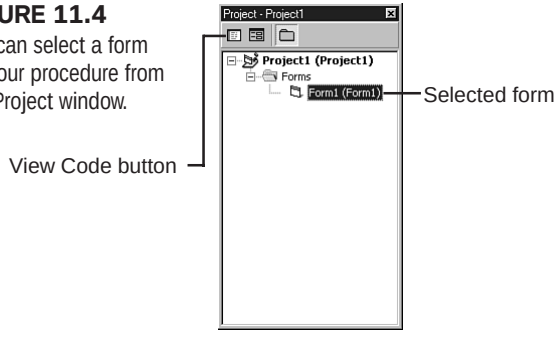
You can create a procedure in either of two places: a form or a module. Where you place the procedure depends on where you need to use it and what its purpose is. If the procedure is

specific to a form or modifies the properties of the form or its associated controls, you should probably place the procedure in the form itself.

If, on the other hand, you are using the procedure with multiple forms in your program or have a generic procedure used by multiple programs, you should place it in a module. The storage location of your procedure is determined by where you create it. If you want, you can move a procedure from a form to a module or vice versa using cut-and-paste editing or even drag-and-drop editing.

Storing a Procedure in a Form File To create a procedure in a form file, you just need to choose the form from the Project window and then access the code for the form. You do so either by double-clicking the form itself (or any control) or choosing the View Code button in the Project window (see Figure 11.4). After the Code window appears, you create a procedure as described in the earlier section "Creating the Procedure."

FIGURE 11.4
You can select a form for your procedure from the Project window.



Using a Module File for Procedures A module file contains only code—no form elements or events. If you already have a module file in your project, you can create a new procedure by selecting the file, opening the Code window, and then using the steps listed earlier to build the procedure.

TIP Double-clicking the module name in the Project window automatically opens the Code window for the module.

If you don't have a module file in your project, or if you want to use a new module, you can create a module by selecting Project, Add Module. You can also create a new module by clicking the arrow on the Add Form button in the toolbar and then choosing Module from the drop-down menu. Either way, you are presented with the Add Module dialog box; select the Module icon and click Open. A new module is created, and the Code window appears for you to begin editing. When you save your project or exit Visual Basic, you are asked for a filename for the module file.

NOTE The toolbar button for adding new forms and modules is a drop-down button, which means clicking on the arrow gives you a list of items. After an item has been selected, the icon on the button changes. ■

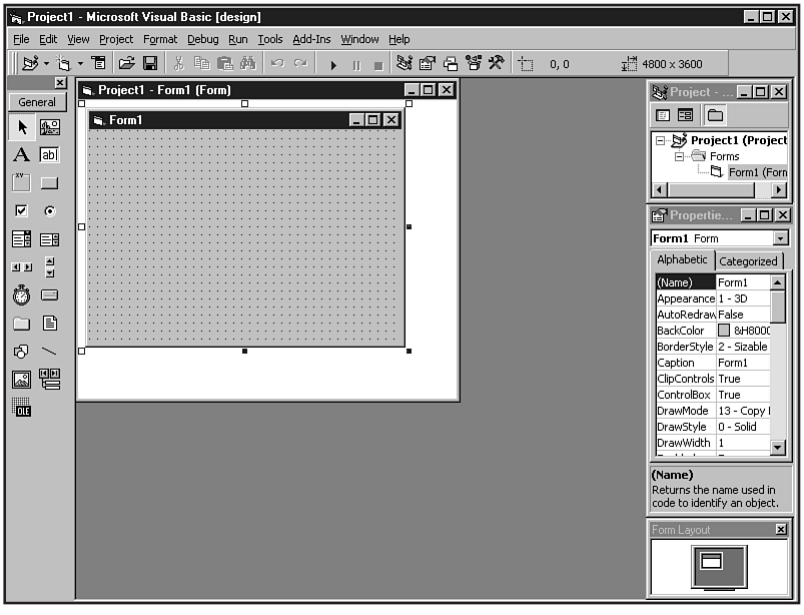
Working with Multiple Forms

Although some programs you write will be simple enough that you can use a single form, most will be made up of multiple forms. One reason for this is the limitation of the amount of space on a single form. Another, more important, reason is that you will want to use multiple forms in your program to separate program tasks logically. For example, if you have a task in your program that is not performed often, putting it onto a separate form makes more sense than trying to squeeze it onto a single form with everything else. Also, by loading and unloading forms as you need them, you can save system resources. In other words, your program takes up as little space as possible while running.

Adding New Forms to Your Program

When Visual Basic first starts a new project, typically it loads one blank form, as shown in Figure 11.5. As you design your program, you add controls to this form and write code to handle events that occur on the form.

FIGURE 11.5
Visual Basic starts a new project with a single blank form.



At some point in your design, you may decide that you need one or more additional forms to handle a new task or provide space to relieve the crowding on the initial form. Adding a new form is simple. You can either click the Add Form button or select Project, Add Form. This

action places a new blank form on the screen. This form looks just like your first form initially did. If you did not rename your first form from the default of `Form1`, the new form is named `Form2` (or `Form3`, `Form4`, and so on). Otherwise, the new form is named `Form1`.

TIP You can add files, forms, or modules from a pop-up menu by right-clicking within the Project window.

After you add a new form, you can place controls on it and write code for its events, just like for the initial form. You also need to be able to access the new form from other forms in your program. Access is handled through the `Load` and `Unload` statements and the `Show` and `Hide` methods of the form object.

▶ **See** "Displaying a Form," **p. 55**

Adding Code Modules to a Project

As you write more code to handle more events and more tasks, you may often find that you need to access the same procedure from a number of different places on a form or from multiple forms. If this is the case, storing the procedure in a module file makes sense.

TIP If you have a library of common functions, such as printing routines, keep them in a separate module file so that you can easily add the library to different projects.

Again, a module file contains only Visual Basic code; it does not contain any controls, graphics, or other visual information. When you want to add a module file to hold your procedures, you can do so either by clicking the arrow on the Add Form button and choosing Module from the drop-down menu, or by choosing Project, Add Module. Either of these actions adds a new module to your project and places you in the Code window for the module (see Figure 11.6).

When you first open a new module, Visual Basic gives it the default name of `Module1` (or `Module2` for a second module, and so on). As you do with your forms and controls, you should give the module a unique name. The module has a `Name` property, just as a form does. To change the name of the module, simply change the value of the `Name` property in the Property window.

Accessing the Forms and Modules of a Project

As you add forms and modules to your program, they are added to the Project window. This window allows you to access any of the pieces of your program easily (see Figure 11.7). You simply select a form or module by clicking its name in the Project window. For a form, you can then click the View Object button to work on the design of the form, or you can click the View Code button to edit the code associated with the form. For a module, only the View Code button is enabled because a module has no visual elements. Double-clicking the name of a form has the same effect as clicking the View Object button. Double-clicking a module name has the same effect as clicking the View Code button.

FIGURE 11.6
You can open the Code window by double-clicking the module name in the Project window.

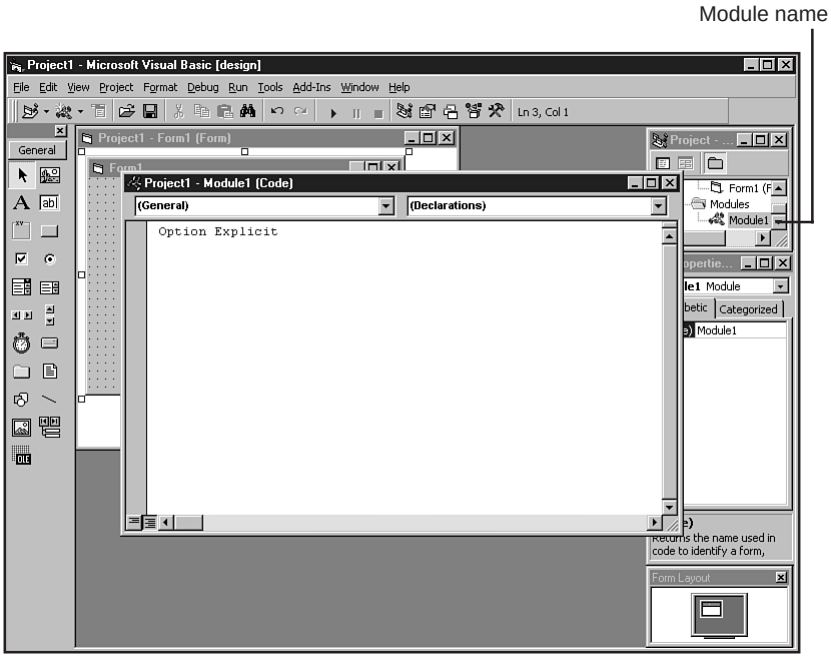
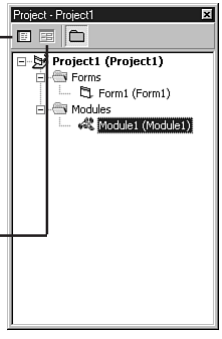


FIGURE 11.7
The Project window gives you easy access to all your forms and modules.



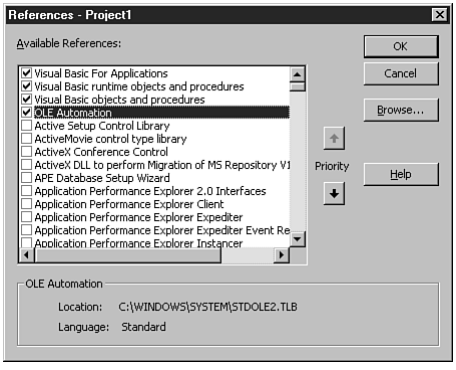
Managing Components in Your Project

Forms and modules are just two of the types of components that you can add to your project. In addition, you can also add *custom controls* and *class modules.* Some of these components, such as forms and modules, are editable code. Others, such as third-party controls and DLLs, are usually already compiled. Although these types of items are part of your project, they do not show up in the Project window and are added by means of some special dialog boxes.

Managing Program References

One of the elements that you have to manage is your program's *references.* The references point to different library routines that enable your code to perform specific tasks. For example, if you plan to access databases with your programs, you need to specify the Data Access Objects library as one that is used by your code. Controlling references is quite easy in Visual Basic. The References dialog box lets you select the references required by your program; to do so, mark the check box to the side of the reference (see Figure 11.8). Mark the ones you need and unmark the ones you don't need. You access the References dialog box by selecting Project, References.

FIGURE 11.8
The References dialog box lets you choose which libraries are used by your program.



TIP After you add a reference to your project, you can view its public constants and functions in the Object Browser, which you display by clicking the Object Browser button or by pressing F2.

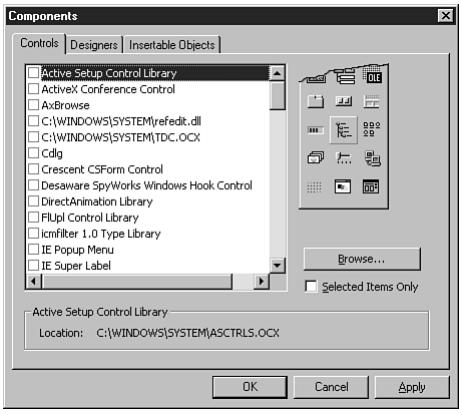
Controlling Your Controls

In a manner similar to library references, you can add and remove custom controls from your project. When you loaded Visual Basic, a number of custom controls were loaded into the Toolbox window automatically. However, you usually need controls designed to perform specific tasks that are beyond the capabilities of the standard controls. You can manage the custom controls in your project by using the Components dialog box (see Figure 11.9). Select Project, Components to access this dialog box. Here, as in the References dialog box, you choose the custom controls to add to your program by marking the check box next to the control name. After you exit the dialog box, your control toolbox is modified to display the new controls.

Adding Forms, Modules, and Classes to the Project

As you develop more programs, you might find that you have standard procedures or forms that can be used in many of your projects. You also might have developed custom procedures for getting the names and passwords of users, for opening files, or for any number of other tasks that are used in almost every program.

FIGURE 11.9
The Components dialog box lets you add controls to your project.



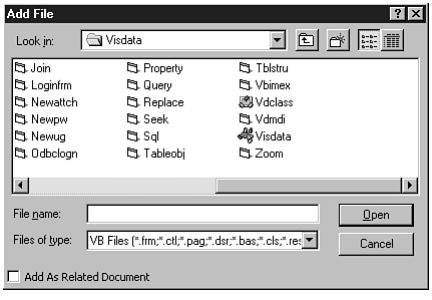
You could rebuild the form or rewrite the procedure for each program, but that would be a very inefficient way to do your program development. A better way is to reuse modules and forms that have been previously developed and fully tested.

Getting these modules and forms into your current project is a simple process. By selecting Project, Add File, you bring up the Add File dialog box (see Figure 11.10). This dialog box lets you locate and select files to be added to your current project. Unfortunately, the Add File dialog box lets you add only a single file at a time. Therefore, if you have multiple files to add, you must repeat the operation several times.

CAUTION

If you add the same form or module to separate projects, remember that changing functions in the module affects all projects that use it. If you are about to change a shared module radically, use the Save *modulename* As option in the File menu or copy the module to another subdirectory first.

FIGURE 11.10
The Add File dialog box can be accessed from the menu system, standard toolbar, by right-clicking in the Project window, or by pressing Ctrl+D.



NOTE Files with the .FRM and .FRX extensions are form files. Files with the .BAS extension are module files.

You also might want to use one of Visual Basic's form templates in your project. These templates are predefined forms that are set up for a specific function, such as an About Box, a Splash Screen, a DataGrid form, or a Tip of the Day form. The advantage of using these templates is that the skeleton of the form is already created for you. You simply add your own graphics, label captions, and minimal code to customize the form to your needs. As an example, Figure 11.11 shows the About Box form template.

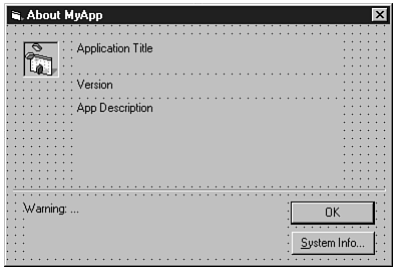


FIGURE 11.11
Form templates make developing common pieces of a program easy.

To access one of the form templates, bring up the Add Form dialog box by clicking the Add Form button on the toolbar or selecting Project, Add Form. You can then choose one of the form types from the New tab of the dialog box (see Figure 11.12).

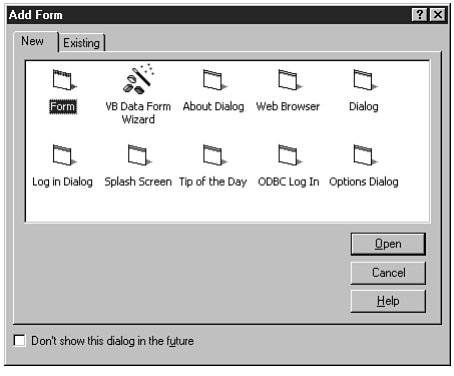


FIGURE 11.12
Form templates can be quickly customized and used in your project.

If you create a form that you think you will use in a number of programs, you can make a template out of it as well. Simply save the form in the form template folder of Visual Basic. Then the next time you want to add a new form, your template will appear in the Add Form dialog box as well.

NOTE If you let Visual Basic install to the default directory, the forms templates are stored in the Visual Basic \Template\Forms folder.

Removing Pieces

To remove a module or form from your project, simply select the form or module in the Project window and choose Project, Remove. Visual Basic asks you to confirm that you want to remove the file and then removes it from your project.

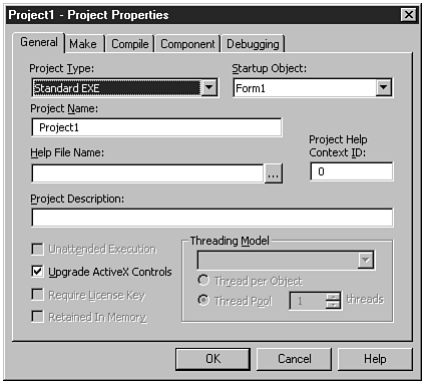
Controlling How Your Program Starts

When you first start a programming project, Visual Basic assumes that the first form created is the one that will be displayed as soon as the program starts. Although this will be the case for many programs, for others you may want to start with one of the forms you create later in the development process. For some programs, you might not want to start with a form at all.

Setting the Startup Form

If the first form is not the one you want to use to start your program, Visual Basic lets you choose which of your forms is shown initially by the program. This selection is made in the Project Properties dialog box, as shown in Figure 11.13. You access this dialog box by selecting Project, Project Properties.

FIGURE 11.13
The Startup Object list lets you choose which form is loaded when your program starts.



Using *Sub Main*

You might have noticed that, in addition to listing all the forms contained in your project, the Startup Object list includes the entry `Sub Main`. This reserved procedure name lets your program start without an initial form. If you choose this option, one of your module files must include a procedure called `Main`.

One reason to start your program with the `Sub Main` option might be that you need to perform some initialization routines before loading any forms. Another reason might be that you are developing a command-line utility that requires no user interaction.

From Here...

This chapter gave you a look at how you manage the various parts of your programs. You saw several techniques for making your programming more efficient. You also were exposed to many of the assorted components that comprise a complete program. For more information on creating and using the various parts, see the following chapters:

- For a basic discussion of how to write Visual Basic code, see Chapter 9, "Visual Basic Programming Fundamentals."
- To learn about how to make your code more efficient, see Chapter 10, "Controlling the Flow of Your Program Code."

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CHAPTER 12

Microsoft Common Controls

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Visual Basic ships with a group of common controls that enable you to develop programs with many of the same features as programs from Microsoft and other vendors. These controls let you create toolbars and status bars, and allow you to display data in various ways. This chapter continues the earlier discussions of controls by covering the capabilities of the Microsoft common controls.

Introduction to the Common Controls

The Windows common controls are a group of controls that let you add some of the same features to your program that Windows uses—hence, the name "common" controls. In Visual Basic 6.0, some of the existing common controls have been updated with new features, and several entirely new controls have been added.

The complete list of common controls is detailed in Table 12.1, including the control buttons that appear in the Toolbox.

Table 12.1 The Microsoft Common Controls

Control Name	Description
ImageList	Stores groups of pictures for use with the other controls.
TabStrip	Allows you to include property-page-style tabs on a form.
Toolbar	Displays a graphical application toolbar. (This control is discussed in Chapter 6, "Giving More Control to the User: Menus and Toolbars.")
StatusBar	Displays status information that can be divided into panels.
ProgressBar	Provides a graphical progress gauge.
TreeView	Organizes information in a collapsible tree.
ListView	Provides an advanced list control with several views.
Slider	Displays a slider bar, much like a stereo equalizer control.
ImageCombo	Provides an enhancement to the standard combo box discussed in Chapter 4, "Using Visual Basic's Default Controls." (New to Visual Basic 6)
Animation	Allows you to add silent video clips to your forms.

Control Name	Description
UpDown	Provides arrow buttons for incrementing and decrementing values.
MonthView	Provides a calendar control, similar to the one used in Microsoft Project 98.
DTPicker	Allows you to enter a date by hand or use the MonthView control to pick it.
CoolBar	Provides a sliding toolbar container with vertical separators, much like those used in Visual Basic's IDE.

Before you can use any of the controls discussed in this chapter, you have to add them to your Toolbox, as follows:

1. Choose Project, Components. The Components dialog box opens.
2. Select the Microsoft Windows Common Controls 6.0 groups you want installed (see Figure 12.1). The three groups contain the following controls:
   - **Microsoft Windows Common Controls 6.0.** All the controls in Table 12.1 up to and including the ImageCombo control
   - **Microsoft Windows Common Controls-2 6.0.** The rest of the controls in Table 12.1 except for the CoolBar control
   - **Microsoft Windows Common Controls-3 6.0.** The CoolBar control
3. Click OK to add the Common controls to the Toolbox (see Figure 12.2).

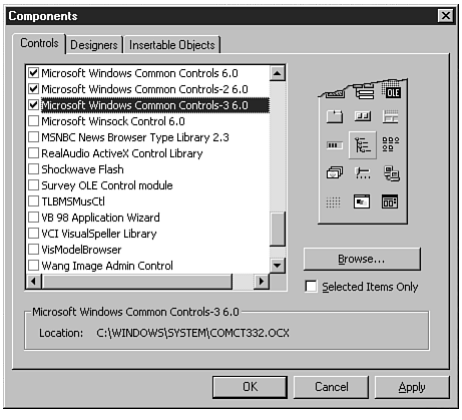


FIGURE 12.1
All three Common control groups are selected and will be added to the Toolbox when you click OK.

FIGURE 12.2
This Toolbox contains the Common controls from all three groups.

If you want to use the Common controls in a new project, you will need to add them to the Toolbox. You also need to perform2 these steps whenever you want to use one of the Common controls in an existing project where you have not used them before. After you add them to the Toolbox and save your project, the Common controls appear in the Toolbox automatically the next time the project is loaded.

The ImageList: A Fundamental Common Control

The ImageList control is just what it sounds like: a list of images. It is like a picture box or Image control, but instead of storing only a single picture, the ImageList stores a collection of pictures. Also, the ImageList does not contain anything visible at runtime; it is merely a storage area for images. If you want to view one of the images contained in an ImageList, you have to use an additional control.

The ImageList is a very important control for you to understand because many of the other Windows Common controls depend on it to display pictures. As a matter of fact, the ImageList control's most common use is to store pictures that another control needs; rarely is it used by itself.

Setting Up an ImageList at Designtime

The most common way to set up an ImageList control is to add pictures manually at designtime. In this case, the pictures are stored in the form itself. The actual image files do not need to be distributed with the application.

NOTE In this chapter, you will fill image lists with images that are included with Visual Basic. You'll find these graphis in your Visual Basic Graphics directory. You can access these same images (if you chose to install them) by finding the corresponding directory on your PC. Icons are ideal for use with the ImageList because they are small, and you can preview them in the File, Open dialog box. ■

Follow these steps to set up an ImageList control at designtime:

1. Draw an ImageList control on your form, and give it a unique name.
2. Open the control's Property Pages dialog box by right-clicking the control and selecting Properties.
3. Select the Images tab from the Property Pages dialog box (see Figure 12.3). Here you can load graphics files and assign each graphic a unique identifier.
4. To add an image, click the Insert Picture button. The Select Picture dialog box then appears. In this dialog box, you can select a bitmap, icon, cursor, GIF, or JPEG file to add to the list.

   As you add images, they are automatically given indexes (again, see Figure 12.3). You can also give them your own unique string identifiers by typing them in the Key field. Using a key is recommended because it allows you to refer to a specific image by name, no matter what the order of the images.
5. When you finish adding images, press OK to close the Property Pages.

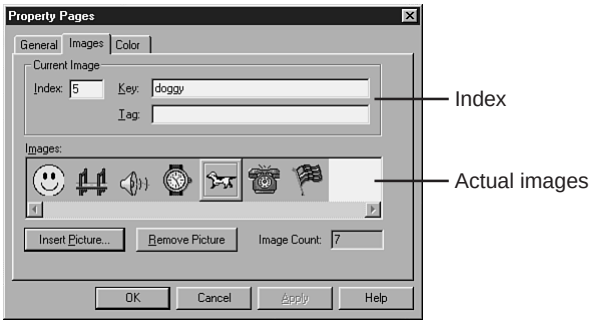


FIGURE 12.3
If you set up an ImageList control at designtime, the images are stored with the form and compiled into the executable program.

Setting Up an ImageList with Code

You can also set up and change an ImageList at runtime by using program code. When you access an ImageList from code, each image is part of a *collection*.

NOTE Collections are a fundamental concept used in many areas of Visual Basic besides the ImageList control. If you are new to the topic, keep reading. Collections are discussed throughout the chapter.

A collection is a group of objects. In the case of the ImageList control, there is a collection called `ListImages`. The objects stored in this particular collection are the images in the ImageList control. By manipulating the `ListImages` collection in code, you can add, remove, and change images. For example, the following line of code adds an image to an imagelist called `ImageList1`:

```
ImageList1.Add ,,LoadPicture("D:\MYDIR\MYPIC.BMP")
```

You can call the `Add` method of the `ListImages` collection repeatedly to add multiple images at designtime. Think of a collection as being similar to, but not exactly like, an array. You can

access it like an array, as in the following line of code, which sets a form's picture to the first image in an ImageList control:

```
Set form1.Picture = ImageList1.ListImages(1).Picture
```

Notice that a specific object is referred to with its *index*—in this case, `1`. Remember, a collection stores objects, unlike an array, which stores values. These objects, in turn, have their own set of properties.

One special property that objects in a collection have is the `Key` property. An object's key is a text string that can be used in the same manner as an index:

```
Set form1.Picture = ImageList1.ListImages("Smiley Face").Picture
```

To use a key to look up an object in a collection, you have to specify it when the object is added to the collection. Each type of collection has defined `Add` and `Remove` methods, which include `Key` and `Index` as parameters. If the index is omitted, it is supplied by Visual Basic. The key, however, is optional.

Organizing Your Data

The ListView and TreeView controls allow you to organize data for viewing in a manner similar to that used by the Windows Explorer (see Figure 12.4). The great thing about these controls is that they effectively separate the controls' appearance from the data contained in the controls. For example, consider a list of 100 items. Using the ListView, you can sort these items and change the way they are viewed by simply setting properties of the control. This is a great improvement over a standard list box, in which rearranging items means reloading the list box.

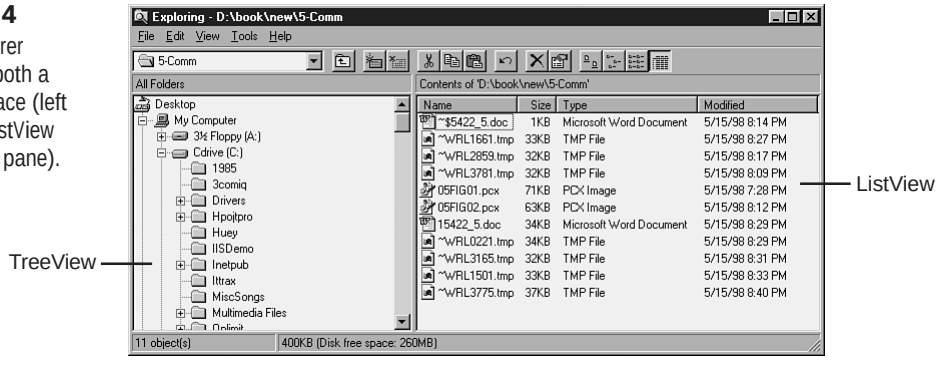


FIGURE 12.4
Windows Explorer makes use of both a TreeView interface (left pane) and a ListView interface (right pane).

In the following section, you create sample ListView and TreeView projects. Keep in mind that they are tricky controls to master. You might want to spend a little time going over the online help files to get a good grounding in their use. Your time will be well spent.

Using the ListView Control

The ListView control is similar to the ListBox but is enhanced in a number of ways. The ListView control can display information in one of a variety of modes: icon lists that are arranged from left to right, a columnar list, or a "report" view. These options correspond to the options in the Windows Explorer's View menu (Large Icons, Small Icons, List, or Details). After the items are stored in the `ListItems` collection, you can simply set the `View` property to switch to any of the modes you want.

The report-style list is special because it shows more information than the other modes. When using the Windows Explorer, you may have noticed that the Details option displays more information than just the filename. In this case, the filename is the main item, and the size, type, and date modified are "sub-items" associated with each filename.

In your programs, you control sub-items with the `SubItems` property, which is an array of strings associated with each item in the list. A `ColumnHeaders` collection supplies the headings at the top of the report.

Recall from earlier in this chapter that the ImageList control supplies pictures for other Common controls. The ListView control can use up to three ImageLists because it can display both large and small icons, as well as pictures in the column headers. You can set these ImageLists in the Property Pages dialog box or in code, as follows:

```
Set lViewMain.Icons = ImageList1
Set lViewMain.SmallIcons = ImageList2
Set lViewMain.ColumnHeaderIcons = ImageList3
```

The ability to add Column Header images is a new feature in the Common controls included with Visual Basic 6.0.

If you don't set the `SmallIcons`, `Icons`, and `ColumnHeaderIcons` properties of the ListView control, no images will appear. Also, using the smaller ImageList dimension (16×16) is a good idea when you are filling the image list that you plan to use for small icons.

Recall that the ListBox control's items are stored in an array. All the items in a ListView control are in a collection called `ListItems`, and each item has several properties, including an index to the icon images and a caption. As with most collections, the `ListItems` collection has an `Add` method, which is defined as follows:

```
listview1.ListItems.Add ,"mykey","My Item",1,1
```

You will learn more details about each parameter of the ListView's `Add` method as you build the sample project.

Starting the Sample Project The sample program will display a list of baseball teams and their win/loss statistics. To begin the project, follow these steps:

1. Start a new Standard EXE project in Visual Basic.
2. As described earlier in the chapter, add the Microsoft Windows Common Controls 6.0 to your Toolbox.

3. Add a ListView control to the form, and name it `lvMain`.

4. Add three ImageList controls to the form, and name them `ilNormal`, `ilSmall`, and `ilHeader`.
5. Add appropriate images to the ImageList controls. The sample code assumes that the `ilNormal` and `ilSmall` ImageLists contain only one image, and the `ilHeader` list contains three images.

Setting Properties of the ListView Control As with most controls, you can set up the ListView control in two ways: by using the Properties window and Property Pages or by using code. If you want to set up the ListView while you are in the design environment, you can use the Property Pages, shown in Figure 12.5. For the sample project, you need to set four properties: `View`, `Icons`, `SmallIcons`, and `ColumnHeaderIcons`. You will learn how to set these properties at designtime, as well as examine sample code that does the job.

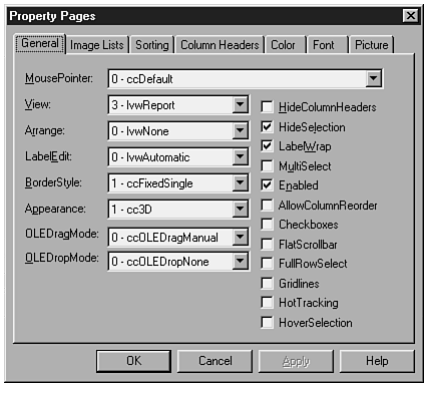


FIGURE 12.5
Property Pages let you set the properties of the ListView control.

First, you need to set the `View` property, which determines how the list presents information to the users. The `View` property has the following four possible values:

- `lvwIcon`—Displays each item in the list using a large icon and a simple text description.
- `lvwSmallIcon`—Displays each item in the list using a small icon and a simple text description. The items are ordered horizontally.
- `lvwList`—Displays icons similarly to the small icon view, except that items are arranged in a single vertical column.
- `lvwReport`—Displays each item with a small icon, a text description, and detailed information, if it is provided. As with the list view, items are arranged in vertical columns.

For the ListView control, you also need to set the names of the ImageList controls that contain the normal, small, and column heading icons that are shown in the list. If you are using the Property Pages, you can select the ImageList controls from drop-down lists on the Image Lists page. These lists contain the names of all the ImageList controls on your form. In the sample project, you set the `View` property from code.

Adding Items to the List The next step is to write some code to add items to the ListView. You can use the sample code in Listing 12.1 to add objects to the `ListItems` collection. Run the program, and you should see the results pictured in Figure 12.6.

Listing 12.1 LISTVIEW.ZIP—Using the *Load* Event to Set Up the ListView Control

```
Private Sub Form_Load()

    'Set up the icons from the image List
    lvMain.Icons = ilNormal
    lvMain.SmallIcons = ilSmall
    lvMain.ColumnHeaderIcons = ilHeader

    ' Add ColumnHeaders.  The width of the columns is the width
    ' of the control divided by the number of ColumnHeader objects.
    Dim clmX As ColumnHeader
    Set clmX = lvMain.ColumnHeaders.Add(, , "Team", , , 1)
    Set clmX = lvMain.ColumnHeaders.Add(, , "Wins", , , 2)
    Set clmX = lvMain.ColumnHeaders.Add(, , "Losses", , , 3)

    'Create a ListItem object.
    Dim itmX As ListItem

    'Add some data setting to the ListItem:

    'Red Sox Stats:
    Set itmX = lvMain.ListItems.Add(, , "Red Sox", 1, 1)  ' Team
    itmX.SubItems(1) = "64"                               ' Wins
    itmX.SubItems(2) = "65"                               ' Losses

    ' You can duplicate the above 3 lines of code
    ' to add information for more teams…

    lvMain.View = lvwReport ' Set View property to Report.

End Sub
```

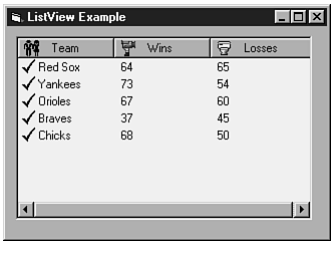



FIGURE 12.6
The ListView looks like this after being set up with your code.

In Listing 12.1, notice that temporary object variables are used to set up the `ColumnHeaders` and `ListItems` collections. You first call the `Add` method, which returns you to a reference to the object it just added. For the code that sets up the column headings, this was not really necessary because you do not refer to the temporary value `clmX` beyond the initial call to the `Add` method.

However, when you add team information, you do not supply your own key. Remember, a key is a string that uniquely identifies an object in a collection. If you don't supply your own key, Visual Basic makes one up. Therefore, the object `itmX` is needed to set the two sub-items. If a key were supplied, you also could have written the code as follows:

```
lvMain.ListItems.Add , "RSox", "Red Sox", 1, 1
lvMain.ListItems("RSox").SubItems(1) = "64"
lvMain.ListItems("RSox").SubItems(2) = "65"
```

Adding a *ListItem* Object to a ListView Control

The examples in this section introduce the `ListItems` collection, which stores `ListItem` objects that are created using the `Add` method. The syntax for a `ListItem`'s `Add` method is as follows:

```
object.Add(index, key, text, icon, smallIcon)
```

Here's what the different pieces are and what they do:

- `object`—For all intents and purposes, you can use *`ListViewName`*`.ListItems`. This element is required.
- `index`—You can use this number to position the `ListItem` object within the `ListItems` collection. If you don't assign a number to this argument, the `ListItem` is added to the end of the collection. This parameter is optional. Remember that the index of an item can change as other items are added or deleted.
- `key`—You can use a string to give a unique, friendly name to the `ListItem`. This parameter is optional.
- `text`—This parameter contains the string that you want the `ListItem` to display in the ListView window. It is optional. However, for novice users of this control, I recommend that you use it. This argument should not be confused with the `key` argument.
- `icon`—This parameter contains the index number or key of the image within the ImageList that has been assigned to the `Icons` property of the ListView control. Use this parameter to select the image you want. This argument is optional. Be careful; if you forget to fill in a value, no large icon appears in the ListView `lvwIcons` view.
- `smallIcon`—Similar to the previous argument, `icon`, this parameter contains the index number of the image within the ImageList that has been assigned to the `SmallIcons` property of the ListView control. It is optional. If you do not fill in a value, no small icon appears in the ListView's `lvwSmallIcons`, `lvwList`, or `lvwReport` views.

If you want to add additional information, as done with the team win/loss information, to the created `ListItem` object, `MyListItem`, you manipulate the object's `SubItems(Index)` property. See your online Visual Basic documentation for additional information on the `SubItems` property.

Changing the View After you have data in the ListView, you can display it in several different views by setting the `View` property in code. To see what the different views look like, you can add a View menu to the sample program.

To create the menu, use Visual Basic's Menu Editor (by clicking the Menu Editor button or by choosing Tools, Menu Editor), and create the menu items, as shown in Figure 12.7.

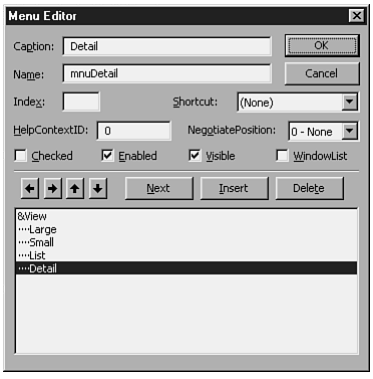


FIGURE 12.7
The Menu Editor shows the menu for the sample program.

After exiting the Menu Editor, you need to add code to each menu item to make it perform a task. The code for each of these items is contained in Listing 12.2.

Listing 12.2 LISTVIEW.ZIP—Using Menu *Click* events for the Sample Project

```
Private Sub mnuDetail_Click()
    lvMain.View = lvwReport
End Sub

Private Sub mnuLarge_Click()
    lvMain.View = lvwIcon
End Sub

Private Sub mnuList_Click()
    lvMain.View = lvwList
End Sub

Private Sub mnuSmall_Click()
    lvMain.View = lvwSmallIcon
End Sub
```

You now can run the program and use the menu to display each different view. Figure 12.8 shows the Large Icon view.

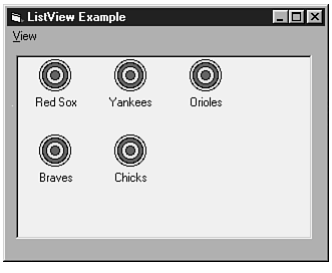


FIGURE 12.8
Whereas the Report view displays detailed information with column headings, the Large Icon view simply shows a picture above the item text.

In the `Form_Load` event, the `ListItem` objects (baseball teams) for the ListView's `ListItem` collection are created and added. As each `ListItem` is added to the `ListItems` collection, values are assigned to `SubItems(1)`, (the "Win" column) and `SubItems(2)` (the "Loss" column) of the `ListItem`, `itmX`.

The `Click` event procedures of the menu items set the `View` property of the ListView control. The views are `lvwIcons`, `lvwSmallIcons`, `lvwList`, and `lvwReport`, respectively.

You have just seen a sample project that demonstrates the ListView's capability to display items. Like the ListBox control, the ListView control has many events and properties, such as the `ItemClick` event, designed to select and manipulate items.

The `ItemClick` event passes an object to your program, so you can take appropriate action:

```
Private Sub ListView1_ItemClick(ByVal Item As ComctlLib.ListItem)
    If Item.Text = "Magic Item" Then MsgBox "You clicked the magic item!"
End Sub
```

The ListView control also has properties to sort the report view based on a column header. By using the `ColumnClick` event, you can easily change the sort order to the selected column, as shown here:

```
Private Sub lvMain_ColumnClick(ByVal ColumnHeader As ComctlLib.ColumnHeader)
       lvMain.SortKey = ColumnHeader.Index - 1
       lvMain.Sorted = True
End Sub
```

As you may have noticed, you can rename items in a ListView by single-clicking the text. Two events, `BeforeLabelEdit` and `AfterLabelEdit`, let your program know which item the users are changing.

As you can see, the ListView is a fairly complex control. To discover all the features, you might try creating several sample programs to test all the properties and methods.

New Features of the ListView Control If you have used the ListView control in prior versions of Visual Basic, you will be happy to know that it has been greatly enhanced for version 6. You have already seen one improvement—the `ColumnHeaderIcons` collection, which allows pictures to be displayed in the report view headings. Several additional features, which allow you to further improve the appearance of the ListView control, are listed here:

- `AllowColumnReorder`—This property allows users to rearrange the column order in a `lvwReport` view. For example, set it to `True` on the sample project, and you should be able to click and drag the "Wins" column to the leftmost position in the report.
- `FullRowSelect`—This new property makes the ListView an excellent candidate to replace the standard list box. As you may have noticed, the default behavior of the ListView is to allow item selection only by clicking the leftmost column. Setting the `FullRowSelect` property to `True` not only allows users to select by clicking any column, but also provides a visual indicator by extending the highlight bar across all columns.
- `GridLines`—This property controls whether gridlines are drawn on the report, which makes it look similar to an Excel spreadsheet.

- `FlatScrollBars`—This property changes the scrollbars to the newer flat-style control.
- `HoverSelection`—Normally, you have to click an item in the ListView to select it. If you set `HoverSelection` to `True`, the item is selected (and the `ItemClick` event fired) when you hover the mouse pointer on the item's icon for a few seconds.
- `HotTracking`—The name of this property sounds like a dating service, but it is actually a mouse pointer enhancement to bring the look and feel of the ListView more in line with the new Microsoft Active Desktop user interface.
- `CheckBoxes`—The `CheckBoxes` property controls whether a check box control is displayed beside each item in the ListView. You can determine or set the state of the check box with the `Checked` property of the item. An `ItemCheck` event also fires when users click the check box.

Also new to the VB6 ListView is the capability to display a picture behind the items. This feature works much like the background of a Web page. You can load the picture by setting the `Picture` property of the ListView, as in the following example:

```
ivMain.Picture=LoadPicture("D:\Pictures\Test.JPG")
```

In addition, these two properties control the behavior of the picture and its interaction with the list items:

- The `TextBackGround` property controls whether the text has an opaque or transparent background.
- The `PictureAlignment` property controls how the picture is painted on the ListView. You can start at the center or any corner of the picture and display as much as possible, or if the picture is smaller than the list view, you can have it displayed over and over in tiled format.

Examples of some of the new display options are shown in Figure 12.9.

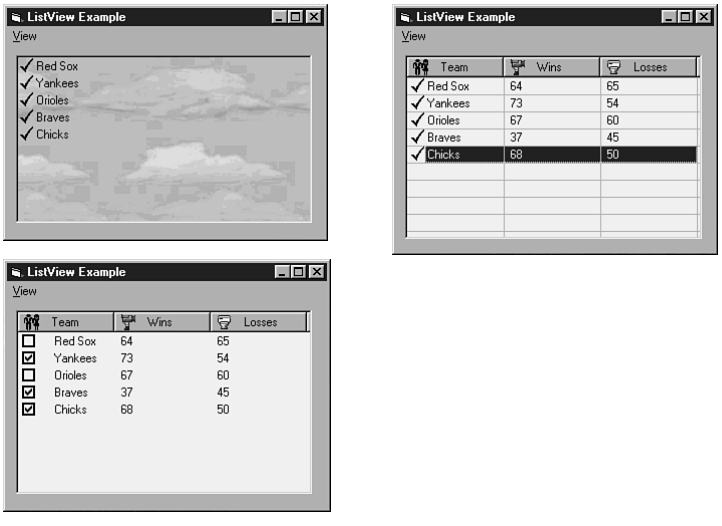


FIGURE 12.9
These examples of ListView configurations were not possible in previous versions of Visual Basic.

Using the TreeView Control

The TreeView control is similar to a ListView in that it can display items with a combination of text and graphics. However, the TreeView does so by showing items within a tree hierarchy. If you have ever taken a math or computer science class, you already may know about the "tree hierarchy." Figure 12.10 shows an example of a tree you might have seen before.

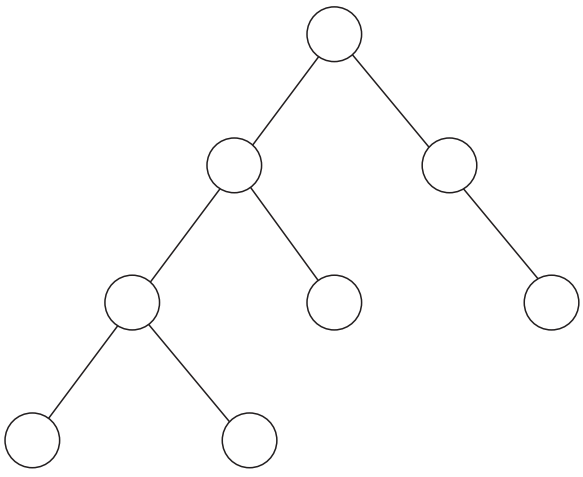


FIGURE 12.10
A true structure defines a relationship between objects (represented by the circles).

Given the hierarchical nature of the TreeView control, *root*, *parent*, and *child* are fundamental concepts that you must understand so that you can work effectively with the control. Also, the TreeView uses the `Node` object extensively. Therefore, mastery of the `Node` object is also a requirement for effective use of the TreeView. The most common example of the TreeView is shown in the left pane of the Windows Explorer (refer to Figure 12.4).

Understanding Nodes A *hierarchy* is an organization in which each part has a defined relationship with the other parts. For example, consider your family tree. Your parents are "above" you in the hierarchy, and your children are "below" you.

In the family tree example, each person is considered to be a *node* on the tree. Relationships between nodes are indicated by *branches.* A node's branches can connect it to other nodes (that is, lines on the family tree connect you to your ancestors), althought a node does not necessarily have to have any descendants.

Like the family tree or a real-life tree, all TreeView controls have nodes. The `Nodes` property of a TreeView control is itself a collection of Node objects. If you have followed the discussion up to now regarding collections, this concept probably makes some sense to you. (If you're unclear about collections, review the ListView section, earlier in this chapter.) Like the ListView's `ListItems` collection, the TreeView's `Nodes` collection has properties and methods, including an `Add` method used to create new nodes:

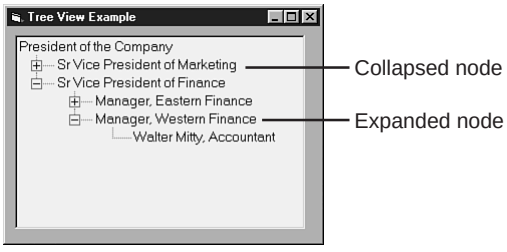
```
tv1.Nodes.Add , , "mykey", "Test Node", 1, 2
```

Like the other `Add` methods discussed so far, it can return a reference to the object just created, as shown here:

```
Dim tempNode As Node
Set tempNode = tv1.Nodes.Add(, , "mykey", "Test Node")
tempNode.Image = 1
tempNode.SelectedImage = 2
tempNode.ExpandedImage = 3
```

The TreeView control presents a "collapsible" view of the tree structure, as shown in Figure 12.11.

FIGURE 12.11
This simple tree structure was created using the TreeView control.



In Figure 12.11, notice the use of plus, minus, lines, and images to indicate which parts of the tree are "expanded" and which are "collapsed." Users can manipulate the tree with the mouse, expanding and collapsing its branches as desired. For the programmer, the key to getting the items to appear where you want them is understanding the relationships between them.

By using the `SingleSel` property, you can make the tree automatically expand a node when users select it. ■

Understanding the *Root* Property At the very top of a tree structure is its root. A root is the node from which all other nodes descend. A tree has only one root node. The tree pictured in Figure 12.11 is a simple organizational chart for a small company. The node called "President of the Company" is the root node, simply because it was the first one added to the TreeView control.

Part of what defines any node in a tree is its root. Therefore, each node in the `Nodes` collection has a `Root` property that refers to the tree's root node. For the tree pictured in Figure 12.11, you can use the following code to verify that every node has the same root:

```
Dim tempNode As Node
For Each tempNode in tv1.Nodes
       Print tempNode.Text & "'s root is " & tempnode.Root.Text
Next tempNode
```

Note that `Root` is both a property of a node and a node itself.

Working with the *Parent* Property You have just seen that every node in the `Nodes` collection can access the root. However, just knowing the root of a node is not enough to define a position in the tree hierarchy.

If you want to know where you are in the sample company structure in Figure 12.11, you need to know more than just where the root (President) is. Now you're ready to examine the first of several tree relationships, the *parent relationship*. To be a parent, a node must have children. In Figure 12.11, the president of the company is a parent to both of the vice president nodes. Both managers shown in the figure also have the same parent, the VP of Finance.

Suppose you were an ambitious little node trying to climb the corporate ladder. You could use this code to check your progress:

```
Dim MyNode As Node

Set MyNode = tv1.Nodes("Me")

If MyNode Is MyNode.Root Then
    MsgBox "You're the boss!"
Else
    MsgBox "Try getting promoted to " & MyNode.Parent.Text
End If
```

As you can see from the example, each node object has a `Parent` property that refers to its parent node. The only exception is the root node, whose `Parent` property does not refer to anything (it has the special value `Nothing`).

Working with the *Children* Property To find out whether a node is a parent, you can query the `Children` property by using code like this:

```
Private Sub TreeView1_NodeClick(ByVal MyNode As Node)
    If MyNode.Children = 0 Then
        MsgBox "I am not a parent"
    End If
End Sub
```

As you can see, the `Children` property returns an integer value that represents the number of children the given node has. To be considered a child, a node must have a direct connection. In other words, as shown in Figure 12.11, the president of the company has two children—the two senior vice presidents.

Working with the *Child* property Whereas the `Children` property simply returns the count of child nodes, the `Child` property returns an actual node (just like the `Root` and `Parent` properties). However, even if a parent has multiple children, the `Child` property returns only the first of the given parent node's descendants. If a given node doesn't have a child, then its `Child` property contains the value `Nothing`. Therefore, you should not try to access it if the `Children` property is `0`. In the example shown in Figure 12.11, the second manager's `Child` property refers to the accountant, Walter Mitty.

The immediate problem that comes to mind is how to access child nodes other than the first one. Each node has several properties that are used to determine who its "brothers and sisters" are, as demonstrated in the following code:

```
Sub PrintAllChildren()

   Dim anyNode As Node
   Dim kidNode As Node
```

```
   Dim inCounter As Integer

   For Each anyNode In tv1.Nodes

     If anyNode.Children <> 0 Then 'this node is a parent

        Print anyNode.Text & "'s children are: "
        Set kidNode = anyNode.child
        Print kidNode.Text

        inCounter = kidNode.FirstSibling.Index
        While inCounter <> kidNode.LastSibling.Index
           Print tv1.Nodes(inCounter).Next.Text
           inCounter = tv1.Nodes(inCounter).Next.Index
        Wend

     End If

   Next anyNode
End Sub
```

Remember, a given node has only one `Child`. All the other nodes that share the `Child`'s parent are considered `"Next"` or `"Previous"` nodes. However, among all the nodes that share the same value for the `Parent` property, you can find a `FirstSibling` and a `LastSibling`.

NOTE Nodes are tricky; there's no question about it. One of the best ways to get a grasp of the concept of nodes is to see the node code (no poetry intended) in action. The online help file examples that Microsoft provides with your version of VB are pretty good once you have a basic understanding of the hierarchy concepts. I suggest that you create several test programs until you are comfortable using the TreeView control. ■

To learn more about the TreeView control, keep reading. This section focused on accessing nodes already in the TreeView control. In the next section, you will add nodes to a TreeView control as part of a sample project.

Using the TabStrip Control

The TabStrip, shown in Figure 12.12, is a control widely used in the Windows interface arsenal. It allows you to divide a form visually into several tabs, creating the appearance of a set of organized folders.

The TabStrip shown in the figure is the sample project you'll create in this section. In this sample project, the purpose of the TabStrip control is to switch between two lists of information; the lists are baseball teams displayed in a TreeView control. The TabStrip enables you to select which league to display.

Starting the Sample Project To begin the TreeTab project, start a new Standard EXE project in Visual Basic. Then follow these steps:

1. Add a TabStrip control, and name it something short and meaningful, like `tsMain`.
2. Add a TreeView control to the form, and name it `tv1`. Now you are ready to start setting the properties of the controls.

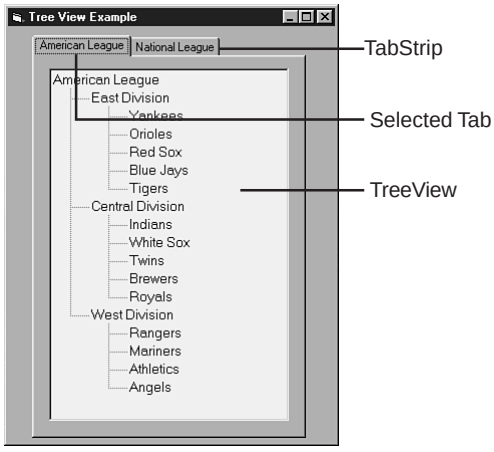


FIGURE 12.12
The sample project uses TabStrip and TreeView controls.

CAUTION

The TabStrip control is *not* a container. This means that controls placed in a TabStrip control do not assume the `Visible`, `Enabled`, and relative `Top` and `Left` properties of the TabStrip, as they would if you were to draw a control into a selected Frame control. Thus, clicking a TabStrip brings it to the front, covering other controls that are before it.

To manipulate how controls appear in relation to a TabStrip, pay particular attention to the `ZOrder` method of the TabStrip and the affected controls. While you're working in design mode, you may need to right-click the TabStrip control and choose Send to Back.

Setting Up the TabStrip The next step in creating the project is to create the tabs in the TabStrip. Because you need to show two leagues, you need two tabs in the TabStrip. To set up the TabStrip control, follow these steps:

1. Start by right-clicking `tsMain` to bring up the TabStrip context menu.
2. Click the Properties menu item at the bottom of the context menu to display the Property Pages dialog box for `tsMain`.
3. Click the Tabs tab, and type `American League` in the Caption field (see Figure 12.13).
4. Click the Insert Tab button to add a tab.
5. In the Caption field, type `National League`.
6. Click OK. The captions then appear in the TabStrip control.

Setting Up the TreeView Control As was the case in the ListView project, you will set up the TreeView control by adding objects to a collection with code. You use the TreeView control to display a hierarchical organization of a selected baseball league. Each league has three divisions: East, West, and Central. The divisions have five, five, and four teams, respectively.

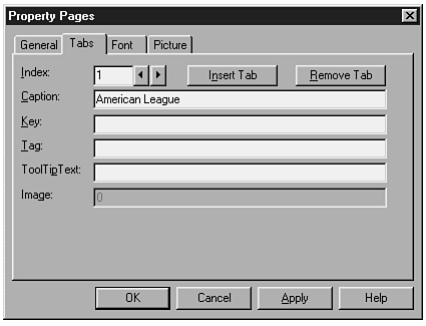


FIGURE 12.13
Using the Property Pages dialog box (which uses a TabStrip itself), you can easily insert tabs into a TabStrip control.

You can take advantage of this common structure by putting the data into two text files, ALEAGUE.TXT and NLEAGUE.TXT. These files contain lists of the 14 teams in each league. You can create them in Notepad or any other text editor, as shown in Figure 12.14.

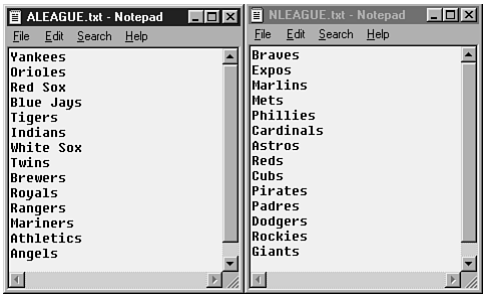


FIGURE 12.14
In the sample program, the TreeView is filled with items from the two text files pictured here.

Create the subroutine shown in Listing 12.3 to load information from the text files into the TreeView control.

Listing 12.3 TREEVIEW.ZIP—Using the *DisplayLeague* Procedure to Load the Selected Information into the TreeView

```
Public Sub DisplayLeague(sLeague As String)

    Dim tempNode As Node
    Dim nCounter As Integer
    Dim sTemp As String

    tv1.Nodes.Clear

    'Add the League
    Set tempNode = tv1.Nodes.Add(, , "R", sLeague)

    'Add the Divisions
    Set tempNode = tv1.Nodes.Add("R", tvwChild, "E", "East Division")
    Set tempNode = tv1.Nodes.Add("R", tvwChild, "C", "Central Division")
    Set tempNode = tv1.Nodes.Add("R", tvwChild, "W", "West Division")
```

continues

Listing 12.3 Continued

```
    'Open the text file with team names
    If sLeague = "National League" Then
    Open App Path & "\NLEAGUE.TXT" For Input As #1
    Else
    Open App Path & "\ALEAGUE.TXT" For Input As #1
    End If

    'Add the 5 EAST teams
    For nCounter = 1 To 5
        Line Input #1, sTemp
        Set tempNode = tv1.Nodes.Add("E", tvwChild, "E" & nCounter, sTemp)
    Next nCounter
    tempNode.EnsureVisible

    'Add the 5 CENTRAL teams
    For nCounter = 1 To 5
        Line Input #1, sTemp
        Set tempNode = tv1.Nodes.Add("C", tvwChild, "C" & nCounter, sTemp)
    Next nCounter
    tempNode.EnsureVisible

    'Add the 4 WEST teams
    For nCounter = 1 To 4
        Line Input #1, sTemp
        Set tempNode = tv1.Nodes.Add("W", tvwChild, "W" & nCounter, sTemp)
    Next nCounter
    tempNode.EnsureVisible

    'Close the Input file
    Close #1

    'Set the Desired style
    tv1.Style = tvwTreelinesText
    tv1.BorderStyle = vbFixedSingle

    'Set the TreeView control on top
    tv1.ZOrder 0

End Sub
```

Notice that the relationships in the tree view are defined as a node is added. The `Add` method's first parameter lists a "relative" node and the second parameter lists the relationship to that relative. The constant `tvwChild` indicates that the new node is a child of the relative node.

Taking Action in the Program Now, you are ready to return to the topic of the TabStrip control and set up the form's `Load` event. When the form first appears, you probably want it to show something, so you can call the `DisplayLeague` procedure to display the American League teams. The code for the `Load` event is shown in Listing 12.4. At this point, you can run your program, and the American League teams are displayed. However, clicking the TabStrip has no effect on the TreeView because you have not yet added the necessary code to the TabStrip's `Click` event. This code, also shown in Listing 12.4, calls the `DisplayLeague` procedure with the name of the desired league.

Listing 12.4 TREEVIEW.ZIP—Working with the *Load* and *Click* Events

```
Private Sub Form_Load()

    'Put the tree view on top of the tab
    tv1.ZOrder 0

    'Call our procedure
    DisplayLeague "American League"
End Sub

Private Sub tsMain_Click()
    Dim nTemp As Integer

    nTemp = tsMain.SelectedItem.Index
    DisplayLeague tsMain.Tabs(nTemp).Caption

End Sub
```

Now your sample program is done. Figure 12.15 shows how the program looks.

FIGURE 12.15
The sample application displays a list of baseball teams when a tab is clicked.

The crux of the project is the `DisplayLeague` procedure. First, this procedure creates a node for the League divisions:

```
Set tempNode = tv1.Nodes.Add("R", tvwChild, "E", "East Division")
```

The constant `tvwChild` tells the application to make this new node a child of the node `"R"`.

Then, to each Division node, several team nodes are added:

```
Set tempNode = tv1.Nodes.Add("E", tvwChild, "E" & nCounter, sTemp)
```

Notice that the first argument in the `Add` method is now `"E"`, which is the unique key of the node of the Eastern Division. The `"E1"` node (which displays Yankees) knows that it is a child of the Eastern Division because of this key.

Next, you tell the entire Division node and its children to remain expanded (TreeView nodes can be expanded and collapsed) in this line:

```
MyNode.EnsureVisible
```

(You also could have set each Division node's `Expanded` property to `True`.)

The last thing that deserves attention is the way the TabStrip reports back which tab has been clicked. In the TabStrip control, tabs are an array of tabs. So, when you click a tab, you are actually selecting a tab, like selecting a ListIndex in a ListBox control. In light of this knowledge, if you want to find out which tab is being clicked, the following line should make a bit more sense to you:

```
nTemp = tsMain.SelectedItem.Index
```

In this example, you simply get the index of the selected tab and store it in the variable `nTemp`.

Accepting User Input

Several of the Windows Common controls offer different ways to accept user input. For example, displaying a calendar when users want to input dates is not necessary, but it makes your program look very professional. One of the great benefits of Visual Basic's many controls is that you can quickly create a sharp-looking program by bringing together prebuilt objects. In this section, you will review the following controls:

- ImageCombo, which is a graphical combo box
- MonthView, which is a calendar control
- DTPicker, which is a date combo box
- UpDown, which is used to enhance numeric input.
- Slider, which is used to input numbers graphically

Using an ImageCombo Control

One of the new controls in Visual Basic 6.0 is the ImageCombo control. From a user interface standpoint, the ImageControl serves the same purpose as the standard ComboBox control discussed in Chapter 4, "Using Visual Basic's Default Controls." However, the image combo box allows you to add pictures beside each item in the combo box's drop-down list, as pictured in Figure 12.16.

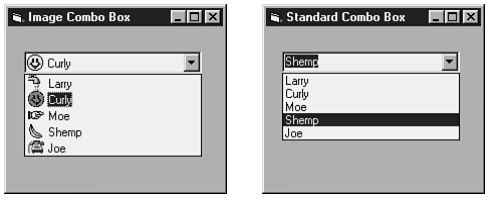


FIGURE 12.16
An ImageCombo looks sharper than a standard combo box.

NOTE Another difference is that the ImageCombo control supports only one style of combo box: the drop-down list. As you may recall, a standard ComboBox control has several other styles available. ■

▶ **See** "The Combo Box," **p. 75**

Setting Up an ImageCombo Box Like many of the other Windows Common controls, an ImageCombo uses an ImageList control to store the pictures to be displayed in the combo box. For each Item in the ImageCombo's `ComboItems` collection, you can actually specify the index of these two images:

- `Image`—Set this property to the index of the image that you want to appear to the left of each item.
- `SelImage`—This property is optional. If you supply a value for this property, the image beside an item changes when the item is selected or highlighted with the mouse. If you do not supply a value for the `SelImage` property, the control uses the image from the `Image` property.

To learn how users interact with the two types of images, follow these steps:

1. Start a new Standard EXE project, and add an ImageList control.
2. Set the size of the images in the list to 16×16, and insert two pictures. For the example, I used a smiley face and an arrow.
3. Add an ImageCombo control to the form, and add the following code to the form's `Load` event:

```
ImageCombo1.ImageList = ImageList1
ImageCombo1.ComboItems.Add , , "Moe", 1, 2
ImageCombo1.ComboItems.Add , , "Larry", 1, 2
ImageCombo1.ComboItems.Add , , "Curly", 1, 2
ImageCombo1.ComboItems.Add , , "Shemp", 1, 2
ImageCombo1.ComboItems.Add , , "Joe", 1, 2
```

   Notice that the `Add` statements use the same `Image` and `SelImage` image indexes for each item.
4. Run the program, and drag the mouse pointer over each item the item list. As you highlight an item, the image should change. In addition, if you have an item selected, the image represented by `SelItem` is displayed beside both the selected item and the highlighted item, as shown in Figure 12.17.

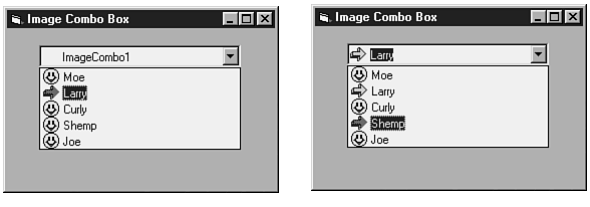


FIGURE 12.17
You can use the `SelImage` property to set apart the highlighted and selected items.

Working with the Selected Item Each item displayed in the ImageCombo is a member of the `ComboItems` collection. To determine whether users have selected items, check the `SelectedItem` property for a reference to the items, as in the following lines of code:

```
If ImageCombo1.SelectedItem Is Nothing Then
        ' No Item is Selected!
Else
        MsgBox "You selected: " & ImageCombo1.SelectedItem.Text
End If
```

NOTE You can also select an item from code by setting the item's `Selected` property to `True`, as in the following example:

```
ImageCombo1.ComboItems(1).Selected = True
```

Why do you need to check the `SelectedItem` property to see whether it is `Nothing`? As you may recall from using the standard combo box control, users can not only select items from the item list, but they also can enter text in the combo box's input area. The ImageCombo control also exhibits this behavior. If the information in the input area does not represent an item in the list, attempting to access properties of the `SelectedItem` object causes an error.

NOTE You can force the users to select one of your items from the list by setting the `Locked` property of the ImageCombo to `True`, which disables free-form text input.

As with the standard combo box, the text for the selected or entered item is available via the `Text` property.

Organizing Combo Box Items Another feature of the ImageCombo control is that you can specify a level of indentation for each item in the `ComboItems` collection. By indenting certain items, you can give your list a sense of organization.

To set an item's indentation, you assign the `Indentation` property an integer value. The `Indentation` property can also be specified as the final optional parameter in the `Add` method, as in the following example:

```
cmbMain.ComboItems.Add , "mykey", "mytext", 1, 2, 1
```

Each indentation level represents 10 pixels. A sample ImageCombo that makes use of the `Indentation` property is shown in Figure 12.18.

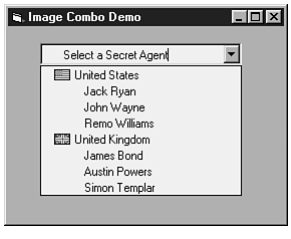


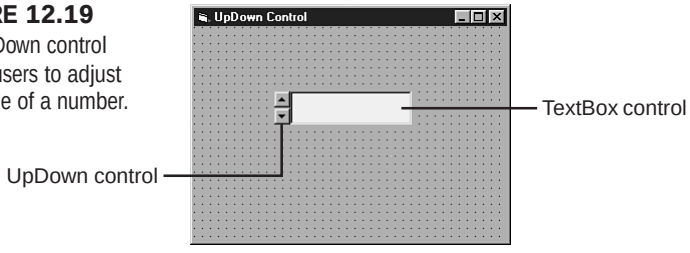
FIGURE 12.18
You can use the `Indentation` property to organize an ImageCombo list.

The UpDown Control

The UpDown control is another Common control used to accept input from users. However, the UpDown control is unique in that it is not designed to be a standalone control. Instead, it works with another "buddy" control to allow users to modify its numeric values easily. In other words, if you have a text field that requires a numeric value, you can link an UpDown control to it so that users can run up and down through numbers without typing anything.

The UpDown control, shown in Figure 12.19 with a text box, consists of a pair of arrow buttons. These buttons let users increment or decrement the value of a number. The UpDown control can be used with any other control that can handle numbers, including text boxes, labels, scrollbars, and sliders.

FIGURE 12.19
The UpDown control allows users to adjust the value of a number.



Setting Up the UpDown Control To set up the UpDown control, follow these steps:

1. On your form, draw a control that can handle numbers, such as the TextBox control.
2. Draw the UpDown control on your form.
3. Set the `BuddyControl` property of the UpDown control to the name of the control that displays the numeric values. Note that you have to type the name of the control (such as `Text1`) or use the `AutoBuddy` property.
4. Set the `BuddyProperty` of the UpDown control to `Default`. This action causes the UpDown control to update the default property of its Buddy control, such as the `Text` property of a text box. You can also set it to another property, as long as the property you select is numeric.

After completing the basic setup of the UpDown control, you can set other properties to control its appearance and behavior. For controlling the appearance of the UpDown control, the two key properties are as follow:

- `Alignment`—Controls whether the UpDown control appears to the left or the right of the Buddy control
- `Orientation`—Controls whether the UpDown control's buttons are oriented horizontally or vertically

The effects of the `Alignment` and `Orientation` properties are shown in Figure 12.20.

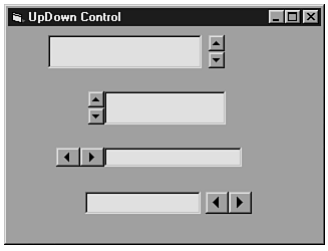


FIGURE 12.20
The UpDown control can be arranged many different ways.

Probably of greater importance to the programmer and users are the properties that determine the behavior of the UpDown control. These properties are as follows:

- `Increment`—Sets the amount that a value changes each time a button is clicked.
- `Max`—Sets the maximum value the control can contain.
- `Min`—Sets the minimum value the control can contain.
- `SyncBuddy`—Causes the UpDown control to update the Buddy control. You might want this property set to `False` only if you are using the UpDown control without a Buddy control. For example, you might use the UpDown control by itself to allow users to move between pages in a report.
- `Wrap`—Determines whether the control starts over with the minimum value if users click the up button after the maximum value is reached (or vice versa).

Working with Values and Events When you use the UpDown control, you can obtain the number selected by the users in two ways: by retrieving the `Value` property of the UpDown control or retrieving the appropriate property of the Buddy control. For almost all cases, either value will do. You might want to use the property of the Buddy control only if the users are allowed to enter a value that is outside the range of the UpDown control.

CAUTION

Keep in mind that the `SyncBuddy` property previously mentioned updates the Buddy control with its values, not the other way around. In the sample figures, if users were to type numbers in the text box, the UpDown control's `Value` property would not be updated. One way to remedy this situation would be to assign the `Value` property in the text box's `Change` event.

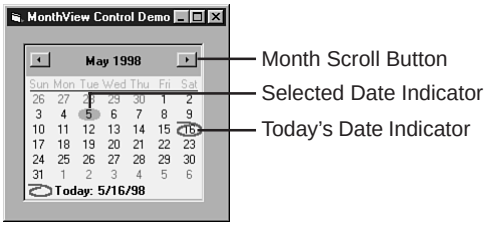
In addition to the usual events that are present for most controls, the UpDown control has three key events of interest:

- `Change`—Occurs any time the `Value` property of the control is changed
- `DownClick`—Occurs when users click the down arrow of the control
- `UpClick`—Occurs when users click the up arrow of the control

Working with Dates

In Visual Basic 6.0, two controls that greatly simplify your ability to enter dates were added to the second Windows Common controls group. These controls are the MonthView control and the DTPicker control. The MonthView control, pictured in Figure 12.21, is a versatile calendar control that lets users select dates visually rather than enter dates with the keyboard.

FIGURE 12.21
A MonthView control allows your users to select a date value by looking at a calendar rather than having to type it.



Changing the Appearance of the MonthView Figure 12.21 shows the MonthView control as it appears by default. You can use several additional properties to change the initial appearance and behavior of the control, however. Some of them are listed in Tables 12.2 and 12.3.

Table 12.2 Appearance Properties of the MonthView Control

Name	Default Value	Description
`ShowToday`	`True`	Controls whether a line appears at the bottom of the calendar indicating the current date.
`ShowWeekNumbers`	`False`	Controls whether a column displaying the week number appears to the left of each month.
`ScrollRate`	`1`	Controls how many months the calendar advances or moves back when users click the scroll buttons. Note that even if this property is set to a value higher than 1, users can still move through the months one at a time by clicking the trailing dates at the corners of the MonthView control.
`DayBold( )`	`False`	Controls whether the specified date is displayed in bold type. This property is useful if you want to indicate special days on the calendar, such as holidays. To use the property, you must specify a date, as in the following example: `MonthView1.DayBold(#7/4/1998#) = True`

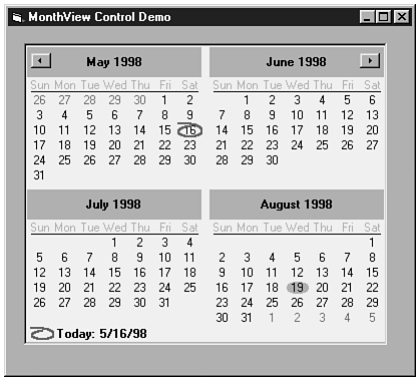
The MonthView control allows you to specify colors for each of its individual sections.

Table 12.3 Color Properties of the MonthView

Name	Description
`ForeColor`	Controls the color of the days of the month and the horizontal line beneath the week labels.
`TrailingForeColor`	Determines the color of the days that are outside the months currently being displayed but still visible on the screen. Trailing days on a normal calendar often appear as empty space at the end of the month.
`MonthBackColor`	Controls the background area behind the days of the month, but not including the title.
`TitleBackColor`	Controls the color of the area behind the month name.
`TitleForeColor`	Sets the color of the text used to display the month name.

Displaying Multiple Months If you want to display more than one month at a time using the MonthView control, you can set the `MonthRows` and `MonthCols` properties. For example, Figure 12.22 shows a MonthView control with both of these properties set to a value of `2`, creating a grid.

FIGURE 12.22
The MonthView control is not limited to displaying a single month at a time.



CAUTION

You cannot display more than 12 months on the screen at one time. Attempting to do so causes an error.

For even more flexibility, you can set the `MonthRows` and `MonthCols` properties at runtime, allowing the users to choose dynamically how much of the calendar they want to view. Note that the size of the MonthView control is not user scalable. In other words, the 2×2 grid shown in Figure 12.22 always has a fixed size. If you change the size of the grid at runtime, the MonthView control automatically expands and contracts to the new size. Therefore, knowing the new size beforehand would be nice. Fortunately, the MonthView control offers a method

called `ComputeControlSize` that returns the size of a MonthView with the specified number of rows and columns, as shown in the following example:

```
Dim sngWidth As Single, sngHeight As Single
MonthView1.ComputeControlSize 4, 2, sngWidth, sngHeight
Debug.Print "New control dimensions: " & sngWidth, sngHeight
```

NOTE The numbers returned by `ComputeControlSize` are in the units of the form's `ScaleMode` property (twips by default).

The preceding code sample calls the `ComputeControlSize` method to determine the size of a 4×2 MonthView control. The resulting height and width are returned via output parameters to the variables `sngWidth` and `sngHeight`.

Working with Values So far, you have seen how to control the display behavior of the MonthView control. However, to do anything useful with the control, you need a way to determine and set the current date. The main property that you use to do so is the `Value` property. You can use the `Value` property to return or set the current date of a month view, as in the following examples:

```
MonthView1.Value = #01/03/1943#
MonthView1.Value = "7/19/75 2:34:00 PM"
MonthView1.Value = Now
Debug.Print "The Selected date is " & MonthView1.Value
```

NOTE You can control the range of valid dates by setting the `MinDate` and `MaxDate` properties of the control.

Although the `Value` property always uses the Visual Basic Date data type, the MonthView control includes several additional properties that represent different parts of the current date value:

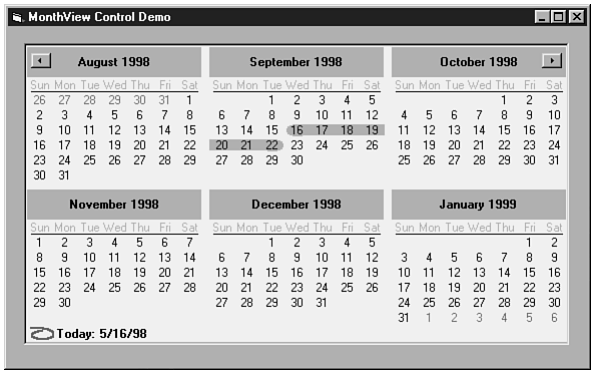
- `Month`—The selected month of the year (1 through 12)
- `Day`—The day of the selected month (1 through 31)
- `Year`—The selected year (for example, 1998)
- `Week`—The selected week of the year (1 through 52)

Each of the preceding properties is automatically updated when the `Value` property changes, and vice versa. You can assign or read integer values to these properties to work with just the information you want.

Although the MonthView control's `Value` property always has only one value, you can set some properties that allow users to select multiple consecutive days on the calendar. By setting the `MultiSelect` property to `True`, the users can click and drag to select a range of days, as shown in Figure 12.23.

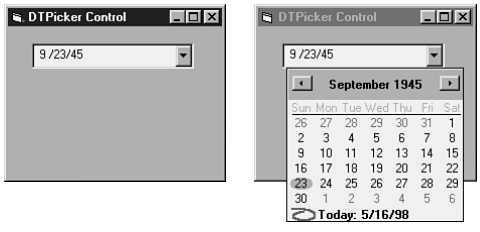
If you set the `MultiSelect` property to `True`, use the `SelStart` and `SelEnd` properties to determine the selected date range.

FIGURE 12.23
The `MultiSelect` property allows the selection of a range of days.



The DTPicker Control The DTPicker (or DateTimePicker) control combines the calendar functionality of the MonthView control with the ability to type a date manually. This control allows users who know the exact date to enter it quickly, and at the same time, it makes a calendar available for those people who need it. The DTPicker looks like a combo box, but when you click the drop-down arrow, a MonthView control appears. Both states of the DTPicker control are shown in Figure 12.24.

FIGURE 12.24
The DTPicker control allows both graphical and text input of dates.



Many of the same properties available in the MonthView control are available in the DTPicker control. However, unlike the MonthView, the DTPicker cannot display multiple months at the same time.

Because the DTPicker control allows manual entry of dates, a few parameters are used to determine their format. You can set the `Format` parameter to any of the following values:

- `0 - dtpLongDate`—Displays the Long Date format, as defined in Control Panel.
- `1 - dtpShortDate`—(default) Displays the Short Date format, as defined in Control Panel—usually `M/D/YY`.
- `2 - dtpTime`—Displays only the time portion of the date value. When this setting is selected, the drop-down button is replaced by up/down arrows, and the calendar does not appear.
- `3 - dtpCustom`—Displays a custom date format.

When you set this control to `3 -dtpCustom`, you can supply your own format string in the `Custom` property. Several formats are shown in Figure 12.25.

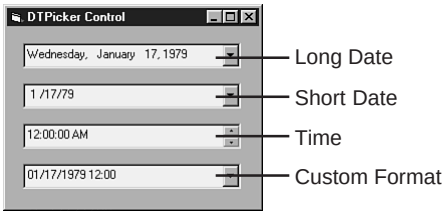


FIGURE 12.25
You can display dates in several formats with the DTPicker control.

Sliding into Numbers

Another of the Windows common controls is the Slider control. The Slider control provides a means for users to enter numeric data into a program. The slider works like the slider switches you might find on your stereo system's graphic equalizer or in a manner similar to the scrollbars that you have in the standard control set of Visual Basic.

▶ **See** "Scrollbars," **p. 78**

You create the slider by drawing it on your form. You then can set four main properties that control the appearance of the slider. These properties are summarized in Table 12.4. The effects of these properties are shown in Figure 12.26.

Table 12.4 Properties of the Slider Control

Property	Settings
`BorderStyle`	Determines the type of border. Set to `0` for no border or `1` for a single-line border.
`Orientation`	Determines the orientation of the sliders. Set this property to `0` for a horizontal slider or `1` for a vertical slider.
`TickStyle`	Controls the placement of the tick marks on the slider. Set this property to `0` to display tick marks below or to the right of the slider, set it to `1` to place tick marks above or to the left of the slider, set it to `2` to place tick marks on both sides, or set it to `3` to show no tick marks.
`TickFrequency`	Determines how many tick marks are displayed. This property can be set to any positive number.

After you set up the appearance of the slider, you need to set several properties that control its operation. The first two properties are the `Min` and `Max` properties, which control the range of values that can be handled by the Slider control. The other two properties are the `LargeChange` and `SmallChange` properties. The `LargeChange` property controls how much the value of the slider changes if users press the PageUp or PageDown keys or click the mouse on either side of the slider bar. The `SmallChange` property controls how much the value of the slider changes if users press the right or left arrow keys. `SelectRange` is the final property affecting the operation of the slider. This property determines whether the slider can select only a single value or possibly select a range of values.

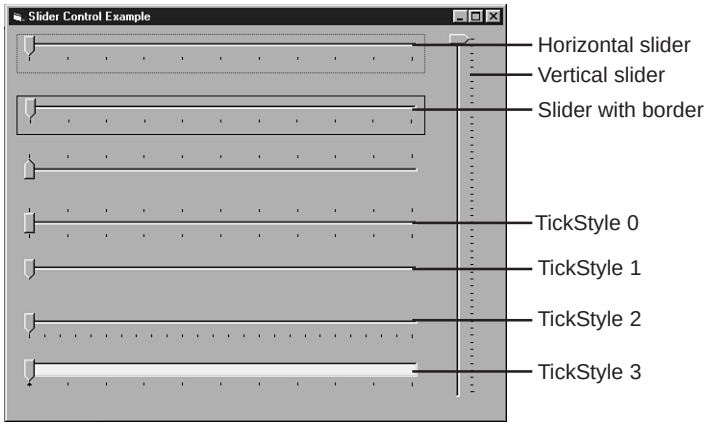


FIGURE 12.26
The Slider lets you graphically enter numeric information.

Using the Slider Control When your users encounter the Slider control in your program, they can click the slider bar and drag it to set a value. They can also use the PageUp, PageDown, and right and left arrow keys to change the value. The information entered by the users is contained in the `Value` property of the slider.

NOTE The keyboard keys only work on a Slider if it has the focus.

If the `SelectRange` property is set to `True`, the users also can select a range of values by holding down the Shift key while clicking and dragging the slider bar. Unfortunately, this technique is not automatic; it must be managed by your code. You need to add code to the slider's `MouseDown` event procedure to determine whether users have held down Shift while dragging the slider. If so, your code can set the slider's `SelStart` property, which defines the starting value of the range, and the `SelLength` property, which defines the extent of the range. Visual Basic's help system contains a good example under the help topic for the Slider Control.

The Color Blender Project To demonstrate the use of the Slider control, you will now build a "color blender" sample project. As you know, Visual Basic forms have a `BackColor` property, which contains a numeric value representing the form's background color. This sample project uses an array of Slider controls to set the `BackColor` property.

Follow these steps to create the color blender project and add the controls for the project:

1. Create a new Standard EXE project.
2. Place a check box on the form, name it `ckGray`, and set the `Caption` property to `Only Shades Of Gray`.

3. Place a Slider control on the form, and name it `sldColor`.
4. Place a label on the form to the left of the slider, and name it `lblColor`.

5. Make a set of control arrays for `lblColor` and `sldColor`. To do so, hold down the Ctrl key and click both `lblColor` and `sldColor`. Choose Edit, Copy. Then choose Edit, Paste to paste the copied controls onto the form. You then are presented with a dialog box asking whether you want to create a control array. Click Yes. (Control arrays are covered in detail in Chapter 13, "Working with Control Arrays.")
6. Add a third element to each control array by choosing Paste again.
7. Using the Properties window, set the caption of `lblColor(0)` to `Red:`, the caption of `lblColor(1)` to `Green:`, and `lblColor(2)` to `Blue:`.
8. Arrange the `lblColor()` and `sldColor()` control arrays on the form as shown in Figure 12.27.

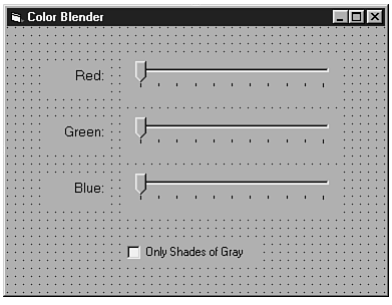


FIGURE 12.27
The main form of the color blender project contains an array of slider controls.

After you set up the interface of the program, you need to add some code to a couple of events to make the program work. The first event is the `Load` event of the form, as shown in Listing 12.5. This event sets the initial condition of the program.

Listing 12.5 SLIDERS.ZIP—Initializing the Program in the *Load* Event of the Form

```
Private Sub Form_Load()

    Dim nCount As Integer
    Dim lRed As Long, lGreen As Long, lBlue As Long

'Set up the sliders
    For  nCount = 0 To 2
        sldColor(nCount ).Min = 0
        sldColor(nCount ).Max = 255

        sldColor(nCount ).TickFrequency = 4
    Next  nCount

    'Initialize the color of the form
    'control. (This will set the color to black. RGB(0,0,0))
    Me.BackColor = RGB(lRed, lGreen, lBlue)

End Sub
```

Next, you need to add the code that actually changes the colors in response to movements of the Slider control. You place this code, shown in Listing 12.6, in the `Scroll` event of the Slider controls.

Listing 12.6 SLIDERS.ZIP—Moving the Slider to Change the Color of the Form

```
Private Sub sldColor_Scroll(Index As Integer)

    Dim nCount As Integer
    Dim lRed As Long, lGreen As Long, lBlue As Long

    'Gray is equal values of Red, Green and Blue
    If ckGray.Value = vbChecked Then
        'move all the sliders

               For nCount = 0 to 2
             sldColor(nCount).Value = sldColor(Index).Value
        Next nCount
    End If

    'Set the RGB value
    lRed = sldColor(0).Value
    lGreen = sldColor(1).Value
    lBlue = sldColor(2).Value

    'Assign the resultant RGB value to the backcolor
    Me.BackColor = RGB(lRed, lGreen, lBlue)
End Sub
```

Running the Project After you enter the code, press F5 to compile and run the program. Then try setting different combinations of the color sliders to see the effect on the color blender.

The Color Blender project works like this: After an initialization process in the `Form_Load` event, most of the work takes place in the `sldColor_Scroll` event. As a user moves a slider from the array of Slider controls, the moved slider's index is passed into the `sldColor_Scroll` event. The application checks the value of the `ckGray` check box. If it is checked (`Value = vbChecked`), the value of the moved slider is assigned to all the controls in the slider control array. This causes all the sliders to move to the same position before any other code is executed.

The application then assigns the value from the `Value` property of each Slider in the `sldColor` control array to their respective color variables—`lRed`, `lGreen`, `lBlue`. The color variables are then passed as parameters to the `RGB()` function. The return of the `RGB()` function sets the `BackColor` property of the form.

Reporting Status and Progress

One of the most important aspects of any program is keeping the users informed about what is going on in the program at any given time. For a program such as a word processor, the users

like to know what's the current page and what's the current position on that page. This type of information, called *status information*, is usually displayed onscreen all the time rather than in a message box. In addition, users want to know how long a given task will take to accomplish and what part of the task is occurring at any given point in time. This type of information can be called *progress information*. In this section, you look at three of the common controls used for these purposes:

- StatusBar, which displays status messages
- ProgressBar, which provides a graphical representation of progress toward a goal
- Animation, which allows you to display a "movie" to let the users know your program is doing something

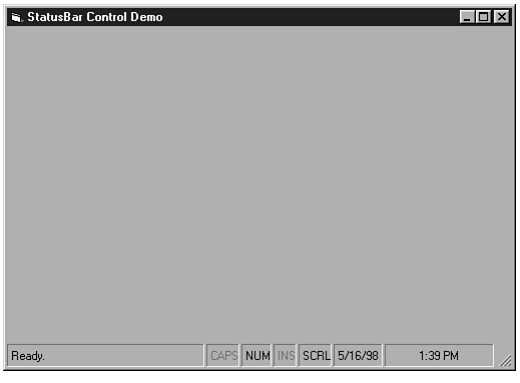
Before you can use any of these controls, you must add them to the Visual Basic Toolbox. For information on how to add controls, see the first section of this chapter, "Introduction to the Common Controls."

Adding a Status Bar to Your Program

Before the advent of the StatusBar control, Visual Basic programmers often used "fake" status bars made from panels and Label controls. They worked quite well (and still do today). However, the StatusBar control provides a simpler alternative. If you are already using one of the other Common controls from the same group, you don't have to worry about the extra overhead of distributing another because all of the controls in the group are included in the same OCX file, which you have to distribute anyway.

Figure 12.28 shows a typical status bar from a Visual Basic program.

FIGURE 12.28
Status bars are usually positioned at the bottom of a form.



Creating a Status Bar You create a status bar by first selecting the control and drawing it on your form. When it is first drawn, the status bar spans the width of its parent form and contains a single panel, as shown in Figure 12.29. Notice that no matter where on your form you draw the status bar, it automatically moves to the bottom of the form. This position is the typical location for a program's status bar.

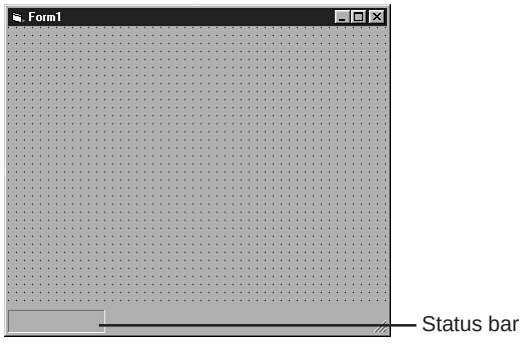


FIGURE 12.29
When you place a status bar on a form, it is configured automatically.

After you draw the status bar, you can start setting the properties to control its appearance and to create any additional panels that you need to display information. As you saw when you first drew the status bar control, it sizes itself to fit across the entire form. You can, however, control the height of the status bar either by setting its `Height` property or by clicking and dragging one of its sizing handles.

Two other properties control the basic appearance of the entire status bar: the `Align` property and the `Style` property.

The `Align` property of the status bar controls which edge of the form, if any, the status bar is "docked" against. The `Align` property has five possible settings:

- `vbAlignNone`—Allows you to position the status bar anywhere on your form.
- `vbAlignTop`—Positions the status bar at the top of the form.
- `vbAlignBottom`—Positions the status bar at the bottom of the form. This is the default setting of the property and the position where users probably expect to find the status bar.
- `vbAlignLeft`—Places the status bar at the left edge of the form.
- `vbAlignRight`—Places the status bar at the right edge of the form.

NOTE Unless you have a specific reason for using a different alignment, sticking with the default, bottom alignment is best. Although another alignment might be a novel approach, it would probably confuse users who are accustomed to the standard alignment.

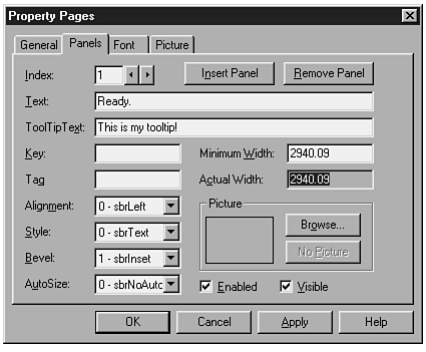
As you can see in Figure 12.28, the StatusBar control allows you to display a number of different messages at the same time. Each section of the status bar is known as a *panel*. The following two settings of the `Style` property of the status bar determine whether the status bar displays a single panel or multiple panels:

- `sbrNormal`—Allows multiple panels to be displayed
- `sbrSimple`—Allows only a single panel to be displayed

If you set the `Style` to `sbrSimple`, then the StatusBar acts like a simple label control, whose single panel caption is controlled via the `SimpleText` property. However, more features are available when you create a multiple panel status bar.

Working with the Panels of the Status Bar The real work of the status bar is handled by its panels. Each panel is a separate object with its own properties that control its appearance and behavior. Each panel is part of the status bar's `Panels` collection. After you draw the status bar on your form and set its basic properties, you can begin adding panels to the bar. You do so through the Property Pages of the status bar, shown in Figure 12.30.

FIGURE 12.30
You can manage your status bar by clicking the ellipsis button to the right of the `Custom` property in the Properties window.



To set up an individual panel, use the Property Pages dialog box to set these eight main properties that control the appearance and behavior of the panel:

- `Text`—Determines the text to be displayed in a text style panel. (Usually you set this property at runtime.)
- `ToolTipText`—Sets the text that is displayed when users rest the mouse pointer over the panel.
- `Alignment`—Determines whether the text in the panel is left-justified, right-justified, or centered in the panel.
- `Style`—Determines the type of panel created.
- `Bevel`—Sets the type of shadowing used for the 3D look of the panel.
- `AutoSize`—Determines how the size of the panel is handled by the program.
- `MinWidth`—Sets the minimum size of the panel.
- `Picture`—Determines what, if any, picture is displayed in the panel.

Although most of these properties are self-explanatory, the `Style` and `AutoSize` properties merit further attention.

You can create seven different styles of panels for your status bar. Although one of the styles (`sbrText`) is designed for you to display your own text, most of the other styles are predefined status items. These styles display the settings of the lock keys (such as Caps Lock, Num Lock, and so on) or the system date and time. These styles are handled by the control itself, so you

can set them up in design mode; this way, you don't have to do anything while the program is running. The styles of panels are summarized in Table 12.5. Each of these styles is also displayed in Figure 12.28.

Table 12.5 Panel Styles Available to Your Programs

Setting	Description
`sbrText`	Displays text or a bitmap. The text displayed is contained in the `Text` property of the panel, whereas the bitmap is contained in the `Picture` property.
`sbrCaps`	Handles the status of the Caps Lock key. This panel displays `CAPS` in bold letters when the key is on and displays the letters dimmed when the key is off.
`sbrNum`	Handles the status of the Num Lock key. This panel displays `NUM` in bold letters when the key is on and displays the letters dimmed when the key is off.
`sbrIns`	Handles the status of the Insert key. This panel displays `INS` in bold letters when the key is on and displays the letters dimmed when the key is off.
`sbrScrl`	Handles the status of the Scroll Lock key. This panel displays `SCRL` in bold letters when the key is on and displays the letters dimmed when the key is off.
`sbrTime`	Displays the current time.
`sbrDate`	Displays the current date

NOTE An eighth setting, `sbrKana`, is also associated with the Scroll Lock key. It displays `KANA` in bold letters when the key is on and displays dimmed letters when the key is off. The `KANA` indicator is a special setting for Japanese programs.

The `AutoSize` property of each panel has three settings that help determine the size of the panel. The default setting, `NoAutoSize`, sets the size of the panel to the dimension specified in the `MinWidth` property; this size does not change as other panels are added and removed. The `sbrContents` setting sets the size of the panel to fit the text that the panel contains, whether this is text you enter or the text used for the key status and date/time panels. The final setting, `sbrSpring`, allows panels to stretch to fit the width of the status bar. This setting prevents any empty space from being present in the bar.

NOTE No matter which setting you choose for the `AutoSize` property, a panel is not made smaller than the dimension set by the `MinWidth` property.

One final property of note is the `Bevel` property. As stated previously, this property determines whether and how the 3D effects of the panel are displayed. This property has three settings: `sbrNoBevel`, which produces a flat panel; `sbrInset` (the default), which produces a panel that

looks embedded in the status bar; and `sbrRaised`, which produces a raised panel. These three bevel styles are shown in Figure 12.31.

FIGURE 12.31
You can create flat, inset, or raised panels.

Managing Panels with Code You have seen how to set the properties of an individual panel, but you also need to know how to add and remove panels. Within the Property Pages, you can simply use the Insert Panel and Remove Panel buttons. However, the status bar also enables you to add and remove panels from code. This task is handled by the three methods of the `Panels` collection:

- `Add`—Creates a new panel for the status bar
- `Remove`—Deletes a specific panel from the status bar
- `Clear`—Removes all the panels of the status bar

NOTE Unlike most other built-in collection types, the `Panels` collection starts with an index of `1`, and the index values run up to the `Count` property.

You have seen that the key status and date/time panels handle their tasks automatically. These things are great, but the real power of the status bar is its capability to change the text that appears in the text-style panel(s) as your program is running. These text panels tell the users the actual status of operations in your program.

To update the status of an item in your program, you assign a text string to the `Text` property of the `Panel` object, as shown in the following line of code:

```
StatusBar1.Panels(1).Text = "Viewing record 1 of 10"
```

You can, of course, set other properties of the panels the same way. You can even set up your entire status bar in code by using the methods of the `Panels` collection and the properties of the `Panel` objects. As an example, Listing 12.7 shows how to set up the status bar shown in Figure 12.32. This listing also uses the `Count` property of the `Panels` collection, which tells you how many panels are present in the status bar.

Listing 12.7 STATUS.ZIP—Setting Up a Status Bar in Code

```
Private Sub Form_Load()

    With StatusBar1

        'Remove the default panel
        .Panels.Remove 1

        'Add a Text panel at the left
        .Panels.Add 1, "mykey", "This is the status text", sbrText
```

continues

Listing 12.7 STATUS.ZIP—Setting Up a Status Bar in Code

```
        .Panels(1).AutoSize = sbrSpring

        'Add the current time display
        .Panels.Add , , , sbrTime

    End With

End Sub
```

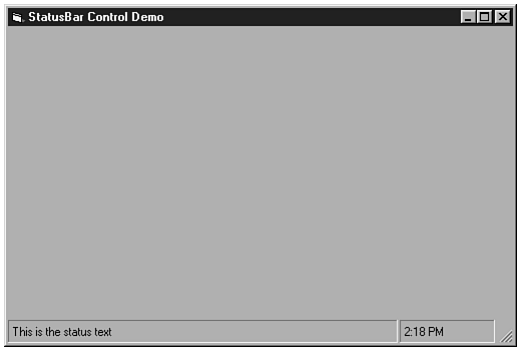


FIGURE 12.32
You can control your status bar by setting properties of the `Panel` objects.

Progress Bar

The status bar is not the only control that you can use to monitor progress in your program. Many programs have some tasks that take a relatively long time, so you'll want the capability to provide users with a dynamic indication of the operation's progress. The ProgressBar control is ideal for this situation. For example, Microsoft Internet Explorer uses a progress bar to indicate the percentage completed of a file transfer operation. In this case, the progress bar lets you know two things: First, as long as the bar is changing, you know that the file transfer is progressing. Second, by looking at the progress bar, you have some idea how much time is left in the transfer operation.

Setting Up the Progress Bar You can easily set up and use the ProgressBar control. As with other controls, you first draw the bar on your form. Then you need to set the bar's properties. Among the several properties that can influence the look of the progress bar, `Height` and `Width` are the key properties. A progress bar typically is many times wider than it is tall. In fact, Microsoft recommends (in the Help system) that you make the width of the bar at least 12 times the height. Figure 12.33 shows a typical progress bar.

The `Value` property of the progress bar sets or retrieves how much of the progress bar appears filled in. If you compare a ProgressBar control to a thermometer, the `Value` property is like the temperature. Everything below the current temperature is filled with mercury, and the remaining area is blank.

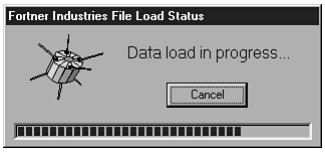


FIGURE 12.33
Progress bars provide a visual indication of how much of an operation has been completed.

`Max` and `Min` are the other properties that you need to set for the progress bar. They represent the maximum and minimum values allowed for the `Value` property. In the case of the thermometer, they represent the top and bottom of the temperature scale. For example, if you set the `Min` property to `0` and the `Max` property to `100`, setting the `Value` property to `50` causes the progress bar to look half full.

The setting of the `Max` and `Min` properties can be any valid integer, though the `Max` property must always be greater than the `Min` property. You can set these properties to any values that make sense for your applications. Some examples are as follows:

- In processing a database, set `Min` to `0` and `Max` to the number of records to be processed. As each record is processed, incrementing the `Value` property informs the users of the processing progress.
- For a file download operation, you might set `Max` to the number of kilobytes or number of blocks in the file. One typical setting is a `Min` of `0` and a `Max` of `100` to represent the percentage of the file that has been transferred.

Updating the Progress Bar as Your Code Runs The key to displaying the progress of an operation in the progress bar is setting the `Value` property. As your code runs through an operation, you periodically update the setting of the `Value` property. As you might expect, you often do so in a loop that performs a repetitive operation, as in the following code sample:

```
'In the following code, "rsMain" is a recordset
'that has already been opened and populated.
'"pbr" is the ProgressBar control.

pbr.Min = 0
rsMain.MoveLast
pbr.Max = rsMain.RecordCount
rsMain.MoveFirst
inCounter = 0

While Not rsMain.EOF
'Insert code to process record here
     inCounter = inCounter + 1
     pbr.Value = inCounter
     rsMain.MoveNext
Wend
```

Adding Video with the Animation Control

The Animation control provides you with an easy way to add animation to your programs. You use this control to play silent Audio Video Interleaved (AVI) clips. The AVI file format is basically a series of bitmaps that are shown in sequence to create the animation effect, similar to

the individual drawings in a cartoon. You typically use the Animation control to indicate that a task is in progress, such as the File, Copy routine of Windows, shown in Figure 12.34. These animations run in the background while other tasks are performed.

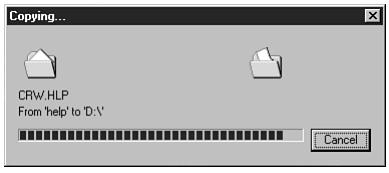


FIGURE 12.34
A copy in progress is indicated by a simple animation.

NOTE Another way to create simple animation effects might be to use a Timer control to change the position of an Image control at a specified interval. Although this method requires a little more coding than is necessary with the Animation control, you do not need to have your animation already saved in an AVI file. The Timer control is covered in Chapter 4, "Using Visual Basic's Default Controls."

Setting Up the Animation Control To set up an Animation control, first add an instance of the control by drawing it on the form. Figure 12.35 shows the initial appearance of the Animation control.

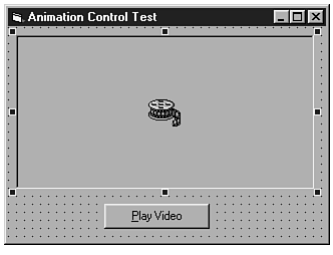


FIGURE 12.35
The Animation control initially looks like a picture box with a reel of film in the middle.

Drawing the Animation control on the form provides the container for the animation sequence. However, to run an animation, you need to open a file and start playback.

You can do this by adding a command button to your form and writing code in the `Click` event to open and play a video file.

To open a file, use the `Open` method of the Animation control, specifying the path to the desired AVI file. (Several AVI videos are included in the \Graphics\Videos directory, if you chose to install them.) After you open an AVI file, execute the `Play` method to start the animation. The following two lines of code play an AVI file:

```
Animation1.Open "C:\Progra~1\Micros~1\Common\Graphics\Videos\FileNuke.Avi"
Animation1.Play
```

Figure 12.36 shows the control during playback. To stop the animation, simply use the `Stop` method of the control.

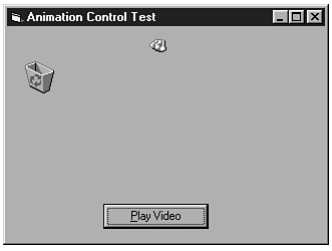


FIGURE 12.36
Calling the `Play` method causes the video to play repeatedly.

TIP Create a form that you can use in all your Visual Basic projects to display status information. The form could include an Animation control and progress bar. You can set the Animation control's `AutoPlay` property to `True` to start the video automatically, without executing the `Play` method.

Optional Parameters of the *Play* Method The default behavior of the Animation control is to "loop" the video playback. In other words, the animation is played over and over from start to finish until the `Stop` method executes. The following three optional parameters to the `Play` method allow you to change this behavior, however:

- `Repeat`—Specifies the number of times to play the video segment.
- `Start`—Specifies the frame where playback should begin.
- `Stop`—Specifies the frame where playback should end. You can use the Windows Media Player (MPLAYER.EXE) to find frame numbers.

These optional parameters are used in the following line of code, which repeats frames 5 through 15 of an animation two times:

```
anmAviPlayer.Play 2, 5, 15
```

You can specify any or all the optional parameters. Any parameters that are omitted use their default values. The parameters must be specified in the order `Repeat`, `Start`, and `Stop`. If you omit one of the earlier parameters, you must use a comma as a placeholder.

From Here...

This chapter introduced you to the group of controls known as the Windows Common controls. Several of the controls covered here are new to Visual Basic 6.0. You can use these controls to enhance your projects in many ways. The best way to learn about them is to test them in your programs. To find out more about related topics, see the following chapters:

- If you have not yet studied the controls that are available in your toolbox by default, see Chapter 4, "Using Visual Basic's Default Controls."
- To learn about using the Toolbar control (which was not covered in this chapter) and creating menus, see Chapter 6, "Giving More Control to the User: Menus and Toolbars."
- For a discussion of using controls in an array, see Chapter 13, "Working with Control Arrays."

CHAPTER 13

Working with Control Arrays

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By now, you've learned how to use controls to allow your programs to interact with your users. The controls you've added to forms so far have been independent controls, with no particular relationship to other controls on your forms. As you design more complex user interfaces, however, you will often find it convenient to work with controls as a group.

In Chapter 4, "Using Visual Basic's Default Controls," you learned how to select multiple controls in the design environment and manipulate their properties as a group. Although this type of manipulation is convenient at design time, it does nothing to allow your program to work with groups of controls at runtime. Using control arrays can make runtime manipulation of multiple controls easy.

Introducing Control Arrays

A *control array* is a group of controls, all of the same type, that have the same name and are identified by an index. If you are familiar with arrays, you will find that control arrays are similar.

Control Array Elements

Each individual control in the array is referred to as an *element* of the array. Each element of a control array must meet several criteria:

- Each control must be of the same type. For example, a control array can contain either labels or text boxes, but cannot contain both.
- Each control must have the same value for the `Name` property.
- Each control is identified by having a unique value for its `Index` property. The `Index` property is an `Integer` type; therefore, its maximum possible value is `32767`.

Often, a control array's elements share the same values for appearance-related properties such as `Font` and `BorderStyle`, but only the `Name` property is required to be the same. All other properties can be different for each element of the array.

Understanding the Advantages of Control Arrays

Working with control arrays instead of a group of individual controls presents a number of advantages; they help you in designing the interface of your program and in handling the program code. The following are some of the advantages of control arrays:

- Adding an element to a control array requires fewer system resources than adding an individual control of the same type. For example, three independent text boxes (`Text1`, `Text2`, and `Text3`) use more resources than a three-element text box array.
- The elements of a control array share a common set of event procedures. This means you have to write program code in only one place to handle the same event for all controls in the array.
- Control arrays provide the only means of adding controls to a form while your program is running.

- Using control arrays, you can avoid hitting the limit of 254 control names per form. Because a control array uses only one name, you can have as many elements of the array as you need. This capability allows you to place more controls on a form.

CAUTION

Don't get control-happy! Placing too many controls on a form makes your forms load slowly and can exhaust your system resources.

Creating a Control Array

You must create a control array at designtime. Although you can add elements to a control array at runtime, at least the first element of the array must be created in the design environment.

You can create a control array in three ways:

- Add a control to a form and then use the design environment's Copy and Paste capabilities to duplicate the control on the form.
- Add individual controls to a form and then change the `Name` properties of all the controls to the same value.
- After adding a control to your form, set its `Index` property to a number between `0` and `32767`.

In the following sections, you'll work through the steps of creating a control array using the first method described.

Adding Control Arrays to a Form

Here, you'll add a four-element array of text boxes and another four-element array of labels to a form. Follow these steps to create the two control arrays:

1. Start a new project, if necessary. Add a new TextBox control to the form, as shown in Figure 13.1.

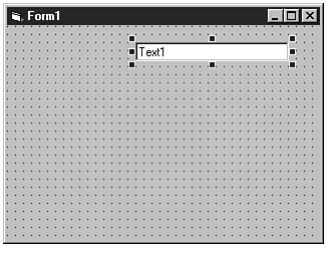


FIGURE 13.1
Although this text box will be part of a control array, it is initially created by normal means.

2. Set the text box's properties as follows:
   - Set the `Name` property to `txtArray` (or any other valid name).
   - Clear the `Text` property.
   - Set the `Font` property to Courier New, 10 point.

   Note that the `Index` property is empty (has no value).
3. Click the text box to ensure that it is still selected, and press Ctrl+C or choose Copy from the Edit menu to copy it to the Clipbord.
4. Click the form to make sure it (and not the Properties window, for example) is the active window. Press Ctrl+V, or choose Paste from the Edit menu to place a copy of the text box on the form.
5. At this point, a dialog box asks you to confirm that it is your intention to create a control array (see Figure 13.2). Choose Yes to create a control array.

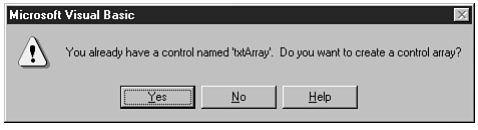


FIGURE 13.2
The easiest way to create a control array is to copy and paste an existing control.

Look at the properties of the new (pasted) control. The Properties window shows that you are setting properties for `txtArray(1)`, which specifically refers to the new element of the control array that is currently selected. Notice that its `Font` and `Text` properties match those of the text box that was copied. Notice also that the new control's `Index` property is set to `1`.

6. Drag the new text box to a position directly below the original.
7. Click the original text box to select it. Notice that its `Index` property has changed from having no value to a value of `0`.
8. The text box that you copied in step 3 is still on the Clipboard, so you don't need to copy it again. Paste another copy of the text box onto the form, and drag it to a position below the other two.

   Note that the new control's relevant properties match the others, and that its `Index` property is `2`. As each control is added to the control array, its `Index` property is assigned a value that is one greater than the `Index` of the previous element. The indexes of a control array start at `0`.

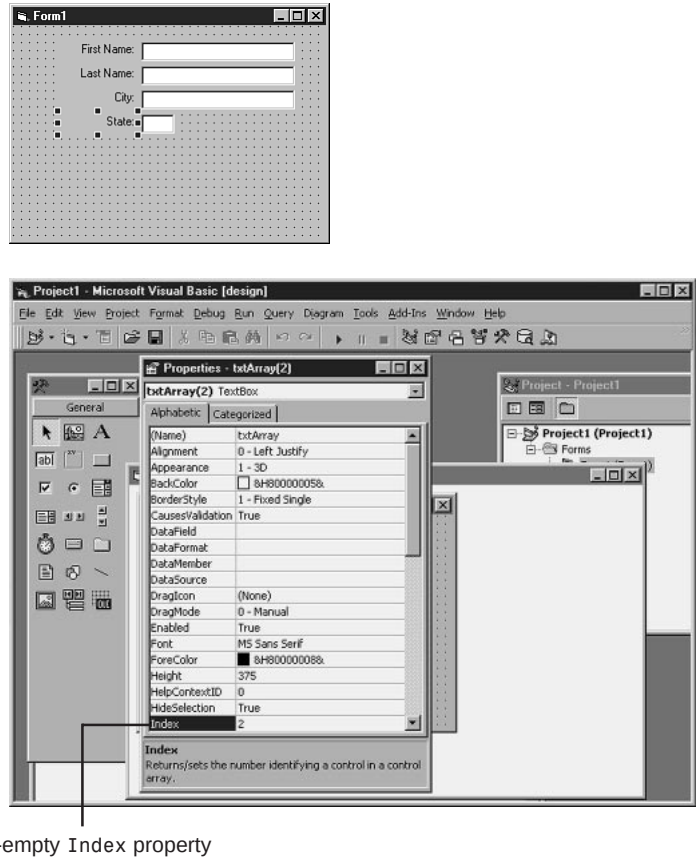
NOTE You don't see the control array confirmation box again, as it appears only when you attempt to make the first copy of the control.

9. Add a fourth TextBox control in the same manner, drag it to a position below the others, and set its `Width` property to 495 twips.

10. Add a Label control named `lblArray` to the left of the first text box. Set its `Caption` property to `First Name:` and its `Alignment` property to `1 - Right Justify`.
11. Copy the Label control to the Clipboard, and paste a copy of it on the form. Answer Yes when asked whether you want to create a control array. Set the copy's `Caption` property to `Last Name:`, and drag it to the left of the second text box. (Note that you can set properties of individual control array elements just as if they were independent controls.)
12. Paste two more copies of the Label control on the form. Drag them to the left of the third and fourth text boxes, and set their `Caption` properties to `City:` and `State:`, respectively.

Figure 13.3 shows the form after completing the design steps. The figure also points out the `Index` property of a control. The non-empty value of the `Index` property indicates that the control is part of a control array.

FIGURE 13.3
This form contains two control arrays.



Writing Code for a Control Array

After you create a control array, you can write a single piece of code to handle a particular event for all the controls in the array. For each event, Visual Basic passes the `Index` property of the control that triggered the event to the event procedure as an argument. This process is illustrated in Figure 13.4.

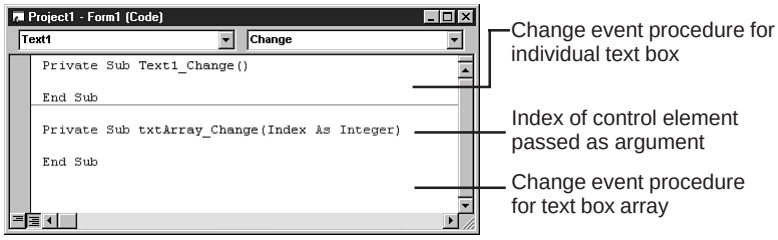


FIGURE 13.4
Control array event procedures can use the `Index` parameter to act according to which element caused the event to occur.

Handling the Control Array's Events To write code for each of the elements of a control array, you simply enter the code in the Code window just as you would for any other control. Then, whenever that event is fired by any of the controls in the array, the code is executed.

Now you can enhance the sample project with an event procedure. Whenever users complete an entry in any of the three text boxes, you want to convert the text that they typed into *proper case* (only the first letter of each word is to be capitalized). You can do so by using Visual Basic's `StrConv` function.

But where do you put this code? Controls that can receive the form's focus have a `LostFocus` event that occurs just before the focus moves from that control to another one. This gives you an excellent opportunity for programmatic validation and formatting of the contents of text boxes. You can add code to the `LostFocus` event procedure of the text box control array. This code is executed whenever any text box loses the focus, meaning a user has most likely just entered something in the text box.

To code the `LostFocus` event procedure for the test application's text box control array, follow these steps:

1. Double-click any of the text boxes that make up the text box control array. The Code window is then displayed, open to the `txtArray_Change` event procedure. Notice that the parameter `Index as Integer` is available inside the procedure.
2. Because you don't want to write code for the `Change` event, change the event displayed in the Event drop-down box to `LostFocus`.
3. You should now see the `txtArray_LostFocus` event procedure, which also has the parameter `Index as Integer` available. Enter the following line of code into this event procedure:

```
txtArray(Index) = StrConv(txtArray(Index), vbProperCase)
```

The left side of this assignment statement, `txtArray(Index)`, refers to a specific element of the `txtArray` control array. Which element? The array subscript `Index`, which is passed into the event procedure as a parameter, allows you to determine which element of the control array just lost the focus (causing this event to fire). Therefore, this line of code assigns to that specific control array element the value of the expression on the right side of the assignment statement—in this case, the contents of that array element's default property (`Text`), converted to proper case via the `StrConv` function.

After you close the Code window, double-click one of the other elements of the text box control array. Notice that the Code window opens to the *exact same event procedure*. Remember, control array elements share event procedures.

Now try your sample application. Start by running the program; then type `TINA MARIE` in uppercase letters in the first text box (next to the First Name label). When you press Tab to move to the next text box, the `LostFocus` event fires and the text that you typed is converted to proper case. Type `jones` (all lowercase) in the Last Name text box. Press Tab again, and notice that this text is also converted to proper case. The `LostFocus` event procedure that you wrote is executed whenever the `LostFocus` event occurs to any of the controls in the array.

Isolating Control Array Elements with the *Index* Property If you need to execute code only for one or more specific members of the array, your code can use the `Index` argument to determine which array element fired the event. Then you can, for example, place the necessary code within an `If` block or `Select Case` block.

Examine this use with the sample project. The code that converts the users' entries into proper case is working fine, but state abbreviations should be all uppercase. Therefore, you should modify the `txtArray_LostFocus` event procedure to isolate the state text box (array element number 3) and perform a different action for it.

Modify the code in the `txtArray_LostFocus` event procedure to match the following:

```
If Index = 3 Then
    txtArray(Index) = UCase(txtArray(Index))
Else
    txtArray(Index) = StrConv(txtArray(Index), vbProperCase)
End If
```

Try this new event procedure by running the program and using all lowercase letters to type your first and last name, city, and state in the appropriate text boxes. Notice how the event procedure modifies the text in the State text box differently than the others.

Manipulating Multiple Controls in Code Another benefit of using a control array is that you can set properties for each element in an array at runtime by using a `For...Next` loop. This way, your program can easily work with all the controls in a control array. For example, the following lines of code convert the text in all the members of a text box control array into uppercase:

```
Dim i As Integer
For i = 0 To 3
    txtArray(i) = UCase(txtArray(i))
Next i
```

Note that the `For...Next` loop counts from 0 to 3, not 1 to 4 because the array elements, by default, are numbered beginning with 0.

Removing Elements from a Control Array

While you are in the design environment, you can remove control array elements from a form in several ways:

- By selecting the control element and pressing the Delete key
- By selecting it and choosing Edit, Delete from the menu system
- By right-clicking it and selecting Delete from the context menu

This way, you can clear the control from the form and reduce the number of elements of the control array. If, for some reason, you want to return the elements of the control array to individual controls that are not part of the array, you need to specify new `Name` property values for all but one of the controls and then delete the `Index` property values of the controls to return them to null values.

CAUTION

When you remove a control from a control array, the rest of the controls are not automatically renumbered. Therefore, deleting controls can leave gaps in the `Index` values of the array's remaining elements. These gaps can cause problems if, for example, you have code that uses a `For` loop to work with the elements of the control array. In this particular case, an error occurs when the loop tries to access a control array element via an `Index` property value that has been deleted.

Working with Control Arrays

Now that you understand the mechanics behind creating control arrays, you will learn some ways that they are commonly used. In general, you group controls into an array when you need to use similar code to process each control, such as four text boxes representing lines in a street address. Simplifying the programming of event procedures is another reason to use a control array. For example, if you have 26 command buttons that represent the letters of the alphabet, it is easier to deal with them as an array than as separate controls.

Using a Control Array in Your Programs

There are a number of uses for control arrays in your programs. The example of simultaneously converting the contents of all text boxes to uppercase is one.

Another common use of control arrays is to find which option button in an array is selected. Because only one option button in a group can be selected at any one time, you can use a `For` loop to determine the value, as illustrated in Listing 13.1.

Listing 13.1 OPTIONARRAY.TXT—Using *LBound* and *UBound* to Determine the Range of a Control Array

```
Dim I As Integer, nChosen As Integer
For I = optArray.Lbound To optArray.Ubound
    If optArray(I).Value Then
        nChosen = I
        Exit Sub
    End If
Next I
```

In Listing 13.1, you might notice that, instead of specifying exact values for the start and end of the `For` loop, the code uses the `LBound` and `UBound` properties. These properties return the lower and upper boundaries of the control array indexes, respectively. Using these properties allows your code to handle additions or deletions in the control array automatically. `Lbound` and `Ubound` are properties of the control array itself, not of individual members of the control array.

NOTE Although `LBound` and `UBound` provide the maximum and minimum values of the array indices, this does not mean that the elements of the array are numbered contiguously.

Parallel Arrays

One handy technique when working with control arrays involves the use of two (or more) different control arrays whose elements match with each other in some way. They are known as *parallel arrays*.

Consider the two control arrays in the sample program. One is a group of text boxes into which the users can enter information; the other is a group of label controls, each of which matches one of the text boxes. Suppose that you want the label that identifies whichever control has the focus to appear in boldface as a visual cue to the users to help spot the current control. You could accomplish this task by adding some code to the `GotFocus` event procedure for the TextBox control array elements; this code should set the `Font.Bold` property for the Label control that matches the TextBox control that has the focus. That is, when a given text box receives the focus, you want its associated label to become bold. You also should add some code to the TextBox control array's `LostFocus` event procedure to set the appropriate Label control's font back to normal.

To accomplish this enhancement, follow these steps:

1. Enter the following line of code into `txtArray`'s `GotFocus` event procedure:

   ```
   lblArray(Index).Font.Bold = True
   ```

   Note that this code, although it is placed in an event procedure of the TextBox control array, actually acts on a member of the parallel Label control array. The `Index` parameter is used to determine which element of the Label control array to act on.

2. Add the following line of code to the end of the existing `txtArray_LostFocus` event procedure:

```
lblArray(Index).Font.Bold = False
```

3. Run the application. When you tab through the text boxes, notice that the associated Label control for the currently selected text box appears bold.

Creating a Menu Item Array

In addition to arrays of controls, you can also create an array of menu items. Like other control arrays, menu item arrays provide the only means to add items to the menu at runtime. You might use a menu item array to keep a list of the files most recently used by your program. This feature is found in many commercial programs.

To create a menu item array, you need to be in the Menu Editor (click the Menu Editor button or choose Tools, Menu Editor). You then create menu items by entering the `Caption` and `Name` properties of each item. When you create the menu item array, you also specify a value for the `Index` property of the item. Figure 13.5 shows the Menu Editor with these properties set for the first of what may be multiple menu items listing recently used files.

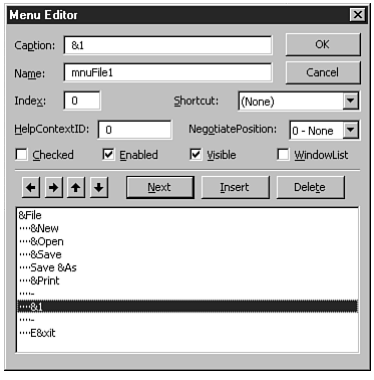


FIGURE 13.5
You can set a Menu control's `Index` property in the Menu Editor to create an array of Menu controls.

Like control arrays, the elements of a menu item array must meet certain requirements:

- All elements must have the same value for the `Name` property.
- All elements must be at the same indentation level in the menu.
- All elements must be contiguous in the menu. If you need a separator bar in the menu, it must also be part of the array.
- Each element of the menu array must have a unique index number.

Loading and Unloading Controls at Runtime

In other chapters, you learned how to add controls to forms while you are in the design environment. In the preceding section, you even learned how you can create control arrays to handle processing of multiple controls easily in code. However, nothing you have seen yet shows you how to add and remove controls at runtime.

TIP If you plan to add menu items at runtime, place the menu item array at the bottom of a menu. By doing this, you cause the menu to expand after the fixed items so that the user is not confused by items changing positions within the menu.

NOTE You can hide and show controls at runtime by setting the `Visible` property appropriately. However, you must create these controls before you can use them. Showing and hiding controls is not the same as adding new controls.

The only way to add controls at runtime is to add elements of a control array. You cannot add a new individual control because you wouldn't have any event code to handle any events triggered by the users. Because event code has already been defined for a control array at designtime, new elements of the array are automatically handled.

CAUTION

If you use `If` or `Select` statements to process code for different index values, you should make sure that your code works for all array elements, even new ones that might have been added at runtime. `LBound` and `UBound` help you accomplish this task; however, keep in mind that the indices in a control array may not be numbered sequentially.

Creating the First Element of a Control Array

Because any new control that you add at runtime must be part of a control array, you must create the array, or at least its first element, at designtime. For many arrays, you will want only a single element to be created at design time. This gives you the maximum flexibility to add and remove controls during program execution. To create the first element of a control array, follow these steps:

1. Draw the control on your form.
2. Set the `Name` property of the control.
3. Set the `Index` property of the control to an integer value (usually `0`).

Note that setting the `Index` property to something other than an empty value creates a control array. If you copy and paste a control, Visual Basic sets the `Index` property for you.

Adding Controls at Runtime

After you create the first element of the array, you can use code to add other elements in response to events. For many applications, you add the controls during form load. One application of this technique would be to create a generic data entry form. By using control arrays, you could pass a recordset to the form and then create the number of controls you need to handle however many fields are in the recordset. (Recordsets represent data in a database and are discussed in Chapter 24, "Database Basics.")

To add a control at runtime, you use the `Load` statement. It is the same statement that you can use to bring a form into memory. With the `Load` statement, you must specify the name of the control to be loaded and its index. To avoid an error, you must ensure that the index is unique. Note that the new control's `Visible` property is set to `False`. The complete process for adding a new control is detailed in the following steps:

1. Use the `Load` statement to create the new control and bring it into memory.
2. The new control is shown in the same position as the original control because it inherits the properties of the original control. Therefore, you need to move the new control using the `Move` method or by setting its `Top` and `Left` properties.
3. Set the new control's `Visible` property to `True` to display it on the form.
4. Set any other necessary properties of the new control. (All other properties are inherited from the original designtime control.)

TIP Setting the index of the new element to one greater than the `UBound` property of the array ensures that you will have a unique index.

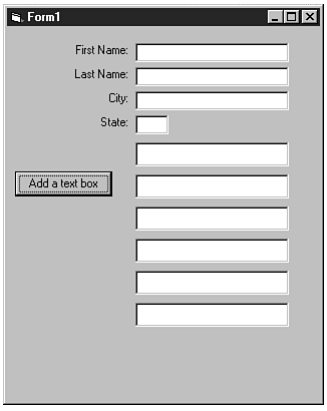
Now examine this technique by adding it to the sample program. Add a test command button that will be responsible for adding a new element to the `txtArray` control array. To do so, follow these steps:

1. At designtime, set the main form's `Height` property to `6000`. This setting allows plenty of room for the new controls that will be added when the program is running.
2. Add a command button in an empty area of the form. Set its `Name` property to `cmdAdd` and its `Caption` property to `Add a text box`.
3. Enter the following code into `cmdAdd`'s `Click` event procedure:

```
Dim i As Integer
i = txtArray.UBound
Load txtArray(i + 1)
txtArray(i + 1).Visible = True
txtArray(i + 1).Top = txtArray(i).Top + txtArray(i).Height + 120
txtArray(i + 1).Left = txtArray(i).Left
```

The preceding code sets the position of the new control array element to a position 120 twips below the most recently added control (taking into account the control's height as well). Run the program and click the command button to give it a try. Figure 13.6 shows how the form looks after several clicks.

FIGURE 13.6
Control array elements can be added at runtime.



Removing Controls at Runtime

Just as you may need to add one or more controls at runtime, you might also need to remove one or more controls at runtime as well. To remove a control, use the `Unload` statement. As with the `Load` statement, you need to specify the name of the control and its index, as shown here:

```
Unload txtArray(5)
```

CAUTION

You can use `Unload` only with controls that were created at runtime. You cannot use `Unload` with any control array elements that were created at design time .

You discovered earlier that you could use control arrays to create a generic data entry form. This form would examine the structure of the recordset and then create controls to handle all the fields in the recordset. In this section, you learn how such a form would work.

To keep it simple, the form will have two arrays—one for the labels describing the fields and one for text boxes to hold the field values. To start the setup of the form, add a label array and a text box array to a form, as shown in Figure 13.7.

NOTE To create array elements rather than separate controls, set the `Index` property of your label and text box to `0`.

You also need to add a Data control to the form to provide the recordset for the form to use. You learn about the Data control and related data-bound controls in Chapter 25, "The Data Control and Data-Bound Controls."

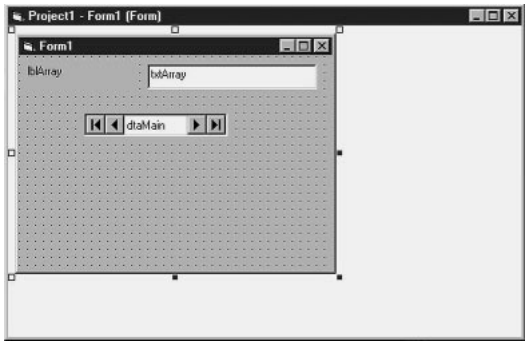


FIGURE 13.7
At designtime, the generic data entry form contains the beginnings of two control arrays.

For the Data control, you will need to set the `DatabaseName` and `RecordSource` properties of the control to access a recordset. After setting up the Data control, assign the control to the `DataSource` property of the text box. This property will be inherited by each of the text boxes you add to the form. Next, place the code in Listing 13.2 in the form.

Listing 13.2 GENDATA.FRM—Using the Fields Collection to Drive the Code for Creating Controls

```
Option Explicit

Dim bFirstLoad As Boolean

Private Sub Form_Activate()
    Dim i As Integer
    Dim nFields As Integer
    Dim sName As String

    If Not bFirstLoad Then Exit Sub

    With dtaMain.Recordset
        nFields = .Fields.Count
        For i = 0 To nFields - 1
            sName = .Fields(i).Name
            If i > 0 Then
                Load lblArray(i)
                Load txtArray(i)
                txtArray(i).Top = txtArray(i - 1).Top + txtArray(i - 1).Height +
120
                txtArray(i).Left = txtArray(i - 1).Left
                lblArray(i).Top = txtArray(i).Top
                lblArray(i).Left = lblArray(i - 1).Left
                txtArray(i).Visible = True
                lblArray(i).Visible = True
            End If
            lblArray(i).Caption = sName
            txtArray(i).DataField = sName
        Next i
    End With
    i = txtArray.UBound
    dtaMain.Top = txtArray(i).Top + txtArray(i).Height + 120
```

```
    Me.Height = dtaMain.Top + dtaMain.Height + 525
    bFirstLoad = False
End Sub

Private Sub Form_Load()
    bFirstLoad = True
End Sub
```

This code adds a new label and text box for each field after the first one. New controls are positioned directly below the last set of controls. Next, the code assigns the `Caption` property of the Label control and the `DataField` property of the TextBox control. After all the fields have been added, the code positions the Data control below the other controls and resizes the form to accommodate all the controls. A runtime example of the form is shown in Figure 13.8.

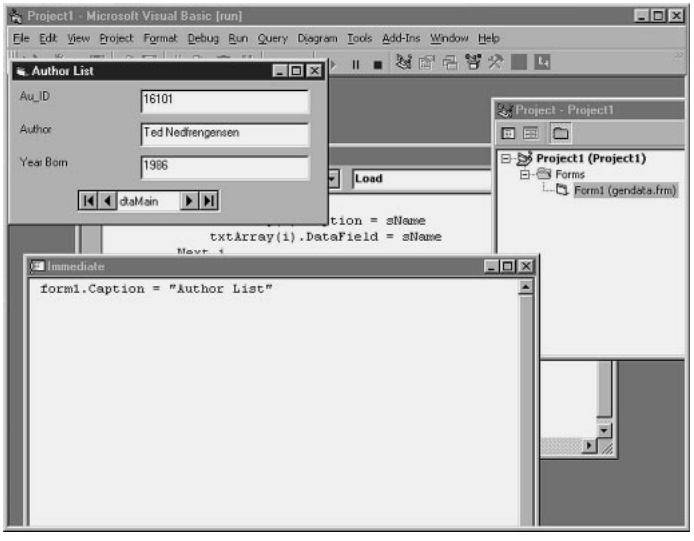


FIGURE 13.8
The generic data form can handle almost any recordset.

From Here...

In this chapter, you learned some of the techniques you can use to make your programs do more with your controls. You learned how to use control arrays to enhance your ability to work with similar controls as a group. You also saw how to add controls dynamically while your program is running.

For more information on some of the topics presented here, see the following chapters:

- To learn more about controls in general, see Chapter 4, "Using Visual Basic's Default Controls," and Chapter 12, "Microsoft Common Controls."
- Databases and recordsets are introduced in Chapter 24, "Database Basics," and discussed further in Chapter 26, "Using Data Access Objects (DAO)."

CHAPTER 14

Creating ActiveX Controls

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As you learned in earlier chapters, you can combine the controls included with Visual Basic to build a powerful application quickly. One of the most exciting features of Visual Basic is the ability to create your own controls. These programmer-built controls, also known as ActiveX controls, can then be used in Visual Basic applications like any other control. (*ActiveX* is a Microsoft term that refers to a group of components that include controls, DLLs, and ActiveX documents.) In addition to the obvious advantage of reusing code, ActiveX controls can be used on a Web page to deliver program-like functionality over the Internet.

In this chapter, you take a look at the various approaches you can take and some of the issues that you need to consider when creating ActiveX controls. The information contained in this chapter is then further expanded in the following chapter, "Extending ActiveX Controls," which teaches you how to build more robust ActiveX controls.

ActiveX Basics

You are familiar with controls such as the TextBox and Label controls. To use these controls, you draw them on a form and control their behavior through properties, methods, and events. When you create your own ActiveX control, you are creating a similar object, except you are determining the properties, methods, and events. After you create your own ActiveX control, you and others can use it in other Visual Basic projects, just like a TextBox control. You can use your controls in any application or development tool that can use ActiveX controls, including other Visual Basic projects or Microsoft Internet Explorer. In fact, using ActiveX controls is an ideal way to create a reusable component that can be used both inside a traditional client/server EXE and on the Internet.

Steps Involved in Building ActiveX Controls

Creating an ActiveX control in Visual Basic is different from creating a Standard EXE application. Therefore, a brief overview of the steps involved is useful:

1. Create a high-level design to determine what you want your ActiveX control to do. An ActiveX control is like a standalone object, so you need to ask yourself what purpose does the object serve? What appearance do you want it have onscreen? What properties, methods, and events need to be made available to the program using the control?
2. Determine whether you will be using other controls as building blocks for your control. For example, you might want to create an ActiveX control that includes a third-party grid. When you are using other controls within your control, consider licensing and distribution issues.
3. Start a new Visual Basic ActiveX control project, and draw the interface for your control.
4. Add code to enable all the properties, methods, and events you want your control to have.
5. Build a test project, and test your control from within Visual Basic. Make sure to use all the properties, methods, and events that you give your control.
6. Compile your control into an OCX file, and perform testing on the compiled version of your control. If you are developing for the Internet, test your control on a Web page.

7. Use the Package and Deployment Wizard or another utility to build a distributable version of the control that includes all the supporting files.

Development Strategies

Building an ActiveX control in Visual Basic can be as easy or difficult as you choose. The level of difficulty depends on whether you use existing controls in your design, how sophisticated the interface will be, and of course, how much code you have to write to make it work. In any case, you can go about building an ActiveX control in three basic ways:

- **Assemble the control from existing controls.** This approach is also known as building a control from *constituent controls*. It is the easiest way to build an ActiveX control because you are just bringing existing controls together. For example, you can package a combo box and a text box together and write minimal code that causes them to interact in the desired manner.
- **Enhance an existing control.** You can use an existing control as a starting point for your own creative efforts by modifying the control properties. For example, you can take a text box and add a custom property called `TextCaps` that causes the text to always be displayed in capital letters. This approach is a good way to get the exact functionality that you need in a control.
- **Create a user-drawn control.** You can draw the interface yourself with graphics methods, creating a totally original control that does not include any existing controls. Drawing your own control requires a little more work than the other two strategies but can be done to provide an original or different user interface.

This chapter introduces you to the world of creating ActiveX controls. You'll learn about each of the preceding development strategies through sample projects, as well as learn about distributing and compiling the finished control. Chapter 15, "Extending ActiveX Controls," looks at some of the more advanced topics relating to ActiveX controls.

Creating an ActiveX Control

Assembling an ActiveX control from other existing controls provides many advantages. First, when you add an existing control to your new custom control, you get the existing control's complete functionality—an important consideration when you think about how many event procedures, methods, and properties are supported by an average control. Second, combining a number of controls into one allows them to be treated as a single unit, which may make things easier from an application architecture standpoint; this approach also allows them to be drawn on the form all at once. An additional advantage is that the users can easily understand a control made up of controls they already know.

Starting the Address Control Project

Now that you have some background information on ActiveX controls, you can get started by creating your first ActiveX control. The control that you'll build in this section is the AddressCtl control, which is simply text box fields that allow the users to enter their names and addresses.

This example will give you a hands-on understanding of the issues involved in developing ActiveX controls in the Visual Basic IDE. The AddressCtl control will be built entirely of existing Label and TextBox controls. First, you will draw the user interface of the control and then add minimal code to make it work in the VB design environment.

To build the Address control, follow these steps:

1. Start Visual Basic 6.0. If it is already running, choose File, New Project.
2. From the New Project dialog box, select ActiveX Control. A new project is created with a UserControl object named `UserControl1`, as shown in Figure 14.1.

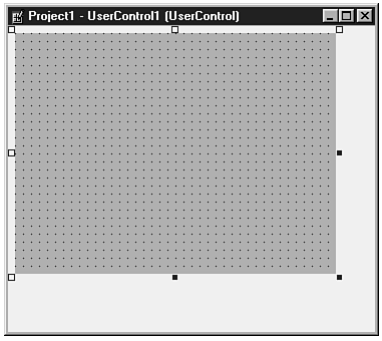


FIGURE 14.1
A UserControl object is similar to a form but has no borders or standard window elements.

3. Change the name of the UserControl object to `AddressCtl` in the Properties window.
4. Choose Project, Project1 Properties. The Project1 Properties dialog box appears.
5. In the Project Name text box, change the name of the project (`Project1`) to something meaningful, such as `Address`.

6. Add five TextBox controls to the form. Set the values of their `Text` properties to empty strings, and give them the following names:
   - txtName
   - txtStreet
   - txtCity
   - txtState
   - txtZip
7. Add five Label controls to the form and give them the following properties:

`Name` **Property**	`Caption` **Property**
`lblName`	`Name:`
`lblStreet`	`Street:`
`lblCity`	`City:`
`lblState`	`State:`
`lblZip`	`Zip:`

8. Arrange the labels next to the appropriate text boxes. Click the UserControl object, and resize it so that the constituent controls fit neatly inside. You can resize your control by using the sizing handles or changing the `Height` and `Width` properties in the Properties window. The sample control should be around 4395 twips wide by 3600 twips high and look like the one in Figure 14.2.

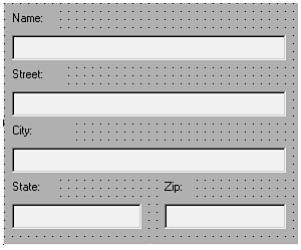


FIGURE 14.2
The full set of constituent controls is drawn on the UserControl object.

9. As with all VB projects, saving your work is important. Do so now before continuing.

Adding Resize Code to the Control

As you know from using standard controls such as a text box, you can adjust the size of a control in design mode by using the mouse or by setting its `Height` and `Width` properties. A TextBox control responds appropriately by automatically redrawing itself at the new size. When you are designing your own ActiveX control, especially one that is made up of existing controls, resizing is an important consideration. As you resize your control, you need to take action to make sure that the constituent controls are not hidden from the user or arranged in a way that prevents useful operation of the control.

To handle this control, you need to add code that responds to the `Resize` event of the UserControl object. This code will be executed whenever someone is drawing your control in a Visual Basic project. To add the necessary code for the Address control, take the following steps:

1. Double-click the UserControl object, as you would a standard form. The Code window opens.
2. From the Procedures box of the Code window, select the `Resize` event.
3. Add the following lines of code to the `UserControl_Resize` event:

```
Private Sub UserControl_Resize()
    With UserControl

        'Enforce minimum dimensions
        If .Height < 3615 Then .Height = 3615
        If .Width < 2175 Then .Width = 2175

        'Resize objects on the control
        txtName.Width = .ScaleWidth - 500
        txtStreet.Width = .ScaleWidth - 500
        txtCity.Width = .ScaleWidth - 500
        txtZip.Width = .ScaleWidth / 2 - 500
```

```
            txtState.Width = .ScaleWidth / 2 - 500

            'Move the Zipcode text box
            txtZip.Left = .ScaleWidth / 2 + 160
            lblZip.Left = .ScaleWidth / 2 + 160

        End With
    End Sub
```

4. Save the changes to your project.

NOTE The size numbers in the sample `Resize` event code are arbitrary. Their purpose is to keep the control's interface looking okay when the developer sizes it.

As the user changes the dimensions of the Address control, the `Resize` event procedure is executed. The first two lines in the preceding code sample prevent the user from making the control instance too small. The remaining lines resize all the constituent controls based on the size of the UserControl object.

Adding a New Property to Your Control

Including multiple text boxes within a single ActiveX control groups them visually and allows you to draw all the text boxes on the form at once. However, for an ActiveX control to be useful, you also need to be able to access its properties, methods, and events as a single control. In other words, if you intend to treat all the constituent controls separately from code, you really have not gained anything by combining them into one control. In the case of the Address control, the purpose of the control is to provide a way to enter address information. For this reason, you will create an `AddressText` property on the Address control that is much like the `Text` property of a text box. The difference here is that the `AddressText` property returns text from *all* the text boxes on the form in a single string.

For simplicity's sake, the property will be read-only, using the `Get` property procedure. (Property procedures are discussed in Chapter 16, "Classes: Reusable Components.")

▶ **See** "Property Procedures," **p. 363**

To set up this property, open the Code window for the UserControl, and add the following procedure code:

```
Public Property Get AddressText() As String
    Dim s As String

    s = txtName & vbCrLf
    s = s & txtStreet & vbCrLf
    s = s & txtCity & vbCrLf
    s = s & txtState & vbCrLf
    s = s & txtZip
    AddressText = s

End Property
```

The `Property Get` procedure code is not complex; it just combines the contents of the constituent controls and returns a single string to the calling application. However, the creation of this

custom property illustrates the concept of taking a programming task (combining the address fields into a string) and encapsulating it in an object (your ActiveX control). The advantage is that other programmers can use this property without having to understand the details of its implementation.

Testing the ActiveX Control

An ActiveX control eventually ends up as a compiled OCX. An OCX file, when registered on another user's machine, can be added to a Visual Basic project or displayed on a Web page in Internet Explorer. However, during the development process, you need a way to test and debug your ActiveX controls within the Visual Basic design environment. This process is slightly more complicated than debugging a Standard EXE project because you have to deal with two separate sets of running code: the ActiveX control itself and the project using the ActiveX control.

Testing with a Project Group

The easiest way to test an ActiveX component is to use a project group. Throughout most of the samples in this book, you will open projects one at a time; that is, when you choose New Project or Open Project from Visual Basic's File menu, any projects already loaded close. However, the Visual Basic development environment allows you to have multiple projects loaded simultaneously. This arrangement is known as a project group and is useful for testing ActiveX components. A typical project group consists of the ActiveX component itself plus a test project (usually a Standard EXE project).

Adding a Test Project to the Group To begin testing the `AddressCtl` component, you need to add a Standard EXE project to the design environment, creating a project group. Just choose File, Add Project and then select a Standard EXE project type from the Add Project dialog box. The Project Explorer window is updated to show both projects, as shown in Figure 14.3.

TIP You can quickly add a Standard EXE project by simply clicking the Add Project button.

FIGURE 14.3
You can open another project at the same time as an ActiveX component for testing purposes.

Setting Up the Test Project When you added the Standard EXE project to the group, you may have noticed that a grayed-out (dimmed) icon was added to your Toolbox. This icon represents your user control, and it remains disabled as long as you have the UserControl form open.

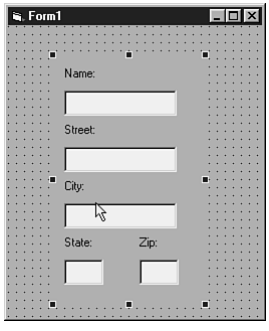
Close the UserControl window, and open the window for the default form from `Project1`. The Toolbox icon for your user control should be available, and hovering the mouse pointer over it displays the name of the sample control, `AddressCtl`, as shown in Figure 14.4.

FIGURE 14.4
To make your ActiveX control available to the project group, close the UserControl window.

Now your custom ActiveX control is available. Go ahead and draw an instance on the form, just as you would with any other control. Notice that it appears just as you drew it on the UserControl, but it acts like a single control; all the text boxes within the control move together and cannot be selected individually.

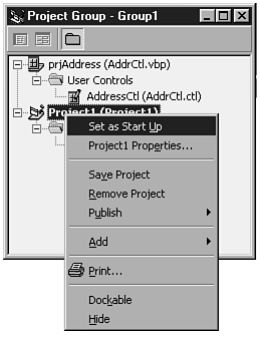
At this point, your ActiveX control object is loaded and running, so try resizing the Address control on your form. As you change its size with the mouse, the code in the `Resize` event of the UserControl keeps the text boxes sized appropriately. If you try to reduce the height of the Address control too much, the control springs back to its minimum size, as pictured in Figure 14.5. You can, however, enlarge the control as much as you like.

FIGURE 14.5
The test application shows the Address control set to its minimum width.



Setting the Startup Project Now that you have drawn an instance of your control on the form, you can start the test project. When you are using a project group, you must first specify which project is the *startup project*. Visual Basic gives that project the focus, starting the other projects automatically. Because the ActiveX control is designed to be used within another project, you need to set the startup project to be the test project, `Project1`. To do so, right-click `Project1` in the Project Explorer window, and select Set as Start Up from the context menu that appears, as shown in Figure 14.6. The `Project1` project should change to boldface to indicate that it is the startup project.

FIGURE 14.6
Set the startup project to be the test Standard EXE project. The ActiveX project starts automatically.



Running the Test Program To start the test project, press F5 or click Visual Basic's Start button. The form should load, and the text boxes on the Address control become active.

Enter some text in each field. Next, press Ctrl+Break to put the project in Break mode. Open the Immediate window by pressing Ctrl+G, and print the value of the `AddressText` property by entering the following statement:

```
Print AddressCtl1.AddressText
```

If you see a list of the values you entered in the control, then the control is working properly. Notice also that as you enter the `Print` command, Visual Basic displays all the properties of your control in a pop-up list, and the `AddressText` property is included.

If you cannot print the value of the `AddressText` property successfully, make sure that the code in the `Property Get` procedure is entered correctly. If you want to learn more about debugging a program, see Chapter 10, "Controlling the Flow of Your Program Code." You can use the methods described there to step through the code in the `AddressText` property procedure, examining the contents of the variables to verify that they are correct.

▶ **See** "Debugging Your Programs," **p. 214**

Testing with Internet Explorer

You have just seen how to use the Address control in a Visual Basic project group. As you already know, a compiled ActiveX control can be used in Internet Explorer on a Web page. However, in previous versions of Visual Basic, testing with Internet Explorer was difficult; you

first had to create a test HTML file outside the Visual Basic IDE and then launch Internet Explorer manually. Fortunately, Visual Basic 6.0 has improved this process. You can now automatically launch Internet Explorer and debug your ActiveX control code from within the Visual Basic IDE.

If you still have the project group open, remove the Standard EXE project from the group. Simply right-click `Project1` in the Project Explorer window, and choose Remove Project from the context menu. The only remaining project should be the Address control.

Start the Address control project by pressing F5 or clicking the Visual Basic Start button. If you have Internet Explorer installed, it should be automatically launched, as shown in Figure 14.7.

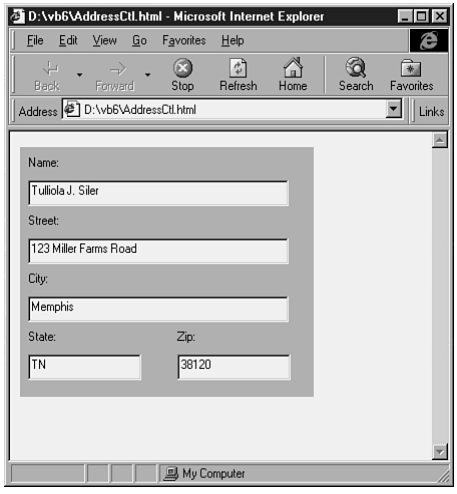


FIGURE 14.7
Visual Basic 6.0 makes testing controls a snap by automatically launching the browser.

After you finish testing the control in Internet Explorer, close the browser and stop the Visual Basic project.

NOTE The Debugging tab of the Project Properties dialog box determines how ActiveX components are launched when you press F5. For more information about it, see Chapter 16, "Classes: Reusable Components."

▶ **See** "Working with Multiple Projects," **p. 235**

Compiling Your Control

So far, you learned how to test the control project running as code in the design environment. However, to use the control outside the design environment (that is, on a user's PC), you must compile your source code into an OCX file and package it for distribution. Others can then install the OCX file on their systems and use your control in their own projects, regardless of whether they are working with a programming language, a Web page, or some other development tool.

Creating the OCX File

The steps for compiling an ActiveX control project are similar to those for compiling a Standard EXE project. However, the end result of compiling an ActiveX control project is an OCX file rather than an EXE program file.

To create an OCX file for the Address control, perform the following steps:

1. Choose Make from Visual Basic's File menu.
2. When the Make Project dialog box appears, enter a filename, such as ADDRESS.OCX. (You might also need to set the directory where you want the file saved.)
3. Click OK. Visual Basic compiles the control and writes the OCX file to disk.

After the ActiveX control is compiled, you should be able to test the compiled control. Keep in mind that an ActiveX control is different from a Standard EXE application in that it does not run on its own. To test your compiled control, you need to use a container application.

Testing the Compiled Control

After you compile your control, it should work just like any other control. Start a new Standard EXE project in Visual Basic, removing the loaded project or project group. Next, display the Components dialog box by pressing Ctrl+T or choosing Project, Components. Click the Browse button, and select your OCX file. When you close the Components dialog box, a new icon should appear in the Toolbox. You should then be able to draw your control on the form as you did earlier when testing with a project group; this time, however, you can use compiled code. (See the earlier section "Setting Up the Test Project.")

NOTE When working with a compiled control in Visual Basic, you cannot debug within the control or view its code.

Distributing the Control to Another Machine

Your ActiveX controls can run on another user's or developer's PC. However, just copying the OCX file to the other computer is not a sufficient way to distribute it. For your control to run on any given PC, the appropriate support files must be installed. The reason for this requirement is that Visual Basic code is a fairly high-level language and thus depends on other runtime libraries (that is, DLL files). For example, one of the most basic requirements to run any Visual Basic program is the file MSVBVM60.DLL (Microsoft Visual Basic Virtual Machine 6.0). Without this file, none of your Visual Basic programs can run.

NOTE Other users who already have Visual Basic (and the support files) installed on their machines may be able to use your control by simply copying your file to their machines and registering it with the `REGSVR32` command, as in the following example:

```
REGSVR32 C:\WINDOWS\SYSTEM\ADDRESS.OCX
```

The bottom line is, for your control to work, it must be properly installed. You can install in two ways, depending on the control's intended use:

- **Standard installation.** If your custom ActiveX control is part of another VB project, it is installed and registered on the user's machine when the application files are installed.
- **Internet installation.** If your control is part of a Web page, you must place the correct `<OBJECT>` tag in the HTML code. The OCX and supporting files, which must placed in CAB files on the Web server, are downloaded and installed by Internet Explorer.

Installing Your Control in a Setup Program A standard installation is the easiest way to install your control on a PC. In a typical Standard EXE installation, a user runs a SETUP.EXE program, which installs and registers all the appropriate files. When you create the installation files for your Standard EXE project, use the Package and Deployment Wizard. The Wizard knows to include your OCX. However, if you think your OCX requires some support files that your application does not, you need to create a Dependency File by using the wizard. Using the Packaging and Deployment Wizard is described in detail in Appendix B, "Packaging Your Applications."

▶ **See** "Packaging ActiveX Components," **p. 788**

Installing Your Control over the Internet As you already know, for your ActiveX control to work on any given PC, the OCX file and other supporting files must be installed. If you intend to use your ActiveX control in a Web page, Microsoft Internet Explorer can automatically download and install the ActiveX control. However, deploying an ActiveX control in this manner is different from the traditional, interactive setup method. When a user accesses a Web page containing an ActiveX control, Internet Explorer downloads the required CAB (cabinet) files from the Web server and then installs the ActiveX components. This is one of the advantages of using Internet Explorer; you can quickly publish your latest ActiveX controls from a central Web server. However, for this process to work, you must provide all the necessary information to Internet Explorer.

First, you need to create CAB files for your ActiveX control. A CAB file is a special type of file that contains one or more compressed files; for example, a single CAB file might contain your compiled OCX and some Visual Basic runtime DLL files. The files contained within a CAB cannot be used until they are extracted to their original size on the client machine. You can create a CAB file with the Package and Deployment Wizard, as discussed in Appendix B, "Packaging Your Applications." However, occasionally you may need to work with a CAB file manually. The Internet Client SDK, available on Microsoft's Web site, provides some tools that you can use to manipulate CAB files from the command prompt.

Another (optional) step is to sign your CAB files digitally. You can buy a digital signature file, which verifies your identity to someone downloading your control. This file is intended as a security feature because an ActiveX control has full access to the machine on which it runs. If you do not sign your CAB files, an Internet Explorer user who wants to use your control has to lower the security settings in Internet Explorer to allow unsigned controls to execute on his or her PC.

A command-line utility included with the Internet Client SDK, `SIGNCODE`, allows you to sign your files. When you compile your ActiveX control into an OCX file, it is given a *global unique identifier*, or *GUID*. This identifier is necessary to add the control to a Web page. To determine this GUID, you can look at the sample HTM file generated by the Package and Deployment Wizard. For an example use of the `<OBJECT>` tag, see Appendix B. After you determine the GUID, use it to embed the control in your Web page.

▶ **See** "Files Created for the Internet," **p. 790**

The final step is to place the CAB and HTML files on the Web server. Make sure that the previously mentioned `<OBJECT>` tag contains the name of the CAB file, as described in Appendix C.

After all the files are in place, other users should be able to use your control on their machines. To verify that the page works, try hitting your Web page on a machine that does not have your control installed. If the control fails to load, check the following:

- From the Security tab in the Internet Explorer Internet Options dialog box (accessed from the View menu), add your Web server to the trusted sites zone. Restart the browser and reload the page.
- Install and register the ActiveX control with a standard setup program. This way, you can verify that the problem is in the CAB file.

While troubleshooting control problems in Internet Explorer, you may want to delete the cached files and objects so that you get a "fresh" copy when you reload the page. You can delete the temporary files by clicking the Delete Files button on the General tab of the Internet Options dialog box. You then can remove your ActiveX control by selecting it in the \Windows\Downloaded Program Files directory and choosing File, Remove Program File.

Enhancing an ActiveX Control

The preceding section introduced the concepts involved in creating an ActiveX control by arranging existing controls on a UserControl object. However, you can also create "new" controls simply by adding capabilities to an existing control. This means that you are working with a single base control but adding properties, methods, and events to provide additional capabilities to the user. For example, you might want to create a special scrollbar control that uses letters instead of numbers or a text box that accepts only certain characters.

Placing the code that performs these tasks into a separate ActiveX control makes it easier to use the code in future programs. For example, rather than add special code to every TextBox control in your program, you can simply use your "enhanced" control in place of the text box. To create these enhanced controls, you use many of the same techniques that you learned in the previous sections:

1. Start a new ActiveX control project.
2. Add the base control to the UserControl window.
3. Add code for properties, methods, and events.

The following sections walk you through these steps, using a text box as the base control. Your "enhanced" text box will be known as a "Limited Character Text Box." It will have a user-defined property that allows the programmer to choose a set of acceptable characters that the user can enter. This additional property, `CharAccept`, will allow the user to restrict text entry to only letters, only numbers, or allow both.

Setting Up the Base Control

The steps for creating the enhanced text control are similar to the steps you used to create the Address control. For the enhanced text control, the steps are as follows:

1. Start a new ActiveX Control project.
2. Add a text box to the UserControl window, with the upper-left corner of the text box in position 0, 0.
3. Name the text box `txtCharSet`, and clear its `Text` property.
4. Set the properties of the ActiveX project and the UserControl to the values specified in Table 14.1.

Table 14.1 Settings for the Limited Character TextBox Control

Item	Setting
Project Type	ActiveX Control
Project Name	TextLimited
Project Description	Text Box for Limited Character Set
User control `Name` property	`TxtCharLimit`
User control `Public` property	`True`

To set the first three values in the table, use the Properties dialog box (which you access by choosing Project, Properties). To set the remaining values, highlight the UserControl object, and press F4 to show the Properties window. After you set up the user interface of the enhanced text control, it should look like the one in Figure 14.8.

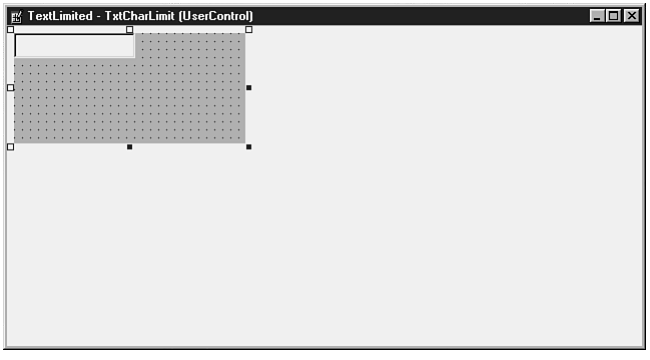


FIGURE 14.8
The base control, pictured here, will be enhanced with additional capabilities.

5. Set up the `Resize` event procedure of the UserControl to make the text box fit the space that is drawn by the developer when using your control. This `Resize` event procedure is shown in Listing 14.1.

Listing 14.1 LIMITED.ZIP—Using the *Resize* Event to Make Sure the Control Fills the Space

```
Private Sub UserControl_Resize()
  txtCharSet.Height = UserControl.ScaleHeight
  txtCharSet.Width = UserControl.ScaleWidth
End Sub
```

The simple two-line `Resize` event procedure is all the code necessary for the user interface of the sample control. Its purpose is to keep the text box the same size as the UserControl object.

6. Save your project.

Before moving on, test the `Resize` event procedure by performing the following steps:

1. Close the UserControl window. If you have the Toolbox open, notice that a new icon appears for your control.
2. Choose File, Add Project. Then add a Standard EXE project.
3. Draw your control on Form1, and try resizing it.

The purpose of jumping the gun by using the control so quickly is to get you used to the idea that the code in your ActiveX control does not have to be executed explicitly. Remember, when you are developing an ActiveX control, the code you write is used at design time in the host program.

For now, remove the Standard EXE project by right-clicking it in the Project Explorer window and choosing Remove Project1. Now, it is time to work on the enhancements to the control.

Enhancing the Base Control

The enhancement you are going to make to the TextBox control is to tell it whether it should accept any characters, just letters, or just numbers. You can do so by adding your own property, called `CharAccept`, which can have one of the following three values:

- `0`—Accepts any character
- `1`—Accepts only numbers
- `2`—Accepts only letters

Creating the *CharAccept* Property To create the `CharAccept` property, you first need to add a private variable to store the property value internally. To do so, create it in the General Declarations section of the UserControl object, as follows:

```
Private mCharAccept As Integer
```

Next, you need to create the new property, called `CharAccept`. You can do so either by entering the `Get` and `Let` procedures by hand, or by choosing Tools, Add Procedure, Property. The code for the `CharAccept` property is fairly easy to understand. When the developer needs the value of the `CharAccept` property, the `Property Get` procedure simply passes what is stored in the private variable. When the value of the `CharAccept` property is set, the `Property Let` procedure assigns one of the valid values to the private variable. The following is the code for both `Property` procedures:

```
Public Property Get CharAccept() As Integer
     CharAccept = mCharAccept
End Property

Public Property Let CharAccept(ByVal nNewValue As Integer)

       Select Case nNewValue
        Case 1 To 2
            mCharAccept = nNewValue
        Case Else
            mCharAccept = 0
       End Select

       PropertyChanged "CharAccept"

End Property
```

Notice the use of the `PropertyChanged` method. This method works in conjunction with the `ReadProperties` and `WriteProperties` events, which is discussed in the next few paragraphs.

You now need to use the `InitProperties` event of the user control to specify an initial value of the property:

```
Private Sub UserControl_InitProperties()
   mCharAccept = 0
End Sub
```

This code ensures that a value is set, even if the developer does not set it.

Using the *PropertyBag* Object You also need to create the code for the `WriteProperties` and `ReadProperties` events to preserve the designtime settings of `CharAccept`. These two events use the `PropertyBag` object to save and retrieve the value of the `CharAccept` property. The `PropertyBag` object enables you to maintain the design environment value of `CharAccept`. The code for these two events, shown in Listing 14.2, is not hard to understand. What is important, however, is why the code is needed.

Listing 14.2 LIMITED.ZIP—Maintaining the Property Value

```
Private Sub UserControl_ReadProperties(PropBag As PropertyBag)
   mCharAccept = PropBag.ReadProperty("CharAccept", 0)
End Sub

Private Sub UserControl_WriteProperties(PropBag As PropertyBag)
   PropBag.WriteProperty "CharAccept", mCharAccept, 0
End Sub
```

Remember that an ActiveX control's code starts executing the moment you draw it on a form. Suppose you set the value of a property during designtime. In the sample control, assume that you set the value of `CharAccept` to `1`. You also can change it several times while your program is running. The normal behavior for a control is to revert to its original designtime values when the program ends, thus adding the requirement of maintaining two separate *states* of the property.

More simply put, if you change a property at designtime, the control has to know to get this new value rather than use the default. Conversely, if the property's value is changed during program execution, the control has to retrieve the value when it returns to the design state.

The `PropertyBag` object allows your ActiveX control to store properties about itself, making this behavior possible. The `PropertyChanged` method provides notification that the user has changed a property. By knowing the state of the program and whether the `PropertyChange` method has been invoked, VB can fire the `WriteProperties` and `ReadProperties` events.

NOTE As you may have noticed, you have to add a lot of code just to create a single property. The next section introduces you to the ActiveX Control Interface Wizard, a Visual Basic Add-in that makes adding property and event procedure code easy. After you finish creating the basic TxtCharLimit control, keep reading to learn how to use the wizard.

Changing the Text Box's Behavior The next step in this sample project is to create the code that makes the limited character text box do something different than a normal text box. In this case, you can use the text box's `KeyPress` event to scan each character as it is entered. Visual Basic will pass the ASCII code of the characters through the event's `KeyAscii` parameter. Depending on the ASCII code and setting of the `CharAccept` property, you can either accept the character or set `KeyAscii` to `0`, which causes the text box not to display the character.

In addition to not displaying the character, you should inform the host program that the user has entered an invalid character. You do so by creating an event called `UserError`. To create this event, add the following line of code to the General Declarations section of the `UserControl` object:

```
Public Event UserError()
```

This event works like an event in any other control. Someone using your control can place code in it. The only thing you have to do is fire the event by using the `RaiseEvent` method.

Because three sets of acceptable characters are available, you can use a `Select` statement to handle the choices. Here's one other item of note: You need to allow the use of the Backspace key (ASCII code 8) in any of the character sets that you use. Otherwise, the user cannot delete the previous character. The code for the `KeyPress` event is shown in Listing 14.3.

Listing 14.3 LIMITED.ZIP—Programming the *KeyPress* Event to Screen User Input

```
Private Sub txtCharSet_KeyPress(KeyAscii As Integer)
    If KeyAscii = 8 Then Exit Sub

    Select Case mCharAccept
        Case 0 'Any character is acceptable
            Exit Sub
        Case 1 'Only numbers may be entered
            If KeyAscii >= 48 And KeyAscii <= 57 Then
                Exit Sub
            Else
                KeyAscii = 0
                Beep
                RaiseEvent UserError
            End If
        Case 2 'Only letters may be entered
            If KeyAscii >= 65 And KeyAscii <= 90 Then
                Exit Sub
            ElseIf KeyAscii >= 97 And KeyAscii <= 122 Then
                Exit Sub
            Else
                KeyAscii = 0
                Beep
                RaiseEvent UserError
            End If
    End Select

End Sub
```

The code in Listing 14.3 is fairly simple. `KeyAscii` represents the typed character, which is checked for validity by `Select Case` and `If` statements. If the character falls outside an acceptable range, the control beeps and raises the `UserError` event.

Testing the Limited Character Text Box

After you enter all the code for the control, you can test the TxtCharLimit control by following these steps:

1. Save your code.
2. Add a Standard EXE project to the project group. (You may have already taken this step.)
3. Close the design and Code windows for the user control. Notice that an icon for your control appears in the Toolbox.
4. Add an instance of the TxtCharLimit control to the form in the test application.
5. Set the properties of the control.
6. Run the test program, and try out the control. Try setting the `CharAccept` property to different values to verify that it accepts only the keystrokes you want.

If you have problems with the control, you can use the same debugging techniques to find the problems in a control as you do to find problems in standard programs. You can set breakpoints and step through the code line by line, whether in the ActiveX Control project or in the Standard EXE project. (See Chapter 10, "Controlling the Flow of Your Program Code," for more information on debugging your code.)

▶ **See** "Debugging Your Programs," **p. 214**

Choosing a Toolbox Icon

You may have noticed by now that all the custom controls you create have the same symbol in the Toolbox. This feature can cause a lot of confusion if you are working with multiple controls. Although the ToolTips provide descriptions of the controls, having custom icons to identify each control is better. You can have this custom icon by setting the value of the `ToolboxBitmap` property of the user control. This property determines what is displayed in the Toolbox for your control. If the property is set to `None`, the default icon is used. You can set the property to any bitmap, but be aware that the Toolbox icon is only 16×15 pixels. Therefore, you should use custom bitmaps that are created in that size.

ON THE WEB

Many free icons and other graphics are available for download from the World Wide Web. For example, visit `www.yahoo.com` and search for "icons" to find a large list of sites.

Using the ActiveX Control Interface Wizard

When you created the `CharAccept` property of the enhanced text box, you created one piece of the public interface of the control. However, your users will probably also want to be able to access most of the standard properties, methods, and events of the text box. For example, you may have noticed that the `Text` property was not accessible for your custom control. This makes sense because no code was added for it; the TextBox control itself is merely an internal element of your own control. Previously, you created the `CharAccept` property by hand. However, as you can imagine, manually creating the dozens of properties of a control could get very tedious.

Fortunately, Visual Basic provides a tool to make this process much easier: the ActiveX Control Interface Wizard. First, you tell the wizard the names of all the properties that you want to have for your control. The wizard then allows you to "bind" the properties of your control to the properties of a component of your control. In other words, it can write the procedure and event code for you to make the `Text` property of your UserControl update the `Text` property of the TextBox.

Adding the Wizard to Visual Basic

To use the ActiveX Control Interface Wizard, you first add it to your design environment. For this purpose, Visual Basic includes the Add-In Manager. To start the Add-In Manager, choose Add-Ins, Add-In Manager to open the Add-In Manager dialog box.

To add the VB ActiveX Control Interface Wizard, click the box next to the name of the wizard. This action places a check mark in the box, indicating that the wizard will be included in the Add-Ins menu. Next, click OK to exit the Add-In Manager and add the wizard to Visual Basic.

Now, to demonstrate how to use the wizard, re-create the Limited Character TextBox control:

1. Start a new ActiveX Control project, and draw a text box on the UserControl window.
2. Set up the names and sizes the same way you did in the earlier example (refer to the section "Setting Up the Base Control").
3. Start the wizard by choosing the ActiveX Control Interface Wizard item from the Add-Ins menu. The wizard starts by displaying the initial screen shown in Figure 14.9.

TIP For the wizard to work most effectively, you must add all the required components to the user control before starting the wizard.

4. Click the Next button to start the actual work of setting up your properties.

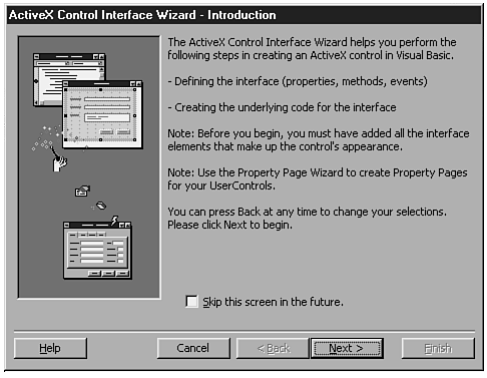


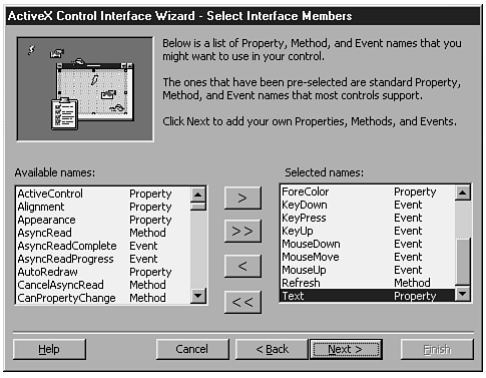
FIGURE 14.9 The ActiveX Control Interface Wizard simplifies the process of creating properties by generating much of the code for you.

Selecting and Creating Properties

The next step in using the ActiveX Control Interface Wizard is to select the properties, methods, and events that you want to have available to your control. Collectively, properties, methods, and events are known as *members*. In the Select Interface Members dialog box, shown in Figure 14.10, the wizard contains a list of the names of just about every item that you could find in any control in Visual Basic. To select a property or method to create, highlight the name of the item in the Available Names list, and then click the right-arrow button to select the item. For the sample control, highlight the `Text` property on the left side, and click the right-arrow button.

TIP You also can select an item by double-clicking it in the list.

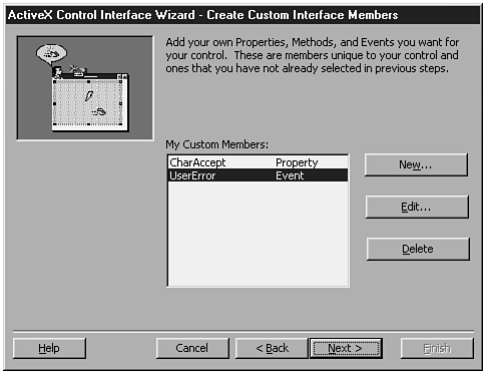
FIGURE 14.10
The first step in creating properties, methods, and events for your control is to add procedures for the commonly used member names.



After you add the `Text` property to the Selected Names list, click the Next button to move to the next page of the wizard.

After selecting the predefined properties, methods, and events for your control, you move to the page of the wizard where you can enter the new custom items for your control. The Create Custom Interface Members dialog box contains a list of all the custom members that will be created for your control (see Figure 14.11).

FIGURE 14.11
The wizard also provides a dialog box to enter member names not listed in the Select Interface Members dialog box.



If you have previously defined public properties or other members, they appear in this list when you first access the dialog box. From this dialog box, you can add new members, and edit or delete existing ones. To add a new member, click the New button of the wizard to open the Add Custom Member dialog box. In this dialog box, you specify the name of the member and its type. Create the `CharAccept` property by typing `CharAccept` in the Name field, and click OK. After you return to the Add Custom Member dialog box, create the `UserError` event by following the same procedure. Finally, click the Next button to move on.

CAUTION

You should not edit or delete members of the control that you previously defined with code alone because the ActiveX Control Interface Wizard works by analyzing comments it places in the code. The wizard may or may not be able to interpret your hand-typed code correctly.

Mapping Properties

The next step in the ActiveX Control Interface Wizard is to assign the public members of the custom control to members of the constituent controls. This process is called *mapping the members*. For example, rather than create your own `Text` property, you can simply map the `Text` property of your custom control to the `Text` property of `txtCharSet`. The Set Mapping dialog box, shown in Figure 14.12, contains a list of all the properties, methods, and events that you identified as being part of the public interface of the custom control.

FIGURE 14.12
Mapping the public members of the control links them to members in the constituent controls.

The Set Mapping dialog box contains two combo boxes to identify the control and the control's member to which a public member should be mapped. To map a single public member of the custom control, follow these steps:

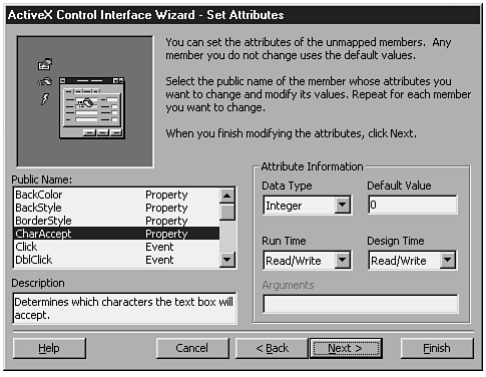
1. Select the member in the Public Name list. For this example, highlight the `Text` property on the left.
2. Select `txtCharSet` from the Control drop-down list. (This list contains the names of all the standard controls in your custom control.)
3. Select the member of that control from the Member drop-down list. In this case, the `Text` property is selected automatically for you. This process is illustrated in Figure 14.12 for the `Text` property of the TxtCharLimit control.

NOTE In the Set Mapping dialog box, notice that you can map more than one public member at a time. The list of public names supports multiple selections. You can select multiple members from the list and then select a component to which to map the members. Each public

member is mapped to the property or method of the component that bears the same name. For example, the `Text` property of the custom control is automatically mapped to the `Text` property of a text or combo box.

4. Click the Next button to proceed to the wizard's final dialog box. This dialog box, shown in Figure 14.13, lets you set the attributes of each public member that is not mapped to a constituent control.

FIGURE 14.13
You can set the attributes for properties and methods before completing the code for the control.



Depending on the type of member you are creating, the wizard enables you to specify different attributes. For a property, you can specify the type of data the property can hold, the default value of the property, and what type of access the user has to the property at designtime and runtime. The access type determines whether a `Property Let`, `Property Get`, or both procedures are created for the property. For runtime access, you can choose Read/Write, Read Only, Write Only, or none. For designtime access, you can choose Read/Write, Read Only, or none.

For the sample control, set the data type of the `CharAccept` property to `Integer`, and set the default value to `0`. You can also type an optional description in the Description box. Property descriptions appear at the bottom of the Properties window during designtime. Because this is the final step of the wizard, you are now ready to click the Finish button.

Finishing the Code

After you click the Finish button, the ActiveX Control Interface Wizard creates a number of code modules in your control. The wizard also displays a summary page, providing details of the steps remaining to finish your control. A sample of this summary page is shown in Figure 14.14.

After reviewing the information on the summary page, you can take a look at the code that was generated by the wizard. You can view the code by clicking the user control in the Project window and then clicking the View Code button.

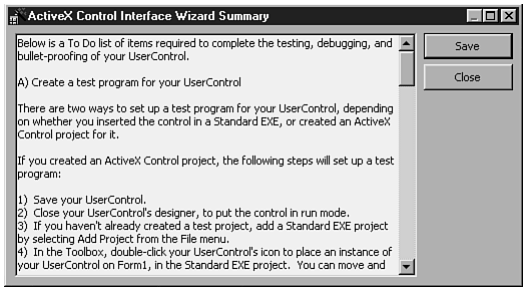


FIGURE 14.14
Refer to the summary page for tips on finishing your control.

Take a look at some of the pieces of the code that is generated. First, in the General Declarations section, you will find that the wizard has created constants for the default values of any unmapped properties. The `CharAccept` property has been given a default value of `0`. In addition, the wizard has automatically created the private property variable `mCharAccept`. It is followed by the declaration of any events that you requested be included in the control. A sample of this code is shown here. If you mapped any events, you will notice that the wizard places comments in the code to indicate how events are mapped to constituent control events:

```
Option Explicit

'Default Property Values:
Const m_def_BackColor = 0
Const m_def_ForeColor = 0
Const m_def_CharAccept = 0

'Property Variables:
Dim m_BackColor As Long
Dim m_ForeColor As Long
Dim m_CharAccept As Integer

'Event Declarations:
Event Click() 'MappingInfo=txtCharset,txtCharset,-1,Click
Event DblClick()
Event UserError()
Event KeyPress(KeyAscii As Integer)
```

The declarations of variables and events are followed by the property procedures. These procedures are created for properties that are mapped to a component property and those that are custom properties. As you can see in the following code segment, the code for the `Text` property is complete, whereas the `CharAccept` property has a skeleton function ready to be finished:

```
'WARNING! DO NOT REMOVE OR MODIFY THE FOLLOWING COMMENTED LINES!
'MappingInfo=txtCharset,txtCharset,-1,Text
Public Property Get Text() As String
    Text = txtCharset.Text
End Property

Public Property Let Text(ByVal New_Text As String)
    txtCharset.Text() = New_Text
    PropertyChanged "Text"
End Property
```

```
Public Property Get CharAccept() As Integer
    CharAccept = m_CharAccept
End Property

Public Property Let CharAccept(ByVal New_CharAccept As Integer)
    m_CharAccept = New_CharAccept
    PropertyChanged "CharAccept"
End Property
```

Note that if you request any methods, the wizard creates them as functions instead of sub procedures.

Finally, the code to read and write property values to the `PropertyBag` object is generated automatically. This code is as follows:

```
'Load property values from storage
Private Sub UserControl_ReadProperties(PropBag As PropertyBag)

    m_BackColor = PropBag.ReadProperty("BackColor", m_def_BackColor)
    m_ForeColor = PropBag.ReadProperty("ForeColor", m_def_ForeColor)
    txtCharset.Text = PropBag.ReadProperty("Text", "")
    m_CharAccept = PropBag.ReadProperty("CharAccept", m_def_CharAccept)
End Sub

'Write property values to storage
Private Sub UserControl_WriteProperties(PropBag As PropertyBag)

    Call PropBag.WriteProperty("BackColor", m_BackColor, m_def_BackColor)
    Call PropBag.WriteProperty("ForeColor", m_ForeColor, m_def_ForeColor)
    Call PropBag.WriteProperty("Text", txtCharset.Text, "")
    Call PropBag.WriteProperty("CharAccept", m_CharAccept, m_def_CharAccept)
End Sub
```

To complete the coding of your control, you need to add the custom code that is required for the `CharAccept` property and `KeyPress` event, shown in Listing 14.4.

Listing 14.4 LIMITED.ZIP—Changes to the Code Generated by the Wizard

```
Public Property Get CharAccept() As Integer
     CharAccept = mCharAccept
End Property

Public Property Let CharAccept(ByVal nNewValue As Integer)

        Select Case nNewValue
         Case 1 To 2
             mCharAccept = nNewValue
         Case Else
             mCharAccept = 0
        End Select

        PropertyChanged "CharAccept"

End Property
Private Sub txtCharSet_KeyPress(KeyAscii As Integer)
    If KeyAscii = 8 Then Exit Sub
```

continues

Listing 14.4 Continued

```
    Select Case mCharAccept
        Case 0 'Any character is acceptable
            Exit Sub
        Case 1 'Only numbers may be entered
            If KeyAscii >= 48 And KeyAscii <= 57 Then
                Exit Sub
            Else
                KeyAscii = 0
                Beep
                RaiseEvent UserError
            End If
        Case 2 'Only letters may be entered
            If KeyAscii >= 65 And KeyAscii <= 90 Then
                Exit Sub
            ElseIf KeyAscii >= 97 And KeyAscii <= 122 Then
                Exit Sub
            Else
                KeyAscii = 0
                Beep
                RaiseEvent UserError
            End If
    End Select

End Sub
```

Adding the custom code is necessary because the wizard creates a only "skeleton" for these items. After all, if the wizard could do everything, then you would be out of a job!

Using the Property Pages Wizard

You have seen Property Pages used for some of the controls that come with Visual Basic. These dialog boxes make it easy for you to set the properties of a control by organizing them into groups. You can create Property Pages for your own custom controls by using the Property Pages Wizard. As with the ActiveX Control Interface Wizard, you have to add the Property Pages Wizard to the desktop through the use of the Add-In Manager. After you take this step, you can access the Property Pages Wizard from the Add-Ins menu of Visual Basic. Upon starting the Property Pages Wizard, you see an introductory screen that explains the purpose of the wizard. Clicking the Next button on this page takes you to the first dialog box, where the real work is done.

Creating the Pages

The Select the Property Pages dialog box lets you define the pages of the Property Pages dialog box (see Figure 14.15). If you have included `Font` and `Color` properties in your control, the wizard starts with two default pages: StandardColor and StandardFont. If you do not need these pages, just click the boxes next to the names to remove them from the Property Pages.

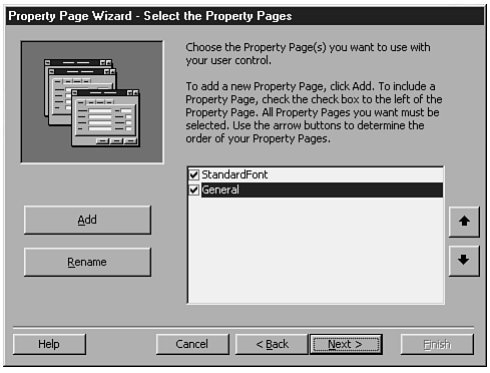


FIGURE 14.15
You can create new pages or rename old ones in the Property Page Wizard.

In addition to the default pages, you can add new pages to the dialog box. Clicking the Add button brings up the Property Page Name dialog box, which is an input box in which you can enter the name of the page to create. As you add a page name, it is placed in the list of available pages and is automatically checked. The order of the page names in the list is the order in which the tabs will appear in your Property Pages dialog box. You can change the order by selecting a page and using the arrow keys to move it within the list.

After you finish adding pages to the dialog box, click the Next button to move to the next dialog box.

Adding Properties to the Pages

The next step in creating your Property Pages is to add the appropriate properties to each page of the dialog box. The Add Properties dialog box is shown in Figure 14.16.

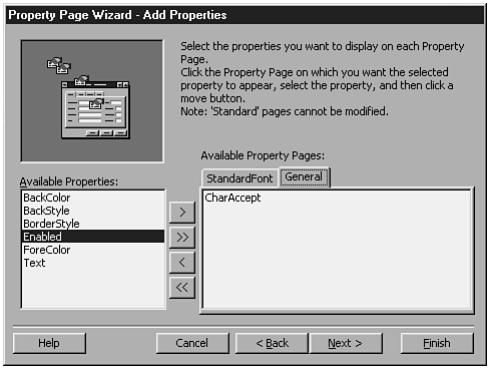


FIGURE 14.16
The Add Properties dialog box displays a list of available properties and shows the defined pages of the dialog box.

To add a property to a page, click the tab corresponding to the page where you want the property placed, and then select the property from the Available Properties list and click the right-arrow button. In Figure 14.16, notice the addition of a General Property Page and the inclusion of the `CharAccept` property. In addition, if you have the default pages of StandardColor and

StandardFont, you will notice that the appropriate properties have already been added to these pages.

TIP You can drag and drop a property onto a tab to place it on the corresponding page of the Property Pages.

After you finish adding properties to the pages, click the Finish button to complete the creation of your Property Pages. Like the ActiveX Control Interface Wizard, the Property Pages Wizard shows a summary page that provides additional information for you to complete your custom control.

Using the Property Pages in Your Applications

To use the Property Pages you created, you need to add an instance of your custom control to a project. Then, in the Properties window, click the ellipsis (...) button next to the `Custom` property. Then, just like the Property Pages of other controls, your Property Pages dialog box presents itself to allow the user to customize the control. A sample of a custom control's Property Pages is shown in Figure 14.17.

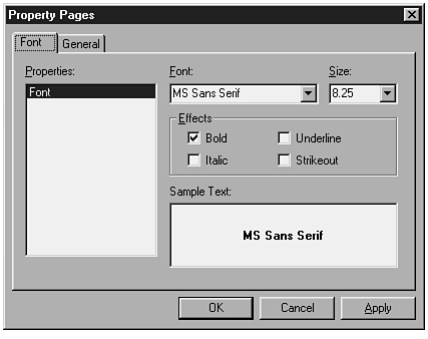


FIGURE 14.17
Your Property Pages help the users set up your ActiveX control.

TIP You also can access the Property Pages by right-clicking the control and selecting the Properties item from the context menu.

Creating a User-Drawn ActiveX Control

The previous two examples have demonstrated how to create ActiveX controls from other controls. The following sections will demonstrate how to create a control totally from scratch by drawing the interface with graphics methods and by creating the properties, methods, and events of the control. The control you create in this chapter is a command button with different foreground and background color settings, which is something you cannot do with a regular command button. Although a command button is a relatively simple example, it introduces you to the process of drawing your own control.

Starting the Project

To begin creating the Color Button control, you need to start a new ActiveX Control project. After creating the project, set the properties of the project and the user control, as shown in Table 14.2.

Table 14.2 Properties of the Project and Control

Item	Setting
Project Name	ColorButton
Project Description	Color Enhanced Command Button
User control `Name` property	`ColorBtn`
User control `Public` property	`True`

Creating the User Interface

In previous examples, you drew the user interface on the `UserControl` object by using existing controls. However, in this user-drawn control, you can create the interface entirely with code in the UserControl's event procedures. You need to place the code to draw the shape of the Color Button in the `Paint` event of the UserControl. The `Paint` event is fired whenever the container (such as a form) that holds your control is redrawn. You can also force the `Paint` event by issuing the `Refresh` method of the control. Keep in mind that your command button is really just a picture. You will be using graphics methods, such as the `Line` method, to draw what the user sees. For example, when a user clicks your control, you will use lines to redraw the button so that it looks like it has been pressed. For more information about graphics methods, refer to Chapter 19, "Using Visual Design Elements."

▶ **See** "Using the Line and Shape Controls," **p. 426**

To draw a rectangular command button, you need only the `Line` and `Print` methods. In this case, the button fills the entire space of the UserControl area. The code for drawing a colored button involves three steps:

1. Use the `Line` method of the `UserControl` object to draw a filled rectangular box the full size of the control. To create a box at the appropriate size, use the `Height` and `Width` of the control as parameters in the `Line` method.
2. To simulate the "raised" state of the button, change the colors of the lines that form the rectangular box. This action involves additional calls to the `Line` method that draw a white line along the top and left edges of the control and a black line along the bottom and right edges of the control. These lines give the button the standard "raised" appearance. (When the button is "pressed," you reverse the appearance by swapping the white and black lines.)
3. Using the `Print` method, draw a caption on the button.

The code for creating the body of the button, which should be placed in the UserControl's `Paint` event, is shown in Listing 14.5.

Listing 14.5 COLORBTN.ZIP—Using the *Line* Method to Draw the Color Button

```
Private Sub UserControl_Paint()
    Dim nHeight As Integer
    Dim nWidth  As Integer

    With UserControl

        'Leave some room for the border
        nHeight = .Height - 10
        nWidth = .Width - 10

        'Set UserControl's BackColor, draw a colored box
        .DrawWidth = 1
        .FillColor = lngBackColor
        .FillStyle = 0
        UserControl.Line (0, 0)-(nWidth, nHeight), , B

        'Draw lower right lines
        .DrawWidth = 3
        If bMouseDown = False Then
            .ForeColor = vbBlack
        Else
            .ForeColor = vbWhite
        End If
        UserControl.Line (0, nHeight)-(nWidth, nHeight)
        UserControl.Line (nWidth, 0)-(nWidth, nHeight)

        'Draw upper-left lines
        If bMouseDown = False Then
            .ForeColor = vbWhite
        Else
            .ForeColor = vbBlack
        End If
        UserControl.Line (0, 0)-(nWidth, 0)
        UserControl.Line (0, 0)-(0, nHeight)

        'Calculate and move to the the caption position
        .CurrentX = (.Width - .TextWidth(m_Caption)) / 2
        If .CurrentX < 5 Then .CurrentX = 5
        .CurrentY = (.Height - .TextHeight(m_Caption)) / 2
        If .CurrentY < 5 Then .CurrentY = 5

        'Draw the Caption
        .ForeColor = lngForeColor
        UserControl.Print m_Caption

End With

End Sub
```

The code in Listing 14.5 should be fairly easy to follow. First, several calls to the `Line` method are used to draw a box and some lines to represent the command button. Next, the button

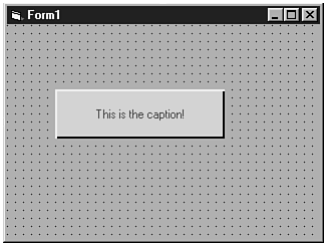
caption is drawn in the center of the control. Note that several module-level variables are referenced in the `Paint` event; for example, the button's color is determined by the variable `lngBackcolor`, which holds the contents of the `BackColor` property. The following variables should be declared in the General Declarations section of the `UserControl` object:

```
Dim lngForeColor As Long    'Button Foreground
Dim lngBackColor As Long    'Button Background
Dim bMouseDown As Boolean   'Is the mouse pressed?
```

The module-level variables are necessary so that their values can be set from the property procedures of the control. The Boolean variable `bMouseDown` determines whether the button is drawn "raised" or "pressed."

Figure 14.18 shows how the basic Color Button control looks on the form of a test project.

FIGURE 14.18
Code in the `Paint` event draws the user interface for the custom command button.



The final step in creating the user interface is to set initial values for the button colors. To do so, place a few assignment statements in the `Initialize` event of the control, as follows:

```
Private Sub UserControl_Initialize()
    lngBackColor = vbCyan
    lngForeColor = vbBlue
End Sub
```

The preceding lines of code provide initial settings for the `Paint` event.

Creating the Properties of the Button

As stated previously, you can keep the design of the command button simple. The four key properties of the button are the `BackColor`, `Caption`, `Font`, and `ForeColor` properties. Three of these properties—`BackColor`, `Font`, and `ForeColor`—will be tied to the corresponding properties of the user control. In addition, the `BackColor` and `ForeColor` properties will be stored as variables for use in the code.

Using the ActiveX Control Interface Wizard, you can easily create the properties that you need. You have to add the `Caption` property as a Custom Member, as well as map the `BackColor`, `Font`, and `ForeColor` properties to those of the `UserControl` object. The wizard creates the `Property Let` and `Property Get` procedures for the four properties. Consider, for example, the `Property Get` procedure for the control's `BackColor` property:

```
Public Property Get BackColor() As OLE_COLOR
    BackColor = UserControl.BackColor
End Property
```

This procedure simply returns the background color of the user control and can be used as is. However, you need to add an extra line to the `Property Let` procedure, as shown here:

```
Public Property Let BackColor(ByVal New_BackColor As OLE_COLOR)
    UserControl.BackColor() = New_BackColor
    lngBackColor = UserControl.BackColor
    PropertyChanged "BackColor"
End Property
```

In this code, notice that a line was added to store the color in the variable `lngBackColor`. This variable, declared in the General Declarations section, is used by code in the `Paint` event. The other properties, shown in Listing 14.6, are coded in a similar fashion.

Listing 14.6 COLORBTN.ZIP—Most of the Property Procedures Were Created by the Wizard

```
Public Property Get Font() As Font
    Set Font = UserControl.Font
End Property

Public Property Set Font(ByVal New_Font As Font)
    Set UserControl.Font = New_Font
    PropertyChanged "Font"
End Property

Public Property Get ForeColor() As OLE_COLOR
    ForeColor = UserControl.ForeColor
End Property

Public Property Let ForeColor(ByVal New_ForeColor As OLE_COLOR)
    UserControl.ForeColor() = New_ForeColor
    lngForeColor = UserControl.ForeColor
    PropertyChanged "ForeColor"
End Property

Public Property Get Caption() As Variant
    Caption = m_Caption
End Property

Public Property Let Caption(ByVal New_Caption As Variant)
    m_Caption = New_Caption
    UserControl_Paint
    PropertyChanged "Caption"
End Property
```

Although you need to declare the variables `lngForeColor` and `lngBackColor`, the ActiveX Control Interface Wizard declares `m_Caption` for you automatically. The reason for this difference is that the `Caption` property is not mapped to the `UserControl` object. You also might want to set the constant for the default caption name, `m_def_Caption`, to something other than `0`. `ColorBtn` would be an appropriate choice.

NOTE The wizard also creates the code for the `WriteProperties` and `ReadProperties` events so that the property values can be saved in the `PropertyBag` object.

Setting Up the Button's Events

You also can use the ActiveX Control Interface Wizard to create the events for the Color Button control. You can do so at the same time you create the properties, or you can run the wizard again. Remember to map the `Click`, `GotFocus`, `MouseDown`, and `MouseUp` events to the corresponding events in the UserControl. (Refer to the section "Mapping Properties" earlier in the chapter.)

After the wizard creates the skeleton code, make an addition to the code for the `MouseDown` and `MouseUp` events. Because you want your custom button to behave similarly to a standard command button, change the appearance of the button as it is "pressed." You do so by drawing black lines along the top and left edges of the button when the `MouseDown` event is fired and by redrawing the white lines along those edges when the `MouseUp` event is fired. This is coded by setting the Boolean variable `bMouseDown` and then running the code in the UserControl's `Paint` event. After you make the additions to these two events, the event code for the ColorBtn control should look like the code in Listing 14.7.

Listing 14.7 COLORBTN.ZIP—Event Code Defined by the Wizard and Enhanced by You

```
Private Sub UserControl_MouseDown(Button As Integer, _
Shift As Integer, X As Single, Y As Single)
    bMouseDown = True
    UserControl_Paint
    RaiseEvent MouseDown(Button, Shift, X, Y)
End Sub

Private Sub UserControl_MouseUp(Button As Integer, _
Shift As Integer, X As Single, Y As Single)
    bMouseDown = False
    UserControl_Paint
    RaiseEvent MouseUp(Button, Shift, X, Y)
End Sub
```

NOTE Do not confuse the events discussed here with the events of the ColorBtn control, as seen from the user's perspective. The code in Listing 14.7 executes when the `UserControl` object receives mouse events. The last statement, `RaiseEvent`, fires the corresponding event in the ColorBtn control, executing any code the user may have placed there. ■

Figure 14.19 shows the pressed state of the ColorBtn control.

Creating Property Pages for the Button

The final task you will perform for the design of the Color Button control is to create the Property Pages so that the user can set the properties of the control easily. Use the Property Page Wizard to create the pages (refer to the section "Using the Property Pages Wizard" earlier in the chapter), and follow these steps:

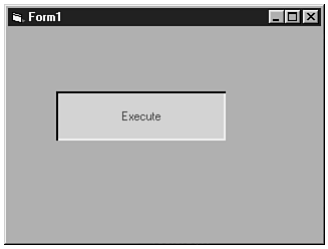


FIGURE 14.19
Black lines give the indication of a pressed button.

1. Add a General page to the pages.
2. Place the `Caption` property on the General page.
3. Verify that the `BackColor` and `ForeColor` properties are on the StandardColor page.
4. Verify that the `Font` property is on the StandardFont page.

Testing the Color Button in a Program

At this point, the design of the ActiveX control is complete. You now are ready to test it in a program. You first need to add a Standard EXE project to the project group containing the ColorBtn. You then need to close the ColorBtn design window to make the control available to your project.

Next, you can draw the control on your form just like any other control. As you draw the button, you will see the typical rubber band box indicating the size of the control. When you release the mouse button, the control will be drawn using the default colors and caption (refer to Figure 14.18 to see how the control looks).

Setting the Button's Properties After the button is placed on the form, set the values of the properties. You can, of course, set the properties from the Properties window. One point to notice is that if you placed a description in the `Caption` property when you defined it in the wizard, this description shows up in the area below the properties list when the `Caption` property is selected. This description is another way to help your users work with your custom control.

Another way to set the properties of your control is to use the Property Pages you created. The dialog box shown in Figure 14.20 enables you to set the `Caption`, `BackColor`, `ForeColor`, and `Font` properties of the control. The `Paint` event is fired whenever you close the Property Pages. At this time, the effects of the new properties are shown.

Writing Code for the Events Writing code for an event procedure of the custom control is like writing code for any other event procedure. You can double-click the control to access the Code window in your test project and then begin typing code. Just to make sure the `Click` event of the ColorBtn control works, place a message box in the event procedure to announce that the button has been clicked. This code is shown in the following line:

```
MsgBox "You clicked the ColorBtn control."
```

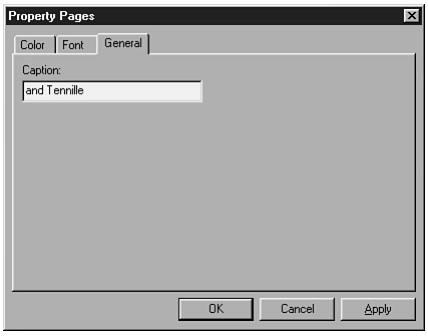


FIGURE 14.20
Property Pages provide an organized way for users to set properties of a control.

After you add the `MsgBox` statement, test the `Click` event by running the project. When you click the ColorBtn control, the message should be displayed. If you want to test any other events, follow the same steps.

From Here...

This chapter showed you how to create ActiveX controls, as an enhancement to existing controls as well as entirely from scratch. You also looked at two wizards that Visual Basic provides to aid in control creation. To learn more about the topics related to those in this chapter, see the following:

- To learn more about creating ActiveX controls, see Chapter 15, "Extending ActiveX Controls."
- To learn about ActiveX documents, see Chapter 32, "ActiveX Documents."

CHAPTER 15

Extending ActiveX Controls

In this chapter

Using the `Ambient` Object to Maintain Uniformity 342

Introducing the `Extender` Object 344

Building the Calculator Control 345

Creating Property Pages 350

Control Error Handling 355

In Chapter 14, "Creating ActiveX Controls," you learned the basics of creating an ActiveX control project in Visual Basic. You also used two add-in wizards to aid in control development. This chapter continues the discussion of ActiveX controls, with some additional topics that will help you build better controls. The following sections cover these topics:

- Using objects that enhance control integration with their containers
- Creating Property Pages for added flexibility without using a wizard
- Handling errors in your ActiveX controls

You'll also build a slightly more involved ActiveX control, the Calculator control.

Using the *Ambient* Object to Maintain Uniformity

With a Standard EXE project, you have a great amount of control over what the user sees, such as the color and layout of the forms. However, ActiveX controls can be placed in a number of containers, determined by the user. In order for the control to behave in a consistent and desired manner in each type of container, it is necessary for the control to have access to information about its container. Fortunately, programmers can write code in a UserControl object that uses the `Ambient` object to determine information about its surroundings.

Setting Up an *Ambient* Object Example

To demonstrate a use of the `Ambient` object, start a new Standard EXE project, and then add an ActiveX Control project to create a project group. Resize the UserControl object so that it is fairly small (about 1605×1050 twips), and close the UserControl window. Next, set the `BackColor` property of `Form1` to purple, and draw an instance of the user control on the form. The results should look similar to Figure 15.1.

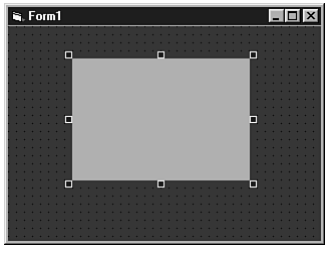


FIGURE 15.1
User controls will not automatically respond to color changes in the container.

Notice that the control's background color does not match that of the form. Most likely, the control would work properly, but the color difference would be a distraction to the users. For the control to match the background automatically, code within the UserControl object needs a way to retrieve the `BackColor` property of its container. Fortunately, the `Ambient` object makes this and other information available.

Keeping Track of the Ambient Colors

To fix this potential problem, you have to set the control's colors to match those of its container. First, delete the instance of the sample control you just created, and return to the UserControl window. Next, add the following lines of code to the `InitProperties()` event procedure:

```
UserControl.BackColor = Ambient.BackColor
UserControl.ForeColor = Ambient.ForeColor
```

Your control should now be able to match itself to the container's colors. To verify this fact, close the UserControl window so that the control becomes available in the Toolbox. Then draw an instance of the user control on the form. When the new control instance appears, it should be the same color as the form (see Figure 15.2).

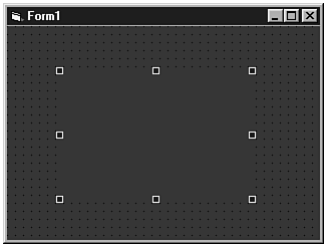


FIGURE 15.2
The `Ambient` object can retrieve information about the control's container, such as the color properties.

What happens, though, if the users of the control change the background color again? Go ahead and set the `BackColor` property of the form to another color. When you do, the form immediately changes to match your selection, but the control remains purple. You get this result because you placed code in the `InitProperties` event but not in the all-important `AmbientChanged` event.

To demonstrate, add code for this event to the user control now:

```
Private Sub UserControl_AmbientChanged(PropertyName As String)
    UserControl.BackColor = Ambient.BackColor
    UserControl.ForeColor = Ambient.ForeColor
End Sub
```

Now, close the UserControl window, and draw an instance of the control on the form. Change the `BackColor` property values, and this time the control's background color changes as well.

Properties of the *Ambient* Object

As you have probably guessed, the `AmbientChanged` event fires when the properties of the `Ambient` object are changed. The example updates the `ForeColor` and `BackColor` properties every time the event is fired, but the `PropertyName` parameter allows you to determine which property changed.

In addition to the color properties, the `Ambient` object contains several others. Some of the more important ones are listed in Table 15.1.

Table 15.1 Important *Ambient* Properties

Property	Description
`BackColor`	Holds the container's background color.
`DisplayAsDefault`	Indicates whether a user-drawn control is the default control in the container.
`DisplayName`	Holds the name of the control instance. You can use the `DisplayName` property to identify the messages presented to the developer at designtime.
`Font`	Represents the font of the container.
`ForeColor`	Holds the foreground color of the container.
`LocaleID`	Indicates the locale in which the control is running. In international programs, this property is useful for changing the language or date formats.
`TextAlign`	Represents the container's text alignment setting.
`UserMode`	Indicates whether the control is running at designtime or runtime. A `UserMode` value of `False` indicates designtime; `True` indicates runtime. Another property, `UIDead`, indicates break mode.

You can access each of the properties in Table 15.1 from within the control by using the `Ambient` object.

Introducing the *Extender* Object

In addition to the properties provided by the `Ambient` object, there is a separate object known as the `Extender` object, which provides some other useful properties. These properties, called *extender properties*, at first glance appear to be part of a control instance. For example, when you place a control on a form, the `Left` and `Top` properties look like they are part of that control. However, in reality, these properties and several others are part of the `Extender` object.

Although the `Ambient` and `Extender` objects both provide information about a control in relation to its container, the `Extender` object is not available until the control has been sited (placed) on its container. Because each container is different, you cannot determine in advance what the container is or which properties it will support. For this reason, you can't access the `Extender` object in a control's `Initialize` event procedure, which is called before the control is completely sited on its container. However, you can access the `Extender` object in the `InitProperties` and `ReadProperties` events.

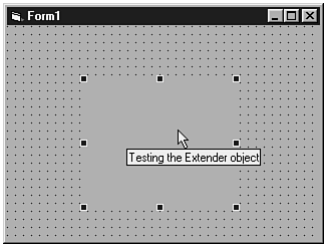
To view the extender properties, draw an instance of the sample control on a form, and press F4 to display the Properties window. Notice that even though you have not added any properties to the user control, several are already listed. They are the properties of the `Extender` object.

To demonstrate, add the following code to the user control's `InitProperties` event:

```
UserControl.Extender.ToolTipText = "Testing the Extender object"
```

Next, draw an instance of the control on the form. The `ToolTipText` property should automatically appear after the control instance is drawn. You can verify this fact by hovering the mouse pointer over the control, as shown in Figure 15.3.

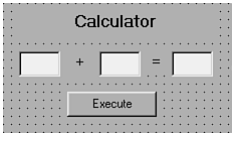
FIGURE 15.3
The `Extender` object allows the control to change properties set by its container.



Building the Calculator Control

In this section, you build a sample Calculator control to be used as the basis for the topics presented in the remainder of this chapter. The Calculator control is a simple ActiveX control that allows users to provide two input values and perform a mathematical operation on them: multiply, add, subtract, or divide. The mathematical operation is controlled by the `Operation` property and performed when the users click a button. The sample control is shown in Figure 15.4.

FIGURE 15.4
This Calculator control has its constituent controls in place.



Creating the Control

To create the Calculator control, start a new ActiveX Control project. Then arrange the following constituent controls on the new UserControl designer:

- `lblCaption`—A label that the users will access through the `Caption` property of the control.

- `txtNum1` and `txtNum2`—Text boxes that hold input from the users.
- `lblOperation`—A label between the text boxes indicating which operation is to be performed.
- `lblEquals`—A label that displays the equal sign (=) to indicate a mathematical equation visually.

- `txtResult`—A text box used to hold the result of the calculation.
- `cmdExecute`—A command button used to perform the calculation. The users can change the button's caption through the `ButtonCaption` property of the control.

After you finish placing the controls, your control should look similar to the one shown in Figure 15.4.

Creating the Interface

The next step in creating the Calculator control is to write code for the properties. As you may recall from the preceding chapter, the ActiveX Control Interface Wizard enables you to expose properties, methods, and events of your control. The sample Calculator control includes a number of properties that can be exposed through the wizard. Follow these steps:

▶ **See** "Using the ActiveX Control Interface Wizard," **p. 323**

1. Start the Wizard by choosing the ActiveX Control Interface Wizard item from the Add-Ins menu. Then click Next.
2. In the Select Interface Members dialog box, add `Caption` property to the control.
3. In the Create Custom Interface Members dialog box, add two new properties, a method, and an event, as shown in Figure 15.5. These custom members are as follows:
   - `Operation` property—Determines whether the control adds, subtracts, multiplies, or divides
   - `ButtonCaption` property—Determines the caption of the command button
   - `ValidateEntries` method—Validates user input into the text boxes
   - `BadEntries` event—Fires when erroneous input is encountered

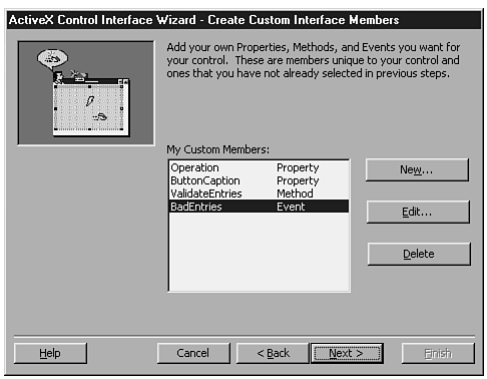


FIGURE 15.5
The Calculator control needs four new control members.

4. In the Set Mapping dialog box, map the `ButtonCaption` property to the `Caption` property of `cmdExecute`. Also, map the `Caption` property of the control to the `Caption` property of `lblCaption`.

You can also map the `BackColor`, `ForeColor`, and `BorderStyle` properties to the corresponding properties of the UserControl object, if you want.

5. Click Finish, and the wizard creates additional source code in your UserControl object.

Now all you have to do is write the program code for the properties, methods, and events.

Setting Up the *Operation* Property

By default, the ActiveX Control Interface Wizard creates the `Operation` property as a Variant and includes a private variable `m_Operation` to hold the property's value. However, you will use an integer value to represent the operation: `0` for addition, `1` for multiplication, `2` for subtraction, and `3` for division.

To make the control easy to use, you shouldn't require the users to memorize these arbitrary integer values. Therefore, you can use an `Enum` to provide the integer values. To allow your control to provide these values, you must first add the `Enum` declaration to the General Declarations section of the UserControl object, as shown in Listing 15.1.

Listing 15.1 CALC.ZIP—Declaring an Enum for the *Operation* Property

```
Public Enum OpType
    Add = 0
    Multiply = 1
    Subtract = 2
    Divide = 3
End Enum

Dim m_Operation As OpType    <--- Change this line
```

In Listing 15.1, you add a new type, `OpType`, as well as change the type of the `m_Operation` variable from Variant to `OpType`. Next, you need to modify the `Operation` Property's `Get` and `Let` procedures, as shown in Listing 15.2.

Listing 15.2 CALC.ZIP—Changing the Property Procedures to Use the *OpType* Type

```
Public Property Get Operation() As OpType
    Operation = m_Operation
End Property

Public Property Let Operation(ByVal New_Operation As OpType)
    m_Operation = New_Operation
    PropertyChanged "Operation"

    Select Case m_Operation
        Case Add
            lblOperation = "+"
        Case Subtract
            lblOperation = "-"
```

continues

Listing 15.2 Continued

```
        Case Multiply
            lblOperation = "X"
        Case Divide
            lblOperation = "/"
    End Select
    txtResult = ""
End Property
```

In Listing 15.2, in addition to changing the property procedures to use the `OpType` type, you also add code to update `lblCaption` and clear `txtResult` when the operation type changes. Using `Enums` in this manner is just one way to make your control more robust. Figure 15.6 shows how the `Operation` property looks in the Properties window for a control instance.

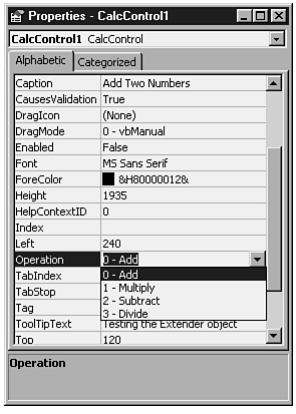


FIGURE 15.6
The `Operation` property provides a list of valid values rather than requiring the users to know them.

Coding Methods and Events

The `ValidateEntries` method determines whether users have typed valid numeric data into the two text boxes. It is a simple function that returns `True` or `False`. The code for this function is shown in Listing 15.3.

Listing 15.3 CALC.ZIP—The *ValidateEntries* Method

```
Public Function ValidateEntries() As Boolean

    'Assume entries are invalid
    ValidateEntries = False

    'Check for Empty Strings
    If Trim$(txtNum1) = "" Or Trim$(txtNum2) = "" Then Exit Function

    'Check for Numeric values
    If Not IsNumeric(txtNum1) Then Exit Function
    If Not IsNumeric(txtNum2) Then Exit Function
```

```
    'If you made it this far, then they are valid!
    ValidateEntries = True

End Function
```

The `Click` event of the `cmdExecute` button contains the code that actually performs the calculation and displays the result. To create this event procedure, use the code from Listing 15.4.

Listing 15.4 CALC.ZIP—The *Click* Event of *cmdExecute*

```
Private Sub cmdExecute_Click()
    Dim nVal1 As Integer
    Dim nVal2 As Integer
    Dim nResult As Integer

    If ValidateEntries() = False Then
        RaiseEvent BadEntries
        txtResult = "???"
        Exit Sub
    End If

    nVal1 = Val(txtNum1)
    nVal2 = Val(txtNum2)

    Select Case m_Operation
        Case Add
            nResult = nVal1 + nVal2
        Case Multiply
            nResult = nVal1 * nVal2
        Case Subtract
            nResult = nVal1 - nVal2
        Case Divide
            nResult = nVal1 / nVal2
    End Select

    txtResult = nResult

End Sub
```

Testing the Control

To see the control from the developer's point of view, close the user control designer. You can create a project group with a Standard EXE test project by selecting File, Add Project. Open the form in the Standard EXE project. Draw an instance of the user control on the form, and display the Properties window. You can set the `ButtonCaption`, `Caption`, and `Operation` properties from this window. Double-click the control, and enter your own code in the `BadEntries` event:

```
Private Sub CalcControl1_BadEntries()
    MsgBox "You have entered invalid numbers!"
End Sub
```

Finally, run the test program, and verify that the calculator fires this event when invalid data is entered.

Creating Property Pages

Chapter 14 included a brief overview of Property Pages, which are tabbed dialog boxes designed to make it easy for users to set design-time properties. As you know, Property Pages can be displayed by pressing the ellipsis button in the `Custom` property of the Properties window, or by right-clicking a control and choosing Properties. In addition to being a neat way to organize the properties of your control, Property Pages included with your control can be used in a development environment other than Visual Basic.

Chapter 14 showed how to create Property Pages by using the Property Pages Wizard. The wizard is designed to provide you with a quick way of creating a property sheet, but it does not provide all the possible options. In this section, you learn how to create Property Pages manually, which allows you to make design and feature choices that are unavailable through the Property Pages Wizard.

▶ **See** "Using the Property Pages Wizard," **p. 330**

The following list describes the general steps involved in creating Property Pages, and the subsequent sections explain these steps in more detail:

1. Create Property Page objects for each group of properties.
2. On the Property Page objects, place controls that the developer can use to edit the properties.
3. Implement the `SelectionChanged` event procedure for each Property Page. This event procedure is responsible for reading in the current values of each control's properties.
4. Implement the `Change` event procedure (or sometimes the `Click` event procedure) for each control on each Property Page.
5. Implement the `ApplyChanges` event procedure for each Property Page. Its task is to copy the new property values from the Property Page controls to the corresponding properties on the user control.
6. Connect the Property Pages to the custom control.

Creating Property Page Objects

The first step in creating the Property Pages dialog box for your control is to create Property Page objects for each group of properties you want to include. How you organize these groups is entirely up to you, although you should use common sense. If your control has only a few properties, you may need only a single Property Page. However, if the control has many properties, you should group related properties on their own Property Pages.

For the sample Calculator control, you'll create only a single Property Page called General. Follow these steps to add the General Property Page object to the user control project:

1. Make sure that ActiveX Control project is selected in the Project Explorer and choose Project, Add Property Page. The Add PropertyPage dialog box appears.

2. Double-click the Property Page icon, and a new Property Page object appears. Notice that it looks similar to a form designer.
3. Bring up the Properties window of the Property Page by pressing F4.
4. Change the `Name` property of the Property Page to `CalcGeneral`.
5. Change the `Caption` property of the Property Page to `General`. (The caption appears in the tab of the Property Page, which is not displayed in the design environment.)

After you create the new Property Page objects, they should appear in your Project Explorer window, as shown in Figure 15.7.

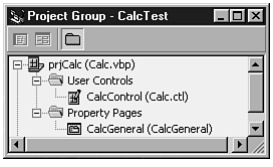


FIGURE 15.7
Property Pages are separate objects in an ActiveX control project.

Placing Controls on the Property Pages

Now that you have created the Property Page objects, you can add the controls you need to edit the properties of custom controls to which the Property Page objects will be attached. The types of controls to use are up to you. Usually, though, you'll use text boxes to represent text properties, check boxes to represent Boolean (true/false) properties, list boxes to represent properties with multiple settings, and so on. Follow these steps to add controls to the Property Pages you have created for the Calculator control:

1. Double-click the `CalcGeneral` object in the Project Explorer window to display the General Property Page.

2. Add three Label controls to the Property Page, using the following properties:

Name	Caption
`lblCaption`	`Caption`
`lblBCaption`	`Button Caption`
`lblOperation`	`Operation`

3. Add two TextBox controls, `txtCaption` and `txtButtonCaption`, to hold the control captions.

4. Add a ComboBox control, `cmbOperation`, to hold the operation types.

After adding all these controls, your General Property Page should look like the one shown in Figure 15.8.

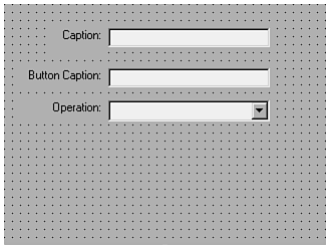


FIGURE 15.8
Here's the `CalcGeneral` Property Page with all its controls.

Implementing the *SelectionChanged* Event Procedure

Imagine for a moment that a developer is using the Calculator control as part of an application. The developer has placed two Calculator controls on a form, one for addition and the other for multiplication. When the developer displays the Property Pages dialog box for one or more of these user controls, the `SelectionChanged` event of the Property Page object fires so that each user control's current property settings can be displayed on the Property Page. To write code to load properties into the text box and combo box, open the code window for the `CalcGeneral` Property Page by double-clicking the Property Page object. Next, enter the lines of code from Listing 15.5 in the `SelectionChanged` event procedure.

Listing 15.5 CALC.ZIP—The *SelectionChanged* Event Procedure

```
Private Sub PropertyPage_SelectionChanged()

    txtCaption.Text = SelectedControls(0).Caption
    txtButtonCaption.Text = SelectedControls(0).ButtonCaption

    cmbOperation.Clear
    cmbOperation.AddItem "0 - Add"
    cmbOperation.AddItem "1 - Multiply"
    cmbOperation.AddItem "2 - Subtract"
    cmbOperation.AddItem "3 - Divide"
    cmbOperation.ListIndex = SelectedControls(0).Operation
    Changed = False
End Sub
```

Notice that each control on the Property Page is assigned a value from a property of a control in the `SelectedControls` collection. As you will see, Property Pages can modify the properties of several controls simultaneously. Currently, you've created a Property Page that can handle only a single control selection.

Implementing the *Change* Event Procedures

When a developer changes the value of a control on a form, the control's `Change` event is fired. For a Property Page, you use this event to notify Visual Basic that the contents of a property have changed.

NOTE Some controls, such as the CheckBox and ComboBox, use the `Click` event instead of the `Change` event to handle the change notification.

All you have to do is set the `Changed` property of the Property Page object to `True`, which tells Visual Basic to enable the Apply button. The code for the `Change` and `Click` events of the `CalcGeneral` page is shown in Listing 15.6.

Listing 15.6 CALC.ZIP—Activating the Apply Button with the *Changed* Property

```
Private Sub cmbOperation_Click()
    Changed = True
End Sub
Private Sub txtButtonCaption_Change()
    Changed = True
End Sub

Private Sub txtCaption_Change()
    Changed = True
End Sub
```

Implementing the *ApplyChanges* Event Procedure

The `ApplyChanges` event is the opposite of the `SelectionChanged` event. Whereas the `SelectionChanged` event procedure loads information into the Property Page, the `ApplyChanges` event procedure saves new values back to the control. This event fires when the developer closes the Property Page or clicks the Apply button. For the Calculator control, you simply need to take the properties from the Property Page's controls and assign them to the custom control, as shown in Listing 15.7.

Listing 15.7 CALC.ZIP—The *ApplyChanges* Event Procedure

```
Private Sub PropertyPage_ApplyChanges()
    SelectedControls(0).Caption = txtCaption
    SelectedControls(0).ButtonCaption = txtButtonCaption
    SelectedControls(0).Operation = cmbOperation.ListIndex
End Sub
```

Connecting the Property Page to the Control

The Property Page you have been building is now complete. To use the `CalcGeneral` Property Page with your control, however, you must first connect the Property Page to the control. (Remember, the Property Page is a separate object or file that can be used with several controls.) To perform this final task, follow these steps:

1. Display the user control designer window for the Calculator control.
2. In the control's Properties window, double-click the `PropertyPages` property. The Connect Property Pages dialog box appears.

3. Place a check mark in the `CalcGeneral` check box, as shown in Figure 15.9.

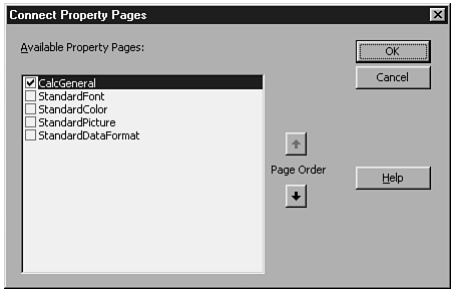


FIGURE 15.9
The checked Property Pages will be attached to the control.

4. Click OK in the Connect Property Pages dialog box to associate the selected pages with the Calculator control.

Using Your Property Page

Now you have completed the property sheet for the Calculator control. When you are working on an application that contains the control, you can set the control's properties from either the Properties window or the Property Pages. To test the sample Property Page, first close all the control project's designers. Next, open the form from the test project. Draw an instance of the Calculator control on the form, and open its Properties window by pressing F4. If you look closely, you'll notice a new property called `Custom`.

To view the Property Page, double-click the `Custom` property, or click the ellipsis button. When you do, the property sheet appears, as shown in Figure 15.10.

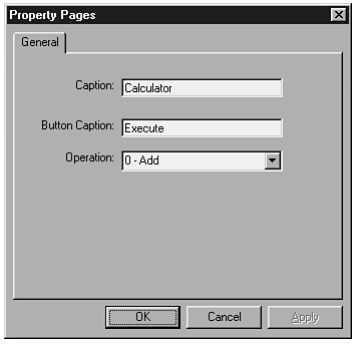


FIGURE 15.10
Here, you see the completed Property Pages for the Calculator control.

Notice that as soon as you change a control on a Property Page, the Apply button becomes enabled.

NOTE Remember to save the changes you have made to the Calculator project. Notice that when you do save changes, Property Page files are stored with .PAG extensions.

Handling Multiple Control Selections

As you may recall from the "Implementing the `SelectionChanged` Event Procedure" section, the `SelectedControls` collection object represents all the controls that the developer has selected when he or she displays the Property Pages. You use the `SelectedControls` object in the `SelectionChanged` and `ApplyChanges` event procedures to access the properties of each selected control. For example, if the developer has two Calculator controls selected, `SelectedControls(0).Caption` represents the first control's caption, and `SelectedControls(1).Caption` represents the caption of the second control. If you write the code appropriately, the developer can apply the same caption to both selected Calculator controls.

You might not want to apply some properties, such as the `Operation` property, to multiple selected controls. In this case, you can use the `Count` property of the `SelectedControls` collection to see whether you should ignore the change or even set the `Visible` property of a control on the Property Page to `False`.

Another way to handle this situation would be to apply only certain changes to all controls and others to only the first control. A sample `ApplyChanges` event that handles multiple controls is shown in Listing 15.8.

Listing 15.8 CALC.ZIP—Applying Changes to Multiple Controls

```
Private Sub PropertyPage_ApplyChanges()

    Dim control As CalcControl

    'Set Captions for every control
    For Each control In SelectedControls
        control.Caption = txtCaption
        control.ButtonCaption = txtButtonCaption
    Next control

    'Set only the first control's Operation property
    SelectedControls(0).Operation = cmbOperation.ListIndex

End Sub
```

To test this procedure, first open the Property Pages dialog box. Next, highlight multiple instances of the Calculator control, and change their properties.

Control Error Handling

The importance of controls running correctly cannot be overstated. Developers and users are depending on using the control as a self-contained, robust object that does not crash under unusual conditions. The developer is, of course, responsible for testing that the application runs correctly with your control, but you can take several precautions to help ensure your controls don't present developers and users with any nasty surprises.

▶ **See** "Packaging ActiveX Components," **p. 788**

First, use plenty of error handling in event procedures. If an error occurs, and you do not handle it with code, the control stops running, bringing down its container as well. Typically, all events that have any code attached to them should be error handled. Some key areas, however, need special attention:

- **File handling.** What if a file does not exist or is write-protected?
- **Input/Output connectivity.** What if the network times out or is unavailable, for example?
- **Interaction with other controls and the container.** Can you successfully use property values from other controls as input to your control?
- **Boundary conditions.** What happens with extreme or incorrect input values (such as, –99999)?

In Chapter 9, "Visual Basic Programming Fundamentals," you learned about using the `On Error` statement to control program flow after an error occurs.

▶ **See** "Controlling Program Flow After an Error," **p. 220**

Adding error handling to your procedures takes only a few lines of code, especially if you create a global error handling routine like the following:

```
Sub ErrorTrap(err as Integer)

Select Case err
      Case 3021
             sMessage = "Database problem!"
      Case 13
             sMessage = "A System Error has occurred"
'... (more error handling code here)

      Case Else
             sMessage = "An unknown Error has occurred"
End Select

End Sub
```

The `ErrorTrap` procedure can be called from every event in your control, in the following manner:

1. Use the `On Error` statement at the beginning of the procedure:

   ```
   On Error Goto Errhandler
   ```

2. In the procedure's Error handler, pass the error number to the `ErrorTrap` function, as follows:

   ```
   Errhandler:
   ErrorTrap err
   ```

Another way to avoid errors is to always use `Get` and `Let` procedures for a control's properties, so you can validate property values when they are set. If you create properties by declaring public variables, you have less control over their values. Using property procedures allows you to raise errors immediately if the users try to assign invalid values.

From Here...

In this chapter, you learned how to enhance ActiveX Controls by creating Property Pages. You also looked at the `Ambient` and `Extender` objects and built a sample control to perform calculations. For additional coverage on related topics, see the following chapters:

- Chapter 14, "Creating ActiveX Controls," provides a basic understanding of ActiveX controls and how to create them.
- Chapter 32, "ActiveX Documents," describes how to transform a standard application quickly for use on the Web.
- Appendix B, "Packaging Your Applications," provides information about deploying ActiveX controls.

CHAPTER 16

Classes: Reusable Components

In this chapter

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Object-oriented programming techniques are useful because they allow you to reuse your code efficiently. This chapter discusses how to create classes in Visual Basic. Classes allow you to create objects and take advantage of object-oriented programming techniques in Visual Basic. When working on a large project, for example, each team member can create a specific class and compile it into an ActiveX DLL for others to use.

Understanding Classes

If you have used custom controls in a Visual Basic program, you have already used classes and objects. For example, when you draw a text box on a form, you are actually creating a specific *instance* of the text box class. For example, if you draw five text boxes on your form, you have created five instances of the text box class. Even though each instance is a distinct entity, they were all created from the same template.

Instances of a class are known as *objects*. Each different class is a template from which a specific type of object is created. In this example, the text box class defines that a text box has a `Text` property. However, the class definition itself does not contain information about the values of the properties. Instead, an object you create from the class, for example, `txtLastName`, actually contains information.

Object-Oriented Programming

You probably have heard the term *object-oriented programming* (*OOP*) or read about it in programming books and magazines. A key element of OOP is its use of reusable objects to build programs.

OOP begins in the design stage, when you determine the objects in an application. For example, suppose you have to write a system to manage paychecks for employees. A traditional design plan would be to determine each program function, such as "Adding an employee to the database" or "Printing an employee paycheck." An object-oriented design would instead try to separate programming tasks along the lines of the objects in the program (employees, database, paycheck, and so on). In order for a design to be considered object-oriented, several facts must be true about the objects. These fundamental concepts of OOP are summarized in the following list:

- **Encapsulation.** Encapsulation, or information hiding, refers to the fact that objects hide the details of how they work. For example, when you set the `Text` property of a text box, you do not know (or care) how the text box internally repaints the characters. Information hiding allows the programmer of an object to change how an object works without affecting the users of the object.
- **Inheritance.** A new object can be defined based on an existing object, and it can contain all the same properties and methods. For example, you can create a new object that contains all the standard properties and methods of an existing `object` plus a few of your own. You can just add your own extra properties and "inherit" the existing ones. Visual Basic, strictly speaking, does not support inheritance.

- **Polymorphism.** Although many objects can have methods bearing the same name, the method can perform differently for each of the objects. Through polymorphism, the program runs the method appropriate for the current object. For example, the + operator can be used with both strings and integers. Even though the same symbol is used for both data types, Visual Basic knows to perform different operations.

An important consequence of an OOP approach is reusable code. Part of what makes an object reusable is its interface, or the methods and properties the object uses to communicate with the outside world. If you build objects with well-defined interfaces, it is easy to change the object internally or even add new interfaces without affecting programs that use the object.

Classes in Visual Basic

You create your own classes in Visual Basic with a *class module*. Class modules can contain several types of elements:

- **Properties.** These elements are used to assign and retrieve values from the class.
- **Methods.** These are public functions or subroutines that are defined in the class.
- **Events.** Just as a control can raise events in the form that contains it, an object created from your class can also raise events in its containing object.

Class modules also contain two special events of their own, `Initialize` and `Terminate`. The `Initialize` event is triggered when a new instance of the class is created, and the `Terminate` event occurs when the object is destroyed.

Object definitions are created in a class module. A class module is like a standard code module in that it contains only variable declarations and procedure code. There is no user interface component of a class module. However, a class can take action using a form that is in the program, just like a normal code module. Class modules can be used in several ways, such as the following:

- In a Visual Basic project, a class module provides a way to create multiple instances of objects anywhere in your program, without using global variables.
- You can create ActiveX objects and compile them into a DLL or EXE that other programmers can use in their code. For example, you can put all of your business financial rules in a class and compile it as an ActiveX DLL. Other programmers can reference the DLL and use the financial rules in their applications.
- You can build an Add-In to Visual Basic, to enhance the functions of the Visual Basic IDE.

Building Class Modules

The easiest way to learn is by doing, so let's create a simple class module. This sample class module will contain employee information. After you create the class module, you learn how to use the employee object in your program.

Starting a New Class Module

First, create a new Standard EXE project in Visual Basic. Then, select Add Class Module from the Project menu. This action creates a new class module with the default name of `Class1` and opens the class module's Code window, as shown in Figure 16.1.

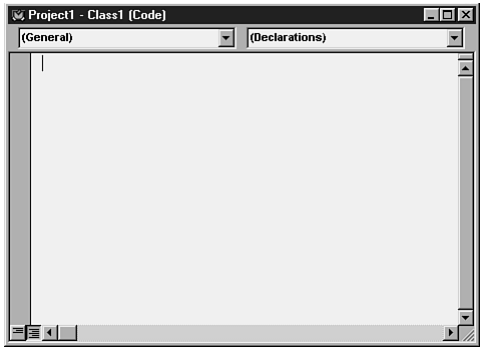

FIGURE 16.1
By using class modules in your VB applications, you can create your own custom program objects.

After creating the new class module, you should give the class a unique and descriptive name. The name of a class module is much more significant than the name of a standard code module because you actually use the class name within program code. Many developers like to use the letter `c` or `cls` to indicate a class name. This simple class example will be an employee class, so name the class module `clsEmployee`.

To name a class, bring up the Properties window for the class module. Press F4 while the Code window is open, or right-click the class module in the Project Explorer and choose Properties from the context menu.

Adding Properties to the Class

After the class module has been created, you can add your own properties. Properties in your own classes are used in the same way as those of controls, for storing and retrieving information. You can add properties to your class in two ways: by using public variables and property procedures.

Public Variables Using public variables is the easiest way to create properties. You just enter them in the declarations section of the class module. For the sample `clsEmployee`, you can add a few simple properties with the following code:

```
Public FirstName As String
Public LastName As String
Public Salary As Currency
Public DateHired As Date
```

NOTE Your classes will also usually have several private variables, but only the public variables will be visible to the rest of your application when the object is created.

After you create an object from your class (you will see how shortly), you can use these properties just like those in a custom control:

```
MyObject.FirstName = "Joe"
MyObject.LastName = "Smith"
Msgbox "Hello, " & MyObject.FirstName
```

The drawback of using public variables for object properties is that no validation is performed on them. In the example, you can assign any values to the `FirstName`, `LastName`, and `DateHired` properties, as long as the value is of the correct type.

Property Procedures Property procedures are more flexible than public variables because they offer the advantage of being able to execute code when someone accesses a property. Property procedures are written like functions, but to users of an object, they behave just like properties. The three types of property procedures are as follows:

- `Property Get`—A function executed when the user reads the property value.
- `Property Let`—A sub executed when the user writes the property value.
- `Property Set`—A special case of `Property Let`, in which the value being passed to the subroutine is itself an object.

You enter property procedures in the class module's Code window. To have Visual Basic create the skeleton of the property procedures, display the Add Procedure dialog box, shown in Figure 16.2, by selecting Add Procedure from the Tools menu. Suppose you want to add another property to the class, the `Department` property. In the Add Procedure dialog box, enter `Department` in the Name field, select Property for the procedure type, and click OK.

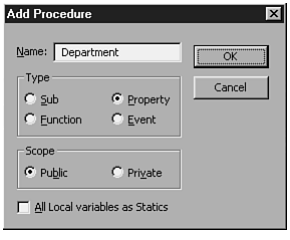

FIGURE 16.2
You can use the Add Procedure dialog box, accessible from the Tools menu, to create many different procedure types, including property procedures.

Using the Add Procedure dialog box causes Visual Basic to add the framework for the `Property Let` and `Property Get` procedures. By default, VB assumes that your property is a variant. For the `Department` property, use a `String` data type, so you can just change the procedure definitions. The new skeleton procedures are pictured in Figure 16.3.

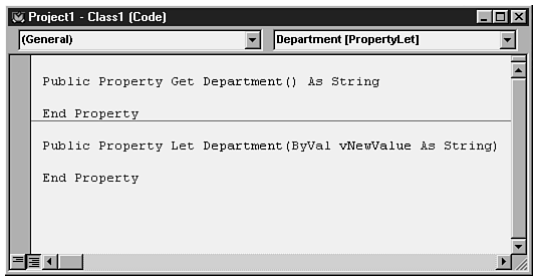

FIGURE 16.3
Although property procedures look like regular functions, application code sees them as a property of the object.

When users access the `Department` property, the appropriate property procedure is executed. Usually, a good action to take is to somehow store the value, as in the following example, which uses a private variable:

```
Public FirstName As String
Public LastName As String
Public DateHired As Date
Public Salary As Currency
Private nDeptNum As Integer

Public Property Get Department() As String
    Select Case nDeptNum
        Case 1
            Department = "Marketing"
        Case 2
            Department = "Accounting"
        Case Else
            Department = ""
    End Select
End Property

Public Property Let Department(ByVal sNewValue As String)
    Select Case Trim$(UCase$(sNewValue))
        Case "MARKETING"
            nDeptNum = 1
        Case "ACCOUNTING"
            nDeptNum = 2
        Case Else
            nDeptNum = 0
    End Select
End Property
```

In the preceding code, the property procedure actually stores the value representing the employee's department in a private integer variable. However, users of the object always assign and return a string. In a real program, the property procedures might do all sorts of things to the value, including storing it in a database.

NOTE To make a property Read-Only, omit the `Property Set` or `Property Let` procedure.

Using *Property Get* with Objects If you understand the code in the preceding section, then you know that the `Property Get` procedure is used to return values from the object and the `Property Let` procedure is used to accept values from the calling program. However, the `Property Let` procedure does not work with objects. For this reason, if the parameter is an object, you need to substitute the `Property Set` procedure, as in the following code:

```
Private objSupervisor As clsEmployee

Public Property Get Supervisor() As clsEmployee
    Set Supervisor = objSupervisor
End Property

Public Property Set Supervisor(objBoss As clsEmployee)
    Set objSupervisor = objBoss
End Property
```

Notice the `Set` statement, which is used to set the value of an object. `Set` also has to be used by the calling code that accesses the property procedures:

```
Dim objEmployee As New clsEmployee
Dim objBoss As New clsEmployee

objEmployee.FirstName = "George"
objEmployee.LastName = "Jetson"
objBoss.FirstName = "Mr."
objBoss.LastName = "Spacely"

Set objEmployee.Supervisor = objBoss

Msgbox "George's Boss is " & objEmployee.Supervisor.LastName
```

Adding Methods to the Class

As you may have noticed, objects can have methods, such as the `Print` method of the PictureBox control. You can create methods in your own class by adding *public procedures* to the class module. Public procedures work just like regular subroutines and functions, but the `Public` keyword indicates that they will be visible to users of your object. For example, the following `CalcRaise` procedure could be added to the employee object:

```
Public Function CalcRaise() As Currency
    Dim sgPercentRaise As Single

    Select Case DateDiff("yyyy", Me.DateHired, Now)
        Case Is > 1
            sgPercentRaise = 0.06
        Case Is <= 1
            sgPercentRaise = 0.02
    End Select

    CalcRaise = Me.Salary * sgPercentRaise + Me.Salary

End Function
```

The `CalcRaise` procedure uses the length of time from the `DateHired` property to determine whether to give the employee a 6 percent raise or a 2 percent raise. This example shows how to encapsulate a business rule within a class. Taking this idea a step further, you could have several different types of employee classes (for example, `clsEmployeePartTime` and `clsEmployeeFullTime`), each with its own `CalcRaise` method.

Declaring and Using Objects

After you have created your own class, you can create new objects in your program by referring to the class module's name:

```
Dim objX As New clsEmployee
```

The `New` keyword causes an instance of the class `clsEmployee` to be created and stored in the object variable `objX`. However, sometimes you may want to delay creation of the instance until later in the program. In this case, use `New` with the `Set` statement when you are ready:

```
Dim objX As clsMyClass
'
'Later...
Set objX = New clsMyClass
```

In the preceding code, the actual object instance is not created until the `Set` statement is executed. In the first example, the object instance is created the first time a property or method of the object is referenced.

NOTE When you are accessing classes in other loaded VB projects or ActiveX DLLs, you can also include the project name in front of the class name. This is the only way to distinguish between classes with the same name from different projects, for example `AS400Agent.clsFileTransfer` versus `SQLObject.clsFileTransfer`.

TIP Always use the `Set` statement with `New` rather than create the object with the `Dim` statement; you can debug your code more easily this way.

Early Versus Late Binding All the declarations so far in this chapter have used *early binding*, meaning the object type is explicitly spelled out in the code. However, late binding is also an option, as in the following example:

```
Dim objX As Object
Set objX = CreateObject("MyObj.MyClass")
```

Late binding uses the `CreateObject` function and a string identifier. The disadvantage of late binding is that because `objX` is declared of a generic type `Object`, the properties and methods cannot be viewed in the Object Browser, and the intelligent typing features are not available. However, sometimes you do want to use late binding because it allows you to change the object without recompiling the program that uses it.

NOTE The `CreateObject` function is not necessary to use late binding. You can also write code to use late binding as follows:

```
Dim objX As Object
Set objX = New MyObj.MyClass
```

One example of when you might want to use late binding is when creating an instance of an object on a remote machine.

Destroying the Object Assigning `Nothing` to an object variable frees up resources associated with the object and causes the code in the class module's `Terminate` to be executed. You accomplish this feat by using a `Set` statement:

```
Set objTemp = Nothing
```

TIP Even though the contents of objects are no longer available when a form or module containing them is destroyed, it is good programming practice to set objects equal to `Nothing` when you are finished with them. This ensures that all memory resources are freed and the object is destroyed.

Creating Objects from Other Projects When you are accessing classes in other loaded VB projects or ActiveX DLLs, you can also include the project name:

```
Dim objX As New MyProject.clsMyClass
```

Remember, to access classes in other projects or DLLs, you have to add them to the Project References list.

Adding Your Own Events

Visual Basic objects can raise events, such as the `Load` event of a form. Events provide a way for an object to execute code written by the user of an object. The object triggers the event by way of an *event procedure*. You have already learned how to place code in event procedures. To create an event in your own class, you need to do two things:

1. Declare the event in the class.
2. Use the `RaiseEvent` statement to trigger the event when appropriate.

Now you can create a sample event in the employee class. Suppose you want to add a way to return errors to the user of an object. First, declare an event called `DataError` in the General Declarations section of `clsEmployee`, by adding a single line of code:

```
Public Event DataError(ByVal sMessageText As String)
```

Next, you need to add code to trigger the event. Recall the earlier method `CalcRaise`, which relies on the `Salary` property of the object. If the user does not assign a value to `Salary` property, then a raise cannot be properly calculated. You can modify `CalcRaise` to send this information to the user via the `DataError` event by adding a simple `If` statement:

```
If Me.Salary = 0 Then RaiseEvent DataError("SALARY UNSPECIFIED!!")
```

As you can see, adding an event is really easy. To access your events, the calling code must declare objects using the `WithEvents` keyword and have an event procedure written that the object can call. For example, placing the following code in the General Declarations section of a form or module would trap the `DataError` event:

```
Dim WithEvents objBoss As clsEmployee
Private Sub objBoss_DataError(ByVal sMessageText As String)
    MsgBox sMessageText, vbCritical, "Error!!!"
End Sub
```

The `WithEvents` keyword causes the name of the object to be added to the object drop-down box so that Visual Basic can create the skeleton event procedure for you.

To test this with the sample, create the `DataError` event in the class module and add code to trap the event as described above. You should then be able to cause the object to fire the event by calling the `CalcRaise` method when the `Salary` property is equal to zero.

Creating an ActiveX DLL

Although including classes in Standard EXE projects is useful, compiling them into a separate ActiveX DLL or ActiveX EXE component is even more useful. These ActiveX components can be installed and registered on another machine so that applications on that computer can access your classes. For example, you could create a database access DLL and install it on the Web server for use with Active Server Pages. The following sections describe some of the steps involved in creating an ActiveX project.

Creating an ActiveX Project

To create an ActiveX DLL, you need to add your class to an ActiveX DLL project. The easiest way to create a project of this type is to choose ActiveX DLL from the New Project dialog box. As you may recall, when you select a new Standard EXE project, you are given a project with a form named `Form1`. Similarly, creating a new ActiveX DLL or EXE project causes VB to create a project with a class module called `Class1`. If you are starting a new class, just rename `Class1` to a better name and begin entering code. If you want to add class modules to the project that you have already written, right-click in the Project Explorer window and choose Add File.

NOTE ActiveX DLL and EXE projects can contain multiple class modules, code modules, and forms. Only the objects designated as public are visible to other applications.

Working with Multiple Projects

In the first part of this chapter, you added a class module to a Standard EXE project. Although the class module was fairly self-contained, it was still a part of the same project as the form. However, when working with an ActiveX DLL project, you will more than likely need an additional Standard EXE project to test your classes because an ActiveX DLL is intended for use from an outside application. In other words, the application's user interface might be one

Visual Basic project and the Data Access class would be another, separate project. In order to effectively develop and test such an application, you have to simulate this interaction between projects. Fortunately, you can do so in several ways, as described here:

- **Use a project group.** Add multiple projects to the Project Explorer window.
- **Use separate instances of Visual Basic.** Launch Visual Basic again and load your ActiveX DLL in the second VB IDE.
- **Use the compiled program.** Use this method to share your classes with other developers.

While you are reading through this section, consider a two-project situation: an ActiveX DLL project that contains a class and a Standard EXE project that uses the class.

NOTE When accessing an ActiveX DLL from an ActiveX EXE project in any of the ways described in the preceding list, you always have to add a reference to the DLL by using the References dialog box. See the section "Referencing and Using the DLL" later in this chapter.

Using a Project Group You can create a project group in Visual Basic by choosing Add Project from the File menu. Each project in a group appears in the Project Explorer window, as shown in Figure 16.4.

NOTE Creating a project group is different from the usual way you deal with multiple Visual Basic projects. Typically you would use the Open Project menu option, which causes the selected project to replace any currently open projects. When you create a project group, multiple projects are loaded in the development environment *at the same time*.

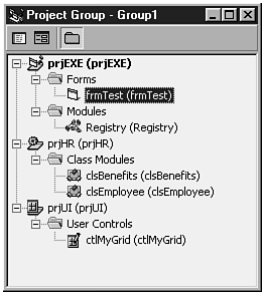

FIGURE 16.4
Project groups allow you to test and debug ActiveX components in a single instance of Visual Basic.

The typical way you use project groups is to first create an ActiveX component and then add a Standard EXE project to test it. You can use Visual Basic's debugging features such as stepping into code and using breakpoints in all projects in the group.

However, before you press Visual Basic's Start button, you may need to designate a Startup Project for the project group. By default, the first opened project is the Startup Project, and its name appears in boldface in the Project Explorer window. To set a different Startup Project, right-click the project's name and choose Set As Start Up.

NOTE Most of the time, you need to make the EXE project the Startup Project. Other controls and DLLs are started also, but only the Startup Project receives the focus.

Using Multiple Instances of VB Sometimes using multiple instances of VB is more convenient than using a project group. If you have very complex EXE and DLL projects, using multiple instances may be a better option because you can look at each project in its own environment. The main difference is that with a project group, Visual Basic handles starting and stopping all the projects. With multiple instances of Visual Basic, you manually have to start the projects needed by a given project. In other words, you first start the ActiveX DLL project and then start the Standard EXE project.

All the debugging features are still available between multiple instances of VB. In other words, you can set breakpoints and step back and forth between code in both projects. However, since additional inter-process communication is involved between multiple instances of Visual Basic, you may have to restart projects more often than you would when using a project group.

Using the Compiled DLL Using a compiled ActiveX DLL requires only a single open instance of Visual Basic. This is not a method for testing code within a class because you cannot use any of the debugging features. However, another developer can use a compiled DLL on his or her machine without having to copy your project and code. Using a compiled DLL involves a few simple steps:

1. **Installation.** Copy the DLL and any components or files it needs to the developer's PC.
2. **Register the DLL.** Use the `REGSVR32` program to register the DLL in the Windows registry.
3. **Reference the DLL.** After the DLL is installed and registered on a machine, it should appear in the References Dialog in Visual Basic.

Referencing and Using the DLL No matter which method you use to load an ActiveX DLL project (project group, multiple VB instances, compiled DLL), you always must *reference* the DLL in your Standard EXE project. Display the References dialog box by choosing References from Visual Basic's Project menu. The list of Available References should contain the project name of your ActiveX DLL. After you place a check mark in the box next to the ActiveX DLL name, it is available to the current project.

NOTE When using multiple instances of VB, you may have to rereference a DLL after you make changes to it. Also, the ActiveX DLL project does not show up in the References dialog box until the project is started.

Accessing the Class In the earlier example, you created a new instance of the employee object by simply naming the class:

```
Dim objBoss As New clsEmployee
```

However, when the class is defined in another compiled ActiveX component, you also have to include the project name:

```
Dim objBoss As New EmployeeDLL.clsEmployee
```

If you have multiple public classes defined in a DLL, you can access all of them:

```
Dim objCEO As New EmployeeDLL.clsExecutive
Dim objDilbert As New EmployeeDLL.clsEngineer
```

Note that as you write code that uses these external classes, all the same editor features (such as parameter lists) are available in the Visual Basic editing window.

Setting the Instancing Property

In ActiveX DLL and ActiveX EXE projects, the Properties window for a class module has an extra property, the `Instancing` property, which is not available in a Standard EXE project. This property determines how instances of a class are created; the options vary for different project types. While learning the basics of classes and OOP, you can forget about this property and experiment with a Standard EXE project. However, this property is usually set during the creation of a class, so I mention it here. Table 16.1 describes the settings of the `Instancing` property.

Table 16.1 Using the *Instancing* Property

Value	Name	Components	Description
1	`Private`	EXE and DLL	The class cannot be accessed from outside the current project.
2	`PublicNot Creatable`	EXE and DLL	Instances of the class can be created only within the project that defines the class. However, other applications can access instances after they are created.
3	`SingleUse`	EXE only	Each time a new instance of a class is created, a new copy of the EXE containing the class is started.
4	`GlobalSingleUse`	EXE only	Like `SingleUse`, but it makes the properties and methods appear as global variables and preocedures in the client program.
5	`MultiUse`	EXE and DLL	Other applications can create any number of instances of the class, and only one copy of the program containing the class is started. ActiveX DLL projects generally use this setting.
6	`GlobalMultiUse`	EXE and DLL	Like `MultiUse`, but it makes the properties and methods appear as global variables and procedures in the client program.

Another way to look at the information in the preceding table is to think of EXE files versus DLL files. An ActiveX DLL file is intended to be a shared component, meaning the same

instance of the ActiveX component is accessed by multiple clients, whereas an EXE runs in its own memory space. In addition, with an ActiveX EXE users can run the program, and at the same time other programs can reference and use classes within it.

Enums

One great feature of Visual Basic is the way it displays information and lists as you are entering code. For example, if you are using the Employee class, Visual Basic can display a list of available properties and methods, as shown in Figure 16.5.

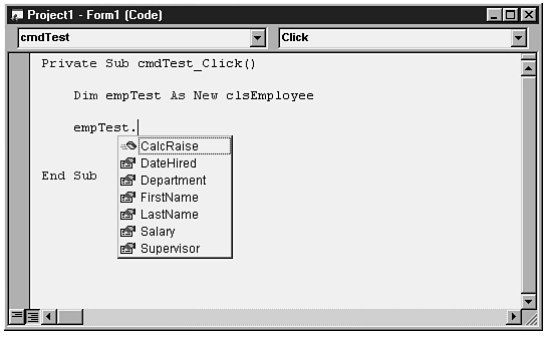

FIGURE 16.5
Features such as Auto List Member and the Object Browser work with classes that you create.

However, if you have written a method in the class, you often need a way to know valid parameter values. One example of this is the Message Box constants (for example, `vbCritical`) that are listed as you type a `MsgBox` statement. Consider the earlier example of the `Department` property in `clsEmployee`. Although you allow the users to enter some string values, you are really storing the employee's department as an integer. In addition, unless the users of the class know a list of valid departments, they will not know that `MARKETING` is an acceptable value.

One way to get around this problem is to use an enumeration, or in Visual Basic, an *enum*. Enumerations allow you to define a group of constants as a data type. You can then use this data type in function parameters.

For example, you could define an `Enum` for employee departments and then redefine the `Department` property of `clsEmployee`:

```
Public Enum Departments
Marketing = 101
Accounting = 102
InformationTech =103
Unknown=104
End Enum

Dim nDeptNum As Integer

Public Property Get Department() As Departments
Department = nDeptNum
End Property
```

```
Public Property Let Department(ByVal NewDept As Departments)
nDeptNum = NewDept
End Property
```

You could then access the `Department` property from code as follows:

```
objEmployee.Department = InformationTech
If objEmployee.Department = InformationTech Then MsgBox "IT department"
```

You can test this out by adding the `Enum` to the sample project you created earlier. Notice that as you type the equals sign to assign or read the value of the `Department` property, a list of valid values is displaed in a drop-down list.

Creating Classes That Contain Collections

A *collection* is a group of items that is itself a type of object. Visual Basic has some built-in collection objects, such as the `Forms` collection and the `Controls` collection. You can use collections with the `For Each...Next` statement to perform actions on all the items they contain. The `MinimizeAll` procedure, shown in Listing 16.1, minimizes each loaded form in an application.

Listing 16.1 COLLECT.ZIP—Using the *For Each* Structure to Handle All the Items in a Collection

```
' Minimizes all loaded forms.
Sub MinimizeAll()
    Dim frmElement As Form
    ' For each loaded form.
    For Each frmElement In Forms
        ' Minimize the form.
        frmElement.WindowState = vbMinimized
    Next frmElement
End Sub
```

Collections solve three problems faced by most programmers when working with objects:

- They provide a standardized way to create and track multiple instances of an object.
- They group similar objects for fixed tasks, such as changing color properties or dragging to a new location.
- Unlike an array, a collection can be used to contain members of different types.
- They organize large systems of objects into a hierarchy.

The following sections describe each of these aspects of using collections when you are creating object-based applications in Visual Basic.

Standard Collection Properties and Methods

User-defined collections share a common set of properties and methods. Some collections may have additional properties and methods, but all collections that you create in Visual Basic have at least the set described in Table 16.2.

NOTE Built-in collections may not necessarily contain all of the following properties and methods.

Table 16.2 Properties and Methods Common to All Collections

Item	Use To
`Count` property	Report the number of objects in a collection
`Item` method	Get a single object from a collection

In addition to the items in Table 16.2, collections usually provide two more methods. The methods in Table 16.3 are common to most collections.

Table 16.3 Methods Common to Most Collections

Method	Purpose
`Add`	Add an object to a collection
`Remove`	Delete an object from a collection

The `Add` and `Remove` methods provide programmers a standard way to create and delete items in a collection. The Visual Basic `Forms` and `Controls` collections are maintained by Visual Basic, so they don't support these methods. The `Add` method usually includes key and index parameters, used to identify an object in a collection. However, `Add` and `Remove` may be implemented differently for different types of collections. For example, compare the `Add` syntax for the `ListView` control's `ListItems` collection and the `ListImages` collection of an image list:

```
ListView1.ListItems.Add index,key,text,IconNumber,smallIconNumber
```

```
ImageList1.ListImages.Add index,key,picture
```

Creating a New Collection for Grouped Actions

You can create collections to contain forms, controls, and objects. Use the `Collection` object data type when creating a new collection. The following declaration creates a new collection named `colSelected`:

```
Dim colSelected As New Collection
```

Declaring a variable as a `Collection` object gives you four built-in properties and methods, as shown in Table 16.4.

Table 16.4 *Collection* Object Built-In Properties and Methods

Item	Task
`Count` property	Returns the number of items in the collection
`Add` method	Adds an object to the collection
`Item` method	Gets a single object from the collection
`Remove` method	Deletes an object from the collection

The code in Listing 16.2 creates a new collection named `colTextBoxes` and adds all the text boxes on a form to the new collection.

Listing 16.2 COLLECT.ZIP—Creating a Collection with This Code

```
Option Explicit

' Create a new collection to contain all the
' text boxes on a form
Dim colTextBoxes As New Collection

Private Sub Form_Initialize()
    ' Variable used in For Each to get controls.
    Dim cntrlItem As Control
    ' Loop through the controls on the form.
    For Each cntrlItem In Me.Controls
        ' If the control is a text box, add it to the
        ' collection of text boxes.
        If TypeName(cntrlItem) = "TextBox" Then
            colTextBoxes.Add cntrlItem
        End If
    Next cntrlItem
End Sub
```

The code in Listing 16.3 uses the collection `colTextBoxes` to clear all the text entered on the form.

Listing 16.3 Using *For Each* to Handle the Collection.

```
Sub cmdClear_Click()
    ' Variable used in For Each to get controls.
    Dim cntrlItem As Control
    ' Clear each of the text boxes in the collection.
    For Each cntrlItem In colTextBoxes
        cntrlItem.Text = ""
    Next cntrlItem
End Sub
```

▶ **See** "Using the ListView Control," **p. 251**

Using the Class Builder

When you create a new class, Visual Basic presents the option of creating an empty class or starting the Class Builder (see Figure 16.6).

NOTE If you do not see the Class Builder as shown in Figure 16.6, use Add-In Manager (available in the Add-Ins menu) to make it available in Visual Basic.

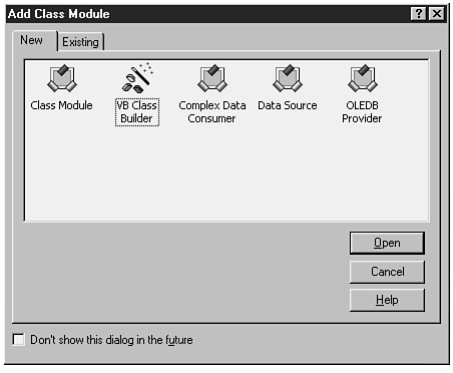

FIGURE 16.6
Double-clicking Class Builder starts a tool to help you organize classes in your application.

The Class Builder can be used to generate outlines for new classes or modify and reorganize existing classes. Figure 16.7 shows the Class Builder with the `clsEmployee` class loaded.

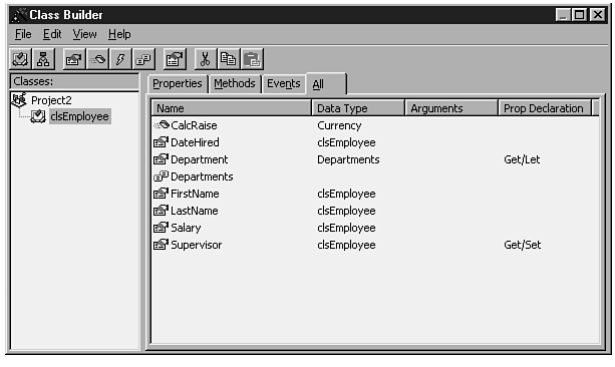

FIGURE 16.7
The Class Builder provides a graphic interface to the classes, properties, methods, constants, and events in your application.

To add an item to your project, click one of the toolbar buttons; the Class Builder displays a dialog box where you can enter all the attributes of the new item. Figure 16.8 shows the dialog box presented for a new method.

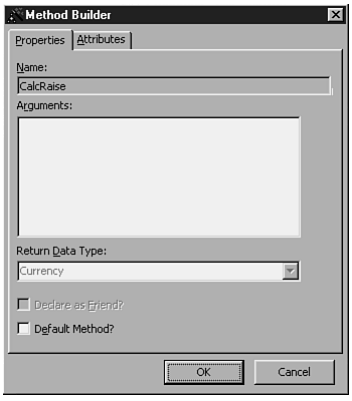

FIGURE 16.8
The Method Builder dialog box presents all options available for a method.

When you close the Class Builder, it updates your project with any changes or additions that you entered. You still have to fill in the working code, but the Class Builder generates the appropriate declarations and supporting code.

From Here...

This chapter provided you with an introduction to the creation of class modules and the objects that can be created from them. To learn more about some of the topics covered in this chapter, see the following chapters:

- To see how collections are used with controls, see Chapter 12, "Microsoft Common Controls."
- You can learn how the techniques applied to classes can be used in creating your own ActiveX controls by referring to Chapter 14, "Creating ActiveX Controls."
- To learn about accessing objects and collections in other applications such as Word and Excel, see Chapter 22, "Using OLE to Control Other Applications."
- Collections are also used with the Internet, as described in Chapter 31, "Active Server Pages."

PART IV

Visual Basic Interfaces

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CHAPTER 17

Multiple Document Interface Applications

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As you begin to write more advanced Visual Basic applications, at some point you will probably want to utilize the Windows Multiple Document Interface (MDI). The MDI allows your programs to work with multiple forms contained within a parent form. Using the MDI makes your interface cleaner than one that has forms scattered about the screen.

The MDI standard can enhance your programs in two ways. First, you can have one container form that acts as the background for your overall application. If a user moves the container form, the child forms contained inside move as well, which helps keep your application's interface organized and self-contained. Second, and perhaps even more powerful, your users can work on multiple documents at one time. MDI applications allow the use of multiple instances of the same form, which can add a great deal of power and flexibility to your programs.

Introducing MDI Applications

Many of the applications that you create in Visual Basic consist of a series of independent forms, like the ones shown in Figure 17.1. Each of these forms is displayed separately on the screen and is moved, maximized, or minimized separately from any other form. With this type of interface, you cannot easily organize the forms or deal with them as a group. Even with this limitation, this interface is a good one to use for many programs and is probably the most prevalent interface design.

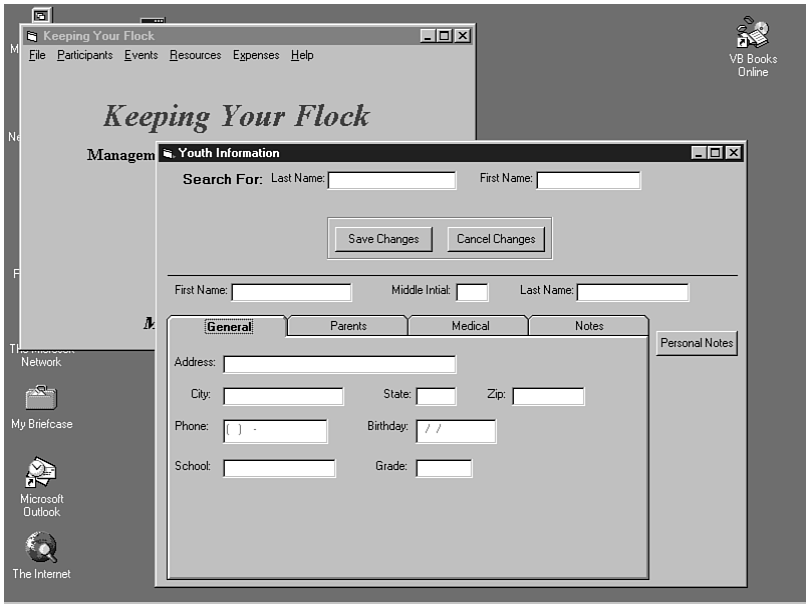
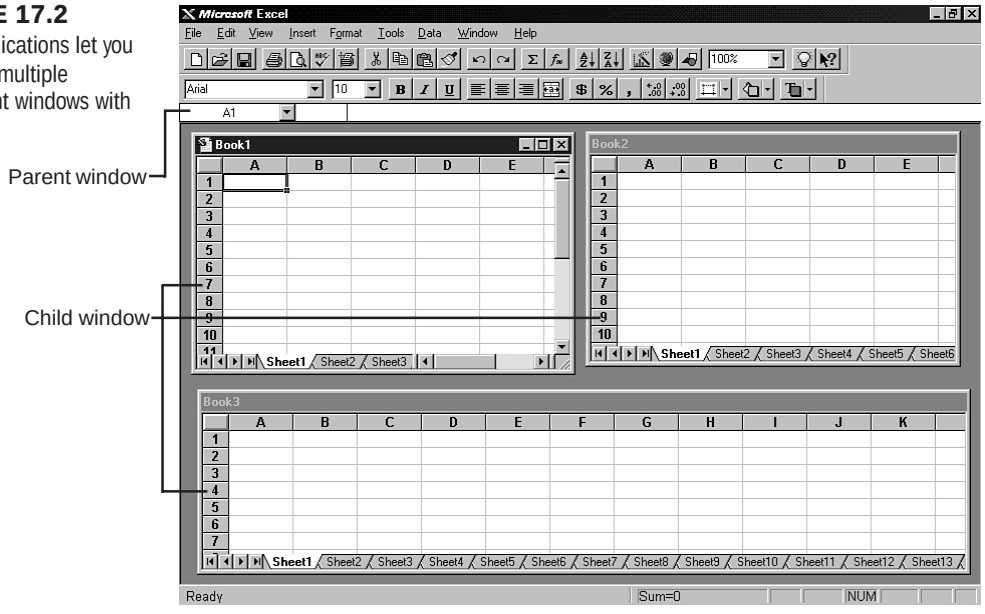


FIGURE 17.1
This program's user interface consists of two forms that appear to have no visual relationship to each other.

An alternative to this standard interface is the Multiple Document Interface, or MDI. This type of application has one *parent form* that contains most of the other forms in the program. Other forms can be *child forms*, which are contained within the parent, or standard forms, which are

not. With an MDI application, you can easily organize all the child forms or minimize the entire group of forms just by minimizing the parent form. Programs such as Microsoft Word and Excel are examples of MDI applications. If you have worked with these programs, you know that you can open multiple windows in the program, access them easily from the menu, and minimize the whole thing with a single click of the mouse. In version 5, even Visual Basic itself went to a true MDI interface style. Figure 17.2 shows three blank workbooks opened simultaneously in Excel as an example of a typical MDI application.

FIGURE 17.2
MDI applications let you manage multiple document windows with ease.



Characteristics of MDI Parent Forms

The MDI form, also known as the parent form, is the container for all the child forms of the application. The MDI form has a number of characteristics that define its behavior:

- An application can have only one MDI form.
- The MDI form can contain only those controls that support the `Align` property, such as the PictureBox or Toolbar controls. You cannot place other controls on the MDI form.
- You cannot use the `Print` method or any of the graphics methods to display information on the MDI form.
- The MDI parent window and all child windows are represented by a single icon on the Windows taskbar. If the parent form is minimized and then restored, all the child forms are returned to the same layout as they had before the application was minimized.
- If a menu is defined for a child form, the menu is displayed in the parent form's menu bar. If a menu is defined for the parent form, it is not shown at all if a child form that has its own menu is the active form.

Characteristics of MDI Child Forms

Just as the MDI form has characteristics of its behavior, the MDI child forms also behave in a certain way. The characteristics of an MDI child form are as follows:

- Each child form is displayed within the confines of the parent form. A child form cannot be moved outside the boundaries of the MDI parent form.
- When a child window is minimized, its icon is displayed in the parent window, not on the Windows taskbar.
- When a child form is maximized, it fills the entire inner area of the parent form. Also, the parent form's title bar contains both the name of the parent form and the name of the maximized child form.
- When one child form is maximized, all other child forms are maximized as well.

Creating a Simple MDI Program

As you will discover with many programming concepts, the best way to understand how MDI applications work is to create a simple MDI program. This section walks you through the process of setting up a "shell" of an MDI program. It will contain an MDI form and a single child form. You can then use this program as the basis for a fully functional MDI application.

The first step is to start a new project in Visual Basic by choosing File, New Project.

Setting Up a Parent Form

ON THE WEB

The sample project MDITest is available on the Web (`www.mcp.com/info`) as the zipped file MDITEST.ZIP. This project demonstrates the MDI application concepts discussed in this chapter. The project's code is fully commented to explain each step.

After you start the new project, the next step is to create the MDI parent form. To create the MDI form for your project, select Project, Add MDI Form, or choose MDI Form from the Add Object button's drop-down menu. Then, from the Add MDI Form dialog box, select the MDI Form icon and click Open. When the MDI form is added to your project, it should look like the one in Figure 17.3.

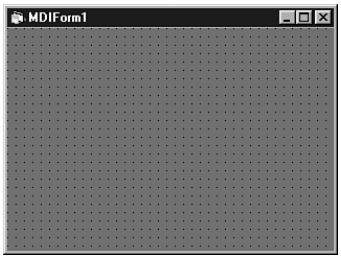
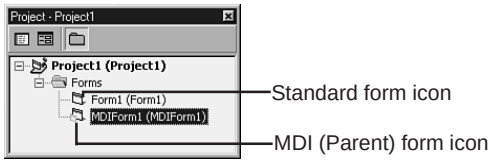


FIGURE 17.3
The MDI form has a darker background than a standard form.

The MDI form is added to the Forms folder in the Project Explorer window. However, if you look closely, you might notice that the MDI form's icon in the Project window is different from the icon used for a standard form. By examining these icons, you can easily identify the type of each form. Figure 17.4 illustrates the difference between normal and MDI form icons.

FIGURE 17.4
Icons show the form type in the Project window.



After you add the form to your project, you should specify a descriptive name for the form and set any of the other properties that you need. Most of the properties of the MDI form are the same ones that you set to control the appearance of a standard form.

▶ **See** "Parts of a Form," **p. 40**

Two properties are unique to the MDI form and deserve special note: the `AutoShowChildren` property and the `ScrollBars` property. The `AutoShowChildren` property determines whether child forms are shown automatically as they are loaded. If the `AutoShowChildren` property is set to `True` (the default value), then child forms are shown as soon as they are loaded. Therefore, the `Load` statement and the `Show` method have the same effect on the form.

The `ScrollBars` property determines whether the MDI form shows scrollbars when necessary. When this property is set to `True` (the default value), scrollbars are shown on the MDI form if one or more of the child forms extends beyond the boundary of the MDI form, as shown in Figure 17.5. If the property is set to `False`, scrollbars are not shown under any conditions.

FIGURE 17.5
Scrollbars let you view portions of child forms that extend beyond the boundary of the parent form.

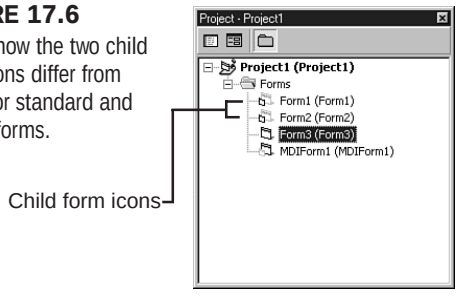
One other property of note is the `Picture` property. Although the MDI form does not support the `Print` method and graphics methods like a standard form does, you can still include a picture as the background of the form.

Setting Up a Child Form

Setting up a child form in an MDI application is even easier than setting up the parent form. A child form is basically a standard form that has the `MDIChild` property set to `True`. Therefore, everything you know about creating standard forms applies to creating the child forms of an MDI application.

For the sample application, all you need to do is set the `MDIChild` property of the form that was first created for the project. To do so, select the form in the Project window, select the `MDIChild` property in the Properties window, and change its value to `True`. You might notice that the icon for the form in the Project window changes from a standard icon to an MDI Child icon. This is the only change that you will notice while you are in the design window (see Figure 17.6).

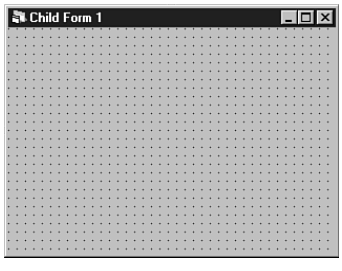
FIGURE 17.6
Notice how the two child form icons differ from those for standard and parent forms.



TIP As with other properties with predefined values, you can double-click the `MDIChild` property in the Properties window to toggle back and forth between the `True` and `False` values.

After you set the `MDIChild` property, all that is left to complete the form is to add the controls you need for your program. You can, of course, design the form first and change the `MDIChild` property later. The order of the operation has no effect on the behavior of the form. A typical MDI child form is shown in Figure 17.7.

FIGURE 17.7
MDI child forms look just like standard forms.



Running the Program

After you finish setting up both the parent and child forms, you are ready to run the program to see how a child form behaves inside the parent form. First, as always, you should save your work. Then click the Start button on the toolbar, or press F5 to run the program. When the program runs, the form layout should resemble Figure 17.8.

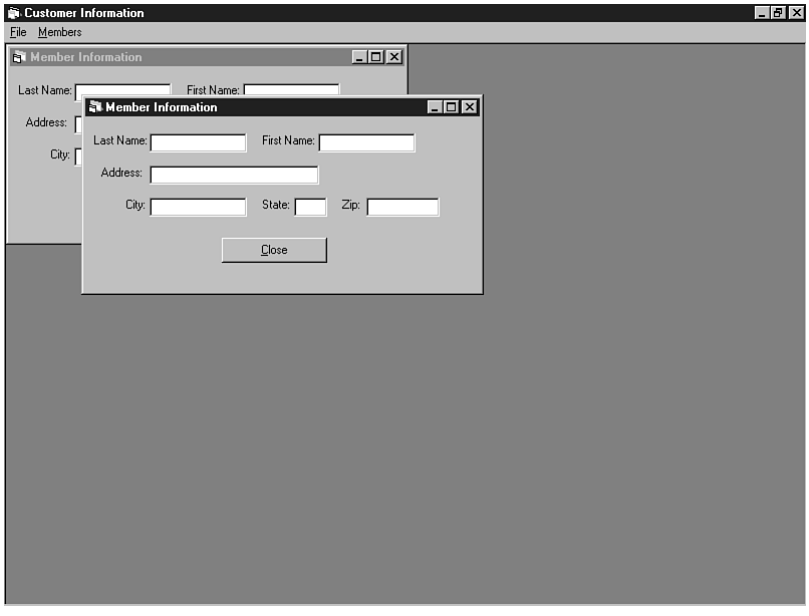


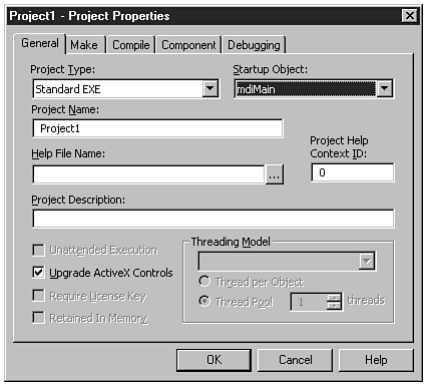
FIGURE 17.8
This simple MDI application shows a parent form and two child forms. Note that the child forms are instances of the same form.

You should try the following tasks so that you fully understand the behavior of the parent and child forms:

- Minimize the child form, and note the location of its icon.
- Move the child form around. It does not move beyond the parent form's boundaries.
- Maximize the child form.
- Minimize and maximize the parent form.

When you started the program, you might have noticed that the child form was shown automatically. In the simple example, you get this result because the child form (the one first created when you started the project) was designated as the project's startup form by default. If you want to have the empty MDI parent form shown when you start the program, you need to change the Startup Object setting in the Project Properties dialog box, as shown in Figure 17.9. You access the project properties by choosing Project, Project Properties.

FIGURE 17.9
Set the startup form and other properties of the project in this dialog box.



Creating Multiple Instances of a Form

You can use the MDI form just to make your application neater and its forms easier to manage. However, if that's all you use MDI forms for, you're missing out on the real power of MDI applications. The most powerful feature of an MDI application is its capability to create and handle multiple instances of a form at the same time. For example, if you are working in Microsoft Word, each document you open or each new document that you create is a new instance of the same basic form. In fact, many MDI applications are made up of only two forms: the MDI parent form and the template form for all the child forms in the application.

NOTE You can have more than one type of template child form in your application. For example, Visual Basic itself has two basic types of MDI child forms: the Form design child form and the Code child form. You can create as many of each of these types of forms as you need, within the constraints of your system.

Creating an MDI application of this type requires a little more work than was required in the sample application. You first have to define the basic MDI child form at designtime and then use object variables to create instances of the form at runtime.

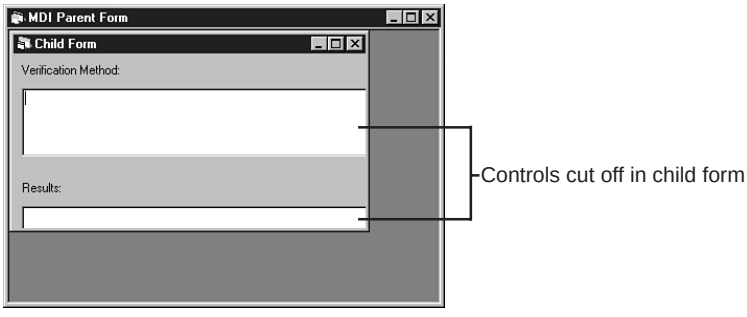
To start the process of creating an MDI application with multiple instances of a form, you need to start a new project and then add an MDI form to the project as described in the section "Creating a Simple MDI Program." Next, be sure to set up the MDI form as the startup object using the Project Properties dialog box.

Setting Up the Basic Form

As was the case in the earlier section "Creating a Simple MDI Program," creating the form template is the same as creating a standard form. You add to the form all the controls that you need for the user interface. Also, you need to write any code necessary for the controls to perform their intended functions. You also need to set the `MDIChild` property of the form to `True`.

One thing you might notice as you first create an MDI application is that the child form, when first shown at runtime, is probably sized differently than it was when you created it (see Figure 17.10). The reason is that Windows, by default, assigns a certain size and position to each MDI child form that is shown.

FIGURE 17.10
MDI applications automatically size and position their child forms.



If the default size and position are not acceptable to you, you need to place code in the `Load` event procedure of the child form to position and size it the way you want. To determine the desired size of the child form, check the `Height` and `Width` properties of the form while you are in design mode, and then add code to the form's `Load` event procedure to set the `Height` and `Width` properties to their original values. The same concept applies to the position of the form. You can set the `Top` and `Left` properties of the child form to set its position. The code in Listing 17.1 shows how to set the size of a child form and center it within the parent form.

NOTE If a child window's size becomes too large for its parent, whether by user action or through code, the parent's size is not changed automatically. The parent does, however, automatically show scrollbars when needed (assuming the `ScrollBars` property is `True`), as mentioned in the section "Setting Up a Parent Form" earlier in this chapter. ■

Listing 17.1 MDIDEMO2.FRM—Use Code to Size and Position the Child Form

```
Private Sub Form_Load()
    Me.Height = 2745
    Me.Width = 3690
    Me.Top = (mdiMain.ScaleHeight - Me.Height) / 2
    Me.Left = (mdiMain.ScaleWidth - Me.Width) / 2
End Sub
```

Figure 17.11 shows the effect of this code.

NOTE You cannot use the StartUpPosition property to set the initial position of a child form in an MDI window. In fact, you cannot change the setting of the property for an MDI child form from its default value of 0 - Manual. ■

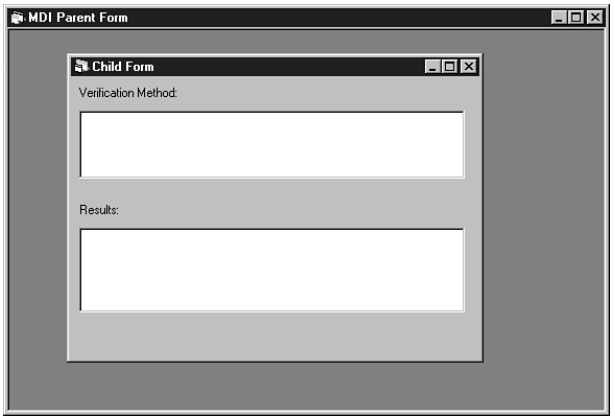


FIGURE 17.11
You can use code to override the default size and position of an MDI child form.

Creating Forms Using Object Variables

After you create the basic child form, you need a means to create an instance of the form (at runtime) and display it in the MDI application. Doing so requires all of two code lines. First, you use a `Dim` statement to create an *object variable* (a variable of `Object` type) that will contain an instance of the form. In the `Dim` statement, you need to use the `New` keyword to tell Visual Basic to create a *new instance* of the form. Otherwise, the statement just creates a new handle to the existing form. After you create the object variable, you use the `Show` method to display the form. However, instead of using the form name, you specify the name of the variable. The two required lines of code are shown here:

```
Dim NewFrm As New frmText
NewFrm.Show
```

To see how this code works, place the lines of code in the `Click` event procedure of the MDI form, and then run the program. Each time you click the MDI form, a new instance of the child form is displayed.

Using the Keywords *Me* and *ActiveForm*

Because all the child forms are the same, and you use the same variable to create each of them, how can you know which form to specify when running code—especially code that is generic and can work with any of the forms?

You will use two particular keywords extensively in working with MDI applications: `Me` and `ActiveForm`. These two keywords let you create generic code routines that work with any child form that you create.

`Me` is a keyword that can be used in any form to refer to itself, just as you can use the word *me* to refer to yourself without having to use your name. You saw how this keyword was used in Listing 17.1 to size and position the child form on startup. If you write all code in the child form using `Me` to refer to the form name, your code will work for whichever instance of the form is active at the time.

`ActiveForm` is actually a property of the MDI (parent) form. Its purpose is similar to the `Me` keyword. `ActiveForm` refers to whichever MDI child form is currently active. By using the `ActiveForm` property in all code that resides in the MDI form, the code operates only on the active form and on no other. The following line of code provides a simple example of the `ActiveForm` property:

```
mdiMain.ActiveForm.Print "This form is currently active."
```

To test this code, place it in the `Click` event procedure of the MDI (parent) form. Make sure more than one child form is loaded. When an empty area of the parent is clicked, the text previously mentioned prints on whichever form is active.

NOTE Notice, here and in Listing 17.1, the use of the prefix `mdi` that was used when naming the MDI parent form. ■

Using the `ActiveForm` property, you can reference any property, method, or event of the currently active child form without having to know its name.

Initializing an Instance of a Child Form

If you need to write code that will be run when an instance of a child form is first created, you can place the code in the child form's `Activate` event procedure. The `Activate` event occurs as each new instance of the form is created, before the `Load` event occurs.

For example, you may want to set a child form's `Caption` property as the form is created. The sample project MDITest, available on the Web, contains code in the child form's `Activate` event procedure that increments a public variable to keep track of how many child form instances have been created and then sets the new form's `Caption` property to reflect that number.

Working with Menus

In Chapter 6, "Giving More Control to the User: Menus and Toolbars," you learned how to create a menu for your application. You also found out that you can have a different menu for each form in your program, if you so desire. MDI forms can also have menus. You create a menu for your MDI form the same way that you create a menu for a standard form, using the Menu Editor. The menu for the MDI form is usually the primary means by which you access the capabilities of an MDI application.

▶ **See** "Creating a Menu Bar," **p. 108**

In an MDI application, the child forms can also have menus. As you do with the menu for the MDI form itself, you create child form menus by using the Menu Editor. However, when a child form that has a menu is displayed, its menu is not displayed as part of the child form but is displayed on the menu bar of the MDI form. This behavior presents a problem in your MDI applications because the MDI child form's menu actually replaces the MDI parent form's menu when the child is active. You cannot access the parent form's menu functions while the child form is active.

You can take advantage of two solutions to the problems associated with the replacement of menus. First, you can duplicate all the necessary parent form functions on each child form. Unfortunately, this approach can lead to a bloated and hard-to-maintain program if you have several child forms with menus.

An alternative solution is to include in the parent window's menu all the menus that are necessary for all child windows. Then you can place code in the child form's `GotFocus` and `LostFocus` events to show (and hide) the parent's menus that are applicable to that child form when that child form has the focus. For example, in a word processing program, you want the File and Help menus to be available all the time, but you want the Edit and Format menus available only when you are working on a document. To make the Edit and Format menus visible, you can place code like the following in the appropriate child form's `GotFocus` event procedure:

```
mnuEdit.Visible = True
mnuFormat.Visible = True
```

The following code, placed in the child form's `LostFocus` event procedure, takes care of making the Edit and Format menus invisible again:

```
mnuEdit.Visible = False
mnuFormat.Visible = False
```

To make sure that any menu code in the parent form acts on the proper child form, use the parent form's `ActiveForm` property as described in the preceding section.

Managing the Children

One of the other benefits of working with MDI applications is that you can easily manage all the child forms. Visual Basic offers a number of tools that make it easy for your users to access the multiple forms that are open inside the MDI form. Your program can provide the users with the means to arrange the child windows automatically. You can even provide a menu item that keeps up with all the open child windows and lets the users access one of them by selecting it from the menu. These capabilities are particularly useful if the users will be switching back and forth between multiple tasks or multiple files in the application.

Using Automatic Organization

One way that users can access multiple forms is by displaying each form on the screen in a particular organizational style. This capability provides the users with access to each form with just a click of a mouse button. The key to this functionality is the MDI form's `Arrange` method. The `Arrange` method organizes all the child forms of the application in a particular pattern. Each of these patterns results in at least a portion of each form's being visible to the users, and they are commonly used by MDI-compliant Windows applications.

To use the `Arrange` method, you specify the name of the MDI form, the method itself, and a constant representing the pattern that you want to use for the arrangement of the forms. The following line of code illustrates the use of the method:

```
mdiMain.Arrange vbCascade
```

You can create four possible window arrangement patterns with the `Arrange` method. Each of these patterns is represented by an intrinsic constant. Table 17.1 summarizes the patterns, and they are illustrated in Figures 17.12 through 17.15.

Table 17.1 Arrangements of MDI Child Windows

Constant	Description
`vbCascade`	The nonminimized forms are arranged in a pattern in which each form is offset slightly from the others.
`vbTileVertical`	Each nonminimized child form occupies the full height of the parent form, and the child forms are displayed side by side. If you have many child forms, they can occupy multiple rows when tiled.
`vbTileHorizontal`	Each nonminimized child form occupies the full width of the parent form, and the child forms are displayed on top of one another. If you have many child forms, they can occupy multiple columns when tiled.
`vbArrangeIcons`	The icons of all minimized child forms are arranged near the bottom of the parent form.

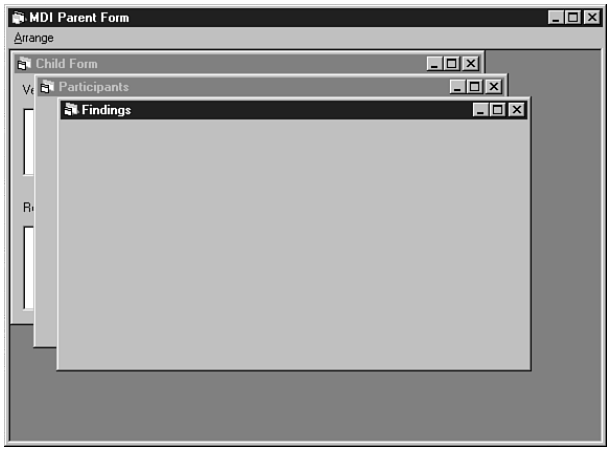


FIGURE 17.12
These child forms have been arranged in a cascade pattern.

Typically, you place the arrangement options in a Window menu on the MDI form. Each arrangement option that you want to support is a separate menu item.

Maintaining a Window List

The other way of providing easy access to the child forms of your application is to maintain a list of the open child forms. Fortunately, this task is easy. You create a window list while you are creating the menu for the MDI parent form. You determine which menu will contain the list and then set that menu item's `WindowList` property to `True` in the Menu Editor, as shown in Figure 17.16.

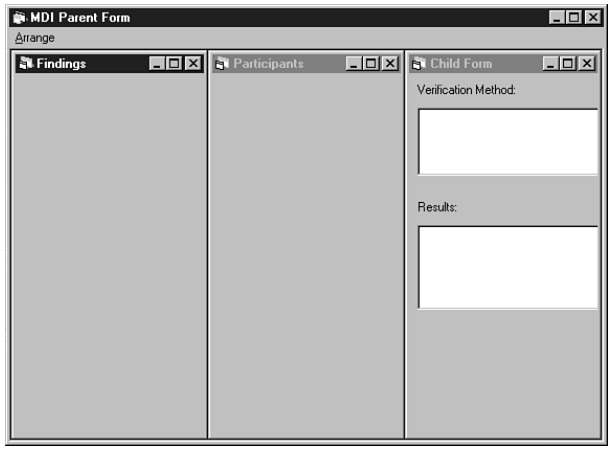


FIGURE 17.13
These child forms have been arranged in a vertically tiled pattern.

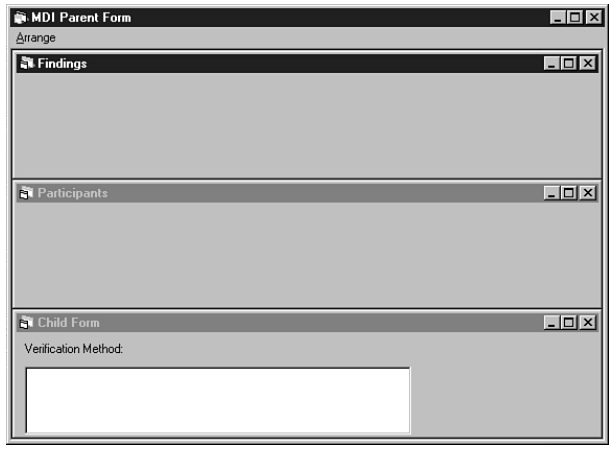


FIGURE 17.14
These child forms have been arranged in a horizontally tiled pattern.

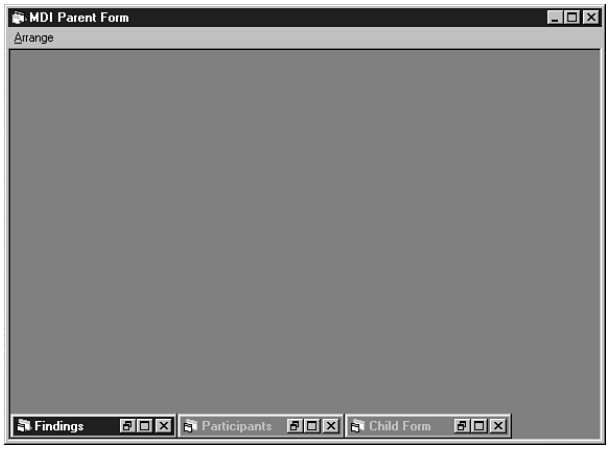
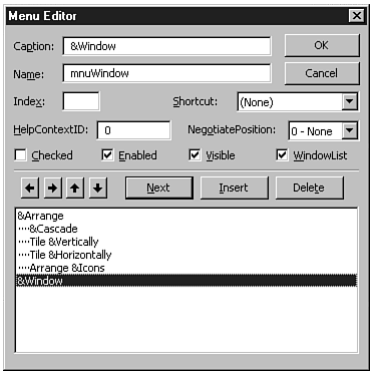


FIGURE 17.15
Minimized child forms are represented by icons arranged at the bottom of the MDI form.

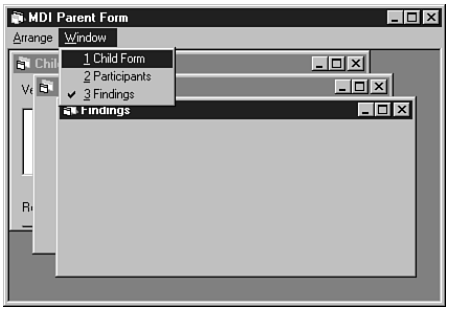
NOTE You also can change the setting of the `WindowList` property from code.

FIGURE 17.16
Check the WindowList box to create a list of open child windows in your MDI menu.



As you add child forms to the application, the window list menu item is automatically updated to include the new form. The caption of the menu item is the caption that is given to the form that you create. The active form in the window list is indicated by a check mark. Figure 17.17 shows a window list for an MDI application.

FIGURE 17.17
The window list lets the users select the form with which to work.



Creating a Sample Application—an MDI Contact Manager

Obviously, the best way to demonstrate the techniques of MDI applications is to build an application that you might actually use. This program uses multiple instances of a template form to become an MDI application.

If part of your job is keeping up with customer contacts, you probably use some kind of contact manager. These programs let you keep up with information about each of your customers, such as their name, address, phone numbers, the date you last contacted them, and so forth. One of the disadvantages of some contact managers is that you can only work with a single

contact at a time. This can be very inconvenient if you are working on an order for one customer and another telephones to discuss a new service. In this case, you have to close the client information for the current customer and open the information for the second customer. Wouldn't it be great if you could just open the information for the second customer in a new window? Well, with an MDI contact manager, you can.

This section shows you how to build a very simple MDI contact manager. The program displays only name and address information for a client and is basically an illustration of the concept. To create a full-fledged contact manager, you have to add additional database code. The program uses a Microsoft Access database and the Jet engine to retrieve the data.

▶ **See** "Using Tables," **p. 570**

Creating the MDI Form

The setup of the MDI form is the same as you have seen in previous sections. You first need to add an MDI form to your project and then set the `AutoShowChildren` property to `False`. You also should set the `Name` and `Caption` properties of the MDI form to something other than the defaults.

After setting the properties of the form, you need to create a menu that displays the customer information in the appropriate child form. The menu items that you need to add are shown in Figure 17.18.

▶ **See** "Creating a Menu Bar," **p. 108**

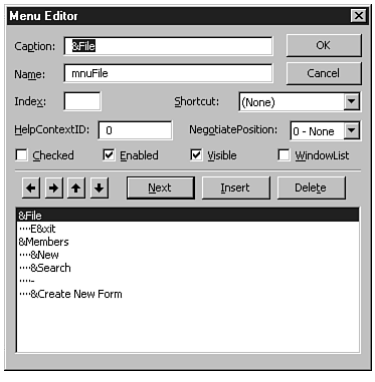


FIG. 17.18
The sample MDI Contact Manager application has these menu items.

One menu item of note is the Create New Form item. The user can use this option to tell the program whether to display a selected customer in the existing child form or to create a new form for each new customer. The Checked property of the item is set to show the status of the user choice.

Of course, after you create the menu, you need to add code to make the menu options work. Listing 17.2 shows the code for the menu items shown in Figure 17.18.

Listing 17.2 MAINMDI.TXT—Use Menu Code to Handle the Tasks of the Contact Manager

```
Private Sub filExit_Click()
    Unload Me
End Sub

Private Sub MDIForm_Load()
    Me.WindowState = vbMaximized
End Sub

Private Sub MDIForm_Unload(Cancel As Integer)
    CustDb.Close
End Sub

Private Sub memCreate_Click()
Dim CheckSet As Boolean
    CheckSet = Not memCreate.Checked
    memCreate.Checked = CheckSet
    CreateForm = CheckSet
End Sub

Private Sub memNew_Click()
    If CreateForm Then
        Dim frmMem As New frmMember
        frmMem.Show
    End If
    ClearCust
End Sub

Private Sub memSearch_Click()
    frmSearch.Show vbModal
    If CreateForm Then
        Dim frmMem As New frmMember
        frmMem.Show
    End If
    ShowCust
End Sub
```


Setting Up the Customer Child Form

The next step in creating the contact manager is setting up the child form that displays a customer's information. To set up the customer form, add a form to your project (or use the initial form that was created) and then set its `MDIChild` property to `True`. You probably also need to change the `Name` and `Caption` properties of the form. (Set the name of the form to `frmMember` to match the code in the menu items.) After setting the properties of the form, you need to add controls to the form to display the data. The completed form is shown in Figure 17.19.

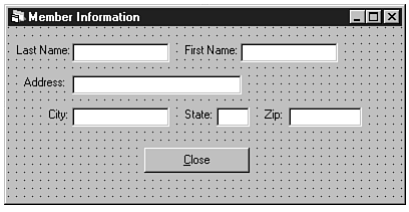


FIG. 17.19
Customer information is displayed in a child form.

Creating the Search Form

As you look up customer records, you need a search form to allow the user to enter a name to find. The search form can be very simple, consisting of a label, a text box to enter the name, and two command buttons to perform or cancel the search. The code for the form is also very simple. If you proceed with the search, the code uses the `FindFirst` method of the recordset that contains the contact information to locate the first name corresponding to the desired search information. The complete search form is shown in Figure 17.20, and the code for the form is shown in Listing 17.3.

NOTE A *recordset* is a special type of object that acts as a link between a Visual Basic program and information stored in a database. You learn about recordsets in Chapter 26, "Using Data Access Objects (DAO)." ■

▶ **See** "Deciding Which Recordset Type to Use," **p. 569**

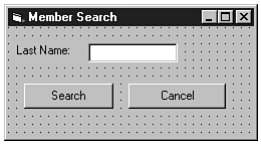


FIG. 17.20
You can make the search form more complex by adding a First Name search as well.

Listing 17.3 SEARCH.TXT—Use the *FindFirst* Method to Locate the Desired Customer

```
Private Sub cmdCancel_Click()
    Unload Me
End Sub

Private Sub cmdSearch_Click()
Dim SrchStr As String
    SrchStr = txtSearch.Text
    CustRset.FindFirst "LastName = '" & SrchStr & "'"
    Unload Me
End Sub
```

Creating the Heart of the Program

The forms provide the interface of the program, but the real heart of the program is a group of procedures that actually display the data and set the program up. To create the procedures, you first need to add a module to your program. You can do this by choosing Project, Add, or by selecting Module from the Add Object button's drop-down menu.

▶ **See** "Determining the Scope of Procedures and Functions," **p. 232**

After the module is added to the project, you need to define a couple of `Public` variables and create the procedure that sets up the program. The public variables are used to provide your entire program with access to the database object. Once you define the variables, you need to create a `Sub Main` procedure to set up the database information and display the MDI parent form. The `Public` variable declarations and the `Sub Main` procedure are shown in Listing 17.4.

Listing 17.4 MDIPROCS.TXT—Use *Sub Main* to Set Up the Database and Load the Main Form

```
Public CustDb As Database, CustRset As Recordset
Public CreateForm As Boolean

Sub Main()
    Set CustDb = DBEngine.Workspaces(0).OpenDatabase("D:\VB6Book\NewDb.mdb")
    Set CustRset = CustDb.OpenRecordset("Customers", dbOpenDynaset)
    mdiMain.Show
    CreateForm = True
End Sub
```

After you create the `Sub Main` procedure, you need to change the project options to make `Sub Main` the startup object of the program.

The next two procedures are the ones which either display information about a current customer or set up the information form for you to enter a new customer. These procedures are called by the appropriate menu items of the MDI form. The key feature to note in these procedures is that the `ActiveForm` property of the MDI form is used to designate which child form will receive the data being sent. The `ClearCust` and `ShowCust` procedures are shown in Listing 17.5.

Listing 17.5 MDIPROCS2.TXT—Use the *ActiveForm* Property to Send the Output of the Procedure to the Proper Location

```
Public Sub ClearCust()
Dim I As Integer
    For I = 0 To 5
        mdiMain.ActiveForm.txtMember(I).Text = ""
    Next I
End Sub
```

continues

Listing 17.5 Continued

```
Public Sub ShowCust()
    With mdiMain.ActiveForm
        .txtMember(0).Text = CustRset!LastName & ""
        .txtMember(1).Text = CustRset!FirstName & ""
        .txtMember(2).Text = CustRset!Address1 & ""
        .txtMember(3).Text = CustRset!City & ""
        .txtMember(4).Text = CustRset!State & ""
        .txtMember(5).Text = CustRset!Zip & ""
    End With
End Sub
```

Running the Program

As you run the program, you can create new windows for each customer that you add, or change the status of the Create New Form menu item to display each customer in the same window. As stated previously, this example is merely is an illustration of the concept, so feel free to add your own enhancements to the program. The MDI contact manager is shown in Figure 17.21.

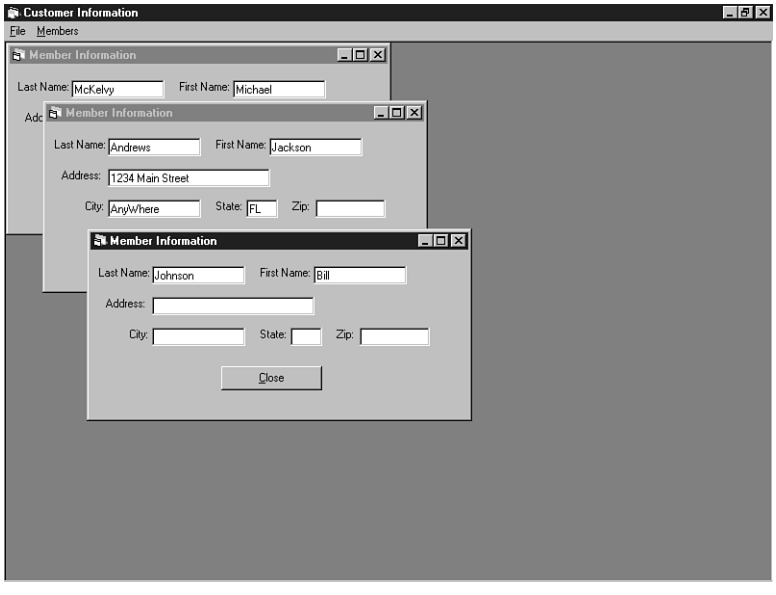


FIG. 17.21
You can display multiple clients at the same time.

Optimizing Your MDI Application

This chapter demonstrated a number of techniques that you can use to create MDI applications. As you can see, the MDI form can be a powerful tool for creating programs. However, there are several considerations to keep in mind to optimize your MDI applications. These

considerations help keep the performance of your programs as crisp as possible and help keep your users from running into problems:

- Each new child window that is loaded consumes memory. Having memory-intensive child windows causes your application to drain memory quickly, so keep the amount of code and the number of controls in your child windows to a minimum.
- If your child and parent windows have the same menu commands (such as File, Open or File, Exit), keep the code in the parent. This means your child form's menu `Click` event procedures should simply call the parent menu's `Click` event procedure for all shared code.
- Change all of your menu `Click` event procedures from `Private` to `Public` so your child and parent windows can share these events.
- Avoid using the `Name` property of your child form. Instead, your child forms should use `Me` (or nothing at all), and your parent form should use `ActiveForm`.
- Put *all* invisible controls (such as a common dialog control or image list) on the MDI parent form. This allows all of your child windows to share these controls, without consuming extra memory.

Adhering to these concepts both simplifies your code and improves the performance of your MDI application.

Creating an MDI Application Framework

The code shown in this section is designed to provide a basic skeleton for any MDI applications that you create. The skeleton code can be modified to suit your specific needs. Then you can use the skeleton project as a template for your other MDI applications. The completed application is shown in Figure 17.22.

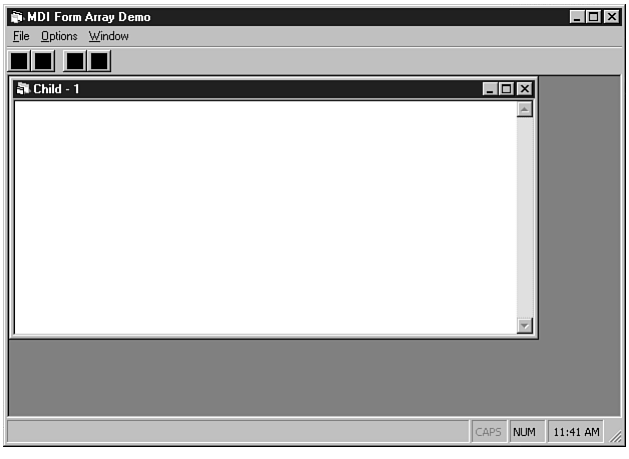


FIG. 17.22
Creating a template project can simplify your future MDI work.

Creating the MDI Parent Template

The MDI parent form is the keeper (or container) of the child windows, so it is responsible for creating new children. With this duty, it is common for the parent to also keep track of the number of child windows it has created. In addition, the parent usually holds shared user interface elements like a toolbar, status bar, and so on.

The code in Listing 17.6 shows the code used to maintain and expose the window count. `WindowCreate` and `WindowDestroyed` are called by the child windows in their `Form_Load` and `Form_Unload` event procedures, respectively. `ChildWindowCount` is a `Public` property that allows the child windows to find out how many children are loaded.

Listing 17.6 MDIPARENT.TXT—Use the Parent to Contain Common Code for All the Child Forms

```
'*********************************************************************
' MDIParent.frm - Demonstrates some basic concepts on how a MDI parent
'   form should behave in an MDI application.
'*********************************************************************
Option Explicit
Private mintChildWinCount As Integer
'*********************************************************************
' Returns how many child windows have been created
'*********************************************************************
Public Property Get ChildWindowCount() As Integer
    ChildWindowCount = mintChildWinCount
End Property
'*********************************************************************
' Called when a window is created to increment the window counter
'*********************************************************************
Public Sub WindowCreated()
    mintChildWinCount = mintChildWinCount + 1
    UpdateButtons True
End Sub
'*********************************************************************
' Called when a window is created to decrement the window counter
'*********************************************************************
Public Sub WindowDestroyed()
    mintChildWinCount = mintChildWinCount - 1
    UpdateButtons mintChildWinCount
End Sub
```

You also might notice a call to `UpdateButtons` in Listing 17.6. This private helper routine enables and disables toolbar buttons. If children exist, then the toolbar buttons are enabled. When the last child is unloaded, `WindowDestroyed` decrements the variable `mintChildWinCount` to `0`, which causes `UpdateButtons` to disable the toolbar buttons.

The most important code in MDIPARENT.FRM is the File menu's `Click` event procedure. This code is responsible for creating windows, opening files, and terminating the application.

Because all of these actions on the MDI parent file menu are also on the child form's file menu, you make this event public (see Listing 17.7).

Listing 17.7 MDIPARENT2.TXT—Handling Menu *Click* Events

```
'*********************************************************************
' File menu handler for the MDI form when no windows are displayed.
' In this demo the child windows will have a menu just like this,
' so we will make this Public so the children can call this event.
'*********************************************************************
Public Sub mnuFileItems_Click(Index As Integer)
    Select Case Index
        '*************************************************************
        ' File New - Create a new child form, then display it.
        '*************************************************************
        Case 1
            Dim frmNew As New frmChild
            frmNew.Visible = True
        '*************************************************************
        ' File Open - Prompt the user for a filename, then load
        '   it into the child window (in OpenFile) if the user didn't
        '   press cancel in the dialog.
        '*************************************************************
        Case 2
            On Error Resume Next
            With cdlg
                .Flags = cdlOFNFileMustExist
                .Filter = "Text Files (*.txt)¦*.txt¦All Files (*.*)¦*.*"
                .ShowOpen
            End With
            If Err <> cdlg.cdlCancel Then OpenFile cdlg.filename
        '*************************************************************
        ' Index 3 is the separator, so don't do anything.
        '*************************************************************
        'Case 3
        '*************************************************************
        ' File Exit - Terminate the application
        '*************************************************************
        Case 4
            Unload Me
    End Select
End Sub
```

When the File, New menu is clicked (`Index = 1`), the `Dim frmNew As New frmChild` line creates a new instance of your child form. However, this doesn't really create the new form. The form is actually created as soon as you access one if its properties or methods. This means that the `frmNew.Visible = True` line is the line of code that creates the form. After the form is created, the `Visible` property is set to `True`, which displays your form.

TIP Forms created using `New` are hidden by default, so remember to display them by setting `Visible = True`.

The File, Open (`Index = 2`) code in Listing 17.8 simply displays an Open dialog box so the user can supply a file name. If the user doesn't click Cancel, then the file is opened using the `OpenFile` routine, as presented in Listing 17.8. The last item in the select statement is `Index 4`, which represents the File, Exit case. This is an easy one because the proper way to terminate an MDI application is to unload the MDI form.

As mentioned earlier, the `OpenFile` code is responsible for opening a text file and loading it into a text box on your child form. This code is very simplistic and includes no basic error handling for such cases as testing for files greater than 44K under Windows 95. However, it does provide a basic example of how to load a file into a text box, which is sufficient for this example.

CAUTION

Avoid using the `End` statement to terminate your applications. `End` terminates your application immediately, which prevents your `Form_Unload` events from being executed. The best way to end an MDI application is to unload the MDI form.

Listing 17.8 MDIPARENT3.TXT—Shared Code

```
'*********************************************************************
' Code shared among the child windows should be put in either a
' module or the MDI parent form.  This OpenFile code will be used
' by all of the children, so we will keep it in the MDI parent form.
'*********************************************************************
Public Sub OpenFile(strFileName As String)
    Dim strFileContents As String
    Dim intFileNum As Integer
    '*****************************************************************
    ' Get a free file handle
    '*****************************************************************
    intFileNum = FreeFile
    '*****************************************************************
    ' Open the file
    '*****************************************************************
    Open strFileName For Input As intFileNum
        '*************************************************************
        ' Put the contents of the file into the txtData control of
        ' the child form. This code will fail if the file is too
        ' large to fit in the textbox, so you should include
        ' additional error handling in your own code.
        '*************************************************************
        With ActiveForm
            .txtData.Text = Input$(LOF(intFileNum), intFileNum)
            '*******************************************************
            ' Set the caption of the child form to the filename
            '*******************************************************
            .Caption = strFileName
        End With
    '*****************************************************************
    ' Always close files you open as soon as you are done with them
```

```
    '*****************************************************************
    Close intFileNum
End Sub
```

You might notice that the `OpenFile` routine simply loads the file into the text box on the active window by referencing the `ActiveForm` property. This is a valid assumption to make, because the active menu will always refer to the active form. Because the user can open a file via the menu (even if he or she is using the toolbar), you can always assume that any actions you perform in your menu event handlers should be applied to the active form.

The MDI Child

Now that you have had a chance to understand what your MDI parent form is responsible for, let's take a look at how the child should behave in this parent/child relationship.

As mentioned earlier, child forms are responsible for calling the `WindowCreated` and `WindowDestroyed` methods of the MDI parent form. Listing 17.9 demonstrates how this is done from the `Form_Load` and `Form_Unload` events. In addition, your child window sets its initial caption based on the MDI parent `ChildWindowCount` property. Although this technique is good for this sample, you might want to make your algorithm for setting your initial caption a little more complex. What do you think would happen if you had three windows, closed the second window, and then created a new window? How could you avoid this problem?

Listing 17.9 MDICHILD.TXT—Use the Child Form for Code Specific to Each Child

```
'*********************************************************************
' MDIChild.frm - Demonstrates some basic techniques on how a MDI child
'   window should behave.
'*********************************************************************
Option Explicit
'*********************************************************************
' When a new form is created it should call the WindowCreated function
' in the MDI parent form (which increments the window count in this
' case). It should also set its caption to distinguish it from other
' child windows.
'*********************************************************************
Private Sub Form_Load()
    MDIParent.WindowCreated
    '****************************************************************
    ' This works, but it has a fatal flaw.
    '****************************************************************
    Caption = Caption & " - " & MDIParent.ChildWindowCount
End Sub
'*********************************************************************
' Make sure txtData always fills the client area of the form.
'*********************************************************************
```

continues

Listing 17.9 Continued

```
Private Sub Form_Resize()
    txtData.Move 0, 0, ScaleWidth, ScaleHeight
End Sub
'*********************************************************************
' Let the MDI parent know that this window is being destroyed.
'*********************************************************************
Private Sub Form_Unload(Cancel As Integer)
    MDIParent.WindowDestroyed
End Sub
```

One other minor detail you might have noticed in this code is the `Form_Resize` event. This code makes sure your TextBox control always covers the entire client area of the form. This code works with any control, so keep this in mind for your own applications.

Another important concept mentioned previously was that your child forms should use event handlers of the parent menu whenever possible (and vice versa). Listing 17.10 contains the event handlers for all of the menus used by MDICHILD.FRM.

Listing 17.10 MDICHILD2.TXT—Handling the Menu Code for the Application

```
'*********************************************************************
' Since the child File menu is identical to the MDI parent File menu,
' we should avoid duplicate code by calling the parent's mnuFileItems
' click event.
'*********************************************************************
Private Sub mnuFileItems_Click(Index As Integer)
    MDIParent.mnuFileItems_Click Index
End Sub
'*********************************************************************
' The options menu is unique to the child forms, so the code should
' be in the child form or separate BAS module.
'*********************************************************************
Public Sub mnuOptionsItems_Click(Index As Integer)
    '****************************************************************
    ' Don't stop for errors
    '****************************************************************
    On Error Resume Next
    '****************************************************************
    ' Show the color dialog (since all menu items here need it)
    '****************************************************************
    MDIParent.cdlg.ShowColor
    '****************************************************************
    ' If the use selected cancel, then exit
    '****************************************************************
    If Err = cdlCancel Then Exit Sub
    '****************************************************************
    ' Otherwise set the color based on the value returned from the dlg
    '****************************************************************
    Select Case Index
        Case 1 'Backcolor...
```

```
            txtData.BackColor = MDIParent.cdlg.Color
        Case 2 'Forecolor...
            txtData.ForeColor = MDIParent.cdlg.Color
    End Select
End Sub
'*******************************************************************
' If you set your indexes of your Window menu properly, you can save
' yourself some code. I was careful to make sure my Window menu items
' indices were equivalent to the possible values for the Arrange
' method.
'*******************************************************************
Private Sub mnuWindowItems_Click(Index As Integer)
    MDIParent.Arrange Index
End Sub
```

The first menu is the File menu, which is identical to the parent form, so you simply call the `mnuFileItems_Click` event in the parent for default processing. The second menu is the Options menu, which only appears in the child form, so you write your implementation code here. However, you make this event handler public so it could be accessed by your Toolbar control, which resides on the parent form. In addition, you use the CommonDialog control on the parent for your code, which displays the color dialog box.

TIP If any menu item on your child form requires greater than 12 lines or so of code (excluding `Dim`s, comments, and white space), you should move that code to a shared module or into the parent form. That prevents this code from consuming too much free memory every time a new form is added.

Finally, you have your Window menu that only applies to child forms (although it is the parent form that is responsible for this menu). By carefully creating your menu control array indices, you are able to write the implementation code for this menu using only one line of code.

ON THE WEB

From the Macmillan Web site, you can download another complete project that makes full use of the MDI concepts covered in this chapter. A text editor application named MDI Text Editor, it is similar in functionality to Windows Notepad, but it allows for multiple document windows to be open simultaneously. You can open this project from within Visual Basic; comments throughout the code explain how it works.

From Here...

This chapter provided you with an introduction to creating MDI applications using Visual Basic. For more information about some of the related topics covered in this chapter, see the following chapters:

- To learn more about setting up forms, see Chapter 3, “Visual Basic Building Blocks.”
- To learn more about creating database programs like the example in this chapter, see Chapter 26, “Using Data Access Objects (DAO).”

CHAPTER 18

Proper Interface Design

In this chapter

Designing Effective Forms 410

User PC Differences 415

Dealing with User Expectations 417

In this chapter, you learn about the part of the program that everyone sees: the user interface. Some programmers are inclined to leave user interface design as an afterthought, thinking the code is the real "guts" of an application and therefore deserves the most attention. However, gripes about fonts, screens, and speed of execution should be taken very seriously. Your users cannot see the code, but the user interface (good or bad) is always right in front of them. Windows offers many opportunities to build an interface that will help get the job done easier. This chapter describes a series of guidelines and examples that will help you make the most of these opportunities.

Designing Effective Forms

Forms are the building blocks of your user interface. Although designing a form in Visual Basic is simple, doing it well is not very easy. Good form design involves more than just inserting controls and programming events. To make a well-designed form, you should understand the form's purpose, how it is going to be used, when it is going to be used, and its relationship with the rest of the program. In addition, within your application, you may have several open forms, each of which must be displayed when appropriate. Some users take advantage of the multitasking freedom offered by Windows, whereas others tend to use only one application at a time. Keep this point in mind when you're designing a user interface (UI): You must manage the flexibility Windows offers to the programmer so that users with any skill level can effectively use the application.

Keep Forms Neat and Uncluttered

The more controls you have on a form, the more important it is to keep them organized. Consider the form shown in Figure 18.1. It looks as though the controls have been placed on the form haphazardly. They are not labeled, lined up, or sized consistently. A better approach is shown in Figure 18.2. Notice that frames, lines, and labels have been added to group related controls. Both illustrations show "working" applications, but the second form has a more visually pleasing appearance, which makes it easier to use.

Visual Basic provides several excellent controls to help you organize a form. One of these controls is the TabStrip control, shown in Figure 18.3, which can be used to segregate controls so that only a few of them are displayed at any given time. This way, you can hide infrequently used options from the average users while still making them available if necessary.

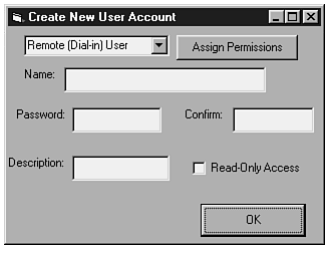


FIGURE 18.1
A messy form can prevent users from finding the information they need.

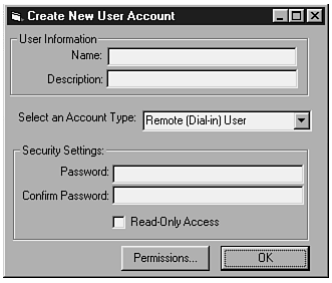


FIGURE 18.2
In a much better design than the form in Figure 18.1, frames and label controls are used to organize the form.

NOTE The Tabbed Dialog control is similar to the TabStrip; the major difference is that it can act as a container for other controls.

▶ **See** "Using the TabStrip Control," **p. 261**

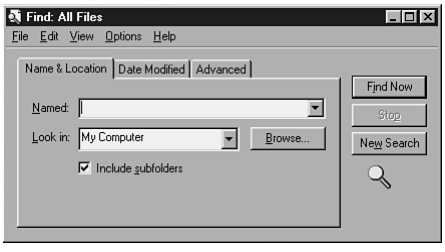


FIGURE 18.3
Use the TabStrip control, and keep your form a reasonable size.

To keep from going overboard with too many controls on a form, you should always keep the form's purpose in mind. Consider the form in Figure 18.3. Everything on the form could fall under the general realm of "program options," but each separate category of options is in a different section of the TabStrip control. If you do find that you need a separate form, make sure logic dictates which controls you put on it.

In addition, make sure to set the appropriate form properties so that the form acts according to its intended purpose. For example, a modal form probably should not have a sizeable border or show up in the Windows taskbar.

▶ **See** "Form Properties Revisited," **p. 52**

Pay Special Attention to Data Entry Forms

Data entry forms are a special breed. They should allow users to work at their own pace, not the programmer's. Common sense is the main rule here: If users have to enter 10,000 records into your database, they don't want to answer a yes/no confirmation dialog for each record.

The preceding section emphasized separating and hiding certain controls. However, a data entry form should maximize the use of form space because showing and hiding forms slows down the process. Speed should definitely be one of your main goals when designing a data entry form. To make the data entry process faster, follow these guidelines:

- Always provide keyboard shortcuts; never require the use of a mouse. (This is good advice for all forms in your program, not just data entry forms.)
- Keep the layout consistent with the order of the users' tasks. In other words, don't make them jump from one section to another unnecessarily to enter information.
- Do not require the users to perform unnecessary work. In other words, if fields 2 through 10 require a value only if field 1 has a value, you don't need to make the users always tab through every field. On the other hand, don't make the behavior of your forms too field dependent; if a form works differently for every possible combination of required fields, you may actually slow down the users.
- Use noticeable but unobtrusive visual cues to provide feedback to the users. The way the VB code editor capitalizes correctly spelled variables and constants is a good example.
- If possible, perform adds and edits on the same form so that the users do not have to learn multiple methods of accessing the same data.

An example of a data entry form is shown in Figure 18.4. Notice that when a data validation error occurs, the offending field is highlighted, and an explanation is provided in the status bar.

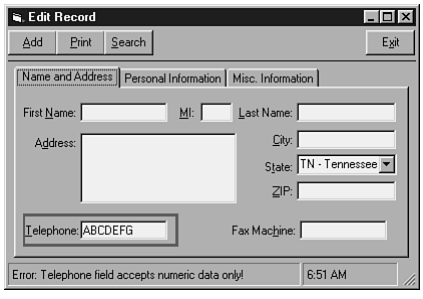


FIGURE 18.4
In this sample data entry form, ease of use is of prime importance.

Use the Right Control for the Job

Visual Basic provides several custom controls that can be placed on a form. However, keep in mind that some controls work better in certain situations than others. The purpose of the form should help guide you in choosing the appropriate controls. For example, both the ListBox and ComboBox controls can be used to select from a list of choices. However, the combo box allows you to save form real estate by hiding the list of choices, as illustrated in Figure 18.5.

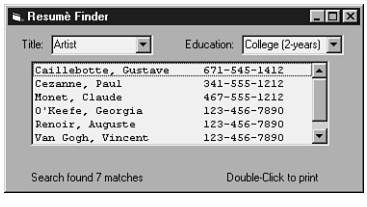


FIGURE 18.5
The amount of space available on a form may influence your choice of custom controls.

In Figure 18.5, list boxes could have just as easily been used for the selection criteria. However, using a combo box is more appropriate because it saves space while still accomplishing the intended task.

▶ **See** "The Combo Box," **p. 75**

Third-Party Controls

Third-party custom controls are useful; however, you should not use them unless doing so is really necessary. Picking a control included with VB over a third-party control offers several advantages:

- The chances are better that the control will be supported in future versions of VB.
- Distributing the control to users is easier.
- Many "native" VB controls, such as the Windows Common Controls, provide the users an interface with which they are already familiar.

Multiple Forms

If your user interface will contain multiple forms, a major decision you have to make is whether to use a single-document interface (SDI) or a multiple-document interface (MDI). MDI applications, discussed in Chapter 17, "Multiple Document Interface Applications," handle multiple forms by enclosing them visually within a "parent" window.

▶ **See** "Introducing MDI Applications," **p. 382**

Forms in an SDI application appear as totally independent windows. Whether you use SDI or MDI, user interaction with forms initiates many program actions through form and control events. If you have multiple forms, you need to code the program so that the users are not allowed to disrupt the intended program flow—for example, show a data form that has not been populated yet.

As an example of a potential problem with multiple forms, consider the two forms shown in Figure 18.6.

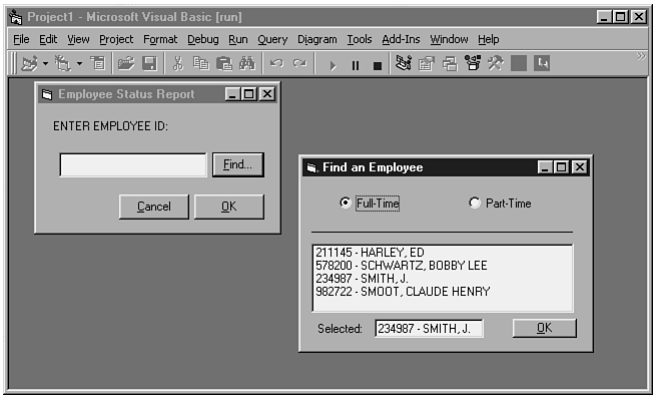


FIGURE 18.6
Forms that your code treats as independent when they really are not can cause unexpected errors.

In the example shown in Figure 18.6, the main form, `frmMain`, is used to retrieve information from the database. If users do not know a valid value for the Employee ID field, they can click the Search button next to the field to display the second form, `frmSearch`. The second form comes up with a valid ID value and returns it to the main form. At first glance, the code to manage the transition between forms is easy to understand.

The Search button on the first form simply shows the second form:

```
Sub cmdSearch_OnClick()
    frmSearch.Show
End Sub
```

The second form, after performing the search function, places the valid value in a text box on the first form and then unloads itself:

```
Sub cmdOK_OnClick()
    frmMain.txtID = sSearchResult
    Unload Me
End Sub
```

Although the simple code listed here would get the job done, it has a couple of basic design problems. First, it treats `frmSearch` like a totally independent form. The users could return to `frmMain` without closing `frmSearch`, either on purpose or by accident, and an orphan form would be left open. If `frmMain` was later unloaded and `frmSearch` tried to access it, an error would occur. The second problem with this arrangement is that the code is hard-wired to these two specific forms, so reusing `frmSearch` in other parts of the application would be difficult. You can solve both of these problems by showing `frmSearch` modally.

Modal forms, as you may recall, keep the application focus until you hide them. In other words, you cannot switch from a modal form to another form without first closing the modal form. In addition, any code that would have been executed after the `Show` method is suspended until the modal form is hidden.

▶ **See** "Form Properties Revisited," **p. 52**

Showing `frmSearch` modally prevents the users from switching back to `frmMain` without first closing `frmSearch`. It also stops code execution in other modules while `frmSearch` is visible. You can use this capability to your advantage and consolidate some of the code. Consider the following search function that returns the value to the calling procedure rather than to any specific form:

```
Function sGetValidValue() As String
    frmSearch.Show vbModal
    sGetValidValue = frmSearch.sSearchResult
    Unload frmSearch
End Function
```

You can now call the preceding function from `frmMain` (or any other form) to display `frmSearch` and retrieve a valid search value:

```
Sub cmdSearch_OnClick()
    frmMain.txtID = sGetValidValue()
End Sub
```

TIP If your project is very large, use modules, subroutines, and even custom DLLs to keep the "guts" of your program separate from the UI and thus easier to maintain.

User PC Differences

From a user interface standpoint, extra thought is required when you're writing a program that is designed to run on a PC other than your own. Visual Basic programs run on Windows 95, Windows 98, or Windows NT (not to mention Windows CE). Each of these operating systems is different, and each PC running them can be set up differently.

NOTE If you want to know programmatically which operating system your user is running, check out the `GetVersionEx` API call or the SysInfo custom control. Instructions for using API calls are discussed in Chapter 20, "Accessing the Windows API."

In addition, the Windows operating system leaves a lot of room for user customization. One of the most noticeable differences may be screen resolution. If you go into the Windows Display Control Panel, you may notice that several options for screen size are available. As a developer and owner of a 21-inch monitor, I like to leave my PC at 1280×1024, which allows me to place a lot on the screen at once. However, most of your end users are likely to be operating at a lower resolution, say 640×480. The easiest solution to this problem is to design your forms for the minimum 640×480 resolution. The users at that resolution will see your application fill up the whole screen, while users at higher resolutions will have extra desktop space to open other windows. But what happens when the user adjusts the size of your form with the mouse? If you do not write code to handle this situation, users at higher resolutions could get unpleasant results, as in Figure 18.7.

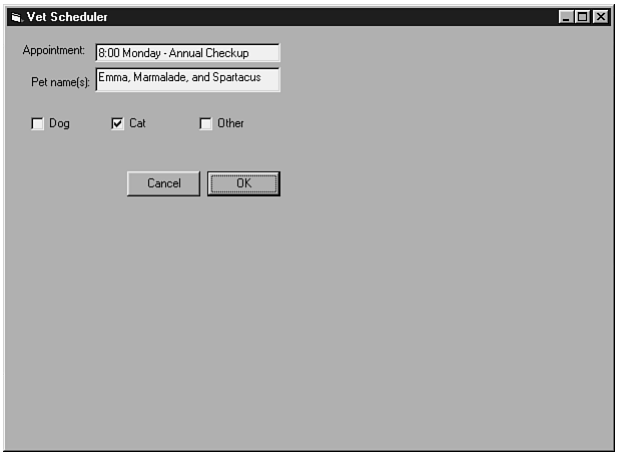


FIGURE 18.7
If you do not respond to users resizing your form, wasted space appears.

In addition, a user can make a form smaller, obscuring some controls. However, if your form is simple enough, you may be able to add some code to the form's `Resize` event to make it resolution independent. By looking at the `Height` and `Width` properties of each control and comparing them to the form's height and width, you can easily add code so that controls will maintain their relative positions when users resize your form. The following code adjusts the sizes of a list box and two command buttons so that their sizes will change with the form:

```
Private Sub Form_Resize()

    If Me.Height <= 1365 Then Exit Sub

    lstMain.Height = Me.Height - 1365
    lstMain.Width = Me.Width - 420

    cmdOK.Top = lstMain.Height + 360
    cmdOK.Left = lstMain.Width - cmdOK.Width

    cmdCancel.Top = cmdOK.Top
    cmdCancel.Left = cmdOK.Left - cmdCancel.Width - 120

End Sub
```

TIP For an even better form, change the font size of your controls as the form size changes.

Note that the first line of code in the Resize event exits the event procedure if the form height becomes too small because an error would occur if a negative value were assigned.

NOTE You also can find third-party controls that can be used to add resolution independence to your applications.

Another customization that can adversely affect your program is the Regional Settings Control Panel, pictured in Figure 18.8. This screen allows users to set their own currency and date format, among other things. If you use these predefined formats in your program, make sure that your variables, database fields, and calculations can handle them.

▶ **See** "Formatting Results," **p. 195**

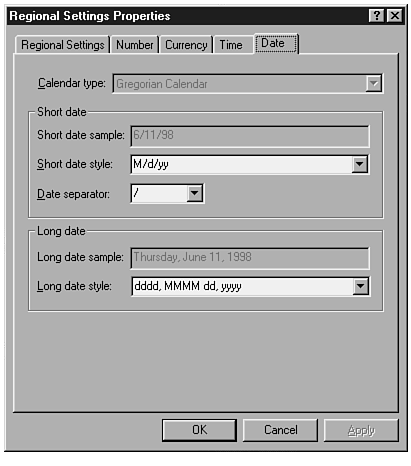


FIGURE 18.8
Make sure your program is prepared to handle changes users make in the Regional Settings Control Panel.

Dealing with User Expectations

Users tend to have ideas about how they think Windows applications should behave. Some of these ideas make sense, and some do not. Most likely, these notions are derived from features they have seen in commercial programs. Of course, users will then expect every simple VB program you write to behave in exactly the same way.

For example, even though your program may have an Exit button, you can count on users to click the Close button in the upper-right corner. If you forget to add code to the `Form_Unload` event to handle this situation, your application could keep running when you don't want it to. The following sections describe several things about which you can count on users having expectations.

The List Box

Many users expect list boxes to behave a certain way. Suppose a list box is set up in a dialog box to select a single item. Some users may prefer to just double-click the item, whereas others single-click it and then press Enter or click OK. These alternative methods are easy to include in your program; simply remember to add code to the list box's `DblClick` event.

TIP In the example described here of selecting items from a list box, both single-clicking and double-clicking are appropriate. However, there are users who do not understand when to use a single-click versus a double-click. You can easily spot these people because they tend to double-click everything, including hyperlinks, command buttons, and even menus. Help teach them the correct procedure by using the hourglass mouse pointer and providing instructions that say specifically whether to single- or double-click.

▶ **See** "The List Box" **p. 70**

Another list box feature available in commercial programs is the ability to enter letters on the keyboard to jump to a specific list item. By default, the list box accepts only a single character. However, you can easily add this "type-ahead" feature to your list box. Simply accumulate the entered characters from the `KeyPress` event in a string, and then move to the matching item in the list. The code in Listing 18.1 does this, plus provides the additional feature of a Timer control that gradually fills the list box. This capability allows users to begin using the type-ahead feature before the list is completely filled.

Listing 18.1 LISTBOX.ZIP—Adding Keyboard Search to a List Box

```
Option Explicit

Dim sLstSearch As String        'The search string
Dim CurrentLetter As String     'Letter being loaded into the list
Dim sWaitForLetter As String    'Letter not yet loaded but selected
Dim dbBiblio As Database        'The sample VB "biblio" database

Private Sub Form_Load()
```

continues

Listing 18.1 Continued

```
    sWaitForLetter = ""
    CurrentLetter = ""

    lblLoaded = "Loading the list . . ."
    Set dbBiblio = OpenDatabase("d:\vb6\biblio.mdb")
    DoEvents

    tmrLoad.Enabled = True

End Sub

Function SearchListBox(lstX As Control, KeyAscii As Integer)
    Dim nSearchPos As Integer
    Dim nSearchLen As Integer
    Dim nResult As Integer

    nSearchPos = lstX.ListIndex
    nSearchLen = Len(sLstSearch)
    sWaitForLetter = ""

    'CHECK FOR BACKSPACE KEY
    If KeyAscii = vbKeyBack Then
        nSearchPos = 0
        If nSearchLen > 0 Then sLstSearch = Left$(sLstSearch, nSearchLen - 1)
    End If

    'CAPTIALIZE THE NEW CHARACTER
    KeyAscii = Asc(UCase$(Chr$(KeyAscii)))

    'IF YOU PRESS 'X' AND DATA IS ONLY LOADED TO 'C' THEN WAIT....
    If nSearchLen = 0 And KeyAscii > Asc(CurrentLetter) Then
        lstX.ListIndex = lstX.ListCount - 1
        sWaitForLetter = Chr$(KeyAscii)
        DoEvents
        Exit Function
    End If

    'ADD NEW LETTER TO SEARCH STRING
    If KeyAscii >= Asc("A") And KeyAscii <= Asc("Z") Then
       sLstSearch = sLstSearch & Chr$(KeyAscii)
    End If

    'DISPLAY SEARCH STRING
    lblSrchtext = sLstSearch

    'RE-CALCULATE LENGTH
    nSearchLen = Len(sLstSearch)

    'SIMPLE SEARCH - COMPARES EACH ITEM TO SEARCH STRING
    While nSearchPos < lstX.ListCount
        nResult = StrComp(sLstSearch, UCase$(Left$(lstX.List(nSearchPos),_\
 nSearchLen)))
        If nResult <= 0 Then
            lstX.ListIndex = nSearchPos
            SearchListBox = 0
            Exit Function
        End If
```

```
        nSearchPos = nSearchPos + 1
    Wend

    'IF ITEM WAS NOT FOUND THEN MOVE TO END OF LIST
    lstX.ListIndex = lstX.ListCount - 1
    SearchListBox = 0

End Function

Private Sub lstSearch_KeyPress(KeyAscii As Integer)

   If KeyAscii = 13 Then Exit Sub

   KeyAscii = SearchListBox(Me.ActiveControl, KeyAscii)

End Sub

Private Sub tmrLoad_Timer()
    Dim sSQL As String
    Dim nTemp As Integer
    Dim rs As Recordset

    'MOVE TO THE NEXT LETTER IN THE ALPHABET
    If CurrentLetter = "" Then CurrentLetter = "A" Else CurrentLetter = _
                               Chr(Asc(CurrentLetter) + 1)

    'IF 'Z' ITEMS HAVE BEEN LOADED THEN STOP THE TIMER
    If CurrentLetter > "Z" Then
            tmrLoad.Enabled = False
            lblLoaded = CStr(lstSearch.ListCount) & " records "
            dbBiblio.Close
            Screen.MousePointer = vbDefault
            lstSearch.SetFocus
            Exit Sub
    End If

    'QUERY THE DATABASE AND ADD RECORDS TO THE LIST BOX
    sSQL = "SELECT Name From Publishers where Name Like '" & CurrentLetter & _
           "*' order by Name"
    Set rs = dbBiblio.OpenRecordset(sSQL)
    While Not rs.EOF
       lstSearch.AddItem CStr(rs.Fields("Name"))
       rs.MoveNext
    Wend
    rs.Close
    lblLoaded = "Loading " & lstSearch.ListCount & " records ..."
    lstSearch.SetFocus
    DoEvents

    'DISPLAY HOURGLASS IF WAITING ON DATA
    If sWaitForLetter = "" Then
        Screen.MousePointer = vbDefault
        Exit Sub
    Else
        Screen.MousePointer = vbHourglass
        nTemp = SearchListBox(lstSearch, Asc(Trim$(sWaitForLetter)))
    End If

End Sub
```

Effective Menus

Another important part of form design is creating consistent, effective menus. Here are some important guidelines:

- Follow standard Windows layout convention: File, Edit, View, and so on.
- Group menu items logically and concisely.
- Use separator bars to group related items in a drop-down menu.
- Avoid redundant menu entries.
- Avoid top-level menu bar items without drop-down menus.
- Don't forget to use the ellipsis (…) to denote menu entries that activate dialog boxes.
- Use standard shortcuts and hotkeys whenever possible.
- Put frequently used menu items in a toolbar.

The steps involved in using the Menu Editor and creating a pop-up menu are discussed in Chapter 6, "Giving More Control to the User: Menus and Toolbars."

▶ **See** "Creating Pop-Up Menus," **p. 122**

Handling Multiple Instances of Your Application

Most Windows programs are started when users double-click a shortcut icon or menu. If users have 10 programs open, they can switch among them by using the taskbar or pressing Alt+Tab. However, many users like to double-click the shortcut icon again, even if the program is already open. Some shortcuts, such as the My Computer icon in Windows 95, simply bring up the existing window, whereas others launch a new instance of the program. For example, you can open multiple instances of Microsoft Word by selecting it from the Start menu, but double-clicking an associated document's icon uses an existing copy of Word. To further complicate matters, the Microsoft Office toolbar checks for an active copy of Word and shows it before launching a new one.

If you provide a desktop or toolbar shortcut to your application, users may expect the shortcut to activate an existing application rather than start a new one. This is especially true if users fill out a form and then minimize it to the taskbar. They may click the shortcut expecting the form to reappear, but if you have not coded for this occurrence, another instance of your application is launched, and the users see an empty form.

For certain applications, allowing multiple instances running at the same time may be desirable. However, if you do not design this capability into your application, errors will surely occur. For example, multiple copies of your application might try to write to the same database at the same time. Fortunately, preventing users from accidentally launching extra copies of your application is easy. The following lines of code in the `Form_Load` event or `Sub Main` do the job:

```
If App.PrevInstance = True Then
    MsgBox "Application already running!"
    End
End If
```

The preceding lines of code check the `PrevInstance` property of the `App` object and end the program if another instance is already running. Although this code prevents conflicts and errors, it does not help the users because they still have to find the other application window manually. With a few additional API calls, you can have your program show the previous application before exiting. Listing 18.2 shows a simple routine to display the previous instance before exiting.

Listing 18.2 PREVINST.ZIP—Handling Multiple Application Instances

```
Option Explicit
Private Declare Function FindWindow Lib "user32" Alias "FindWindowA" _
                         (ByVal lpClassName As String, ByVal lpWindowName _
                         As String) As Long
Private Declare Function ShowWindow Lib "user32" (ByVal hwnd As Long, _
                         ByVal nCmdShow As Long) As Long
Private Declare Function SetForegroundWindow Lib "user32" (ByVal hwnd As Long) _
                         As Long
Private Const SW_RESTORE = 9

Private Sub Form_Load()
    Dim sTitle As String
    Dim hwnd As Long
    Dim lRetVal As Long

    If App.PrevInstance Then
        sTitle = Me.Caption

        App.Title = "newcopy"
        Me.Caption = "newcopy"

        hwnd = FindWindow(vbNullString, sTitle)
        If hwnd <> 0 Then
            lRetVal = ShowWindow(hwnd, SW_RESTORE)
            lRetVal = SetForegroundWindow(hwnd)
        End If
        End
    End If

End Sub
```

In the preceding code, you first rename the current application's title and form caption properties so that the `FindWindow` API function cannot find it. Then you use three API calls to find the window belonging to the previous application, restore it, and move it to the foreground. The Windows API functions are discussed in more detail in Chapter 20, "Accessing the Windows API."

NOTE The methods for dealing with multiple instances described here pertain to a Standard EXE project. ActiveX DLLs are discussed in Chapter 16, "Classes: Reusable Components."

▶ **See** "Setting the Instancing Property," **p. 371**

Perceived Speed

Perception is reality. I am referring here to how users' *observations* can influence their like or dislike of your program. Application speed is a prime example. You may have written the fastest VB code ever, but it matters little if users think it runs slowly. VB programmers tend to get defensive when users complain about speed because "the users don't know what the program is doing." However, you can incorporate a few tricks to make your program seem faster.

The key to a program's perceived speed is that something needs to happen when a user clicks an icon. Users are more willing to wait if they think the computer is working as fast as it can. Booting Windows is a good example; it usually takes quite a long time. However, all the graphics, beeps, and hard drive noise keep you distracted enough to make the wait acceptable. The techniques discussed in the following sections give you suggestions for creating "faster" VB applications.

Program Startup Time At the beginning of your program, you probably will have some initialization to perform—for example, opening a network database. The `Sub Main` subroutine is an excellent place for all the initialization code required at startup time. If your program has only a few forms (two to five), you can load all of them during `Sub Main` so that they appear quickly when the application needs to show them. Although loading all these forms slows the application's performance at startup, the application's runtime performance is much faster. The `Load` method places the forms in memory, but they remain invisible to the users until the `Show` method is executed.

However, this technique may cause program startup time to get a bit lengthy, so displaying a *splash screen* during load time is a good idea. A splash screen (see Figure 18.9) displays information about the program and its designer, as well as indicates to the users that some action is happening.

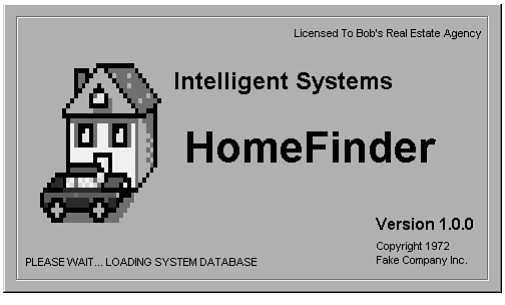


FIGURE 18.9
This splash screen gives the users something to look at while program initialization takes place.

TIP If you are updating a label's caption on a splash or status screen, make sure to call `DoEvents` or the label's `Refresh` method so that program initialization does not prevent the label from being updated.

Inform the Users of Progress When your application looks like it is doing something, users tend to be more forgiving of long wait times. One way to keep them informed is to use a ProgressBar control on your form. If you are updating records in a database, you can use a

progress bar to indicate the number of records processed so far. To do so, simply add an extra line of code or two to update the progress bar as you move to the next record.

▶ **See** "Adding a Status Bar to Your Program," **p. 279**

However, sometimes the progress bar is not an option. For example, Visual Basic's `FileCopy` command might take some time depending on the size of the file. However, `FileCopy` is a self-contained statement, so you have no place to insert the progress bar update code. In this case, a video would be an easy alternative. Before starting the file copy, display a video with the animation control. Windows 95 uses this trick when copying files and emptying the Recycle Bin. The users see the video and think that it is linked to the file copy in progress when, in fact, it is a separate process running by itself.

▶ **See** "Setting Up the Animation Control," **p. 285**

From Here...

Although no steps guarantee a successful user interface, a bad user interface will certainly guarantee that no one will use the program. However, with the rapid pace of advances in computing, the definition of what is a "good" interface will surely keep changing. Consider, for example, the process of setting a VCR clock. Early VCR clocks were programmed with buttons and switches, but this method was soon replaced with onscreen displays. Now an over-the-air radio signal makes the whole process automatic in some models. Like the VCR example, your Visual Basic user interfaces will evolve over time, as the industry sets knew standards and you learn how to best meet your users' expectations.

For more information on the topics dicussed in this chapter, check out the following chapters:

- If you want to learn about the different types of controls that are available, see Chapter 4, "Using Visual Basic's Default Controls."
- For more details on creating menus and other UI elements, see Chapter 6, "Giving More Control to the User: Menus and Toolbars."
- To find out additional information on creating your own ActiveX components with class modules, see Chapter 16, "Classes: Reusable Components."
- To understand how to develop an MDI application, see Chapter 17, "Multiple Document Interface Applications."
- To learn more details about designing user interfaces, see Chapter 19, "Using Visual Design Elements."

CHAPTER 19

Using Visual Design Elements

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Using Graphics 426

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In Chapter 18, "Proper Interface Design," you learned how to design the visual portion of your program in order to provide an appropriately usable and aesthetically pleasing interface for the users. This chapter continues that discussion to explore some of the design elements that you can use to give your programs a professional appearance.

Using Graphics

A typical user interface for an application consists of a menu, labels, text boxes, command buttons, and perhaps a few controls for specific pieces of data. However, without graphics, an otherwise functional interface can be quite boring and unintuitive. Graphics can be used to enhance the user interface in the following ways:

- Highlighting specific information on the screen
- Providing a different view of the information, such as using a graph
- Providing a more intuitive link to the application's functions

The subject of design and use of graphics is large and complex. Obviously, then, this single chapter cannot cover all the bases. However, it provides you with enough information so that you can begin building a more visually pleasing user interface.

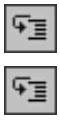
You can use graphics in two basic ways in VB: *controls* and *methods*. For example, you can draw a line on a form either by placing a Line control on the form or by using the `Line` method.

NOTE The Windows API also contains many graphics-related functions. See Chapter 20, "Accessing the Windows API," for information on accessing these functions.

Graphics controls work just like any other custom controls in that they have events and properties and can be drawn at designtime with the mouse. Graphics methods are functions you can call from within the VB language at runtime. Although you can think of graphics controls as objects *placed* on the form, graphics methods draw on the form itself.

Graphics Controls

Visual Basic's Toolbox includes several graphics controls. Some of these controls, such as the Line control, are simple controls intended to act as visual enhancements by themselves. Others, such as the PictureBox control, include a variety of properties and methods to allow extended functionality. Each of the VB graphics controls is discussed in the following sections.



Using the Line and Shape Controls The Line and Shape controls provide the easiest means to add a graphic element to a form. You can draw the controls on the form at designtime and place them where you need them. During the execution of a program, these controls can be hidden or moved. Setting the appropriate property values in your code can change their colors.

As you would guess by its name, the Line control places a line on the form. You can control the width of the line, the line style, the color, and the position of the terminal points of the line through the control's properties. For example, start a new Standard EXE project and place a Line control on the form. Then enter the following code in the form's `Resize` event:

```
Private Sub Form_Resize()
    'A FORM'S (0,0) COORDINATES
    'ARE IN ITS UPPER-LEFT CORNER

    Line1.Y1 = Form1.ScaleHeight / 2
    Line1.X1 = 0

    Line1.X2 = Form1.ScaleWidth
    Line1.Y2 = Line1.Y1

End Sub
```

The code in the `Resize` event adjusts the size and position of the line so that it remains a horizontal line in the center of the form. By default, a Line control creates a solid line, but you can create dashed or other line styles by setting the `BorderStyle` property. Figure 19.1 shows several Line controls drawn on a form using the various styles and the `BorderStyle` property options for the Line control.

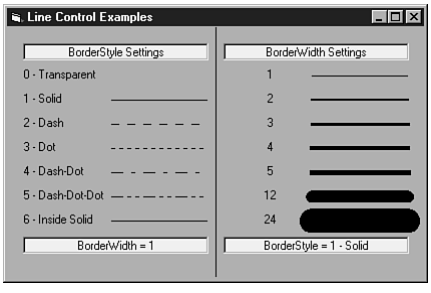


FIGURE 19.1
The Line control enables you to place lines of various styles on a form.

NOTE The `BorderStyle` property does not have any effect when the `BorderWidth` property is greater than one. ■

The Shape control provides another simple means of placing graphics elements on a form. You can use the Shape control to create any of the six shapes shown in Figure 19.2. As with the Line control, the `BorderStyle` property can be used to change the style of the line used to draw a shape.

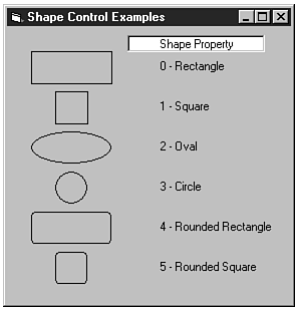


FIGURE 19.2
You can change the `Shape` property of the Shape control to create any of the shapes pictured.

NOTE Although a Shape control placed behind a set of controls can appear to visually enclose other controls, it cannot act as a *container* for those controls.

▶ **See** "Using Containers," **p. 66**

Although you can set the Shape control to several different types of shapes, it does not use mathematical coordinates as the Line control does. Instead, you use the `Height` and `Width` properties to set the size of a shape.

Pictures and Images Another way to enhance your user interface with graphics is to place actual pictures on your form. These pictures can be loaded into the Image and PictureBox controls or on the form itself. Some possible sources for pictures are drawings you have created in a paint program or 35mm photos converted to files by your scanner. The types of files you can display are listed in Table 19.1.

Table 19.1 Graphics File Formats Compatible with Visual Basic

File Extension	Type of File
.BMP	Windows bitmap file
.DIB	Device Independent Bitmap file
.ICO, .CUR	Icon
.WMF	Windows metafile
.EMF	Enhanced Windows metafile
.GIF	Graphics Interchange Format; a file format originally developed by CompuServe and used on Internet Web pages
.JPG	JPEG images, named after the Joint Photographic Experts Group; similar to GIF but uses compression to reduce file size; used extensively on Internet Web pages

Using the *Picture* Property The PictureBox control, Image control, and form all have a `Picture` property that can be set either at designtime or runtime. Loading an image file at designtime is easy. Try a simple example by placing an image on a form, as shown here:

1. Start a new project, and bring up the Properties window for the form.
2. Click the ellipsis button at the far right of the line to call up the Load Picture dialog box, shown in Figure 19.3.
3. From the Load Picture dialog box, select a picture file. The selected picture then appears on your form.

NOTE Files loaded at designtime are stored saved with your form, which can increase program size and form load time.

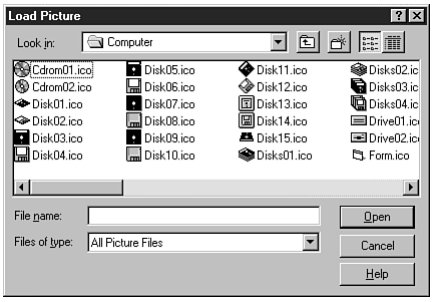


FIGURE 19.3
To place a picture in a form, PictureBox, or Image control at designtime, use the Load Picture dialog box. Pictures can also be loaded during program execution.

While your program is running, pictures can be moved from one control to another by assigning the `Picture` property or can be loaded from a file type listed in Table 19.1. To set the `Picture` property from a file, use the `LoadPicture` method. The following code sample shows you how to load pictures on a form, Image control, and PictureBox control at runtime:

```
'Examples of Loading pictures
Form1.Picture = LoadPicture("C:\MYPIC.BMP")
Image1.Picture = LoadPicture("D:\PAMELA.JPG")
Picture1.Picture = image1.PicturePicture1.Picture = LoadPicture("")
```

Note that passing an empty string to the `LoadPicture` function clears the current picture. Visual Basic also has a `SavePicture` statement, which is used to save pictures from the `Picture` property to a disk file. However, some limitations do exist on the file formats that can be saved. Although the `LoadPicture` function works with GIF or JPG files, the `SavePicture` function does not save in those formats. Pictures saved from the `Image` control are always saved in BMP format. For a complete list of restrictions, look up `SavePicture` in the Help index.

Loading Pictures on a Form A picture loaded on a form has a relatively fixed behavior, much like background wallpaper in Windows. The picture starts in the upper-left corner and is not sized or scaled in any way to match the size of the form. If the picture is smaller than the form, space is left below and to the right of the picture. If the picture is larger than the form, the entire picture is still loaded, but only part of it is visible. As the form is resized, the amount of the picture shown changes.

With the exception of the Label and Shape controls, the picture does not show through the background of the controls on the form. The Label and Shape controls allow the picture to show through if the `BackStyle` property of the control is set to `Transparent`. Figure 19.4 illustrates controls placed on a form containing a picture. Note how the background picture shows through the Label control just above the text box.

TIP You cannot resize a picture that is placed directly on a form. If you want the picture to be a different size, you need to resize the original graphic file using a graphics utility.

The key advantage to placing your picture directly on the form is that this method uses fewer system resources than placing the picture in a Picture or Image control. Another benefit of placing the picture on the form is that you can use drawing methods to annotate the picture.

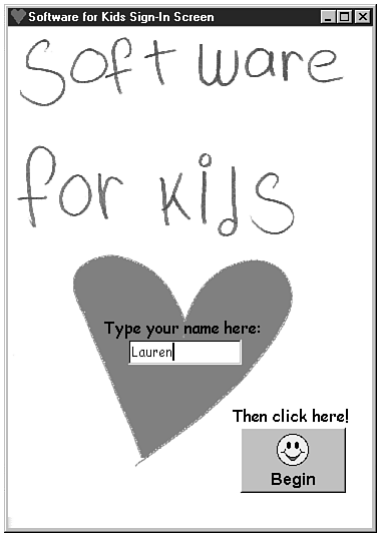


FIGURE 19.4
Some controls placed on a form do not allow the picture to show through.

For example, you can display a product's picture and then, by using the `Print` method, overlay the price or other database information on top of the picture. This capability is available with the PictureBox control as well but is not available with the Image control.

TIP Placing a graphic image directly on a form is an excellent way to provide a texture or background image behind the rest of the form's objects.

Placing the picture directly on the form does, however, have several drawbacks, including the following:

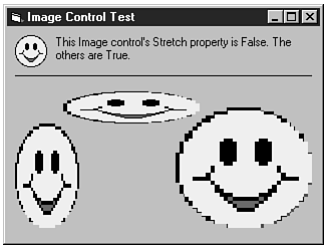
- You cannot hide the picture; it can only be loaded or unloaded.
- You cannot control the placement of the picture on the form.
- You can place only one picture at a time on the form.
- You cannot resize the picture. It's placed on the form in its original (saved) size.

You can overcome these drawbacks by using the Picture or Image control.

Using the Image Control Using an Image control to display pictures provides a frame for the picture, allowing you to position it anywhere on the form. Another advantage is that the Image control can not only display pictures, but it also can resize them. The `Stretch` property determines whether the Image control is sized to fit the picture or the picture is sized to fit the control as drawn. If the `Stretch` property is set to `False` (the default), the Image control is automatically resized to fit the picture you assign to it. If the `Stretch` property is set to `True`, the picture is automatically resized so that the entire picture fits within the current boundaries of the Image control.

You can test this behavior at designtime by assigning a picture to an Image control, setting the `Stretch` property to `True`, and resizing the control. Figure 19.5 shows the same picture in several Image controls. The one with the `Stretch` property set to `False` shows the image at its original size, and others show some possible effects of resizing the Image control if the `Stretch` property is set to `True`.

FIGURE 19.5
The `Stretch` property of the Image control allows you to resize a picture.



TIP If you are loading pictures of different sizes into an Image control in your application, you should set the `Stretch` property to `True`. Otherwise, the size of the Image control changes with each picture. If the appearance of the pictures is unsuitable due to stretching, consider using the PictureBox control. It may be more desirable in some circumstances, such as a displaying a person's photograph, to hide some of the picture rather than show it all distorted.

Using the PictureBox Control Although the PictureBox control uses more system resources than the Image control, it has some added features. First, it can be used as a container for other controls, allowing you to treat controls drawn within it as a group. In addition, you can use drawing methods (for example, `Line` and `Print`) to draw on the picture box.

To use the picture box as a container, first draw a picture box on your form. Next, select a control from the toolbox, and draw the control within the boundaries of the picture box. When you move the picture box or set its `Visible` property, the controls contained within it are also affected.

The most striking difference between the Image and PictureBox is that the PictureBox does not allow resizing of the picture. The default behavior of the PictureBox control is to show only as much of a picture as can fit in its current boundaries. If the picture is larger than the PictureBox control, the upper-left corner of the picture is shown. If the picture is smaller than the PictureBox control, space is left around the edges of the picture. In either case, the entire picture, displayed or not, is loaded in the PictureBox control and available if the control is resized. Setting the `AutoSize` property to `True` changes this default behavior, causing the PictureBox control to resize itself to fit the current picture. As with the Image control, the top-left corner of the control is anchored in place, and resizing of the control occurs to the right and down. However, don't confuse the `AutoSize` property with the Image control's `Stretch` property; the PictureBox control always preserves the aspect ratio of the picture being shown, regardless of the dimensions of the PictureBox control. Figure 19.6 shows the same picture in each of two PictureBox controls—one with the `AutoSize` property set to `False` and the other with the `AutoSize` property set to `True`.

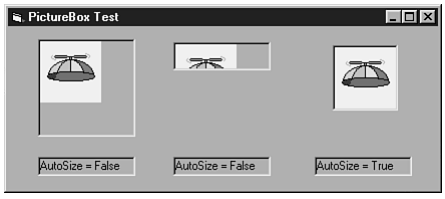


FIGURE 19.6
The `AutoSize` property determines whether the PictureBox control changes to fit the size of the picture being displayed. Note that the size of the picture itself does not change.

The easiest way to understand how the `AutoSize` property works is to create a simple test application. First, create a standard project with a file list box and a picture box. Then place the following code in the form:

```
Private Sub Form_Load()
    Picture1.AutoSize = True
    File1.Path = "C:\Windows"
    File1.Pattern = "*.BMP"
End Sub

Private Sub File1_Click()
    Picture1.Picture = LoadPicture(File1.Path & "\" & File1.filename)
End Sub
```

As you click a filename in the file list box, notice that the size of the picture box adjusts itself to the size of the loaded picture. Often this type of behavior would be undesirable because the picture box might cover other controls. In that case, you can use an image control or display the picture on a separate form.

Graphics Methods

Using controls is not the only way to add graphics to your application. Visual Basic also provides several methods that you can use to draw on a form or in a PictureBox control. You also can use them with the `Printer` object to send the output to the printer. If no object is specified with the method, the form that currently has focus receives the output of the methods.

You can use the following methods to create many types of graphics images:

- `Line`. This method draws a line or a box.
- `Circle`. This method draws a circle or oval.
- `PSet`. This method places a single point on the target object.
- `Point`. This method returns the color of a specific point.
- `PaintPicture`. This method draws an image stored in another control onto the target object.
- `Cls`. This method clears the output area of the target object.
- `Print`. This method places text on the target object.

You can use each of the preceding methods to draw on an object. Before I cover each method in more detail, though, I should mention that certain properties of the object being drawn on affect the way these methods work. These properties are listed in Table 19.2.

Table 19.2 Drawing Properties That Affect the Appearance of Graphics

Property Name	Purpose
`DrawMode`	Determines how the drawing color interacts with the colors already present on the object
`DrawStyle`	Sets a drawing pattern
`DrawWidth`	Sets the border width of lines and circles
`FillColor`	Determines the color used to fill a rectangle or circle
`FillStyle`	Determines the pattern used to fill a rectangle or circle
`ForeColor`	Determines the primary color used to draw with the graphics methods, if no color is specified in the method call
`AutoRedraw`	Determines whether the output of the graphics methods is automatically refreshed when the window has been obscured (`Form` and `PictureBox` only)

Lines and Circles You use the `Line` method to draw lines and boxes. To draw lines, supply the starting and ending points of the line on a coordinate system whose origin is in the upper-left corner. The following statements, for example, draw a green line from the upper-left corner of a form to the lower-right corner:

```
Dim x2 As Single, y2 As Single
x2 = Form1.ScaleWidth
y2 = Form1.ScaleHeight
Line (0, 0)-(x2, y2),vbGreen
```

If you omit the starting point of the line, the current position becomes the starting point. The current position is the ending point of the last line, or you can set it with the object's `CurrentX` and `CurrentY` properties. For example, the following code uses the `Line` method to draw a triangle on a form. In each call to the `Line` method, note that the first set of coordinates is omitted.

```
Private Sub Form_Click()
    Form1.CurrentX = 1500
    Form1.CurrentY = 750
    Line -(2000, 750), vbRed
    Line -(2000, 1250), vbBlue
    Line -(1500, 750)
End Sub
```

In the last of the preceding code segment statements, the optional parameter for the color of the line is omitted. If no color is specified, the line is drawn in the color specified in the object's

`ForeColor` property. You can add the optional parameter `B` or `BF` after the color parameter to draw boxes and filled boxes, respectively. For example, the following statements draw two boxes on a form:

```
Line (100, 850)-(500, 1800), vbBlue, B
Line -(900, 2450), , BF
```

When you're drawing a box, the coordinates passed to the `Line` method represent the upper-left and lower-right corners of the box.

The `Circle` method also has many optional parameters. The simplest form of the method is the following:

```
Circle (X,Y),R
```

This command draws a circle of radius `R` with a center at the position specified by `X` and `Y`. As with the `Line` method, the pattern and color of the circle's border and fill are determined by the settings of the object's properties. The full syntax of the `Circle` method is as follows:

```
Object.Circle [Step] (x,y), radius, [color, start, end, aspect]
```

The *`start`* and *`end`* arguments are used to draw an arc rather than a full circle. The values of *`start`* and *`end`* are the angles from horizontal expressed in radians. (The value of an angle in radians is determined by multiplying the angle in degrees by /180.) The values of *`start`* and *`end`* can range from zero to 2, or zero to –2. If you use a negative value for *`start`* and *`end`*, the lines are drawn from the center of the circle to both ends of the arc. The following code produces an arc that appears to move around a circle, much like a radar screen:

```
Private Sub Form_Click()
    Const PI = 3.14159
    Const ARCSIZE = 45
    Dim x As Integer, y As Integer, r As Integer
    Dim arcstart As Single, arcend As Single
    Dim nCount As Integer

   'Draw a circle in the middle of the form
    x = Me.ScaleWidth / 2
    y = Me.ScaleHeight / 2
    r = x / 2
    Me.DrawMode = vbCopyPen
    Me.FillStyle = vbFSTransparent
    Me.Circle (x, y), r

    'Draw the sweeping radar arc
    Me.DrawMode = vbXorPen
    Me.FillColor = vbRed
    Me.FillStyle = vbSolid

    For nCount = 0 To 360
        arcstart = nCount
        arcend = nCount + ARCSIZE
        If arcend > 360 Then arcend = arcend - 360
        Me.Caption = "Arc of " & ARCSIZE & " degrees starting at " _
                     & nCount
        Circle (x, y), r, , -arcstart * PI / 180, -arcend * PI / 180
        DoEvents
```

```
        Circle (x, y), r, , -arcstart * PI / 180, -arcend * PI / 180
    Next nCount

    Me.Caption = "Done"

End Sub
```

The *Print* Method Although you might not traditionally associate the `Print` method with graphics because it produces text, it is a graphics method in that it "draws" the text on your object like any other graphics method. You can use the `Print` method in conjunction with other graphics methods to create charts or drawings or to annotate existing bitmaps. The `Print` method itself is quite simple. The following code displays a single line of text at the current position on the form:

```
Print "This is a one-line test."
```

The output of the `Print` method is controlled by the properties of the object being printed on. These properties are as follow:

- `CurrentX`. This property sets the horizontal position for the starting point of the text.
- `CurrentY`. This property sets the vertical position for the starting point of the text.
- `Font`. This property determines the font type and size used for the text.
- `ForeColor`. This property determines the color of the text.
- `FontTransparent`. On a form or picture, this property determines whether the background behind the text shows through the spaces in the text.

You can experiment with printing and other graphics methods by using Visual Basic's Immediate window. Follow these steps:

1. Create a new project and add a PictureBox control.
2. Set the form and picture box's `AutoRedraw` properties to `True`.
3. Run your project and then press Ctrl+Break.
4. Enter code statements that use graphics methods in the Immediate window:

```
form1.print "Hey"
picture1.Print "Now"
```

The *PSet* Method You can use the `PSet` method to draw a single point on the form using the color specified by the `ForeColor` property. The size of the point drawn is dependent on the setting of the `DrawWidth` property. A larger `DrawWidth` setting produces a larger point. The `PSet` method draws the point at the coordinates specified in the argument of the method. The following code draws 100 points at random positions on the current form:

```
Dim i As Integer, x As Integer, y As Integer

    Me.DrawWidth = 5

    For i = 1 To 100
        'Choose random x and y
        x = Int(Me.ScaleWidth + 1) * Rnd
        y = Int(Me.ScaleHeight + 1) * Rnd
        PSet (x, y)
    Next i
```

The *PaintPicture* Method The `PaintPicture` method works exactly like it sounds; it paints a picture from one object onto another. By carefully setting the `height` and `width` arguments for the source and target objects, you can enlarge or reduce the size of the source picture. The following code paints part of a picture from a PictureBox control onto a form:

```
frmdest.PaintPicture picSource.Picture, 50, 50, 750, 750, 0, 0, 500, 500
```

The code in the preceding line takes a piece of a picture from the PictureBox control `picSource`, enlarges it, and places it on the form `frmDest`. As you can see, the `PaintPicture` method contains several arguments:

- **Source Picture.** All or part of this source picture is drawn in a "target region" on the destination object.
- **Target X and Y.** These two numerical arguments specify the coordinates of the upper-left corner of the target region. In the preceding line of code, drawing occurs on `frmDest` 50 scale units (in this case twips) from the left edge and 50 scale units from the top edge.
- **Target Size.** This argument specifies the horizontal and vertical size of the target region. If this size is different from the source picture or region, the picture is stretched or compressed to fit the target region.
- **Source X and Y.** The third pair of numbers in the command specifies the upper-left corner of the source region—that is, the part of the picture being copied.
- **Source Size.** This argument specifies the height and width of the source region.

These first three arguments are the only ones that are required for the `PaintPicture` method. All other arguments are optional. If only the three required arguments are specified, the entire source picture is copied to the target at full size.

The following are some uses of the `PaintPicture` method in creating graphics:

- To provide a zoom feature for looking more closely at specific regions of a picture. This capability would be useful for implementing print preview in your application.
- To copy or clear a specified region of a picture.
- To move the contents of a PictureBox control to the `Printer` object—for example, to put a company logo on your report.

For an example that uses `PaintPicture` and some of the other methods discussed so far, see the application in Figure 19.7.

This application captures song title and artist information from a satellite TV music service. Here's how it works:

1. Code in a Timer control activates the "Snappy" video capture device to capture the current picture on the TV screen. The result of the video capture is stored in the `Picture` property of the Snappy custom control.
2. The `PaintPicture` method is used to copy the bottom section with the displayed song information from the Snappy control to the larger PictureBox control at the right of the form.

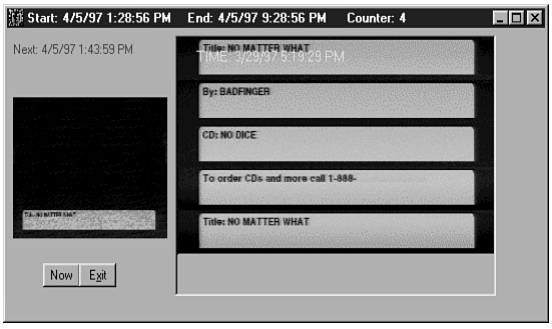


FIGURE 19.7
You can use the `PaintPicture` method to combine parts from several images into a single composite image.

3. The process is repeated several times so that all the information is captured in a composite picture in the PictureBox control.
4. The tape counter information is added to the PictureBox control with the `Print` method, and the `SavePicture` method saves the image to disk. The entire process repeats itself in a few minutes for the next song.
5. The resulting bitmap files provide a means to locate your favorite songs on tape.

Other Graphics Methods Two other methods mentioned in the list in the earlier section "Graphics Methods" are the `Cls` method and the `Point` method. The `Cls` method, which stands for *Clear Screen* like the DOS command, clears all graphics drawn with graphics methods from a form or PictureBox control. The `Point` method returns the RGB color setting of a specified point, as in the following example:

```
Private Sub Form_Load()
    'Draw a red box
    Me.AutoRedraw = True
    Line (0, 0)-(500, 500), vbRed, BF

End Sub

Private Sub Form_MouseDown(Button As Integer,_
        Shift As Integer, X As Single, Y As Single)
    If Point(X, Y) = vbRed Then
        MsgBox "The point (" & X & "," & Y & ") is in the box"
    Else
        MsgBox "The point is not in the box"
    End If

End Sub
```

The code in the `MouseDown` event uses the `Point` method to determine whether the location clicked by the user is within the red box drawn during the form load.

Finally, although coverage of graphics API in detail is beyond the scope of this chapter, you should note that some graphics API calls allow you to do things that ordinary graphics methods do not. For example, consider the ListView control, which works like the far right pane of the Windows Explorer. In the report view (or detail mode in Explorer), selecting an item highlights only the left column, making it difficult to read one row all the way across. However, you

can use the graphics API to draw your own lines across the columns. The example in Listing 19.1 uses a few API calls to do just that.

Listing 19.1 DRAWAPI.ZIP—Using the Graphics API to Enhance a *ListView* Control

```
Private Declare Function GetDC Lib "user32" (ByVal hwnd As Long) _
                         As Long
Private Declare Function ReleaseDC Lib "user32" (ByVal hwnd As Long, _
                         ByVal hdc As Long) As Long
Private Declare Function LineTo Lib "gdi32" (ByVal hdc As Long, _
                         ByVal X As Long, ByVal Y As Long) As Long
Private Declare Function MoveToEx Lib "gdi32" (ByVal hdc As Long, _
                         ByVal X As Long, ByVal Y As Long, _
                         lpPoint As POINTAPI) As Long

Private Type POINTAPI
        X As Long
        Y As Long
End Type

Private Sub Form_Load()

    'This code adds 100 items to a listview control

    Dim objTemp As ListItem
    Dim i As Integer
    Me.ScaleMode = 3

    With Me.ListView1
        .View = lvwReport
        .ColumnHeaders.Add , , "Column1"
        .ColumnHeaders.Add , , "Column2"
        For i = 1 To 100
                Set objTemp = .ListItems.Add(, , "Item " & i)
                objTemp.SubItems(1) = "Top " & objTemp.Top
                .Refresh
        Next i
    End With

End Sub

Private Sub ListView1_ItemClick(ByVal Item As ComctlLib.ListItem)
    Dim hdc As Long
    Dim pointx As POINTAPI
    Dim lRetVal As Long
    Dim nHeight As Integer
    Dim lTemp As Long

   'The form's ScaleMode property MUST be
   'set to pixels for this to work properly.

    nHeight = Me.TextHeight("X")

    With ListView1
        .Refresh
        hdc = GetDC(.hwnd)
```

```
        lTemp = MoveToEx(hdc, 0, Item.Top, pointx)
        lTemp = LineTo(hdc, .Width, Item.Top)
        lTemp = MoveToEx(hdc, 0, Item.Top + nHeight, pointx)
        lTemp = LineTo(hdc, .Width, Item.Top + nHeight)
        lTemp = ReleaseDC(.hwnd, hdc)
    End With

End Sub
```

The code in Listing 19.1 demonstrates one of the basic concepts of using graphics API calls: the device context. A device context can be used by other graphics API calls to draw on an object. The example uses the `GetDC` API call to determine the device context for the ListView control and then uses the `LineTo` API call to draw on the ListView control.

Working with Text and Fonts

To write almost any program in Visual Basic, you need to know how to work with text. In earlier chapters, you learned something about displaying text in labels and text boxes. You also learned about string functions used to manipulate text in code. This chapter will expand on that knowledge by showing you how to display text in a way that is most intuitive to the users of your programs.

Text Box Behavior

In Chapter 4, "Using Visual Basic's Default Controls," you were introduced to the text box. You already know that the `Text` property is used to store and retrieve information. In addition to the standard properties discussed in that chapter, several other properties make the TextBox control even more versatile:

- `Locked`. This property prevents the users from entering information in the text box.
- `MaxLength`. This property limits the number of characters that the text box can accept.
- `PasswordChar`. This property causes the text box to hide the information typed by the users.
- `SelLength`, `SelStart`, and `SelText`. These properties allow the users to manipulate only the selected (highlighted) part of the text in the text box.

Locking Out Users First, take a look at the `Locked` property, which allows you to use a text box for display only. The obvious question is why would you want to do that instead of just using a Label control? The answer is that although a locked text box does not allow users to update it, they still can scroll, select, and copy text. Of course, program code can always modify text in a text box whether or not it is locked. To lock a text box, simply set the `Locked` property to `True`, as in the following examples:

```
'LOCKS A SINGLE TEXT BOX
txtTest.Locked = True
txtTest.Text = "You can't edit this!"
```

```
'LOCKS EVERY TEXT BOX ON THE FORM
Dim objControl As Control

For Each objControl In Me.Controls
    If TypeOf objControl Is TextBox Then objControl.Locked = True
Next objControl
```

From a user interface standpoint, the `Locked` property allows you to use the same screen for data entry and lookup. Locking text boxes prevents unauthorized personnel from changing information, as shown in Figure 19.8.

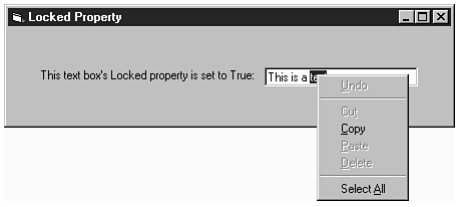


FIGURE 19.8
Using the `Locked` property prevents inadvertent editing of text. In the pop-up menu (automatically implemented by Windows), notice that only the Copy option is available for a locked text box.

NOTE Do not confuse the `Locked` property with the `Enabled` property. The `Locked` property does not create the grayed-out effect. Additionally, it allows the users to select and copy text from the text box, but the `Enabled` property does not.

The *MaxLength* Property When you're designing a data entry form, one of the tasks you must perform is *data validation*. One type of data validation is making sure the data entered will fit in the designated database field. For example, Social Security numbers are by definition nine digits. Although this check can be performed in VB code with the `Len` statement, you can avoid the extra code by using the TextBox control's `MaxLength` property. The `MaxLength` property allows you to specify the maximum number of characters that can be entered in a text box, regardless of its size on the form.

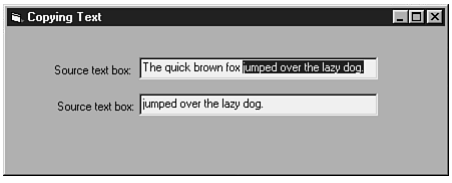
The *PasswordChar* Property If you are using a text box as part of a login form, you will want to be able to hide the passwords entered by the users. To do so, simply enter a character in the `PasswordChar` property of the text box. This property changes the text box's display behavior so that the password character is displayed in place of each character in the `Text` property. You may have seen this effect many times when logging in to Windows.

Note that the contents of the `Text` property still reflect what was actually typed by the users, and your code always sees the "real" text. Although you can enter any character, using the asterisk (`*`) character for hiding text is customary.

Editing Text in a Text Box A standard text box allows the users to highlight text with the mouse or by using Ctrl+Shift with the cursor keys. Your code can then manipulate the selected text with the `SelText`, `SelLength`, and `SelStart` properties. You can use these properties to work with a selected piece of text in your program. Look at the example in Figure 19.9. In this

case, the `SelText` property would contain just the phrase "jumped over the lazy dog." The `SelLength` property would contain the integer value 25, which is the length of that string. And the `SelStart` property would contain the integer value 20, which means the selected phrase starts with the 20th character in the text box.

FIGURE 19.9
Your users can copy text from one text box and paste it into another.



In addition to determining what has been selected, you can also set the properties from code to alter the selection. Every time you set the `SelStart` property, you must set the `SelLength` property to highlight some characters. To select the first three characters, you could use this code:

```
txtTest.SelStart = 0
txtTest.SelLength = 3
```

The `SelLength` property can be changed multiple times. This causes the selection to increase or decrease in size, automatically updating the `SelText` property. Setting the `SelText` property from code causes the currently selected text to be replaced with a new string—for example:

```
txtTest.SelText = "jumped into oncoming traffic."
```

One use of these properties is to highlight the entire contents of a text box. Suppose, for example, you have populated some text boxes for users to edit. When they press the Tab key to move to a text box, you might want to highlight whatever is in the text box automatically. This way, the user can start typing immediately, without deleting the existing text. This example is illustrated in the following code for a text box's `GotFocus` event:

```
Private Sub txtSelect_GotFocus()
  txtSelect.SelStart = 0
  txtSelect.SelLength = Len(txtSelect.Text)
End Sub
```

This same feature can be added by using the `SendKeys` statement to send the keystrokes for highlighting the entire text box:

```
Private Sub txtSelect_GotFocus()
 SendKeys ("{HOME}+{END}")
End Sub
```

Working with Fonts and Colors

Although drawings and pictures add a definite visual impact to your applications, the heart and soul of most of your programs will likely be the text fields for data entry and information display. Often, adding an image to enhance onscreen text is not possible or even useful. Instead, you must make sure that you use appropriate fonts and colors to get your point across.

Using the *Font* Object If you have used a word processor program, then you are already familiar with fonts. At designtime, you assign fonts to controls and forms by using the Properties window. If you set the font of a form, any controls subsequently drawn on the form will use the same font.

You may remember from earlier chapters that the `Font` property of an object is actually an object that has its own properties. The following `Font` object properties can be used to control the appearance of fonts in your program:

- `Name`. String identifier for one of the fonts installed on your system—for example, `"Arial"` or `"Times New Roman"`.
- `Bold`. True/False property that controls the boldface attribute of the font. The bold letters appear darker and heavier than nonbold characters.
- `Italic`. True/False property that determines whether letters are *italicized*.
- `Underline`. True/False property that controls whether the text is displayed with a thin line under each character.
- `Size`. Controls the point size of a font. One point is 1/72 of an inch; therefore, capital letters in a 72-point font are about one inch high.
- `Strikethrough`. True/False property that controls whether a thin line is drawn through the middle of the text.
- `Weight`. Controls the width of the line used to draw text. The two settings for `Weight` are 400 and 700. These settings correspond to normal and bold text, respectively.
- `Charset`. Controls the character set (standard, extended DOS, Japanese). This property is explained in more detail in the Help file.

As you may have already noticed, before you can set a particular font, you have to know its name. Not all systems have the same fonts installed. The `Screen` and `Printer` objects have a `Fonts` collection that lists the available fonts. You can write a quick program to list the available fonts on your system. Start a new project now and place the following code in the form's `Click` event. Clicking the form causes the name of each installed font to be printed on the form:

```
Dim nCount As Integer
Me.AutoRedraw = True
For nCount = 0 To Screen.FontCount - 1
  Me.Font.Name = Screen.Fonts(nCount)
  Me.Print Screen.Fonts(nCount)
Next nCount
```

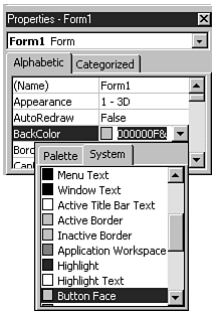
Also, note that most fonts contain extra characters, beyond those that you can type on the keyboard. For example, the MS Sans Serif font contains special characters for fractions and accented letters. These characters can be displayed by using the `Chr$` function. The following code displays all 256 available characters (many of which are unprintable) on the form:

```
Dim i As Integer

For i = 0 To 255
    Me.Print Chr$(i); " ";
    If Me.CurrentX >= Me.Width Then Me.Print
Next i
```

Adding a Splash of Color A form designed with totally battleship gray components is dull and plain. However, you can easily assign color to the form and controls on it by using the `ForeColor` and `BackColor` properties. To set these properties at designtime, you can use either a Color list or a Color Palette. To view the Color list, bring up the Properties window for a control or form and click on the `ForeColor` or `BackColor` property. The Color list is shown in Figure 19.10.

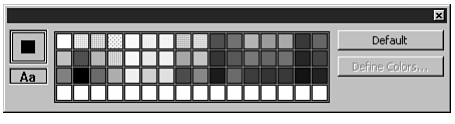
FIGURE 19.10
You can set the `ForeColor` and `BackColor` properties from the Color list.



Notice that the Color list has two sections: Palette and System. Palette allows you to pick specific colors, whereas System lists the colors in the current Windows color scheme. If you use System colors, changing the Windows system colors in the Display control panel makes the colors in your program change, too. Considering this point is important when you're distributing a program.

The Color Palette, shown in Figure 19.11, allows you to change foreground and background colors at the same time. To view the Color Palette, select a control or form and then choose Color Palette from the View menu.

FIGURE 19.11
The Color Palette box is another means of changing colors at designtime.



Change colors at designtime and then look at the `ForeColor` or `BackColor` properties. Notice that they are actually represented as numbers; for example, blue is represented by `&HFF0000&` in hexadecimal or decimal `16711680`. VB also has built-in constants for some colors, listed in Table 19.3. To set colors of objects within your program code, simply assign numbers to the `ForeColor` and `BackColor` properties, as in the following code:

```
Form1.ForeColor = vbYellow
Form1.BackColor = vbBlue
```

Table 19.3 Visual Basic's Built-In Color Constants

Constant	Numeric Value (Decimal)
vbBlack	0
vbRed	255
vbGreen	65280
vbYellow	65535
vbBlue	16711680
vbMagenta	16711935
vbCyan	16776960
vbWhite	16777215

NOTE System color constants are also available. For example, the following statement sets the color of a form to the same color as the Windows desktop:

```
Form1.BackColor = vbDesktop n
```

The color constants use such unusual numbers because each number represents the levels of red, green, and blue in a given color. If you want to create a custom color and know how much of each primary color to include, you can find out the color number by using the `RGB` function. Each primary color can have a setting between 0 and 255. For example, the following code determines the number for the color gray (equal parts red, green, and blue):

```
Dim lNewColor As Long
lNewColor = RGB(192,192,192)
Form1.BackColor = lNewColor
```

NOTE An easy way to find out a color number for use in code is to select the color from the Color list and make a note of the number displayed in the Properties window.

Another useful color function is the `QBColor` function. In earlier versions of BASIC, such as QuickBasic and GWBasic for MS-DOS, consecutive integer numbers represented colors. The `QBColor` function returns the hexadecimal RGB equivalent color. This capability is useful if you want to generate random colors, as in the following example:

```
Private Sub Form_Click()

    Dim lRGBColor As Long
    Dim nIntColor As Integer

    'Choose random number between 0 and 15
    nIntColor = Int(16 * Rnd)
    lRGBColor = QBColor(nIntColor)
    Me.BackColor = lRGBColor

End Sub
```

The preceding code example, when placed in the `Load` event of a form, causes the form's background color to change every time you click it.

Using Fonts and Colors with a RichTextBox Control The text box is great for general use, but the RichTextBox control allows even greater control over how text is displayed. The strength of the RichTextBox control, introduced in Chapter 6, "Giving More Control to the User: Menus and Toolbars," is that it can display multiple formats and colors within the same text area.

▶ **See** "Rich Text Boxes," **p. 445**

One use of this control can be to display database detail information in a neatly formatted manner, as in the application in Figure 19.12. When a user clicks an employee's name, the title and other information are displayed in the rich text box on the right of the form.

Although the information is displayed in a fancy format, the programming effort behind it is minimal. The first step is to use WordPad or Microsoft Word to create a template for your detail display. Enter what you want the data to look like, but use placeholders instead of actual data. A sample template is shown in Figure 19.12. Note that the # characters are used to surround each placeholder so that it is not confused with actual data.

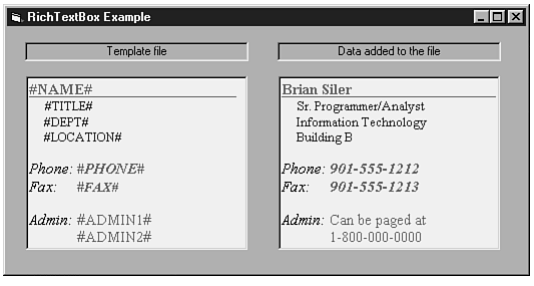


FIGURE 19.12
The formatted RTF template file has to be created only once, and then it can be easily used to display data.

To display information in the rich text box, you must first load the template and then find and replace each placeholder. The following sample code uses a user-defined function, `ReplRTBfield`, to search for a placeholder and then replace it with data:

```
Sub ReplRTBfield(sField As String, sValue As String)
    rtbInfo.Find "#" & sField & "#"
    rtbInfo.SelText = sValue

End Sub

Private Sub cmdDisplay_Click()

   rtbInfo.LoadFile (App.Path & "\info.rtf")
   ReplRTBfield "NAME", "Brian Siler"
   ReplRTBfield "DEPT", "Accounting"
   ReplRTBfield "TITLE", "CIA"

End Sub
```

Although the code in this example is simple, you could easily expand it into a powerful formatting tool. The `Find` method of the rich text box allows you to replace your own codes in an RTF template instead of selecting and formatting each individual piece of text with VB code.

From Here...

Although I cannot suggest any steps that guarantee a successful user interface, a bad user interface certainly guarantees that no one will use your program. However, with the rapid pace of advances in computing, the definition of what is a good interface will surely keep changing. Consider, for example, the process of setting a VCR clock. Early VCR clocks were programmed with buttons and switches, but this method was soon replaced with onscreen displays. Now an over-the-air radio signal makes the whole process automatic in some models. Like the VCR example, your Visual Basic user interfaces will evolve over time, as the industry sets new standards and you learn how to best meet your users' expectations.

To learn more about the visual aspects of user interface design, see the following chapters:

- To find out about the controls that can be used in designing VB programs, see Chapter 4, "Using Visual Basic's Default Controls," and Chapter 12, "Microsoft Common Controls."
- For general interface design tips, see Chapter 18, "Proper Interface Design."
- To learn how to design an application for the Internet, see Chapter 32, "ActiveX Documents."

PART V

Advanced Programming Topics

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CHAPTER 20

Accessing the Windows API

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The Windows API, or *Application Programming Interface*, is a set of functions that Windows exposes to programmers. These Windows operating system functions can be called from Visual Basic to perform tasks that cannot be programmed with standard VB code. For example, standard Visual Basic does not have a function to reboot the computer. However, rebooting can be accomplished through a Windows API call. You can think of many of the functions included with Visual Basic as "wrappers" around the underlying Windows API routines. Using Windows API functions is a bit more complicated than using standard user-defined functions, so writing your own wrapper functions is common. Although by no means an exhaustive guide, this chapter provides a solid foundation for common uses of the Windows API.

Understanding the Windows API

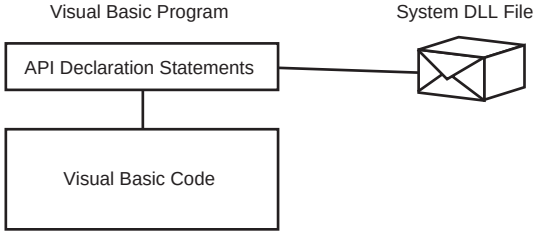
From the point of view of the Visual Basic programmer, Windows API functions can be thought of as similar to "normal" VB functions. They contain input and output parameters and sometimes a return value. However, API functions are already compiled in a separate file, known as a dynamic link library (or DLL).

To use these functions, you have to add a few lines of code that define the external function for Visual Basic. In other words, to use an API function, you must first *declare* it. API declarations are entered in the General Declarations section of a module. Just as you declare variables, you also must declare API functions so that your code can access them; and, as a declared variable provides a link to a memory location, an API declaration provides a link to an external DLL.

NOTE The usual place for API declarations is in a module, but you can add them to forms and classes as well by adding the `Private` keyword in front of the declaration.

The `Declare` statement lists all the parameters of the API function, the DLL in which it is located, and the data type of the return value. Unlike a normal VB function, an API declaration has no function code. Instead, the single-line statement merely points to the DLL file containing the function. This relationship is illustrated in Figure 20.1.

FIGURE 20.1
API functions are stored in system DLLs. The API declaration makes these functions visible to your VB code.



NOTE Many `Declare` statements include the use of the `Alias` parameter. An *alias* specifies the "real" name of an API function as it is stored in the DLL, which may not match the name you want to give the function in your program. For example, a function named `_lopen` appears in the kernel32 DLL, but `_lopen` is not a valid function name within Visual Basic. In this case, the proper API declaration is as follows:

```
Declare Function lopen Lib "kernel32" Alias "_lopen" -
(ByVal lpPathName As String, ByVal iReadWrite As Long) As Long.
```

Visual Basic sees the function internally as `lopen` but knows from the `Declare` statement's `Alias` parameter to pass the call to the function named `_lopen` inside the kernel32 DLL.

Let me demonstrate the use of a Windows API function with the example mentioned earlier, rebooting the system. First, start a Standard EXE project, and add a new module by choosing Add Module from the Project menu. Next, go to the declarations section of the module, and enter the following `Declare` statement on a single line:

```
Declare Function ExitWindowsEx Lib "user32" (ByVal uFlags As Long,_
                 ByVal dwReserved As Long) As Long
```

NOTE Notice the underscore at the end of the first code line. `Declare` statements can be entered on multiple lines if the line continuation character (_) is used.

Notice that the `Declare` statement contains the name of the function (`ExitWindowsEx`), the name of the library (`user32`), and a list of parameters. After you enter the `Declare` statement, the `ExitWindowsEx` function is visible within Visual Basic and can be called from other code.

However, before calling the API function, you need to set up some valid values for the two parameters. The following constants are acceptable values for the first parameter, `uFlags`:

```
Public Const EWX_FORCE = 4
Public Const EWX_LOGOFF = 0
Public Const EWX_REBOOT = 2
Public Const EWX_SHUTDOWN = 1
```

If you look at the constants in the preceding list, you may notice that they roughly correspond to the choices available when you're closing Windows. Each constant passed to the `uFlags` parameter causes the function to behave differently, much like the `Flags` property of a `CommonDialog` control.

The second parameter, `dwReserved`, is typical of many Windows API functions. It is a reserved parameter not intended for general use, so you can just use `0` for its value.

NOTE Constants used with the Windows API are just like normal Visual Basic constants. For the sake of readability, I suggest placing these constants in the same module as the function declaration.

After you have entered the declaration statements and constants, calling the API function from code is easy. For example, place the following lines of Visual Basic code in the `Form_Load` procedure to reboot your computer:

```
Dim lRetVal As Long
lRetVal = ExitWindowsEx(EWX_REBOOT, 0)
```

Executing the preceding code causes Windows to attempt to shut down, prompting you to save open documents.

Using the Windows API in Visual Basic

The Windows API is sometimes called the *Win32* API, in reference to the use of 32-bit functions. The 16-bit API was used in Windows 3.11 and earlier versions of Visual Basic. Although Windows 95 and NT provide backward compatibility for applications compiled using 16-bit calls, you cannot declare a 16-bit API function in Visual Basic 6.0. This point is important to remember when you're upgrading old projects.

Using the API Viewer

Windows API function declarations and the constants and types used with them are listed in the file WIN32API.TXT. This file is installed in the WINAPI subdirectory of the Visual Basic program directory. To use an API function in your program, simply copy and paste the information you need from this file. Comments are also included in the file to help you make some sense of the function's purpose.

Visual Basic comes with a tool called the API Text Viewer, which is designed to make adding API functions quick. The API Text Viewer, shown in Figure 20.2, organizes the Windows API functions alphabetically and allows you to copy multiple API functions to the Windows Clipboard.

To use the API Viewer, click the API Text Viewer icon in your Visual Basic program group. Next, from the File menu, choose Load Text File and select WIN32API.TXT. (Note that you are given the option of converting WIN32API.TXT to a database file for faster loading.) After the API Viewer parses the text file, you are presented with a list of available API declarations in the Available Items box.

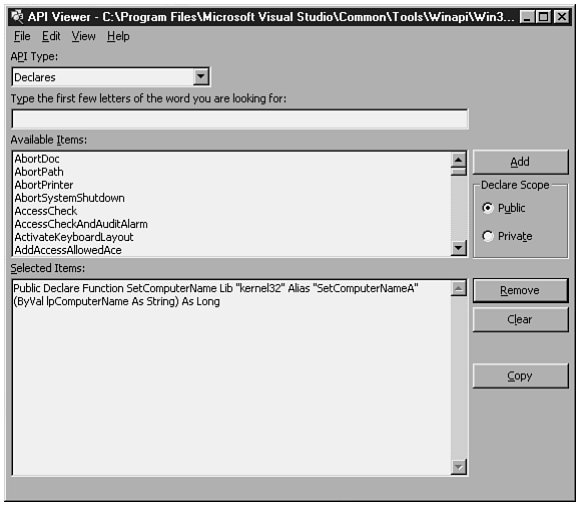


FIGURE 20.2
The API Viewer lets you copy any combination of types, declares, and constants to the Windows Clipboard.

Test it yourself by copying the `GetDiskFreeSpace` function to the Clipboard. The quickest way to locate a specific function is to enter the first few letters to jump to it in the list.

Before continuing, note a new feature in the API Viewer: the ability to choose Public or Private declarations. All this feature really does is include the word *Private* or *Public* for you; you can still edit the API declaration later if desired. Public API declarations can be placed in a code module and accessed from other forms and modules in the project. On the other hand, if you want to place an API declaration in a form, it must be declared as Private. Since our example uses a form, go ahead and click the Private radio button.

Double-click `GetDiskFreeSpace`, and you will notice that it appears in the Selected Items box. Note that you can double-click additional function names to add them to the Selected Items box. Constants and types used by the API can be displayed if you set the API Type drop-down box, although it is up to you to know which constants go with the selected functions.

When you're finished browsing the list, click the Copy button. This action places any selected items on the Windows Clipboard. Next, start a new Visual Basic Standard EXE project and add a module. Open the Code window for the new module, and choose Paste from the Edit menu. The declaration for `GetDiskFreeSpace` should appear in your Code window:

```
Private Declare Function GetDiskFreeSpace Lib "kernel32" Alias
"GetDiskFreeSpaceA" _
                 (ByVal lpRootPathName As String, lpSectorsPerCluster As Long, _
                 lpBytesPerSector As Long, lpNumberOfFreeClusters As Long, _
                 lpTtoalNumberOfClusters As Long) As Long
```

Now that the declaration is available to your program, you can write code that calls the `GetDiskFreeSpace` API function. Add a command button to the form, and add code to the `Click` event to call the `GetDiskFreeSpace` function, as in the following example:

```
Private Sub Command1_Click()
   Dim lSecPerClust As Long
   Dim lBytesPerSec As Long
   Dim lFreeClust As Long
   Dim lTotalClust As Long
   Dim lReturn As Long

   lReturn = GetDiskFreeSpace("C:\", lSecPerClust, lBytesPerSec,  _
                 lFreeClust, lTotalClust)

   Msgbox "Free Clusters on drive C = " & lFreeClust

End Sub
```

The preceding example calls the `GetDiskFreeSpace` API function with the appropriate parameters and displays one of the returned values in a message box. However, the example is not really practically useful; more than likely, you will be interested in the number of free bytes rather than clusters. Also, if you intend to use this function multiple times within your program, a lot of overhead is required to get back the results. You will solve both of these problems in the next section by creating a wrapper function.

Creating a Wrapper Function

Often programmers create a "wrapper" function around one or more Windows API calls. A wrapper function is a standard VB function that handles calls between the rest of your program and the API function. Although using this type of function sounds like an extra step, one of its purposes is actually to eliminate extra steps associated with calling the API function. For example, suppose you are writing an installation program and need to check for the amount of free storage space on a given disk drive. The Windows API function `GetDiskFreeSpace` returns free space information, but not in the exact format you need. A simple user-defined function such as `dblFreeBytes`, shown in Listing 20.1, calls the API but returns only the required information.

Listing 20.1 APIWRAP.ZIP—The Wrapper Function Returns Only the Information Needed by the Rest of the Program

```
Declare Function GetDiskFreeSpace Lib "kernel32" Alias "GetDiskFreeSpaceA" _
                 (ByVal lpRootPathName As String, lpSectorsPerCluster As Long, _
                 lpBytesPerSector As Long, lpNumberOfFreeClusters As Long, _
                 lpTtoalNumberOfClusters As Long) As Long

Function dblFreeBytes(sPath As String) As Double
   Dim sDrive As String
   Dim lReturn As Long
   Dim l1 As Long   'l1 = Sectors Per Cluster
   Dim l2 As Long   'l2 = Bytes Per Sector
   Dim l3 As Long   'l3 = Number Of Free Clusters
   Dim l4 As Long   'l4 = Total Number Of Clusters

   sDrive = Left$(sPath, 1) & ":\" 'Get drive letter from path

   lReturn = GetDiskFreeSpace(sDrive, l1, l2, l3, l4)

   dblFreeBytes = l1 * l2 * l3

End Function
```

As you can see from the preceding listing, `GetDiskFreeSpace` actually returns four values. If you called this function directly several times throughout your program, you would have to add four `Dim` statements and know the purpose of each parameter. However, using `dblFreeBytes`, which automates the mundane work of the API call for you, is much easier:

```
If dblFreeBytes(app.path) < REQUIRED_BYTES Then
 Msgbox "Error: Not Enough Disk Space!"
End If
```

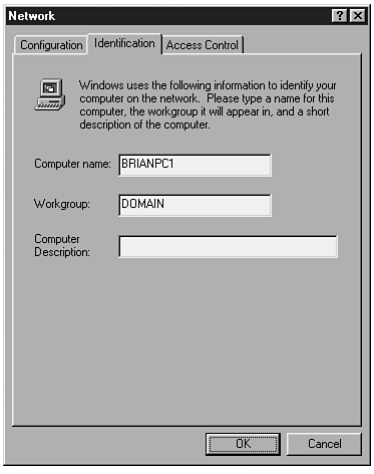
Wrapper functions can also be used to eliminate the extra string manipulation required by many API functions. Typically, API functions that modify a string passed to them require you to supply the length of the string and fill the string with spaces. An example of using a wrapper function to get around this step is demonstrated in Chapter 21, "Working with Files."

▶ **See** "Using INI Files in Visual Basic," **p. 485**

Creating a Wrapper Class

In the spirit of object-oriented programming, you can take the idea of a wrapper function one step further and create a wrapper class. You can use the sample class, `ComputerInfo`, to manipulate the Windows computer name. You can manually change the computer name from the Network Control Panel, shown in Figure 20.3.

FIGURE 20.3
The API calls in the `ComputerInfo` class can set your computer name.



Two API calls are used to retrieve and set the computer name: `GetComputerName` and `SetComputerName`. Your class will encapsulate these functions into a single property that is easier to deal with from Visual Basic. Listing 20.2 shows the code for the `ComputerInfo` class, which includes one property and one event.

Listing 20.2 COMPNAME.ZIP—The *ComputerInfo* Class Sets the Windows Computer Name

```
Option Explicit

'Notice these API declarations are private - we don't want them accessed di-
rectly
Private Declare Function GetComputerName Lib "kernel32" Alias "GetComputerNameA" _
                         (ByVal lpBuffer As String, nSize As Long) As Long
Private Declare Function SetComputerName Lib "kernel32" Alias "SetComputerNameA" _
                         (ByVal lpComputerName As String) As Long

Public Event RebootNeeded()

Public Property Get ComputerName() As String
    Dim sName As String
    Dim lRetVal As Long
    Dim iPos As Integer
```

continues

Listing 20.2 Continued

```
    'API's generally require fixed-length strings, which means
    'pre-filling them with spaces, nulls, or Dim sName As String * 255
    sName = Space$(255)

    'Actually call the API
    lRetVal = GetComputerName(sName, 255&)

    'If the API returns 0 then it didn't work, so exit
    If lRetVal = 0 Then Exit Property

    'GetComputerName puts a null character, Chr$(0), on the end of the
    'string, so we need to remove it before returning the computer name.
    iPos = InStr(sName, Chr$(0))
    ComputerName = Left$(sName, iPos - 1)

End Property

Public Property Let ComputerName(ByVal sNewName As String)

    Dim lRetVal As Long
    lRetVal = SetComputerName(sNewName)
    RaiseEvent RebootNeeded

End Property
```

In this specific example, the reason that you create the `RebootNeeded` event is two-fold: First, although the new computer name can be verified in the Control Panel, the `GetComputerName` API will continue to return the old computer name until you reboot. Second, if you are on a network, you probably will need to reboot to register the new name. In any case, a custom event was used so that the calling program can take the appropriate action. A sample section of code used to test the `ComputerInfo` class is shown in Listing 20.3.

Listing 20.3 COMPNAME.ZIP—Testing the *ComputerInfo* Class from a Form

```
Dim WithEvents clsCompName As ComputerInfo

Sub TestComputerInfoClass()

    Dim sName As String

    'Create a new instance of the class
    Set clsCompName = New ComputerInfo

    'Display the computer name
    sName = clsCompName.ComputerName
    MsgBox "The current computer name is: " & sName

    'Set a new Computer name
    sName = InputBox$("Enter new computer name")
    clsCompName.ComputerName = sName

End Sub

Private Sub clsCompName_RebootNeeded()
    MsgBox "You need to reboot to make the changes effective!"
End Sub
```

The `ComputerInfo` class is a good example of using Visual Basic's object-oriented capabilities to your advantage. Not only does it make using the `ComputerName` APIs easier, but it is also very easy to include in multiple projects. You can also continue to add properties and events to the `ComputerInfo` class as needed.

Useful API Calls

The best way to learn about the Windows API is to practice. If you look at the WIN32API.TXT file, you'll notice that quite a few API calls are available. The following sections will introduce some of the most interesting ones.

Fun API Calls

The next two API calls you will explore on your tour are both easy to use and fun. The first function, `sndPlaySound`, allows you to play waveform (.WAV) sound files on the sound card. They have two parameters: the name of the sound file and flags to control how the sound is played. Listing 20.4 shows an example.

Listing 20.4 APIDEMO.ZIP—Playing WAV Files with *sndPlaySound*

```
Declare Function sndPlaySound Lib "winmm.dll" Alias "sndPlaySoundA" (ByVal _
                 lpszSoundName As String, ByVal uFlags As Long) As Long

Public Const SND_ALIAS = &H10000    '  name is in WIN.INI or the Registry
Public Const SND_ASYNC = &H1        '  play asynchronously
Public Const SND_SYNC = &H0         '  play synchronously (default)
Public Const SND_NOWAIT = &H2000    '  don't wait if the driver is busy
Public Const SND_LOOP = &H8         '  loop the sound until next sndPlaySound

Sub SoundCheck()
    Dim lRetVal As Long

    lRetVal = sndPlaySound("C:\WINDOWS\MEDIA\CHIMES.WAV", SND_SYNC)
    lRetVal = sndPlaySound("SystemStart", SND_ALIAS + SND_ASYNC + SND_NOWAIT)

 'The alias names of system sounds are listed in the registry together,
 'to find them search for SystemStart

End Sub
```

All the constants that begin with the prefix `SND` are listed together and commented in the API text file. The two of most concern are `SND_ASYNC` and `SND_SYNC`, which control whether the program will wait until the sound is finished before continuing.

Another API function, `SystemParametersInfo`, can be used to set the Windows background wallpaper. I used this function with a video capture camera to create a "virtual window office" at work. An example with `SystemParametersInfo` is shown in Listing 20.5.

Listing 20.5 APIDEMO.ZIP—*SystemParametersInfo* Can Set the Windows Background

```
Public Const SPIF_UPDATEINIFILE = &H1
Public Const SPIF_SENDWININICHANGE = &H2
Public Const SPI_SETDESKWALLPAPER = 20
Declare Function SystemParametersInfo Lib "user32" Alias "SystemParametersInfoA" _
                 (ByVal uAction As Long, ByVal uParam As Long, ByVal lpvParam _
                  As Any, ByVal fuWinIni As Long) As Long

Sub ClearWallpaper()

    Dim lRetVal As Long
    lRetVal = SystemParametersInfo(SPI_SETDESKWALLPAPER, 0&, "(None)", _
              SPIF_UPDATEINIFILE Or SPIF_SENDWININICHANGE)

End Sub

Sub SetWallPaper(sBitmapFile As String)

    Dim lRetVal As Long
    lRetVal = SystemParametersInfo(SPI_SETDESKWALLPAPER, 0&, sBitmapFile, _
              SPIF_UPDATEINIFILE Or SPIF_SENDWININICHANGE)

End Sub
```

The `SetWallpaper` and `ClearWallpaper` functions cause the Windows wallpaper bitmap to change immediately. The constants in the last parameter of the API call, although not necessary, cause any changes to be reflected in the Control Panel. If you peruse the API text file, you'll notice that you can control many additional display options with the `SystemParametersInfo` function.

Finding and Controlling Other Windows

You can control window behavior and find out information about other windows with several API calls. Most of these API calls use the *window handle* to identify the window to which you are referring. A window handle is simply a unique number assigned to each window currently running on your system. In Visual Basic programs, the window handle is available to the `hwnd` property of a form. However, if you want to manipulate a window outside your Visual Basic program, you have to first use API calls to obtain its handle.

NOTE In this section, I break temporarily from my `l` prefix naming convention for long variables. Window handles are understood to be long, and the API declarations typically refer to them as `hwnd`. ■

Finding Window Handles To find the handle of a window, you can use the `FindWindow` API function. It has two parameters: the Window Name and the Window Class name. You can supply one or both parameters to `FindWindow`, and it will return the window handle or zero if no matching window exists.

For example, run Notepad and you will see that the initial caption of the Notepad window is `Untitled - Notepad`. To find this window, you could call `FindWindow` as follows:

```
hwndNotepad = FindWindow(vbNullString, "Untitled - Notepad")
```

Notice that here you use only the window caption, sending the class name parameter a null string. However, suppose you saved or opened a file. Notepad's caption would change to reflect the new filename, so the preceding line of code would no longer successfully find the window. However, I happen to know that the name of the Windows Notepad class is `Notepad`, so I could use that instead:

```
hwndNotepad = FindWindow("Notepad", vbNullString)
```

TIP Windows class names are not always this obvious; for example, one of the early Visual Basic form class names was `ThunderForm`. However, a Windows class spy utility, such as the one included with Visual C++, makes finding class names easy.

The preceding line of code can find the handle of the Notepad window no matter what the caption. This example works fine with one instance of Notepad, but what if multiple copies are running? The answer is to introduce a few more API calls: `GetWindow`, `GetWindowText`, and `GetWindowClass`.

Like `FindWindow`, `GetWindow` is used to return a window handle. However, rather than search by name, `GetWindow` finds windows based on their relationships to other windows. `GetWindow` can be used in a loop to browse through the entire window list, as shown in Listing 20.6. The code in this listing counts the number of instances of Notepad and prints the caption of each.

Listing 20.6 APIDEMO.ZIP—Finding All the Notepad Windows

```
Public Const GW_HWNDFIRST = 0
Public Const GW_HWNDLAST = 1
Public Const GW_HWNDNEXT = 2
Public Const GW_HWNDPREV = 3
Public Const GW_OWNER = 4
Public Const GW_CHILD = 5
Public Const GW_MAX = 5

Declare Function GetWindow Lib "user32" (ByVal hwnd As Long, ByVal wCmd As Long) _
                 As Long
Declare Function FindWindow Lib "user32" Alias "FindWindowA" (ByVal lpClassName _
                 As String, ByVal lpWindowName As String) As Long
Declare Function GetClassName Lib "user32" Alias "GetClassNameA" (ByVal hwnd _
                 As Long, ByVal lpClassName As String, ByVal nMaxCount As Long) _
                 As Long
Declare Function GetWindowText Lib "user32" Alias "GetWindowTextA" (ByVal hwnd _
                 As Long, ByVal lpString As String, ByVal cch As Long) As Long
```

continues

Listing 20.6 Continued

```
Sub TestFindWindow()

    Const MAX_TEXT_SIZE = 50

    Dim hwndCurrent As Long
    Dim iCount As Integer
    Dim sClass As String
    Dim sCaption As String
    Dim lRetVal As Long

    iCount = 0
    hwndCurrent = FindWindow("Notepad", vbNullString)

    While hwndCurrent <> 0

        'Get the class name of the current Window
        sClass = Space$(MAX_TEXT_SIZE + 1)
        lRetVal = GetClassName(hwndCurrent, sClass, MAX_TEXT_SIZE)

        'If the Window is Notepad then increment count, print caption
        If Trim$(sClass) = "Notepad" & Chr$(0) Then
              iCount = iCount + 1
              sCaption = Space$(MAX_TEXT_SIZE + 1)
              lRetVal = GetWindowText(hwndCurrent, sCaption, MAX_TEXT_SIZE)
              Debug.Print Left$(sCaption, lRetVal)
        End If

        hwndCurrent = GetWindow(hwndCurrent, GW_HWNDNEXT)

    Wend

    Debug.Print "Number of open Notepad windows: " & iCount

End Sub
```

CAUTION

Take care to understand the role of null characters in API calls. In Listing 20.6, the `GetClassName` and `GetWindowText` API functions both put a `Null` on the end of the returned string. For this reason, I added a `Null` to the end of the word `Notepad` in the `If` statement so that the comparison would work. The `Trim` function removes spaces but not the ending `Null`. Another way to handle this dilemma is to use the return value of the `GetClassName` API with `Left$` as follows:

```
If  Left$(sClass,lRetVal) = "Notepad"  Then ... etc
```

In any case, it would probably behoove you to write a quick function to remove extra null values and trailing spaces from a given string.

Using the Window Handle So now that you have gone to all the trouble of finding a window handle, what can you do with it? The answer is quite a bit. For starters, you can control the state of the window with the `ShowWindow` API:

```
lRetVal = ShowWindow(hwndNotepad, SW_SHOWMINIMIZED)
```

You can also use the `SendMessage` and `PostMessage` API calls to send Windows messages to a window. For example, the following line would cause Notepad to close as if you had ended it from the Windows Task Manager:

```
lRetVal = SendMessage(hwndNotepad, WM_CLOSE, 0&, 0&)
```

The preceding line of code causes Windows to send the `WM_CLOSE` message to the specified window. Upon receiving the message, Notepad exits, possibly prompting the user to save an open document. The `PostMessage` API has the same syntax as `SendMessage`, with the important distinction that it works *asynchronously*, meaning it does not wait until the message has been processed before continuing.

In the example, notice that the last two parameters are zeros because they are specific to an individual message and `WM_CLOSE` does not use them. For example, if you use a `WM_CHAR` message to send a character, these last two parameters are used to specify the character. Remember that you can send literally hundreds of messages, each with its own purpose.

CAUTION

Although the examples shown here are relatively safe when used with Notepad, other programs may react undesirably, causing errors. For the best results when using the Windows API with other windows, (1) read and understand the documentation for the API and/or Windows message, (2) make sure you are working with the right window, and (3) be prepared to reboot a lot.

Waiting on a Program to Finish Running

Sometimes you may need to launch other programs from within VB. Visual Basic has a built-in function to do so, `Shell`, which is covered in Chapter 21, "Working with Files."

▶ **See** "Launching Other Programs with the `Shell Function`," **p. 475**

However, the drawback of using `Shell` is that *it* does not wait for the shelled program to finish running before executing the next line of code:

```
'THIS DOES NOT WORK!!!
dRetVal = Shell("MyBat.Bat")
MsgBox "Batch file complete!"
```

The preceding lines of code do not have the intended result. The message box appears as soon as the `Shell` function is executed, whether the batch file is finished or not. In the 16-bit world of Windows 3.11 and Visual Basic 3.0, this problem was easy to get around with a few lines of code and two API calls. However, in the 32-bit world, things are a lot more complicated. In-depth coverage of 32-bit processes and threads would probably require half a book. Rather than go into that much detail, I will briefly describe a function to accomplish this task, from Microsoft Knowledge Base article Q129796. A function adapted from this example is shown in Listing 20.7.

Listing 20.7 SHELLWAIT.ZIP—Microsoft's Method of Waiting on a Program to Finish Executing

```
Private Type STARTUPINFO
         cb As Long
         lpReserved As String
         lpDesktop As String
         lpTitle As String
         dwX As Long
         dwY As Long
         dwXSize As Long
         dwYSize As Long
         dwXCountChars As Long
         dwYCountChars As Long
         dwFillAttribute As Long
         dwFlags As Long
         wShowWindow As Integer
         cbReserved2 As Integer
         lpReserved2 As Long
         hStdInput As Long
         hStdOutput As Long
         hStdError As Long
      End Type

      Private Type PROCESS_INFORMATION
         hProcess As Long
         hThread As Long
         dwProcessID As Long
         dwThreadID As Long
      End Type

      Private Declare Function WaitForSingleObject Lib "kernel32" (ByVal _
         hHandle As Long, ByVal dwMilliseconds As Long) As Long

      Private Declare Function CreateProcessA Lib "kernel32" (ByVal _
         lpApplicationName As Long, ByVal lpCommandLine As String, ByVal _
         lpProcessAttributes As Long, ByVal lpThreadAttributes As Long, _
         ByVal bInheritHandles As Long, ByVal dwCreationFlags As Long, _
         ByVal lpEnvironment As Long, ByVal lpCurrentDirectory As Long, _
         lpStartupInfo As STARTUPINFO, lpProcessInformation As _
         PROCESS_INFORMATION) As Long

      Private Declare Function CloseHandle Lib "kernel32" (ByVal _
         hObject As Long) As Long

      Private Const NORMAL_PRIORITY_CLASS = &H20&
      Private Const INFINITE = -1&

      Public Sub ExecCmd(cmdline$)
         Dim proc As PROCESS_INFORMATION
         Dim start As STARTUPINFO

         ' Initialize the STARTUPINFO structure:
         start.cb = Len(start)

         ' Start the shelled application:
         ret& = CreateProcessA(0&, cmdline$, 0&, 0&, 1&, _
```

```
            NORMAL_PRIORITY_CLASS, 0&, 0&, start, proc)

        ' Wait for the shelled application to finish:
        ret& = WaitForSingleObject(proc.hProcess, INFINITE)
        ret& = CloseHandle(proc.hProcess)
    End Sub
```

By using the `ExecCmd` function from Listing 20.7, you can rewrite the example from the beginning of this section as follows:

```
'THIS WORKS AS INTENDED
ExecCmd "MyBat.Bat"
MsgBox "Batch file complete!"
```

Note that actually performing this task requires a fairly involved set of API declarations, but the `ExecCmd` function makes them easy to use.

Callbacks and Subclassing

API calls allow you to interact with the Windows operating system at a lower level than with standard VB code alone. When you write programs in standard VB, you are essentially using VB code as a wrapper for the Windows API. Although most of your programs will not be required to use complex API calls, at times you must use the API if the task you are trying to accomplish has not been implemented in the VB language directly. One area in which you may need the API is in processing Windows messages, which can be handled by callbacks and subclassing. These techniques are discussed in the following sections.

Callbacks A callback is a function in your Visual Basic program that is called by Windows. Consider, for example, the declaration for the `EnumWindows` API function:

```
Declare Function EnumWindows lib "user32" (ByVal lpEnumFunc as Long, _
                                           lParam as Any) As Long
```

Notice that the first parameter of `EnumWindows` is a pointer to a function. The function pointed to is one you write in a Visual Basic module—your callback function. The `EnumWindows` function iterates through the Windows task list, executing your callback function each time. To pass a pointer to `EnumWindows`, you use the `AddressOf` keyword and the name of your callback function, as in the following example:

```
lRetVal = EnumWindows(AddressOf MyCallBackFunc, 12345&)
```

Executing the preceding line of code (only a single time) causes `EnumWindows` to call `MyCallBackFunc` repeatedly for each window in the task list. When `EnumWindows` calls `MyCallBackFunc`, it passes two parameters: a window handle and the second parameter originally passed to `EnumWindows`. (The second parameter can be used by your callback function however you see fit, much like the `SendMessage` parameters.) For this reason, callback functions are written specifically for the API that calls them. In other words, a valid callback function for `EnumWindows` needs to be declared according to certain rules. Specifically, it must have two parameters and return a `Long` value. The return value is used to stop `EnumWindows` before it finishes enumerating all the windows.

Listing 20.8 shows a sample version of `MyCallBackFunc`, used with `EnumWindows`. The use for the second parameter in this case is a form name. Each time `MyCallBackFunc` is called, it prints some information about the window handle passed to it on the specified form.

Listing 20.8 CALLBACK.ZIP—Callback Function Demo

```
Declare Function EnumWindows Lib "user32" (ByVal lpEnumFunc As Long, _
                 lParam As Any) As Long

Function MyCallBackFunc(ByVal hwnd As Long, lParam As Form) As Long

    Dim sInfo As String

    'sGetWindowInfo is a wrapper
    'for GetClassName and GetWindowText.

    sInfo = sGetWindowInfo(hwnd)

    lParam.Print "hwnd=" & hwnd & vbTab & sInfo

    'Returning False causes EnumWindows to stop
    'moving through the window list
    MyCallBackFunc = True

End Function

Sub InitiateCallback()
    'This code is called from the form's command button

    Dim lRetVal As Long
    Form1.Cls
    lRetVal = EnumWindows(AddressOf MyCallBackFunc, Form1)

End Sub
```

A sample run is shown in Figure 20.4.

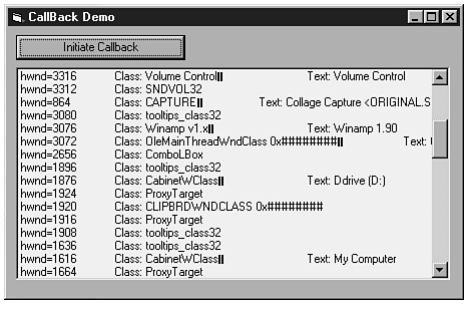


FIGURE 20.4
`EnumWindows` passes your callback function the handle of each window in the task list.

Subclassing Now that you have examined callbacks, you're ready to look at a closely related concept called *subclassing*. To understand subclassing, you should first think of a standard Visual Basic form. You can think of the form as a special type (or class) of window. This class of

window has been programmed to intercept specific events, such as the `MouseMove` event. The Visual Basic form "knows" to run the `MouseMove` event procedure because that is what it has been programmed to do. But what about all the Windows messages that the form is ignoring? And what if you want to change the way Windows handles the existing messages?

To intercept and react to messages, you must change the way the form class handles events. You do so through a technique known as subclassing, which, prior to VB version 5.0, could only be accomplished with a custom control. However, now that callbacks are possible, you can use a callback function with the `SetWindowLong` API function to intercept Windows messages.

Creating an Event Handler with Subclassing A good example of subclassing is in the article "Passing Function Pointers to DLL Procedures and Type Libraries," which is included in the Visual Basic help files. The code for that example is shown in Listings 20.9 and 20.10, followed by a step-by-step explanation.

Listing 20.9 SUBCLASS.ZIP—Subclassing Example

```
Declare Function CallWindowProc Lib "user32" Alias "CallWindowProcA" _
                 (ByVal lpPrevWndFunc As Long, ByVal hwnd As Long, ByVal Msg _
                 As Long, ByVal wParam As Long, ByVal lParam As Long) As Long
Declare Function SetWindowLong Lib "user32" Alias "SetWindowLongA" (ByVal hwnd _
                 As Long, ByVal nIndex As Long, ByVal dwNewLong As Long) As Long

Global Const GWL_WNDPROC = -4
Public lpPrevWndProc As Long
Public gHW As Long

Function WindowProc(ByVal hw As Long, ByVal uMsg As Long, ByVal wParam As Long,
_
         ByVal lParam As Long) As Long
    Debug.Print "Message: "; hw, uMsg, wParam, lParam
    WindowProc = CallWindowProc(lpPrevWndProc, hw, uMsg, wParam, lParam)
End Function

Public Sub Hook()
    lpPrevWndProc = SetWindowLong(gHW, GWL_WNDPROC, _
    AddressOf WindowProc)
End Sub

Public Sub Unhook()
    Dim temp As Long
    temp = SetWindowLong(gHW, GWL_WNDPROC, _
    lpPrevWndProc)
End Sub
```

Although the code in Listing 20.9 is used to intercept messages sent to a form, a rule for callbacks is that they must be located in a module, so that is the place where the guts of the sample code resides. The form-level code is shown in Listing 20.10.

Listing 20.10 SUBCLASS.ZIP—Form-Level Code for the Subclass Example

```
Private Sub cmdHook_Click()
    Hook
End Sub

Private Sub cmdUnhook_Click()
    Unhook
End Sub

Private Sub Form_Load()
 gHW = Me.hwnd
End Sub
```

To look at these listings step by step, start with the `Hook` subroutine in Listing 20.9. `Hook` passes the address of the callback function, `WindowProc`, to the `SetWindowLong` API. `SetWindowLong` makes `WindowProc` the message handler for the form, replacing whatever VB message handler was already in place. The address of the VB message handler being replaced is returned and stored in `lpPrevWndProc`. `UnHook` calls `SetWindowLong` again with this variable to return control to the standard message handler. The `Hook` and `Unhook` subroutines act as a kind of switch that controls where Windows messages are sent. When `Hook` is called, all Windows messages are routed to `WindowProc`.

`WindowProc` accepts four parameters: the window handle of the form and the three parameters associated with each message. The first line of code in `WindowProc` simply prints all this information in the Immediate window. The second line calls yet another API function, `CallWindowProc`. `CallWindowProc` passes the message information on to the standard Windows message handler, whose address is available in the `lpPrevWndProc` variable.

So, in effect, the "custom" message handler `WindowProc` really doesn't do anything but print the message and call the message handler that would have been called anyway. A sample run is shown in Figure 20.5.

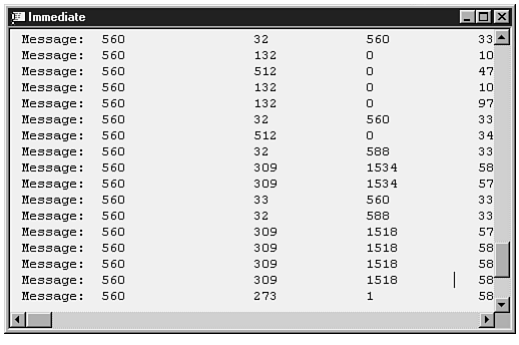


FIGURE 20.5
A sample program uses subclassing techniques to install its own Windows message handler.

To really prove that you are actually intercepting messages, you need to make `WindowProc` do something special, like throw away a message. Go back to the `MouseMove` event example. Place the following line of code in the form's `MouseMove` event procedure:

```
Debug.Print "THE VB MOUSE MOVE EVENT HAS FIRED!"
```

Run the sample program again, and notice that the Immediate window lists the output from the preceding `Print` statement, as well as the one in `WindowProc`. However, by modifying `WindowProc`, you can turn off the VB `MouseMove` event:

```
Function WindowProc(ByVal hw As Long, ByVal uMsg As Long, ByVal wParam As Long, _
          ByVal lParam As Long) As Long
    Debug.Print "Message: "; hw, uMsg, wParam, lParam
    If uMsg <> 512 Then WindowProc = CallWindowProc(lpPrevWndProc, hw, uMsg, _
       wParam, lParam)

    '(Decimal 512 is 200 hex which is WM_MOUSEMOVE in the API text file.)
End Function
```

From Here...

This chapter is by no means a complete API reference; rather, its intention is to introduce you to some of the issues involved when using the Windows API. Keep in mind that the Windows APIs are not the only APIs around. You can purchase third-party DLLs that perform a variety of functions, such as ZIP file creation or custom reporting. In this case, the documentation and `Declare` statements would be included with the product.

The Windows API documentation for Visual Basic is severely lacking. To use the Windows API effectively, you will almost certainly have to find another source. The standard API reference for Visual Basic programmers is Daniel Appleman's *Visual Basic Programmer's Guide to the Win32 API*, which has thorough and in-depth coverage. Another source is the Microsoft Developer Network Online, available at `http://www.microsoft.com/msdn/`.

For more detail on the informatin found in this chapter, refer to the following chapters:

- To learn about some graphics-related API calls, see the section "Other Graphics Methods" in Chapter 19, "Using Visual Design Elements."
- To use API calls to access INI files, see Chapter 21, "Working with Files."
- To see how API calls can be used to alter how bitmaps are painted on the screen, see Chapter 23, "Master's Toolbox."

CHAPTER 21

Working with Files

In this chapter

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No matter what development language and platform you use, at some point you will probably need to write code that interacts with underlying operating system files. For example, you might need to copy files or launch another program. You can do all this interactively by using Windows Explorer or an MS-DOS prompt window. As you will see in this chapter, you can accomplish these same file operations easily by using Visual Basic code.

Another use for files is the storage and retrieval of information. In other chapters, you learned how to use databases to store information. However, sometimes the power of the Visual Basic database engine may not be necessary or even appropriate. For example, you may want to create a simple activity log or process a comma-delimited text file. In this chapter, you will examine a couple of options that allow you to store and access information in three types of text files: sequential files, random access files, and initialization (.INI) files.

File Functions in Visual Basic

Files are the basic organizational unit of an operating system. There are many different types of files, from user-created documents to games to operating system commands. This section discusses some of the functions used to work with files from Visual Basic. Another method of accessing files, using the `FileSystemObject` interface, is discussed in Chapter 30, "Using VBScript." (This object interface was originally a part of VBScript but is now available in Visual Basic starting with version 6.) The functions discussed in this section have been around for a long time and are considered to be the "traditional" Visual Basic file functions.

▶ **See** "Accessing the File System" **p. 675**

Using *Dir* to Find and List Files

One useful file function is the `Dir$` function. This function works like the `Dir` command at an MS-DOS command prompt. You can use the `Dir$` function to retrieve a list of one or more operating system files that match a file specification or path. A path can include the name of a directory, a specific filename, or both. For example, C:*.BAT is the path to all the files in the root directory of drive C having a BAT extension. The syntax of the `Dir$` function is as follows:

```
stringvar = Dir$(path[,attributes])
```

Finding Files One use of `Dir$` is to determine whether a file exists. If you try to open a database or access a file that does not exist, an error occurs. However, you can use `Dir$` first to check for a file's existence before opening it, as in the following example:

```
If Dir$("C:\MYFILE.TXT") = "" Then
Msgbox "The file was not found. Please try again!"
End If
```

The `Dir$` function returns the filename without the full path if the specified file is found, or it returns an empty string if no files were found. The preceding line of code displays a message box if MYFILE.TXT does not exist in the root directory of drive C. If the file does exist, the string `myfile.txt` is returned. To make things even simpler, you can create a generic function that returns a Boolean value `True` if the given file exists:

```
Public Function bFileExists(sFile As String) As Boolean
     If Dir$(sFile) <> "" Then bFileExists = True Else bFileExists = False
End Function
```

This function could then be used to check any filenames passed to the program by the user, as in the following example:

```
Dim sUserFile As String

sUserFile = InputBox$("Enter the file name:")

If Not bFileExists(sUserFile) Then
        MsgBox "The file does not exist. Please try again."
        End

End If
```

Notice that the code sample ends the program if the file does not exist, to prevent any errors that might occur later. Another way to handle this situation would be to keep asking the user for a filename until a valid filename is entered.

Listing Files and Folders Another use of the `Dir$` function is to return a list of files in the specified path. If you use the `Dir` command at an MS-DOS prompt, each matching file is listed on the screen. However, because the `Dir$` function is designed to return only a single string variable, you have to use a loop and retrieve one filename at a time. (You also can display a list of files with a file list box, which is one of Visual Basic's default controls. These controls are covered extensively in Chapter 4, "Using Visual Basic's Default Controls.")

Suppose that your C:\DATA directory contains several picture files with a BMP (bitmap) extension. The path used to retrieve these files with the `Dir$` function would be C:\DATA*.BMP. You can use the following lines of code to retrieve the filenames and add them to a list box:

```
Dim sNextFile As String

sNextFile = Dir$("C:\Data\*.BMP")

While sNextFile <> ""
    lstPictureList.AddItem sNextFile
    sNextFile = Dir$
Wend
```

In the preceding example, notice that only the file path to `Dir$` is supplied on the first call. Each subsequent call to `Dir$` has no arguments, indicating that you want to use the previous file path and move to the next filename in the list. When no more files match, `Dir$` returns an empty string and the `While` loop terminates.

CAUTION

When you use `Dir$` in a loop, always exit the loop after an empty string is returned. If you try to make another call to `Dir$` with no arguments, a runtime error occurs.

The second, optional parameter of the `Dir$` function is used to provide additional conditions (beyond the specified path) with which to select files. For example, using the constant

`vbDirectory` returns only the subdirectories (or folders) in the specified path. The constant `vbVolume` causes `Dir$` to return the specified drive's volume label. The available constants are summarized in Table 21.1. (You also can display a list of folders with a directory list box.)

Table 21.1 Constants Control the Behavior of the *Dir$* Function

Constant	Value	Purpose
`vbNormal`	0	(Default value)
`vbHidden`	2	Include hidden files
`vbSystem`	4	Include system files
`vbVolume`	8	Return drive volume label
`vbDirectory`	16	Display subdirectories
`vbReadOnly`	1	Include read-only files

NOTE Constants can be added together if you want to use more than one. For example, the following code finds the system, hidden, and read-only file IO.SYS on a Windows 95 machine:

```
Debug.Print Dir$("C:\IO.SYS",vbHidden+vbSystem+vbReadOnly)
```

Note that the `vbHidden` constant refers to a file's attributes and not the Windows Explorer option that hides certain file types. You can view the attributes of a file by right-clicking the file's name and choosing Properties, as depicted in Figure 21.1, or by using the MS-DOS `ATTRIB` command.

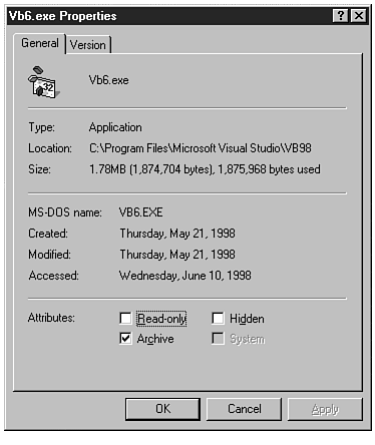


FIGURE 21.1
File attributes, shown in the Windows Explorer, can determine whether the `Dir$` function returns a specific filename.

File-Manipulation Functions

As with the `Dir$` function, most of the file-manipulation commands in Visual Basic are as straightforward as their MS-DOS equivalents, although with a few limitations. These commands are summarized in Table 21.2.

Table 21.2 Summary of File Functions

Action	Syntax
Copy a file	`FileCopy` *`source, dest`*
Delete one or more files	`Kill` *`path`*
Rename a file	`Name` *`oldname`* `As` *`newname`*
Create a new folder	`MkDir` *`pathname`*
Remove an empty folder	`RmDir` *`pathname`*
Change current directory	`ChDir` *`pathname`*
Change current drive	`ChDrive` *`drive`*

Several of these system functions are described in the following sections.

Copying Files The `FileCopy` command has the limitation that you cannot use wildcards to specify multiple files. `FileCopy` can copy files locally or over a network, as shown in the following examples:

```
 'The following line copies a file while changing its name:
FileCopy "D:\My Documents\Hey Now.txt",  "C:\DATA\TEST.TXT"

'The following lines of code use a network path for the source file:
Dim sDest As String
Dim sSource As String

 SSource = "\\myserver\deptfiles\budget98.XLS"
SDest = "C:\DATA\BUDGET.XLS"

FileCopy sSouce, sDest
```

The `FileCopy` statement automatically overwrites an existing file, unless the file is read-only or locked open by another application.

NOTE When you copy files over a network or dial-up connection, using the `On Error` statement to trap errors is a good idea. For example, if the network is down or another user has the file exclusively locked, your program could bomb unexpectedly. You can easily provide an error trap and retry dialog, as described in Chapter 9, "Visual Basic Programming Fundamentals." ■

▶ **See** "Using the On Error Statement" **p. 219**

TIP When you are performing file operations that take a long time (more than a few seconds), display an `AVI` file like Windows does. This capability is discussed in the section "Adding Video with the Animation Control" in Chapter 12, "Microsoft Common Controls."

Deleting Files Visual Basic also allows you to delete files by using the `Kill` statement. `Kill` can use wildcards to specify multiple files, as in the following example:

```
Kill "D:\NewDir\*.doc"
```

Renaming Files The `Name` statement is like MS-DOS's `RENAME` command but can be used on only one file at a time:

```
Name oldname As newname
```

You also can use `Name` like the `MOVE` command in MS-DOS if the specified paths are different:

```
 'Moves the file to a new directory
MkDir "D:\NewDir"
Name "C:\Windows\Desktop\TEST1.TXT" AS "D:\NewDir\TEST2.TXT"
```

In the preceding example, note the `MkDir` statement, which you probably have guessed is used to create a new directory. The `MkDir` and `RmDir` statements add and remove directories, just like their `MD` and `RD` counterparts in MS-DOS.

Setting the Current Directory In the examples discussed so far, the path has always included the drive and directory. However, as you may recall from using MS-DOS, during the context of your MS-DOS session, you are always "in" a certain directory, which is usually displayed to the left of the MS-DOS cursor. For example, if you type `CD \WINDOWS`, you can rename, copy, or delete files within the WINDOWS directory without specifying C:\WINDOWS in the pathname. The same concept of a *current directory* applies to Visual Basic. By using the `ChDir` and `ChDrive` statements, you can set the current working directory on each drive and switch between current drives, eliminating the need to specify the full path for each file operation:

```
'Change to the desired directory and drive and rename a file
chdir "C:\Windows\Desktop"
chdrive "C:"
Name "TEST1.TXT" As "TEST2.TXT"

'Delete a file in the current directory
ChDrive "D:"
ChDir "D:\DATA"
Kill "OLDDATA.DAT"
```

Performing deletes can be dangerous if you don't know the current directory. Fortunately, Visual Basic offers a function that provides this value: the `CurDir$` function. The syntax of `CurDir$` is

```
stringvar = CurDir$([Drive])
```

NOTE You can use the `Left$` function to get the current drive, as in the following example:

```
sDriveLetter = Left$(CurDir$(),1)
```

Launching Other Programs with the *Shell* Function

From time to time, you may need to launch another Windows program from your Visual Basic code. For example, you could use Visual Basic to schedule a data transfer or file cleanup. You could easily do so by checking the current system time and then running the secondary program when appropriate. You can run other programs by using the `Shell` function. The syntax for `Shell` is as follows:

```
DoubleVar = Shell(pathname[,windowstyle])
```

The following lines of Visual Basic code use `Shell` to run Notepad and bring up a text file called README.TXT:

```
Dim dTaskID As Double
dTaskID = Shell("Notepad D:\readme.txt", vbNormalFocus)
```

The first parameter of `Shell` is the command to be executed and the second, optional parameter is the window style. In the preceding example, the constant `vbNormalFocus` tells the `Shell` statement to run Notepad in a normal window with focus. The constant specifies two attributes of the new window: style and focus. Style describes how the window will be displayed (normal, minimized, maximized or hidden), and the focus describes whether the application will become the foreground application (only one running application can have the focus). The default window style is minimized with focus. This means the shelled application does not obscure another application's window, but the shelled program has the focus.

Launching another application with `Shell` is easy. If you need to wait for it to complete before your Visual Basic code continues, you need to use slightly more complex code with some additional Windows API calls. This specific API example is discussed in Chapter 20, "Accessing the Windows API."

▶ **See** "Waiting on a Program to Finish Running," **p. 461**

Locating Files Relative to Your Application

When you work with files in Visual Basic, "hard-coding" a file or folder name within your program is never a good idea. A commercial application such as Microsoft Office lets you change the default installation directory to anything you want. Even if you install the application in an off-the-wall location like D:\JUNK123\, it still can find all its other files (such as templates and clip art) and function normally.

Likewise, your applications will be more successful and professional if they can survive on any drive or installation path. If you include files beyond the actual program EXE (like a database), you can add some minor coding so that your program can locate these files in a manner that is transparent to the user.

Figure 21.2 shows an album selection screen. This program allows the user to click an album image to play the album. The program is designed to run from a CD-ROM drive. This means the path to the program might be D:\TUNES\TUNES.EXE if your CD-ROM drive letter is D. The album cover pictures and database information are also stored in the \TUNES subdirectory on the CD-ROM.

FIGURE 21.2
When your program is running from an unknown location, such as a mapped network drive or CD-ROM, use `App.Path` to locate the necessary supporting files.

For the program to always find the images, no matter what the CD-ROM drive letter, it uses the `Path` property of the `App` object (`App.Path`), as in the following example:

```
'Open database
Set db = OpenDatabase(App.Path & "\albums.mdb")

'Load image
Set picture1 = LoadPicture(App.Path & "\Picture1.GIF")
```

`App.Path` returns the directory in which the application is running. In the preceding example, the returned value is D:\TUNES or whatever directory the TUNES.EXE file is located in.

NOTE After you have saved your project and are working in the Visual Basic IDE, `App.Path` returns the path to your project's directory (with the .VBP file). If the project hasn't yet been saved, `App.Path` returns the current directory.

In the preceding examples, notice that you have to add a backslash before specifying the filename. `App.Path` doesn't add the final backslash unless it returns the root directory. You can use the `Right$` function to check for this at the beginning of your program:

```
'Sets sAppPath (assumed to be a public variable) for use later in the program
sAppPath = App.Path
If Right$(sAppPath,1) <> "\" then sAppPath = sAppPath & "\"

'Later  in  the program:
Dim sDBLocation As String
sDBLocation = sAppPath & "finance.mdb"
```

Some programmers use the `ChDir` command (discussed earlier) to change the current directory to `App.Path` at the beginning of the program. I tend to stay away from this command because it also may affect other Windows programs.

TIP If your application uses many files spread across several directories and drives, you should take the next step and keep file locations in an INI file or database. (See "Understanding INI Files" later in the chapter.)

Working with Text Files

Sometimes you may need to store and retrieve information but not need the power of a database (not to mention the extra coding, configuration, and support files that go along with it). In these cases, a text file may be just the thing you need. In this section, you will learn about a simple type of file: a free-form, sequential text file. *Sequential* means that the file is accessed one byte after the other in sequence, rather than jumping to a specific location. *Free form* means that the file has no predefined structure; it is entirely up to the programmer.

Sequential Text Files

Suppose you have a form in which the user must choose salespersons from a list, as shown in Figure 21.3. Your mission is to load the names of each salesperson into a list box so that the user can select these names. You could just put a bunch of `AddItem` statements in the `Form_Load` event. However, doing so would be a poor solution because you have hard-coded information in the program. Any time the sales force changed, the program would have to be recompiled. A better solution is to use a text file with the salespersons' names in it. The program then reads the names from the text file and populates the list box.

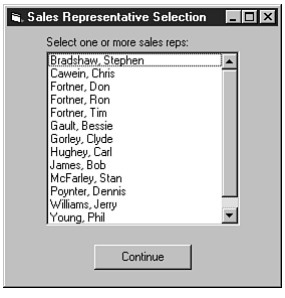


FIGURE 21.3
The list box is populated with the contents of a text file.

To create the file itself, you can use a text editor such as Notepad, placing each salesperson's name on a separate line, as shown in Figure 21.4.

FIGURE 21.4
Data stored in sequential text files can be easily edited.

This process is simple, and the file can be edited by anyone—even if that person doesn't have a database tool. For example, a secretary could maintain this file on a network server, and the application could copy the most recent version at startup. Of course, if you are using a database anyway, you might want to go ahead and place the names of the sales force in a table. However, a standard text file could still be used for importing into the table.

NOTE The concept of a shared network file also applies to databases and other documents, which may be useful if everyone on your network uses the same desktop application programs.

Reading from a Sequential Text File

Now that you know how easily you can create a sequential text file, you're ready to write some code to read information from the file. One easy way to process a sequential text file is to read it a line at a time. For the salesperson example described in the preceding section, the steps used for filling up the list box are very straightforward:

1. Open the file for input.
2. Read a line from the file and store it in a variable.
3. Add the contents of the variable to the list box.
4. Repeat steps 2 and 3 for each line in the file.
5. Close the file.

The code for filling up the list box, which is discussed in the following sections, is shown in Listing 21.1.

Listing 21.1 LISTFILL.ZIP—Filling a List Box from a Text File

```
Sub FillListBox()
  Dim sTemp As String
  lstPeople.Clear

  Open "C:\DATA\PEOPLE.TXT" For Input As #1
  While Not EOF(1)
 Line Input #1, sTemp
      LstPeople.AddItem sTemp
  Wend
  Close #1
End Sub
```

Now, examine the code a little closer. First, before you read or write information, you must open the file with the `Open` statement. The `Open` statement associates the actual filename (PEOPLE.TXT in the example) with a *file number*. A file number is an integer value used to identify the file to other Visual Basic code:

```
Open "C:\DATA\PEOPLE.TXT" For Input As #1
```

NOTE In the preceding example, 1 is the file number. However, if you open and close multiple files throughout your program, using this number might not be a good idea. In that case, you should use the `FreeFile` function, which returns the next available file number, as in the following example:

```
Dim nFile As Integer
nFile = FreeFile
Open "C:\MYFILE.TXT" for Input As #nFile
```

After you finish using a file, you should close it with the `Close` statement (refer to Listing 21.1). This way, you can free up the file number for use with other files.

In addition to providing the filename and number association, the `Open` statement tells Visual Basic how you intend to use the specified file. (Many different options are available with the `Open` statement, as discussed in the Help file.)

TIP Before you open a file for input, use the `Dir$` function to see whether it actually exists.

The keyword `Input` indicates that the file will be opened for Sequential Input, which means that you can only move forward through the file in sequence. The act of reading information from the file automatically moves an internal file pointer forward for the next read. The code in Listing 21.1 uses a `Line Input` statement in a `While` loop to read information. The first `Line Input` statement reads the first line, the second `Line Input` reads the second line, and so on. A line in a file is delimited by an end of line marker, which in Windows is the carriage return character followed by the line feed character. The syntax of the `Line Input` statement is

```
Line Input #filenumber,variablename
```

where *`filenumber`* is an open file number and *`variablename`* is a string or variant variable. If you try to read more lines of text than are in the file, an error occurs. Therefore, you should use the `EOF` (end-of-file) function to check whether you have reached the end of file before attempting to read again.

After you open the file, you can choose from several methods of reading information from it. In the example, each name is the only piece of information on each line, so no further processing on the string variable is necessary. However, sometimes you may want to read less than a whole line or store more than one piece of information on a single line. In these cases, you can use the `Input #` statement or the `Input` function.

The `Input #` statement is designed to read information stored in a delimited fashion. For example, the following line of a text file contains three distinct pieces of information: a string, a number, and a date. Commas, quotation marks, and the `#` symbol are used to delimit the information.

```
"Test",100,#1998-01-01#
```

The following line of code correctly reads each item from the file into the appropriate variables:

```
Input #1, stringvar, intvar, datevar
```

Remember that the `Input #` statement looks for those delimiters, so make sure that your `Input #` statements match the format of the file.

Another method of reading information is the `Input` function. The `Input` function allows you to specify the number of characters to read from the file, as in the following example:

```
'Reads five Character from file number 1
s = Input(5,#1)
```

Now, compare how each of the methods just discussed would process the same line in a file:

```
'Assume our file has the following line repeated in it:
"This is a test string."

Dim s As String

Line Input #1, s
's contains the entire string including quotes

Input #1, s
's contains the string without quotes

s = Input(5,#1)
's Contains the first 5 characters ("This)
```

Writing to a Sequential Text File

One good use of a sequential text file is a log file. For example, I have a scheduler application that runs programs and database updates. I rarely work at the machine on which the scheduler application is running, but I can connect over the network and view the log file to see whether the updates have completed.

TIP You can create batch files, FTP scripts, and many other simple file formats on-the-fly by using sequential text files.

Listing 21.2 is a subroutine called `LogPrint`, which can be added to your program to log error messages. It writes the error message and date to a sequential text file.

Listing 21.2 LOGPRINT.ZIP—Using a Sequential Output File to Build an Application Log

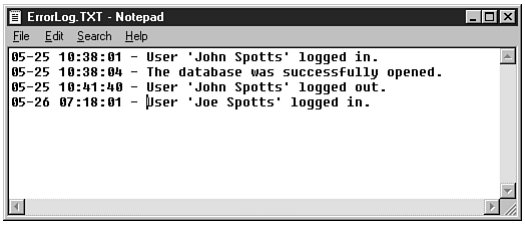
```
Sub LogPrint(sMessage As String)
  Dim nFile As Integer
  nFile = FreeFile
  Open App.Path & "\ErrorLog.TXT" for Append Shared as #nFile
  Print #nFile,format$(Now,"mm-dd hh:mm:ss") & " - " & sMessage
  Close #nFile

End Sub
```

The function can be called from an error routine or to inform you of a program event:

```
LogPrint "The database was successfully opened."
```

The output of the log file can be viewed with a text editor, as shown in Figure 21.5.

FIGURE 21.5
With a few lines of code, you can add a log file to your application.



Recall from Listing 21.1 (in the preceding section) that you opened the file in input mode by using the keyword `Input`. To write data, you open the file for sequential output. However, instead of using the keyword `Output`, you use `Append`. Compare the following two lines of code, each of which opens a file for output:

```
'Append mode - adds to an existing file or creates a new one
Open "ErrorLog.TXT" for Append as #1
```

```
'Output Mode - always creates a new file, erases any existing information
Open "ErrorLog.TXT" for Output as #1
```

Append mode means data written to the file is added to the end of any existing data. This is perfect for the log file application because you want to keep adding to the log file. Opening a file for `Output` means that any existing data will be erased. In either case, the `Open` statement automatically creates the file if it does not exist. After a file has been opened for `Output`, you can use a couple of different statements to write information to it. The `Print#` and `Write#` statements, described in the next section, provide different formatting options for sequential files.

Using *Print* and *Write* The `Print#` statement works almost exactly like the `Print` method described in Chapter 20, "Accessing the Windows API," except instead of going to an onscreen object, the output is routed to the open file. Unless a semicolon or other separator is at the end of the list of things to be printed, a new line is automatically inserted into the file after each print. The syntax of the `Print#` statement is

```
Print #filenum,expressions
```

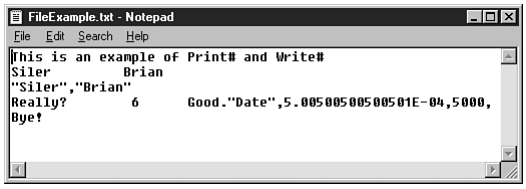
Another statement, the `Write#` statement, works like the `Print#` statement but automatically adds separators and delimiters. The syntax of the `Write#` statement is

```
Write #filenum,expressions
```

The `Write` statement is intended for use with the `Input#` statement, described earlier in the "Reading from a Sequential Text File" section. Some examples of both statements are listed here, and the resulting file is shown in Figure 21.6.

```
Print #1, "This is an example of Print# and Write#"
Print #1, "Siler","Brian"
Write #1, "Siler","Brian"
Print #1, "Really?", 2*3;Spc(5);"Good.";
Write #1,"Date",1/1/1998,1000*5;
Print #1, vbCrLf & "Bye!"
```

FIGURE 21.6
Whereas `Print#` gives you more control over output format, `Write#` adds delimiters for easy retrieval of information.



Random Files—Creating Your Own File Format

Sequential files do not have any structure. As a matter of fact, the structure is defined by the code that reads the file rather than in the file itself. As you learned in the previous section, this feature is advantageous from a readability standpoint but limits the functions that a programmer can use to search through the file. For example, Visual Basic does not contain a function to jump to a specific record in a sequential file because Visual Basic does not know the file's structure. One way to move some structure into the file itself is to store user-defined record types rather than just string data. You can then open them in Random mode and are not limited to sequential access.

Creating a Record Type

Custom record types are really just user-defined data types. You create user-defined data types by using the `Type` statement. Type declarations are entered in the general declarations section of a Code window. The following code uses the `Type` statement to declare an `Employee` record type:

```
Private Type Employee
    EmpID As Integer
    LName As String * 30
    Fname As String * 20
    Title As String * 20
End Type
```

The custom record type can then be accessed from code by using dot notation, as in the following example:

```
Dim emp1 As Employee
Emp1.Fname= "Joe"
Emp1.Lname= "Smith"
Emp1.Title= "Chicken Plucker"
Emp1.EmpID = 12345
```

Notice that accessing fields in a custom data type is similar to accessing an object's properties, as discussed in Chapter 4, "Using Visual Basic's Default Controls."

Opening a Random Access File

The main difference between opening a random access file and a sequential file is that you must specify the record length in the `Open` statement. The record length for a user-defined data type can be obtained by using the `Len` statement on a variable of that type, as in the following example:

```
Dim emp1 As Employee
Open "D:\EMPINFO.DAT" for Random As #1 Len = Len(emp1)
```

The preceding line of code opens the file EMPINFO.DAT for random access. The `Len=` part of the `Open` statement tells Visual Basic that subsequent reads and writes to the file will assume that the file contains only records the length of `emp1`.

Adding Records with *Put*

After you open a file for random access, use the `Put` statement to store records in the file. The syntax of the `Put` statement is as follows:

```
Put filenumber,[recnumber],variablename
```

The following code uses the `Put` statement in a `For` loop to write five records of type `Employee` to file #1:

```
For i = 1 To 5
    emp1.LName = InputBox$("Enter Last Name")
    emp1.Fname = InputBox$("Enter First Name")
    emp1.Title = InputBox$("Enter Title")
    emp1.EmpID = i
    Put #1, , emp1
Next i
```

Notice the omission of the *`recnumber`* parameter, which specifies the location in the file where the new record should be written. This approach is useful for altering existing records in a file. If you do not specify this parameter, the record is written to the current file pointer location.

Retrieving Records with *Get*

To retrieve records from a random file, use the `Get` statement. The `Get` statement can be used to read information back into your record type, as in the following example that reads record number 4 in the file into the variable `emp1` and then displays the `Title` field:

```
Get #1, 4, emp1
MsgBox "Employee title is " & emp1.Title
```

The syntax of the `Get` statement is similar to `Put`:

```
Get filenumber,[recnumber],variablename
```

If you omit the *`recnumber`* parameter, `Get` behaves like the sequential `Line Input` statement; that is, each subsequent `Get` reads the next record.

Random Access with *Seek*

To move from record to record, use the `Seek` statement. The `Seek` statement has two parameters, the file number and record number, as shown here:

```
Seek #1,3
```

The preceding line of code causes the next `Put` or `Get` to access record number 3.

INI Files

INI files (pronounced "any files" by us southerners) are useful for storing program information and user settings. An INI file is basically a text file with a simple structure that allows you to save and retrieve specific pieces of information; its filename extension is INI, short for *initialization*. By storing information in an INI file, you can avoid hard-coding values in your program. This way, you can easily change values without recompiling the program. In the following sections, you will look at some possible uses for INI files and discover what you need to do to use them in a program.

Understanding INI Files

The structure of INI files is simple. INI files can be viewed and edited with Notepad, or any other text editor. A sample INI file is shown in Figure 21.7.

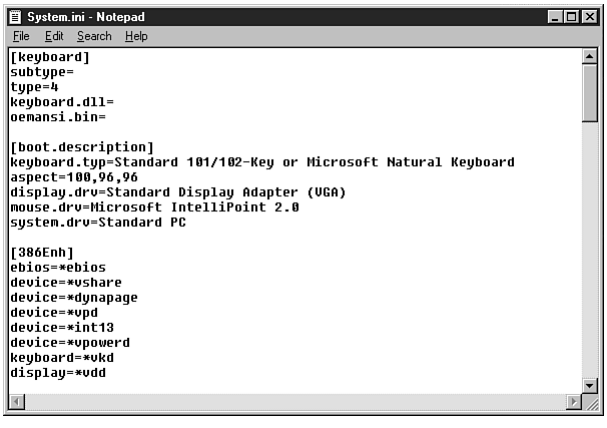


FIGURE 21.7
INI files can be used to store user settings and other information in an organized manner.

The three elements to an INI file are *sections*, *keys*, and *values*. (Microsoft calls a section an *application*; the reason for this involves the history of INI files when an application stored its own settings in WIN.INI.) The parts of an INI file are summarized in Table 21.3.

Table 21.3 Parts of an INI File

Element	Description
Section	A name enclosed in brackets ([]) that groups a set of values and keys together.
Key	A unique string. The key will be followed by an equal sign (=) and a value. A key needs to be unique only within a specific section.
Value	The actual information of a particular key in the INI file. A section and key together are used to read or write a value.

The order of sections and keys within the file is not important because the section and key names (should) point to only one value. One final note on the structure of an INI file: A semicolon (;) is used to indicate a comment; any keys or values following a semicolon are ignored. For example, look at this INI section:

```
[Settings]
DBLocation=P:\USERINFO.MDB
;DBLocation=D:\CODE\TEST.MDB
```

In the preceding section, switching from a local development database to a production database is easy. You can simply "comment out" the line you don't want.

Using INI Files in Visual Basic

One reason INI files are easy to use is that you do not have to worry about creating the file, opening the file, or finding the correct line. Before you can use INI files, however, you have to declare two Windows API functions and write a couple of "wrapper" functions around them. (To learn more about API calls, see Chapter 20, "Accessing the Windows API.") Simply add a new module to your program, and enter the code from Listing 21.3 in the General Declarations section.

TIP Build a library of useful functions like these in a separate module (for example, UTILITY.BAS) that can easily be added to multiple projects.

Listing 21.3 INIFUNC.BAS—Using INI Files in Your Program

```
 'API DECLARATIONS
Declare Function GetPrivateProfileString Lib "kernel32" Alias _
                 "GetPrivateProfileStringA" (ByVal lpApplicationName _
                 As String, ByVal lpKeyName As Any, ByVal lpDefault _
                 As String, ByVal lpReturnedString As String, ByVal _
                 nSize As Long, ByVal lpFileName As String) As Long
Declare Function WritePrivateProfileString Lib "kernel32" Alias _
                 "WritePrivateProfileStringA" (ByVal lpApplicationName _
                 As String, ByVal lpKeyName As Any, ByVal lpString As Any, _
                 ByVal lpFileName As String) As Long
```

continues

Listing 21.3 Continued

```
Public Function sGetINI(sINIFile As String, sSection As String, sKey _
                As String, sDefault As String) As String

    Dim sTemp As String * 256
    Dim nLength As Integer

    sTemp = Space$(256)
    nLength = GetPrivateProfileString(sSection, sKey, sDefault, sTemp, _
              255, sINIFile)
    sGetINI = Left$(sTemp, nLength)

End Function

Public Sub writeINI(sINIFile As String, sSection As String, sKey _
           As String, sValue As String)

    Dim n As Integer
    Dim sTemp As String

    sTemp = sValue

    'Replace any CR/LF characters with spaces
    For n = 1 To Len(sValue)
        If Mid$(sValue, n, 1) = vbCr Or Mid$(sValue, n, 1) = vbLf _
        Then Mid$(sValue, n) = " "
    Next n

    n = WritePrivateProfileString(sSection, sKey, sTemp, sINIFile)

End Sub
```

After the code in Listing 21.3 has been entered, you can now use the function `sGetINI` and the subroutine `writeINI` to easily read and write to an INI file. The following example shows how you can retrieve settings from an INI file for use at program startup.

Listing 21.4 INIEXAMPLE.ZIP—Using an INI File for Program Settings

```
Sub InitProgram()

Dim sINIFile As String
Dim sUserName As String
Dim nCount As Integer
Dim i As Integer

'Store the location of the INI file
sINIFile = App.Path & "\MYAPP.INI"

'Read the user name from the INI file
sUserName = sGetINI(sINIFile, "Settings", "UserName", "?")

If sUsername = "?"  Then
      'No user name was present - ask for it and save for next time
      sUserName = InputBox$("Enter your name please:")
      writeini sINIFile, "Settings","UserName",sUserName
End If
```

```
'Fill up combo box list from INI file and select the user's
'last chosen item
nCount = Cint(sGetINI(sINIFile, "Regions", "Count", 0) )
For i = 1 to nCount
cmbRegn.AddItem sGetINI(sINIFile, "Regions", "Region" & i,"?")
Next i

cmbRegn.Text = sGetINI(sINIFile, "Regions", _
               "LastRegion",cmbRegions.List(0))

End Sub
```

The code in Listing 21.4 first checks the INI file for a username. By providing the default value `?`, you know whether the username already exists in the INI file and can prompt for it. The default value is a great feature because it does not matter whether the INI file even exists.

The next part of the code sample reads the number of regions from the INI file and uses that value to place each region in a combo box. The final statement sets the `Text` property of the combo box to a value from the INI file, using the first item in the list as a default.

NOTE Remember that `writeINI` is a subroutine, so it does not require parentheses.

Driving your program from INI files, as demonstrated in Listing 21.4, allows you to make minor changes to the program quickly and easily without even recompiling it.

From Here...

In this chapter, you looked at some of the file functions built in to the VB language, as well as examined how to use INI files in your application. From Visual Basic, you can copy, delete, and rename files, as well as store information in a variety of formats. Although the methods discussed in this chapter do not have the power of a database engine, they are well suited to simple tasks in which you cannot have a lot of extra overhead.

For more information about the topics discussed in this chapter, see the following chapters:

- If you want to learn about more advanced methods of information storage, see Chapter 24, “Database Basics.”
- To find out additional information about API functions, see Chapter 20, “Accessing the Windows API.”
- To learn more about text file access from a Web browser, see Chapter 30, “Using VBScript.”

CHAPTER 22

Using OLE to Control Other Applications

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Working with Excel **496**

Using the OLE Container Control **497**

OLE, which stands for *object linking and embedding*, was introduced as a way to integrate the Microsoft Office family of products. Applications that support OLE allow users to use one application from within another without leaving the context of the original program's interface. The Microsoft Office suite is a stellar example of a group of individual programs that use OLE to work together. This capability makes a software suite much more than just a group of programs that are packaged together.

For example, by using OLE, you can embed an Excel spreadsheet in a Word document. A user working on that Word document can edit the spreadsheet by simply double-clicking it. This action opens Excel functionality while still working in Word.

The benefits to users include the ability to edit different types from a single, unified user interface. A benefit for programmers is that the Office applications contain a great set of exposed OLE (or ActiveX) objects that you can access from Visual Basic. Visual Basic also provides you with a very nice OLE Container control, which makes it very easy to give your users access to OLE-compliant applications from within your VB programs.

When you use Office's OLE objects in Visual Basic, you are essentially "remote controlling" Word or Excel. This means that not only must the applications be installed on a user's machine, but your application acts just as though a user were entering and typing the commands. The application loads, and depending on how you write your VB code, users may be able to watch or interact with it. For these reasons, OLE automation may be slow, but it is still useful in some circumstances.

The following are some advantages of using OLE automation:

- **Professional-looking reports.** Word and Excel can produce some nice printed reports. By driving Word and Excel remotely from VB, you can easily print reports using these programs' advanced formatting capabilities.
- **Automated document creation.** You can create documents and spreadsheets from VB code. For example, you can create a weekly summary of available job openings from a database and email it to prospective applicants.
- **Information retrieval.** You can use OLE objects in Visual Basic to extract information from an Excel spreadsheet and store it in a database.

In this chapter, you examine some of the ways to use Word and Excel from Visual Basic. Although the examples in this chapter will use standard Visual Basic, note that Office applications now practically have Visual Basic built in, so much of the same code described here can be included as VBA code in the document or worksheet itself.

Working with Word Objects

The capability of controlling an instance of Microsoft Word from within a Visual Basic program can lead to some powerful added value for your applications. Users will appreciate being able to edit a Word document without having to leave a specialized program. In this section, you learn how to add Word functionality to your programs.

The Microsoft Word Object Library

To use Word objects from Visual Basic, you must have Word installed on your computer. After Word has been installed, you should see the Microsoft Word Object Library available in Visual Basic's References dialog box, as shown in Figure 22.1.

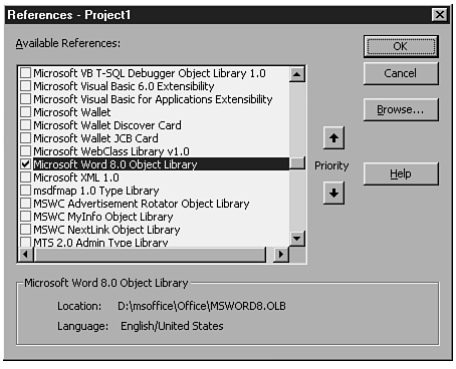


FIGURE 22.1
To use Word objects in Visual Basic, add a reference to the Word Object Library. (The Word reference from Office 97 is shown here.)

To add the reference, choose References from the Project menu, and place a check mark next to the Microsoft Word Object Library. After referencing the Word Object Library, you can press F2, or choose View, Object Browser to see the objects Word makes available to your program, as in Figure 22.2.

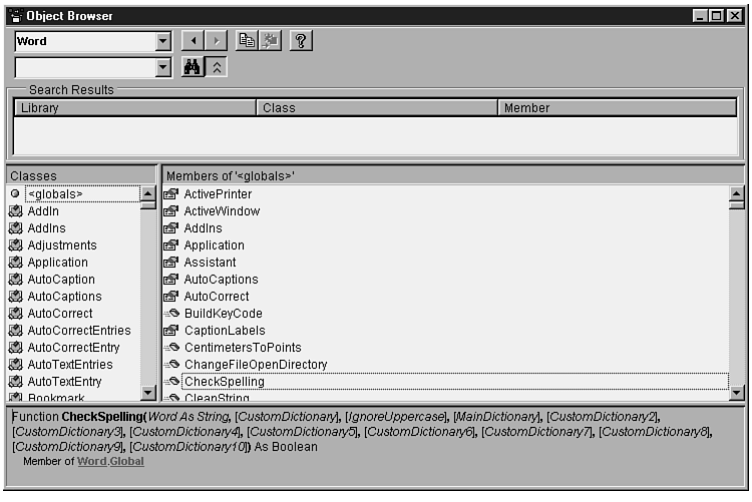


FIGURE 22.2
The Object Browser is a useful tool for discovering what you can do with Word and Excel from Visual Basic.

In the following sections, you explore how to manipulate Microsoft Word from Visual Basic by using the Microsoft Word Object Library.

Creating Application and Document Objects

The two most important Word objects you need to know about are the `Word.Application` and `Word.Document` objects, which provide access to instances of the Word application and Word documents, respectively.

To launch Word from Visual Basic code, simply create a new instance of the `Word.Application` object, as you would with any other object:

```
Dim objWord As Word.Application
Set objWord = New Word.Application
```

Here, notice that early binding is used with the `Set` statement, which makes programming with objects easier, as discussed in Chapter 16, "Classes: Reusable Components."

▶ **See** "Declaring and Using Objects," **p. 366**

The preceding two lines of code launch Word on your PC. Word then appears on the task list, but it remains invisible until you set the object's `Visible` property to `True`, as in the following example:

```
objWord.Visible = True
```

You can also create `Word.Document` objects from the application object. The `Word.Application` object contains a `Documents` collection. Recall from Chapter 13 that you can use the `Add` method of a collection to add new objects.

Now you can try a simple example. First, start a new Standard EXE project in Visual Basic and reference the Word Object Library as previously described. Next, add two command buttons, `cmdStart` and `cmdClose`, and enter the code from Listing 22.1 in the form.

Listing 22.1 WORDDEMO.TXT—Using Word from Visual Basic

```
Dim objWord As Word.Application

Private Sub cmdStart_Click()
    Dim objDoc As Word.Document

    'Start Word and make it visible
    Set objWord = New Word.Application
    objWord.Visible = True

    'Create a new document
    Set objDoc = objWord.Documents.Add

    'Make it the active document
    objDoc.Activate

    'Add some text to the document
    objDoc.ActiveWindow.Selection.InsertAfter "This is some text"
    objDoc.ActiveWindow.Selection.InsertParagraphAfter
    objDoc.ActiveWindow.Selection.InsertAfter "This is some more text."
    objDoc.ActiveWindow.Selection.InsertParagraphAfter
```

```
    'Make selected text bold face
    objDoc.ActiveWindow.Selection.Font.Bold = True

    'Unselect text
    objDoc.ActiveWindow.Selection.EndOf


End Sub

Private Sub cmdClose_Click()

    'Close word without saving changes
    objWord.Quit False

    'Destroy object reference
    Set objWord = Nothing

End Sub
```

When you execute the preceding program and click the `cmdStart` button, a new Word document is created. The code in the `Click` event procedure uses the `Selection` object of the document to enter some text and make it boldface.

NOTE In Listing 22.1, a form-level variable for the `Word.Application` object is used so that it can be referenced from multiple subroutines.

In Listing 22.1, you created a document object from the application object. You also can just create the document object directly, as in the following example:

```
Dim objDoc As Word.Document
Set objDoc = New Word.Document
objDoc.ActiveWindow.Selection.TypeText "Hello!"
```

The preceding code creates a new Word document, although unlike the code in Listing 22.1, it uses an existing instance of Word. In other words, if the user already has Word open, a new document is created in the existing copy of Word; whereas the first example creates a new instance of Word regardless.

When you are finished with document or application objects, you can close a document by using the `Close` method and close Word by using the `Quit` method:

```
objDoc.Close False
objWord.Quit False
```

The optional parameter `False` tells Word not to save changes. Omitting this parameter causes Word to prompt the user if a document has not been saved. Depending on your application, you may want to leave Word open for the user to edit a document. In this case, just omit the `Close` and `Quit` methods.

Saving, Opening, and Printing Documents

After creating a Word document in Visual Basic, you can use the `Save` and `SaveAs` methods of the document object to save it to disk. You should first use the `SaveAs` method to specify a filename:

```
objDoc.SaveAs "C:\Temp\MyDoc.Doc"
```

The `Save` method has no parameters; it is intended for saving a document after you have already specified a filename:

```
If objDoc.Saved = False then objDoc.Save
```

Note that you can use the `Saved` property to check whether a document has been saved since any changes were made.

NOTE If you use the `Save` method without first calling `SaveAs`, Word prompts the user for a filename.

To open an existing document, create an instance of the `Word.Application` object and use the `Set` statement with the `Open` of the `Documents` collection:

```
Set objDoc = objWord.Documents.Open ("C:\Temp\Junk.Doc")
```

In the preceding line of code, if the file JUNK.DOC does not exist, Word displays an error message. You can handle this situation yourself in Visual Basic by using an `On Error` statement and checking the document object to see whether the document was actually opened:

```
On Error Resume Next
Set objDoc = objWord.Documents.Open("C:\Temp\Junk.Doc")
If objDoc Is Nothing Then MsgBox "Open was not successful!"
```

To print in Word, use the `PrintOut` and `PrintPreview` methods. The following line of code causes Word to print a document:

```
objdoc.PrintOut
```

If you are creating a report in Word, you might want to use the `PrintPreview` method instead so that the user can view the report and decide whether to print it.

Working with Text

In Listing 22.1, you used the `InsertAfter` and `InsertParagraphAfter` methods to add text to a Word document. However, many additional ways are available for you to work with text in Word.

For example, you can use the `Words` collection to retrieve text a word at a time. The following code sample adds the words in a `Word.Document` object to a list box:

```
For nWord = 1 to objDoc.Words.Count
    lstWords.AddItem "Word " & nWord & " is " & objDoc.Words(nWord).Text
Next nWord
```

You can also replace words in a document by assigning a value to the `Text` property, although you should keep in mind that replacing a single word with multiple words changes the number of words.

NOTE The `Word.Document` object also contains `Sentences` and `Paragraphs` collections.

An easy way to insert text at a specific location is to use bookmarks. In Microsoft Word, you can place the cursor at a certain location and choose Bookmark from the Insert menu to create a named bookmark. From code, you can use the `Bookmarks` collection to identify a bookmark:

```
Set objDoc = objWord.Documents.Add("D:\DATA\MyTemplate.DOT")
objDoc.Bookmarks("Name").Range.Text = "John Smith"
objDoc.Bookmarks("Address").Range.Text = "123 Fourth Street"
objdoc.SaveAs "D:\DATA\JSMITH.DOC"
```

In this example, you create a new document from a custom template, add some data at the bookmark locations, and save the document and data to a new filename. Note that this code assumes that the document template `MyTemplate` contains predefined bookmarks.

Other Useful Features

If you want to create a report using Word, you need to call methods and set properties to control the formatting of the report. One way to make your report look neat is to add tables to the document's `Tables` collection, as in the following code sample:

```
Dim objTable As Word.Table
Set objTable = objDoc.Tables.Add(objDoc.Range(), 10, 2)
objTable.Cell(1, 1).Range.Text = "Hello"
objTable.Cell(1, 2).Range.Text = "Dolly
objTable.Columns(2).AutoFit
```

The preceding code inserts a 10-row, 2-column table in the document and adds some text. Finally, the `Autofit` method is called on the second column to size it to the text in the column.

Another interesting feature is the ability to add your own variables to open documents. This feature is useful, for example, if you have several documents open and need a way to identify them. To add a variable, make up a name and use the `Add` method of the `Variables` collection:

```
objDoc.Variables.Add "EMPLOYEEID", "8675309"
```

You can then use your variable to identify a document:

```
For Each objDocTemp In objWord.Documents
        If objDocTemp.Variables("EMPLOYEEID") = "8675309" Then
            Set objDoc = objDocTemp
        End If
Next objDocTemp
```

For the preceding code to work, you must set `objDoc` to `Nothing` if it was used previously.

Word.Basic

Throughout the preceding sections, you explored how to use the Microsoft Word Object Library. You used early binding, meaning that objects are declared as a specific type rather than the more generic Object data type. However, if you have to maintain older Visual Basic applications, you may find a different library, the WordBasic library. Applications that use this object generally declare them as late bound, as in the following example:

```
Dim objWord As Object

Set objWord = CreateObject("Word.Basic")
```

The commands also differ slightly:

```
objWord.FileNew
objWord.StartOfDocument
objWord.FontSize 24
objWord.Insert "Some Big Text"
objWord.FontSize 12
objWord.InsertPara
objWord.Insert "Some Smaller Text"

objWord.FileSaveAS "C:\TEST.DOC"
Set objWord = Nothing
```

Using the preceding example is definitely not the preferred way to access Word from VB, but it is mentioned here so that you are not confused if you run into some old code.

Working with Excel

You can also control Excel from your Visual Basic applications by using the same techniques that you use with Microsoft Word. Like Word, Excel has its own object library, which must be referenced in your Visual Basic project. By using OLE automation with Excel, you can create some neat-looking reports, such as the one shown in Figure 22.3. The layout and formatting of the report was created in Excel, and Visual Basic was used to supply the data.

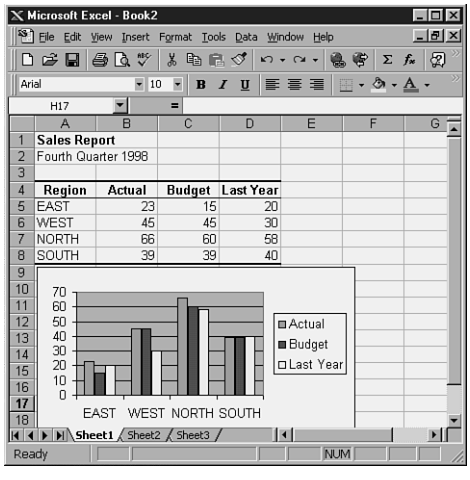


FIGURE 22.3
This report, which includes a graph and several columns of numbers, would be very difficult to create with Visual Basic's built-in printing functions.

Creating Excel Objects

To start an instance of Excel, use the `Workbook` and `Worksheet` objects. The following code starts Excel and creates a new workbook containing one worksheet:

```
Dim objExcel As Excel.Application
Set objExcel = New Excel.Application
objExcel.Visible = True
objExcel.SheetsInNewWorkbook = 1
objExcel.Workbooks.Add
```

Setting Cell and Range Values

To set the values of individual cells in a worksheet, you can use the `Cells` collection or the `Range` property of the `Worksheet` object:

```
With objExcel.ActiveSheet
    .Cells(1,2).Value = "10"
    .Cells(2,2).Value = "20"
    .Cells(3,2).Value = "=SUM(B1:B2)"
    .Range("A3") = "Total"
End With
```

NOTE `Range` also works with named ranges of one or more cells:

```
objExcel.ActiveSheet.Range("myrange").Font.Color = vbRed
```

Notice that a `With` statement is used so that the object name is not repeated. In Excel, you may find that the object you need to reference is several levels deep in a collection:

```
ObjExcel.Workbooks(1).Sheets("Portfolio").Range(2,4).Font.Bold = True
```

Although this approach may seem confusing, it is a good way to organize a large number of classes. When you're programming Excel and Word, you can employ several methods to make working with collections easier:

- Create an intermediate object variable.
- Use the dot notation, as in the preceding line of code.
- Use a `With` statement to avoid extra typing.

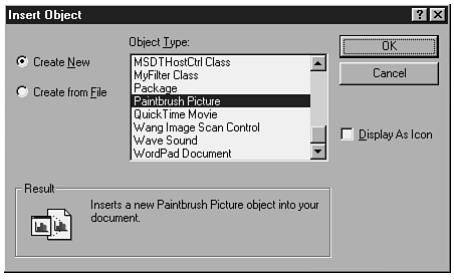
Using the OLE Container Control

The OLE Container control allows you to embed or link OLE objects in your program. In preceding sections, you learned about using OLE objects to control another application. Using the OLE control is different in that the external object appears on a form in your program rather than as a separate application. In other words, you can have a form with buttons, labels, and an OLE control that contains a Word document. You can create the embedded object either at designtime or runtime, as long as the OLE control has been placed on your form.

Creating an Embedded Object at Designtime

As an example, create an embedded Windows Paintbrush object now. First, start a new Standard EXE project and draw the OLE Container control on the form. As soon as you draw the OLE Container control, the Insert Object dialog box, shown in Figure 22.4, appears.

FIGURE 22.4
The Insert Object dialog box lets you specify an embedded object at designtime.



The Insert Object dialog box lists all the available objects that can be used with the OLE control. If you do not select an object, the OLE control becomes a placeholder for an object, which can be created at runtime. For the example, choose Paintbrush Picture and click OK.

States of an Object After choosing an object type and clicking OK, you may have noticed that Visual Basic's toolbars and menus changed. This change happened because the OLE object in the control was *activated*. When an object is active, you can interact with it. In the sample project, because you created a Paintbrush picture object, you can now draw in the control with the mouse and perform all the drawing operations you normally could in Paintbrush.

Draw some lines in the box, and deactivate the object by clicking outside the control on the form. Notice that you can still see your drawing in the inactive object, but the Visual Basic environment has returned to "normal." When an object is inactive, you cannot interact with it. The `DisplayType` property of the OLE control determines whether inactive objects are displayed as icons or as the actual contents (that is, the drawing).

Run your program by pressing F5, and notice that the object's behavior remains the same. Double-clicking the object activates Paintbrush so that you can edit the object, as shown in Figure 22.5.

Saving an Embedded Object to a File Now you can add saving and loading capability to the sample application. Add two command buttons, `cmdSave` and `cmdLoad`, to the form and enter the following code:

```
Private Sub cmdSave_Click()
    Open "C:\OBJECT.DAT" For Binary As #1
    OLE1.SaveToFile 1
    Close #1
End Sub
Private Sub cmdLoad_Click()
    Open "C:\OBJECT.DAT" For Binary As #1
    OLE1.ReadFromFile 1
    Close #1
End Sub
```

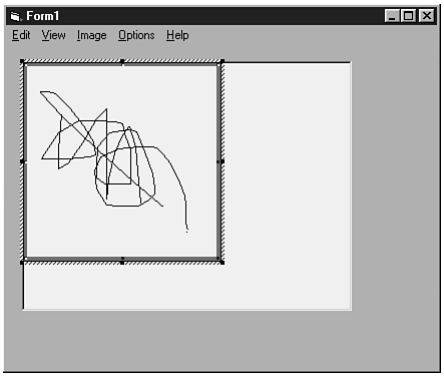


FIGURE 22.5
Notice that an active OLE object's File menu does not automatically appear because saving the file is up to the programmer.

Notice that even though you are using methods of the OLE control to save and load the file, you still have to open the file yourself by using the `Open` statement. You can test the code by saving the drawing, making some changes to it, and then loading the original drawing back into the control.

Creating an Embedded Object at Runtime

In the preceding example, you created an embedded Paintbrush picture object at designtime. You can also create an "empty" OLE Container control at designtime and load the embedded object at runtime.

To create an empty OLE Container control, just choose Cancel when the Insert Object dialog box appears, or right-click the control and choose Delete Embedded Object if one already exists.

Create an embedded object at runtime by using the OLE control's `CreateEmbed` method. The `CreateEmbed` method takes two parameters: a source document and the class name of the object. You can leave the source document parameter empty if you want a blank object. The following line of code creates a Paintbrush picture object in an OLE control named `OLE1`:

```
OLE1.CreateEmbed "","Paint.Picture"
```

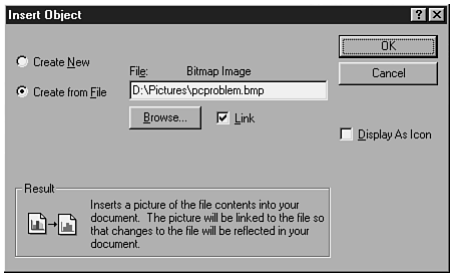
Notice that you have to specify the class name to create the object. You can view a list of valid class names by clicking the ellipses (...) in the Properties window by the `Class` property of the OLE control.

Creating a Linked Object

The OLE control is also capable of creating linked objects. A linked object is linked to an external file rather than embedded in your application. When you activate a linked object, the application window appears for editing the object.

To create a linked document, you must specify a source document name. For a Paintbrush picture object, you specify the location of a bitmap file, as shown in Figure 22.6.

FIGURE 22.6
To create a linked object at designtime, choose a filename and select the Link check box.



You can also create a linked object at runtime by using the `CreateLink` method, as in the following example:

```
OLE1.CreateLink "C:\Windows\Pinstripe.BMP"
```

When you're using linked objects, changes you make to the object's file are reflected in your program. Also, if you edit the linked object in the program, changes are made to the source file. How the object is updated is controlled by the `UpdateOptions` property, which has the following values:

Constant	Description
`vbOLEAutomatic`	The object is updated automatically when changes are made to the source file (default).
`vbOLEFrozen`	The object is updated when the source file is saved from the source application.
`vbOLEManual`	The object is updated when the `Update` method is called.

In the example from the previous section, changing the `UpdateOptions` property determines when the changes made to the Paintbrush drawing are reflected in the OLE control.

From Here...

In this chapter, you learned about using OLE to control other applications and embed objects in a program. Although the focus was on specific products, keep in mind that you may have other non-Microsoft products with their own type libraries installed on your system. To build on the material discussed in this chapter, refer to the following chapters:

- To learn more about classes and collections, see Chapter 16, "Classes: Reusable Components."
- To find out how to include data in your reports, see Chapter 24, "Database Basics."

CHAPTER 23

Master's Toolbox

In this chapter

Caller ID with Visual Basic **502**

Building a Screen Saver with Visual Basic **509**

SQL Server to Access Database Table Export Program **512**

Using the Windows API to Create Transparent Images **519**

This chapter is for people who learn by example. After the previous edition, many readers wanted even more examples, so based on their suggestions, this chapter includes a hodge-podge of various projects built with Visual Basic. In addition, the projects in this chapter bring together practical applications of information from the other chapters. After you are comfortable with Visual Basic, try some of these things; most of them are even fun!

Caller ID with Visual Basic

Caller ID is a service provided by the telephone company that lets you know the caller's name and/or number on a display screen, much like an office phone system. The information is transmitted between rings so that you can see the information before picking up the phone.

In this age of unsolicited telemarketing calls, Caller ID is a great invention, but of course there's a catch: To screen calls, you have to be near the display unit when the phone rings—that is, unless you write the Visual Basic program described in this section (see Figure 23.1). This program simulates the standard Caller ID display box with one addition—sound. When the phone rings, this program plays a sound file that you assign to a specific caller. For example, you can have the computer sound card scream "Don't answer it!" when the telemarketers make their rounds.

Although this application is fairly specific, in building it you learn a way to communicate with a modem from Visual Basic, a technique which can be applied to other areas.

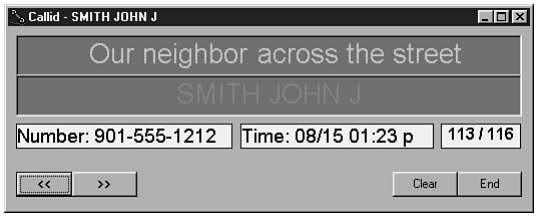


FIGURE 23.1
The Caller ID program alerts you by playing a sound file.

Requirements for Using the Sample Program

Because this program interacts with the "real world" to some degree, you must follow some basic requirements to use it:

- You have to subscribe to a Caller ID service.
- You must have a modem that supports Caller ID data attached to the phone line.
- You have to know the commands to get your modem to display the data and the exact format in which it will be displayed.

Before you even get into Visual Basic, you should determine the commands necessary to use Caller ID with your modem and test it in a terminal program such as HyperTerminal. For example, issuing the command `AT#CID=1` to my modem causes it to activate Caller ID display. Then, whenever the phone rings, the information is presented in the terminal session as follows:

```
RING

DATE = 0417
TIME = 2005
NMBR = 9015551212
NAME = SILER BRIAN

RING
```

NOTE The format and Caller ID implementation vary from modem to modem. For example, my ISDN modem returns the information in an entirely different manner. Although you can easily modify this program to suit your modem, being familiar with your modem's Caller ID format is imperative.

After you have determined how to get the Caller ID information from your modem using a terminal session, the next step is to write a Visual Basic application that talks to the modem, receives this information, and takes action based on it. The sample application described in this section issues the command to turn on Caller ID display, and then it repeatedly polls the modem to check for Caller ID data. If any data appears, the program plays the appropriate WAV file. The heart of this program is the Microsoft Communications (MS Comm) Control, which is the component that allows you to talk to the modem from VB.

VB Techniques You'll Be Using

In addition to the newly covered MS Comm Control, this program brings together some material covered in other chapters of the book: INI files, the Timer control, and API calls. In order to successfully complete this example, you should have a good understanding of each of these concepts.

Playing Sounds An API call is used to play sounds on the computer's sound card. This specific example is covered in Chapter 20, "Accessing the Windows API." Refer to that chapter if you need help using the `sndPlaySound` API call.

▶ **See** "Useful API Calls," **p. 457**

Using Intervals The `Timer` control, covered in Chapter 4, "Using Visual Basic's Default Controls," is used to initiate the process of checking for Caller ID data. In the sample program, the `Timer` event is coded with only a single line as follows:

```
Private Sub tmrMain_Timer()

    CheckForCall

End Sub
```

`CheckForCall` is a custom function you will write that checks the modem for new information.

▶ **See** "Special-Purpose Controls," **p. 78**

The INI Configuration File An INI file stores the information about each call as well as the path to the WAV file you want to play for each caller. You could, of course, store this information in a database or other file, but I picked an INI file because it has low overhead and is easy to edit. A sample INI file is shown here:

```
[General]
ComPort=3
InitString="AT#CID=1"
CallCount=3

[XREF]
VANDELAY INDUST=Dad at Work
PIERCE JAMES J=Nelda and Jerry Pierce
TAYLOR TECHNOLOG=This is a sales call, don't answer!
MEMPHIS, TN=Cellular phone in Memphis

[Sounds]
PAY PHONE=D:\wav\Dad.wav
VANDELAY INDUST=D:\wav\Hello.Wav

[Call1]
Time=05/25 03:05 p
Number=901-362-6030
Name=LAZENBY N D

[Call2]
Time=05/25 09:31 p
Number=901-555-1212
Name=PRENTICE BRUCE

[Call3]
Time=05/26 12:43 p
Number=901-754-7222
Name=FRIDAY JOE
```

The INI file is divided into a few basic sections:

- `[SOUNDS]`. This section contains the path to the WAV file for each caller name.
- `[XREF]`. This section contains a "friendly name" to display for the caller instead of the phone company name.
- `[CALL##]`. The program creates a new section as each call is received.
- `[GENERAL]`. This section contains the current number of `[CALL]` sections as well as some initialization information.

The program uses the INI wrapper functions `sGetINIString` and `writeINIString` described in Chapter 21, "Working with Files," to manipulate the INI file.

▶ **See** "Understanding INI Files," **p. 484**

Starting Out with the Program The next section will focus on the new material related to the communications control. However, if you are following along, complete the following steps to get started:

1. Start a new Standard EXE project.
2. Add a module to the project.
3. Add the code from Chapter 21 necessary to access INI files.
4. Add the code for the `sndPlaySound` API call from Chapter 20.
5. Draw a `Timer` control on the form, `tmrMain`, and set the `Interval` property to 900.
6. Make `Sub Main` the Startup object for the project.
7. You can also begin creating your INI file, using the sample in the preceding section as a model.

Setting Up the Communications Control

The Microsoft Communications (MS Comm) Control allows your Visual Basic programs to transmit and receive data across a serial port or modem (also known as a COM port), much like a terminal emulation application. Before you can use the control in a program, you must add it to the Toolbox. To do so, right-click in an empty area of the Toolbox and select Components from the menu. From the Components dialog box, place a check in the box next to Microsoft Comm Control 6.0 and click OK. The control should then appear in your Toolbox.

Next, draw an instance of the control on your form. Note that it always appears as an icon no matter how large you attempt to draw it.

To set up the MS Comm Control for use with your modem, you need to set these properties:

- `CommPort`. An integer that specifies the COM port to which your modem is attached—for example, `2` for COM2.
- `Settings`. A string that specifies the baud rate and parity settings.

These two properties can be set at design time or at the beginning of your program in the `Load` event or `Sub Main` procedure. If you have a modem on COM3, for example, the statements read as follow:

```
Form1.MSComm1.CommPort = 3
Form1.MScomm1.Settings = "9600,N,8,1"
```

Even if you set the `CommPort` and `Settings` properties at designtime, you still must perform several activities at program startup, namely initializing the communications control and sending the modem a command to turn on Caller ID display. The complete `Sub Main` procedure from the sample application is shown in Listing 23.1.

Listing 23.1 CALLID.ZIP—Initialization Routine for the Caller ID Program

```
Sub Main()
    Dim nComPort As Integer
    Dim sInit As String
    Dim sTemp As String
    Dim bStop As Boolean
```

continues

Listing 23.1 Continued

```
    sINIfile = App.Path & "\CALLID.INI"
    nComPort = CInt(sGetINIString(sINIfile, "General", "ComPort", "2"))
    sInit = sGetINIString(sINIfile, "General", "InitString", "AT#CID=1")

    With frmMain
        'SET UP THE COM PORT
        .MSComm1.CommPort = nComPort
        .MSComm1.Settings = "9600,N,8,1"
        .MSComm1.InputLen = 0

        'OPEN THE CONNECTION AND SEND THE INIT STRING
        .MSComm1.PortOpen = True
        .MSComm1.Output = sInit + Chr$(13)

        'WAIT A FEW SECONDS FOR MODEM RESPONSE
        nTemp = 0
        bStop = False
        While nTemp < 32000 And bStop = False
            nTemp = nTemp + 1
            If .MSComm1.InBufferCount >= 2 Then
                sTemp = .MSComm1.Input
                If InStr(sTemp, sInit) = 0 Then bStop = True
            End If
        Wend

        'IF THE MODEM DIDN'T SAY OK THEN END
        If InStr(sTemp, "OK") = 0 Then
            MsgBox "Modem did not respond with OK.", vbOK + vbCritical, "Error"
            End
        End If
        DoEvents

        'CLEAR REMAINING BUFFER INPUT
        sTemp = .MSComm1.Input

        'START THE TIMER
        .tmrMain.Enabled = True

    End With

    'DISPLAY CALLER INFORMATION FROM LAST TIME
    nCount = CInt(sGetINIString(sINIfile, "General", "CallCount", "0"))
    DisplayList nCount
    frmMain.Show

End Sub
```

The code in Listing 23.1, which executes only at program startup, demonstrates how to send and receive commands with the modem. Commands are sent to the modem using the MS Comm Control's `Output` property. (Note that the carriage return is added, just as you would type it.) In other words, if you want to dial a number using the `ATDT` command, you simply assign the command to the `Output` property. In Listing 23.1, this property is used to send the initialization string from the INI file to the modem.

If you think back to the process of sending commands to a modem by hand, you may remember that the modem responds with status messages such as `OK` or informational messages such as the Caller ID data or a register setting. The MS Comm Control captures these messages and stores them in a buffer. You use the control's `Input` property to pull information from this buffer into your program, typically by assigning it to a variable. In Listing 23.1, you check the `InputBufferLen` property to determine whether the control has any data waiting in the buffer. If data is present, you check the data with the `Instr` function to see whether the modem has responded to the initialization string with `OK`.

NOTE The `InputLen` property controls the number of characters removed from the buffer when you access the `Input` property. Setting it to zero, as done here, causes every character in the buffer to be returned. ■

If the modem responds with `OK`, then you have successfully established communications with it and are ready to begin the process of checking for Caller ID information. To do so, you set the `Enabled` property of the timer to `True`, which starts the process. The only remaining item in the `Main` function is to display the last caller (stored in the INI file) on the form. The procedure `DisplayList` simply reads the values from the `[Call##]` section of the INI file and populates the labels on the form.

Checking for Calls

The most important routines in the sample Caller ID program are `CheckForCall` and `WriteCIDData`, shown in Listing 23.2. `CheckForCall` takes care of handling the input from the modem, and `WriteCIDData` actually parses the Caller ID information into the INI file.

Listing 23.2 CALLID.ZIP—Procedures That Parse the Information from the MS Comm Control

```
Sub CheckForCall()
    Dim nPrevCount As Integer
    Dim l As Long
    Dim sFile As String

    With frmMain
        If .MSComm1.InBufferCount >= 2 Then

            'STOP TIMER AND GET INPUT FROM COM PORT
            .tmrMain.Enabled = False
            sTemp = .MSComm1.Input

            'If input is a small string then ignore
            'It is just the first 'RING' response.
            If Len(sTemp) < 10 Then
                .tmrMain.Enabled = True
                Exit Sub
            End If
```

continues

Listing 23.2 Continued

```
            'STORE CALL COUNTER, ADD INFO TO INI FILE
            nPrevCount = nCount
            WriteCIDData (sTemp)

            'IF NO DATA WAS FOUND THEN EXIT
            If nCount = nPrevCount Then
                ClearStuff
                .lbldbName = "No Data Sent " & Now
                Exit Sub
            End If

            'DISPLAY CALLER INFORMATION ON THE FORM,
            'PLAY THE SOUND FILE A COUPLE OF TIMES
            DisplayList nCount

            sTemp = sGetINIString(sINIfile, "Call" & nCount, "Name", "Unknown")
            sFile = sGetINIString(sINIfile, "Sounds", sTemp, "?")
            If sFile <> "?" Then
                l = sndPlaySound(sFile, SND_SYNC)
                l = sndPlaySound(sFile, SND_ASYNC)
            End If
        End If

        'CLEAR ANY EXTRA INPUT FROM THE COMM CONTROL
        sTemp = .MSComm1.Input

        'RESTART TIMER FOR NEXT CALL
        .tmrMain.Enabled = True

    End With

End Sub
Sub WriteCIDData(sInput As String)
    Dim sName As String
    Dim sNumber As String
    Dim sTime As String
    Dim sDate As String
    Dim sSection As String

    'PARSE EACH PIECE OF INFORMATION FROM THE INPUT STRING
    'THIS WILL VARY FROM MODEM TO MODEM (MINE IS A CARDINAL 33.6)

    sNumber = "?"

    If InStr(sInput, "MESG =") Then
        nTemp = InStr(sInput, "MESG =")
        sName = Mid(sInput, nTemp + 7)
        sNumber = "NO NUMBER SENT"
    Else
        nTemp = InStr(sInput, "NMBR =")
        If nTemp <> 0 Then sNumber = Mid(sInput, nTemp + 7, 10)

        nTemp = InStr(sInput, "NAME =")
        If nTemp <> 0 Then sName = Mid(sInput, nTemp + 7)
```

```
        nTemp = InStr(sInput, "DATE =")
        If nTemp <> 0 Then sDate = Mid(sInput, nTemp + 7, 4)

        nTemp = InStr(sInput, "TIME =")
        If nTemp <> 0 Then sTime = Mid(sInput, nTemp + 7, 4)

        sTemp = Left$(sNumber, 3) & "-" & Mid$(sNumber, 4, 3) _
                    & "-" & Right$(sNumber, 4)
        sNumber = sTemp
    End If

    If sNumber = "?" Then Exit Sub

    'WRITE INFORMATION TO THE INI FILE

    nCount = nCount + 1
    writeINIString sINIfile, "General", "CallCount", CStr(nCount)

    sSection = "Call" & nCount
    writeINIString sINIfile, sSection, "Time", Format$(Now, "mm/dd hh:mm a/p")
    writeINIString sINIfile, sSection, "Number", sNumber
    writeINIString sINIfile, sSection, "Name", sName

End Sub
```

The reason you need so many `Instr` calls is that when you receive information using the MS Comm Control, it comes across as one long string, with embedded carriage returns and line feeds. Notice that `WriteCIDData` sends the information to the INI file, and then it is read back as separate fields by the `CheckForCall` function.

ON THE WEB

This project is available at the Web site `www.mcp.com/info`. The project files are contained in the file CALLID.ZIP.

Building a Screen Saver in Visual Basic

Windows comes with programs known as screen savers, which are executed automatically after a period of inactivity. The theory behind a screen saver is that it will "save" your monitor from having information permanently burned on the picture tube. This burning was particularly a problem with older text-only terminals, which could have the same menu sitting on them for hours at a time. (It is also the reason that owners' manuals for televisions warn against using video games.) You can set the screen saver in the Screen Saver tab of the Display Properties dialog box, as shown in Figure 23.2.

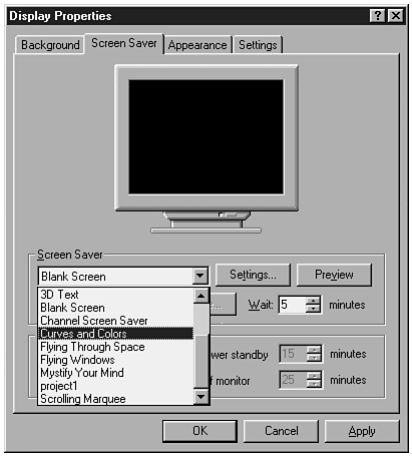


FIGURE 23.2
You can write a VB program to act as a screen saver.

In recent years, the screen saver has almost become an art form, with everything from 3D pipes to flying toasters. However, if you want to be really creative, you can create your own screen saver. In Visual Basic, this task is actually very easy. You write the screen saver just like a normal program, but you program the events differently. For example, mouse movement stops the program. In the next section, you create a simple screen saver.

Setting Up the Main Form

Your screen saver will actually be a Standard EXE project. To begin, start a new Standard EXE project, and modify the form's designtime properties as follows:

1. Set the `WindowState` property to `Maximized`.
2. Set the `BorderStyle` property to `None`.
3. Set the `BackColor` property to the color black.

As you know, a screen saver ends when a user moves the mouse or presses keys on the keyboard. Add `End` statements to the form's `MouseMove` and `KeyPress` events as follows:

```
Dim nMouseCount As Integer
Private Sub Form_KeyPress(KeyAscii As Integer)
    End
End Sub

Private Sub Form_MouseMove(Button As Integer, Shift As Integer, _
 X As Single, Y As Single)
    nMouseCount = nMouseCount + 1
    If nMouseCount > 5 Then End
End Sub
```

Note that you use a counter so that the program does not end on the first `MouseMove` event. You need this counter because Windows sends a couple of `MouseMove` events to the program when it starts.

Adding Animation

Run the screen saver program in the Visual Basic IDE, and you see a blank screen until you press a key or move the mouse. This screen saver is not very exciting; it needs some animation, which can be added with the Timer control and some Image controls. The Timer control is covered in Chapter 4, "Using Visual Basic's Default Controls." Go ahead and add a simple animation now. For my screen saver, I created a car chase, as you can see in Figure 23.3.

▶ **See** "Creating a Simple Animation" **p. 83**

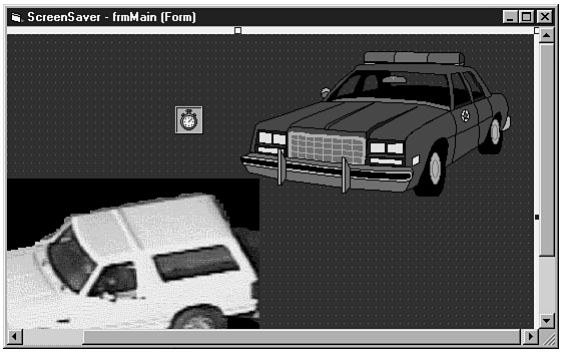


FIGURE 23.3
This screen saver form is shown in design mode, with all the animation elements.

The code for such an animation is simple; just be sure to include a `DoEvents` statement so that the `MouseMove` event can be processed:

```
Dim CarX As Integer, CarY As Integer

Private Sub Form_Load()
If App.PrevInstance Then End
CheckCommandLine
CarX = Me.Width + 1000
CarY = 0
End Sub

Private Sub tmrMain_Timer()
    CarX = CarX - 35
    CarY = CarY + 13

    If CarX < LeftBorder - 1000 Then Form_Load

    imgCar.Top = CarY
    imgCar.Left = CarX
    imgBronco.Top = CarY + 230
    imgBronco.Left = CarX - 7000

    DoEvents
End Sub
```

Also, note that the program ends in the `Load` event if a previous instance occurs. This code is very important because Windows sometimes launches multiple instances of a running screen saver.

Interacting with Windows

Now that you have the screen saver animation completed, you just need to add a few lines of code so that your program works properly as a screen saver. As you may know, the Screen Saver tab of the Display Properties dialog box allows you to configure and preview a screen saver. In each case, Windows sends a different command line to your program. Add the `CheckCommandLine` function to your form so that it acts appropriately:

```
Sub CheckCommandLine()
    Dim sCmdLine As String
    sCmdLine = Trim$(LCase$(Command$))

    'RUNNING AS A SCREEN SAVER
    If sCmdLine = "/s" Or sCmdLine = "" Then
        Exit Sub
    End If

    'RUNNING IN SETUP (CONFIG) MODE
    If sCmdLine = "/c" Then
        MsgBox "Config Screen Not Available"
        End
    End If

    'RUNNING IN PREVIEW MODE
    If Left$(sCmdLine, 2) = "/p" Then
        'parameter can be retrieved with Val(Mid$(sCmdLine,3))
End
    End If

End Sub
```

Finally, all you need to do is compile your project, change the filename extension from .EXE to .SCR, and copy the program to the Windows directory. It should then automatically show up in the list of available screen savers in the Screen Saver tab of the Display Properties dialog box.

SQL Server to Access Database Table Export Program

Large companies tend to rely on all different types of databases, ranging in scale from a mainframe all the way down to a single-user database on an employee's PC. Frequently, new applications that require access to these databases appear, creating a complex web of dependencies between them. For example, a consultant may be hired to write an application that needs to read some data from an established SQL Server database. With ODBC, you can simply allow the consultant's application to attach to the database. However, in certain situations this setup might pose a problem:

- The SQL Server administrator now has to maintain additional login information for the new application.
- SQL Server performance may be negatively affected by the extra application.

- Changing the SQL Server tables accessed by the new application may require changing the application code, which will be difficult after the consultant is long gone.

An easy answer to these problems is to build an export file on an automated basis for the new program to use. An Access database is an ideal format for this export file because the program can use it just as it would the SQL Server.

Building the Sample Program

In case you have not noticed, I like to rely on INI files a lot. There's a reason for this: They can make your program more useful. This result should be especially apparent in this example because the INI file contains all the information the program needs to perform the export operation. You can compile the program once and use several INI files for different exports. It is intended to be a command-line utility and is executed like this:

```
MDBMAKE C:\Data\REVENUE.INI
MDBMAKE C:\Data\Employee.INI
```

The INI files themselves contain information that the program needs to connect to the SQL Server and create the Access tables. For example, entries specify the Access database (destination database) and the SQL Server connect string (source database):

```
DBFile=\\MYSERVER\PUBLIC\HRDATA\HRDATA.MDB
SQLConnect="ODBC:DATABASE=personnel:uid=fred:pwd=garvin:DSN=MYSQLDB"
```

Next, the `[Tables]` section specifies the name and number of tables you want to create:

```
[Tables]
Tables=4
Table1SQL=hrinfo
Table1MDB=hrinfo
Table1INI=hrinfo
```

Each table also contains a section that specifies the number and type of the fields in the table. For example, the `hrinfo` section might look like this:

```
[hrinfo]
Fields=2
Fd1Name="EmployeeID"
Fd1Type=DOUBLE
Fd2Name="Name"
Fd2Type=TEXT
Fd2Size=40
```

While executing, the program uses `For` loops to browse through each section in the INI file as it needs the field information. For example, the `hrinfo` table created by the program has two fields: `EmployeeID`, which is of type `Double`, and `Name`, which is a 40-character text field.

Understanding the Sample Program

The SQL export program has just a few generic functions and no real user interface (other than a progress screen). The important functions are as follows:

- `CreateLocalFile`. Creates the database (MDB) file.
- `CreateTable`. Creates an empty table in the database.
- `TransferTable`. Transfers data from the SQL Server table to the new database.
- `Main`. Controls the flow of the program.

These functions are shown in Listing 23.3. Following the listing is an explanation of what happens during a sample program run.

Listing 23.3 SQLXPORT.ZIP—Transferring Information from SQL to Access

```
'Important variables:
Dim dbLocal As Database     'Destination database (Access)
Dim dbSQL As Database       'Source database (MS SQL Server)
Dim sDBLocalPath As String  'Path to destination database
Dim sINIPath As String      'Path to INI File

Sub Main()
    Dim sConnect As String      'SQL Server Connect String
    Dim nTables As Integer      'Number of tables to transfer
    Dim nCurTable As Integer    'Counter for current table
    Dim sSQLTable As String     'Name of the SQL table
    Dim sMDBTable As String     'Name of the Access table
    Dim sSection As String      'INI file [Section]
    Dim nCommand As Integer     'Commands can be run on the
    Dim sCommand As String      'Access database (i.e. create index)

    'GET INI FILE NAME
    sINIPath = App.Path & "\SQLXPORT.ini"
    If Trim$(Command$) <> "" Then sINIPath = Command$

    'READ INFO FROM THE INI FILE
    sDBLocalPath = sGetINIString(sINIPath, "General", "DBFile", "test.mdb")
    sConnect = sGetINIString(sINIPath, "General", "SQLConnect", "ODBC;")
    nTables = CInt(sGetINIString(sINIPath, "Tables", "Tables", "0"))

    'SHOW FORM AND CONNECT TO SQL SERVER
    frmWait.Show
    frmWait.lblWait = "Connecting to SQL Server..."
    DoEvents
    On Error GoTo MainError
    Set dbSQL = OpenDatabase("", False, True, sConnect)

    'CALL FUNCTION TO CREATE MDB FILE
    frmWait.lblWait = "Creating MDB file..."
    DoEvents
    CreateLocalFile
    DoEvents

    'CREATE TABLES IN THE NEW MDB FILE
    For nCurTable = 1 To nTables
        sSQLTable = sGetINIString(sINIPath, "tables", "table" & nCurTable & _
                                  "SQL", "none")
        sMDBTable = sGetINIString(sINIPath, "tables", "table" & nCurTable & _
```

```
                                "MDB", "none")
        sSection = sGetINIString(sINIPath, "tables", "table" & nCurTable & _
                                "INI", "none")
        frmWait.lblWait = "Transferring " & sMDBTable
        TransferTable sSQLTable, sMDBTable, sSection
    Next nCurTable

    'THE DATABASE HAS BEEN CREATED, RUN COMMANDS ON IT IF NECESSARY
    nCommand = 0
    sCommand = ""
    While sCommand <> "?"
        If nCommand <> 0 Then dbLocal.Execute sCommand
        nCommand = nCommand + 1
        sCommand = sGetINIString(sINIPath, "General", "Command" & nCommand, "?")
    Wend

    'CLOSE EVERYTHING DOWN AND END
    frmWait.lblWait = "Disconnecting..."
    dbLocal.Close
    dbSQL.Close
    Unload frmWait
    DoEvents
    End

MainError:
    frmWait.Hide
    Screen.MousePointer = vbDefault
    WriteErrMsg "Main - Error " & Err & ": " & Error
    End
    Exit Sub

End Sub
Sub TransferTable(sSQLTable As String, sLocalTable As String, sSection As _
            String)

'This function transfers data from SQL server to an Access table

    Dim rstemp As Recordset 'SQL recordset
    Dim aTable As Recordset 'Access table
    Dim nTemp As Integer    '  Counter
    Dim nFields As Integer  '  variables
    Dim nCount As Integer   '
    Dim sSQL As String      'SQL statement
    Dim sTemp As String


On Error GoTo TRTError:

    frmWait.ProgressBar1.Visible = True
    nCount = 0
    frmWait.ProgressBar1.Min = 0

    'The user can either transfer a SQL table as-is,
    'or the results of a query involving multiple tables.
```

continues

Listing 23.3 Continued

```
    'This next IF statement determines which and sets up the
    'SQL statement- either "Select * from table" or the
    'user-defined SQL statement.

    sSQL = sGetINIString(sINIPath, sSection, "SQL", "")
    If sSQL = "" Then
        Set rstemp = dbSQL.OpenRecordset("Select Count(*) from " & sSQLTable, _
                        dbOpenSnapshot, dbForwardOnly)
        frmWait.ProgressBar1.Max = CInt(Trim$(" 0" & rstemp.Fields(0)))
        rstemp.Close
        DoEvents
    Else
        nTemp = 2
        sTemp = sGetINIString(sINIPath, sSection, "SQL" & nTemp, "")
        While sTemp <> ""
            If sTemp <> "" Then sSQL = sSQL & sTemp
            nTemp = nTemp + 1
            sTemp = sGetINIString(sINIPath, sSection, "SQL" & nTemp, "")
        Wend
        frmWait.ProgressBar1.Max = 2000 'Set arbitrary value on progress bar
    End If


    'Actually open the recordset
    If sSQL = "" Then
        Set rstemp = dbSQL.OpenRecordset("Select * from " & sSQLTable, _
                        dbOpenSnapshot, dbForwardOnly)
    Else
        Set rstemp = dbSQL.OpenRecordset(sSQL, dbOpenSnapshot, dbForwardOnly + _
                        dbSQLPassThrough)
    End If

    'Open Local table
    Set aTable = dbLocal.OpenRecordset(sLocalTable, dbOpenTable)
    nFields = rstemp.Fields.Count - 1

    'Transfer each record
    While Not rstemp.EOF
        aTable.AddNew
        For nTemp = 0 To nFields
            aTable.Fields(nTemp) = rstemp.Fields(nTemp)
        Next nTemp
        rstemp.MoveNext
        nCount = nCount + 1
        frmWait.ProgressBar1.Value = nCount
        aTable.Update
    Wend
    rstemp.Close
    aTable.Close
    Exit Sub

TRTError:
    WriteErrMsg "TRT-Error " & Err & ": " & Error
```

```
    End
    Exit Sub

End Sub
Sub CreateTable(ByRef tbl As TableDef, sTableName As String, sINISection As _
         String)
'This function creates an empty table in an Access database

    Dim nFields As Integer      'Number of Fields
    Dim Fd() As New Field       'Array of fields
    Dim nCurField As Integer    'Counter for current field
    Dim sTemp As String

 On Error GoTo CRTError:

    nFields = CInt(sGetINIString(sINIPath, sINISection, "Fields", "0"))
    If nFields = 0 Then Exit Sub
    ReDim Fd(1 To nFields)

    tbl.Name = sTableName

    For nCurField = 1 To nFields
        Fd(nCurField).Name = sGetINIString_
           (sINIPath, sINISection, "Fd" & nCurField & "Name", "ERROR" & _
                      nCurField)
        sTemp = sGetINIString(sINIPath, sINISection, "Fd" & nCurField & "Type", _
                      "TEXT")
        Select Case sTemp
            Case "DOUBLE"
            Fd(nCurField).Type = dbDouble
            Case "MEMO"
            Fd(nCurField).Type = dbMemo
            'VB4/5 only
            Fd(nCurField).AllowZeroLength = True
            Case "BYTE"
            Fd(nCurField).Type = dbByte
            Case "INTEGER"
            Fd(nCurField).Type = dbInteger
            Case "DATE"
            Fd(nCurField).Type = dbDate
            Fd(nCurField).Required = False

            Case Else 'Text
            Fd(nCurField).Type = dbText
            Fd(nCurField).Size = CInt(sGetINIString_
              (sINIPath, sINISection, "Fd" & nCurField & "Size", "50"))
            Fd(nCurField).AllowZeroLength = True
        End Select

       tbl.Fields.Append Fd(nCurField)
    Next nCurField
    Exit Sub
```

continues

Listing 23.3 Continued

```
CRTError:
    WriteErrMsg "CRT-Error " & Err & ": " & Error
    End
    Exit Sub
End Sub
Sub CreateLocalFile()
'This procedure creates the MDB file itself
    Dim MainTable() As New TableDef
    Dim sTemp As String
    Dim nTables As Integer
    Dim nCurTable As Integer
    Dim sSQLTable As String
    Dim sMDBTable As String
    Dim sSection As String

On Error GoTo CRLError

    If bFileExists(sDBLocalPath) Then Kill sDBLocalPath
    Set dbLocal = CreateDatabase(sDBLocalPath, dbLangGeneral)

    nTables = CInt(sGetINIString(sINIPath, "Tables", "Tables", "0"))
    ReDim MainTable(1 To nTables)

    For nCurTable = 1 To nTables
        sSQLTable = sGetINIString(sINIPath, "tables", "table" & nCurTable & _
                        "SQL", "none")
        sMDBTable = sGetINIString(sINIPath, "tables", "table" & nCurTable & _
                        "MDB", "none")
        sSection = sGetINIString(sINIPath, "tables", "table" & nCurTable & _
                        "INI", "none")
        CreateTable MainTable(nCurTable), sMDBTable, sSection
        dbLocal.TableDefs.Append MainTable(nCurTable)
    Next nCurTable
    Exit Sub

CRLError:
    WriteErrMsg "CRL-Error " & Err & ": " & Error
    End
    Exit Sub
End Sub
Private Sub WriteErrMsg(sMessage As String)
    'Should an error occur, this function writes it to
    'another INI file. I did it this way because the
    'program runs as a scheduled process on a remote
    'machine, so no one would be there to answer an error
    'dialog. There is a second VB program that continuously
    'checks the Error.ini file and pages me with the error message.

    Dim sErrorINI As String
    sErrorINI = sGetINIString(sINIPath, "General", "ErrorINI", "error.ini")
    writeINIString sErrorINI, "Error", "Message", sMessage
    writeINIString sErrorINI, "Error", "Error", "True"
End Sub
```

First, the `CreateLocalFile` function gets the filename from the `Dbpath=` INI entry and uses Visual Basic's `CreateDatabase` function to create the new (and empty MDB) file. Next, the program uses a `For` loop to read through each table in the `[Tables]` section, repeatedly calling the `CreateTable` procedure. The `CreateTable` procedure, in turn, loops through the fields in the `[tablename]` section of the INI file, creating fields in the new table.

After a table is created, the `TransferTable` procedure takes care of transferring the data from an SQL Server table to one of the new tables. The procedure first creates a recordset from the SQL Server table and then loops through each record in the recordset, transferring the value for each field to the new table. During this process, users see a progress bar, as shown in Figure 23.4, to let them know something is happening.

FIGURE 23.4
The SQL data export program displays a progress bar while in action.

Using the Windows API to Create Transparent Images

One of the most complex features in the Win32 API is the Graphics Device Interface (GDI) APIs. Because these APIs are very complicated, tedious, and GPF prone, Microsoft played it safe and excluded most of them from VB. Although leaving out the APIs shelters you from the complexity and makes your programs more robust, it severely limits your ability to do the "cool" things that many users expect. VB4 helped to relieve this problem to some extent by providing new features such as the `PaintPicture` function and the `ImageList` control, but it still fell short. This means that sometime in the near future you are going to find yourself calling the GDI APIs from your application. To demonstrate some of the more common GDI APIs, you'll write a cool function called `TransparentPaint` in this section.

NOTE The version of the `TransparentPaint` routine you see in this chapter is a Win32 version of the `TransparentBlt` code (written by Mike Bond) that originally appeared in the Microsoft KnowledgeBase KB article number Q94961. This version contains many modifications to the code and includes a wealth of new comments.

`TransparentPaint`, shown in Listing 23.4, is designed to treat a bitmap like an icon when you paint it on a surface. You can designate a part of the icons to be transparent, but you cannot do the same with bitmaps. `TransparentPaint` overcomes this limitation by allowing you to make all of a single color on a bitmap transparent. To accomplish this difficult feat, you need to create a series of temporary bitmaps and do some painting in memory only. Although this abstract concept can be complicated, the comments in `TransparentPaint` help explain what is happening at each step.

Listing 23.4 TRANSPAR.ZIP—Code for the *TransparentPaint* Procedure

```
'*********************************************************************
' Paints a bitmap on a given surface using the surface backcolor
' everywhere lngMaskColor appears on the picSource bitmap
'*********************************************************************
Sub TransparentPaint(objDest As Object, picSource As StdPicture, _
    lngX As Long, lngY As Long, ByVal lngMaskColor As Long)
    '*****************************************************************
    ' This sub uses a bunch of variables, so let's declare and explain
    ' them in advance...
    '*****************************************************************
    Dim lngSrcDC As Long     'Source bitmap
    Dim lngSaveDC As Long    'Copy of Source bitmap
    Dim lngMaskDC As Long    'Monochrome Mask bitmap
    Dim lngInvDC As Long     'Monochrome Inverse of Mask bitmap
    Dim lngNewPicDC As Long  'Combination of Source & Background bmps

    Dim bmpSource As BITMAP  'Description of the Source bitmap

    Dim hResultBmp As Long   'Combination of source & background
    Dim hSaveBmp As Long     'Copy of Source bitmap
    Dim hMaskBmp As Long     'Monochrome Mask bitmap
    Dim hInvBmp As Long      'Monochrome Inverse of Mask bitmap

    Dim hSrcPrevBmp As Long  'Holds prev bitmap in source DC
    Dim hSavePrevBmp As Long 'Holds prev bitmap in saved DC
    Dim hDestPrevBmp As Long 'Holds prev bitmap in destination DC
    Dim hMaskPrevBmp As Long 'Holds prev bitmap in the mask DC
    Dim hInvPrevBmp As Long  'Holds prev bitmap in inverted mask DC

    Dim lngOrigScaleMode&    'Holds the original ScaleMode
    Dim lngOrigColor&        'Holds original backcolor from source DC
    '*****************************************************************
    ' Set ScaleMode to pixels for Windows GDI
    '*****************************************************************
    lngOrigScaleMode = objDest.ScaleMode
    objDest.ScaleMode = vbPixels
    '*****************************************************************
    ' Load the source bitmap to get its width (bmpSource.bmWidth)
    ' and height (bmpSource.bmHeight)
    '*****************************************************************
    GetObject picSource, Len(bmpSource), bmpSource
    '*****************************************************************
    ' Create compatible device contexts (DCs) to hold the temporary
    ' bitmaps used by this sub
    '*****************************************************************
    lngSrcDC = CreateCompatibleDC(objDest.hdc)
    lngSaveDC = CreateCompatibleDC(objDest.hdc)
    lngMaskDC = CreateCompatibleDC(objDest.hdc)
    lngInvDC = CreateCompatibleDC(objDest.hdc)
    lngNewPicDC = CreateCompatibleDC(objDest.hdc)
    '*****************************************************************
    ' Create monochrome bitmaps for the mask-related bitmaps
    '*****************************************************************
```

```
hMaskBmp = CreateBitmap(bmpSource.bmWidth, bmpSource.bmHeight, _
    1, 1, ByVal 0&)
hInvBmp = CreateBitmap(bmpSource.bmWidth, bmpSource.bmHeight, _
    1, 1, ByVal 0&)
'*****************************************************************
' Create color bitmaps for the final result and the backup copy
' of the source bitmap
'*****************************************************************
hResultBmp = CreateCompatibleBitmap(objDest.hdc, _
    bmpSource.bmWidth, bmpSource.bmHeight)
hSaveBmp = CreateCompatibleBitmap(objDest.hdc, _
    bmpSource.bmWidth, bmpSource.bmHeight)
'*****************************************************************
' Select bitmap into the device context (DC)
'*****************************************************************
hSrcPrevBmp = SelectObject(lngSrcDC, picSource)
hSavePrevBmp = SelectObject(lngSaveDC, hSaveBmp)
hMaskPrevBmp = SelectObject(lngMaskDC, hMaskBmp)
hInvPrevBmp = SelectObject(lngInvDC, hInvBmp)
hDestPrevBmp = SelectObject(lngNewPicDC, hResultBmp)
'*****************************************************************
' Make a backup of source bitmap to restore later
'*****************************************************************
BitBlt lngSaveDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
    lngSrcDC, 0, 0, vbSrcCopy
'*****************************************************************
' Create the mask by setting the background color of source to
' transparent color, then BitBlt'ing that bitmap into the mask
' device context
'*****************************************************************
lngOrigColor = SetBkColor(lngSrcDC, lngMaskColor)
BitBlt lngMaskDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
    lngSrcDC, 0, 0, vbSrcCopy
'*****************************************************************
' Restore the original backcolor in the device context
'*****************************************************************
SetBkColor lngSrcDC, lngOrigColor
'*****************************************************************
' Create an inverse of the mask to AND with the source and combine
' it with the background
'*****************************************************************
BitBlt lngInvDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
    lngMaskDC, 0, 0, vbNotSrcCopy
'*****************************************************************
' Copy the background bitmap to the new picture device context
' to begin creating the final transparent bitmap
'*****************************************************************
BitBlt lngNewPicDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
    objDest.hdc, lngX, lngY, vbSrcCopy
'*****************************************************************
' AND the mask bitmap with the result device context to create
' a cookie cutter effect in the background by painting the black
' area for the non-transparent portion of the source bitmap
'*****************************************************************
```

continues

Listing 23.4 Continued

```
    BitBlt lngNewPicDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
        lngMaskDC, 0, 0, vbSrcAnd
    '*****************************************************************
    ' AND the inverse mask with the source bitmap to turn off the bits
    ' associated with transparent area of source bitmap by making it
    ' black
    '*****************************************************************
    BitBlt lngSrcDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
        lngInvDC, 0, 0, vbSrcAnd
    '*****************************************************************
    ' XOR the result with the source bitmap to replace the mask color
    ' with the background color
    '*****************************************************************
    BitBlt lngNewPicDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
        lngSrcDC, 0, 0, vbSrcPaint
    '*****************************************************************
    ' Paint the transparent bitmap on source surface
    '*****************************************************************
    BitBlt objDest.hdc, lngX, lngY, bmpSource.bmWidth, _
        bmpSource.bmHeight, lngNewPicDC, 0, 0, vbSrcCopy
    '*****************************************************************
    ' Restore backup of bitmap
    '*****************************************************************
    BitBlt lngSrcDC, 0, 0, bmpSource.bmWidth, bmpSource.bmHeight, _
        lngSaveDC, 0, 0, vbSrcCopy
    '*****************************************************************
    ' Restore the original objects by selecting their original values
    '*****************************************************************
    SelectObject lngSrcDC, hSrcPrevBmp
    SelectObject lngSaveDC, hSavePrevBmp
    SelectObject lngNewPicDC, hDestPrevBmp
    SelectObject lngMaskDC, hMaskPrevBmp
    SelectObject lngInvDC, hInvPrevBmp
    '*****************************************************************
    ' Free system resources created by this sub
    '*****************************************************************
    DeleteObject hSaveBmp
    DeleteObject hMaskBmp
    DeleteObject hInvBmp
    DeleteObject hResultBmp
    DeleteDC lngSrcDC
    DeleteDC lngSaveDC
    DeleteDC lngInvDC
    DeleteDC lngMaskDC
    DeleteDC lngNewPicDC
    '*****************************************************************
    ' Restores the ScaleMode to its original value
    '*****************************************************************
    objDest.ScaleMode = lngOrigScaleMode
End Sub
```

For simplicity's sake, I have omitted the API declarations from Listing 23.4. I could go on for pages explaining exactly what is happening during each step of `TransparentPaint`, but I won't because this sub contains the same comments I've made in this listing. Also, following this listing would be more difficult if it were broken into several smaller blocks. After you read the comments for this sub, I encourage you to single-step through the TRANSPARENT.VBP project, which you can get from Macmillan's Web site at `www.mcp.com/info`. Reading this project will help you to visualize what is happening at each step.

Although `TransparentPaint` is a difficult procedure to follow, using it is easy. Listing 23.5 loads a bitmap from a resource and paints it on the upper-left corner of the form using `TransparentPaint`. Next, it paints the picture using `PaintPicture`. The last parameter, `vbGreen`, tells `TransparentPaint` to replace any bits in the bitmap that are green, with the background color of the form. The result is shown in Figure 23.5.

Listing 23.5 TRANSPAR.ZIP—Using the TransparentPaint Procedure

```
'*********************************************************************
' Transparent.frm - Demonstrates how to use basTransparent's
'   TransparentPaint using a bitmap from a resource file.
'*********************************************************************
Option Explicit
'*********************************************************************
' Gets a StdPicture handle by loading a bitmap from a resource file
' and paints it transparently on the form by using Gray as the mask
' color.
'*********************************************************************
Private Sub cmdPaintTransBmp_Click()
    TransparentPaint Me, LoadResPicture(103, 0), 0, 0, QBColor(7)
End Sub
```

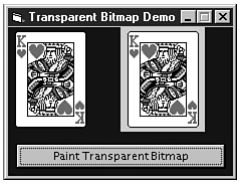


FIGURE 23.5
`TransparentPaint` is a must for your multimedia applications.

Try replacing the resource file in this project with your own resource file to see how `TransparentPaint` works. Also, try using different mask colors as well as the images from picture boxes. Now you never have to write an application that appears to be of inferior quality because it doesn't use transparent bitmaps.

From Here...

In this chapter, you explored a variety of specific projects. If you need more information on any of the topics discussed, see the following chapters:

- To learn about API calls, see Chapter 20, "Accessing the Windows API."
- For more information on INI files, see Chapter 21, "Working with Files."

PART VI

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CHAPTER 24

Database Basics

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It's probably fair to say that most business-oriented computer applications work with data in one form or another. This data often is stored in one or more databases. Visual Basic can create powerful data management programs with a little planning and effort. The most fundamental part of that planning is in how the data is structured. A poorly designed database can doom even the most well-intentioned program from the start. On the other hand, a well-designed database can make a programmer's life much easier.

Creating an organized data structure requires you to learn about two separate tasks. First, you must learn about how to design a database. In the design, you decide what data goes in the database and how it will be organized. Second, you must learn how to translate the design into the actual database. You can do so in a variety of ways. In this chapter, you examine many of the considerations involved in designing databases and their structures. You can apply these concepts to any type of database, not just those that you may be designing to use in your Visual Basic applications.

Designing a Database

Like most tasks, building a database starts with a design. After all, you wouldn't try to build a house without a blueprint, and most people wouldn't attempt to prepare a new dish without a recipe. Like these other tasks, having a good design for your database is a major first step in creating a successful project.

In designing a database application, you must set up not only the program's routines for maximum performance, but you must pay attention also to the physical and logical layout of the data storage. A good database design does the following:

- Provides minimum search times when locating specific records
- Stores data in the most efficient manner possible to keep the database from growing too large
- Makes data updates as easy as possible
- Is flexible enough to allow inclusion of new functions required of the program

Design Objectives

When you're creating the design for your database, you must keep several objectives in mind. Although meeting all these design objectives is desirable, sometimes they are mutually exclusive. The primary design objectives are as follows:

- Eliminate redundant data
- Be able to locate individual records quickly
- Make enhancements to the database easy to implement
- Keep the database easy to maintain

Key Activities in Designing Your Database

Creating a good database design involves the following seven key activities:

- Modeling the application
- Determining the data required for the application
- Organizing the data into tables
- Establishing the relationships between tables
- Setting index and validation requirements for the data
- Creating and storing any necessary queries for the application
- Reviewing the design

Now, look briefly at the initial two activities in the list. First, take a look at modeling the application. When you model an application, you first should determine the tasks that the application is to perform. For example, if you're maintaining a membership list, you know that you want to create phone directories and mailing lists of the members. As you're determining the tasks to be performed by the application, you are creating what is called the *functional specification*. For a project that you are creating, you probably know all the tasks that you want to perform, but writing down these tasks in a specification document is a good idea. This document can help you keep focused on what you want your program to do. If you're creating the program for another person, a functional specification becomes an agreement of what the application will contain. This specification also can show milestones that need to be achieved on a set schedule.

When you're creating the program for other people, the best way to learn what task must be performed is to talk to the people requesting the work. As a first step, you can determine if they already have a system that they are looking to replace, or if they have reports that they want to produce. Then you can ask a lot of questions until you understand the users' objectives for the program.

After you determine the functional specifications for the program, you can start determining what data the program needs. In the case of a membership application, knowing that you have to produce directories and mailing lists tells you that the database needs to contain the address and phone number of each of the members. Taking this situation a little further, you know that, by presorting mail by ZIP code, you can take advantage of reduced rate postage. Therefore, you need an index or query that places the mailing list information in zip code order. So, you can see that the model not only tells you the data needed but also defines other components of the database.

Organizing the Data

One of the key aspects of good database design is determining how the data will be organized in the database. To have a good design, you should organize the data in a way that makes the information easy to retrieve and makes maintenance of the database easy. Within a database, data is stored in one or more *tables*. For many database applications, you can accomplish efficient data management by storing data in multiple tables and by establishing relationships

between these tables. In the following sections, you learn how to determine what data belongs in each table of your database.

Tables as Topics A *table* is a collection of information related to a particular topic. By thinking of a key topic for the table, you can determine whether a particular piece of data fits into the table. For example, if a country club wants to track information about members and employees, the club management might be tempted to put both in the same table (because both groups refer to people). However, look at the data required for each group. Although both groups require information about a person's name, address, and phone number, the employee group also requires information about the person's Social Security number, job category, payroll, and tax status. If you were to create just one table, many of the entries would be blank for the members. You also would have to add a field to distinguish between a member and an employee. Clearly, this technique would result in a lot of wasted space. It also could result in slower processing of employee transactions or member transactions because the program would have to skip a number of records in the table. Figure 24.1 shows a database table with the two groups combined. Figure 24.2 shows the reduction in the number of fields in a member-only database table.

FIGURE 24.1
Combining the employee and member tables wastes a lot of space.

Names : Table

LastName	FirstName	Address	City	State	ZIP	Employee	SSN	Title	Payrate
Sparks	Lauren	4302 Brooks Barre	Memphis	TN	38101	Yes	111-22-3456	Game Tester	$15.42
Layton	Michael	123 Tina Marie Pky	Collierville	TN	38017	No			
Cawein	Chris	409 Jackie Road	Boland	MS	10934	No			
Thomas	June	29 Windsor	Philbert	AR	72300	Yes	222-33-4567	Pastry Chef	$21.00
Sparks	Jeffrey	9534 SS North	Memphis	TN	38101	No			
McFarland	Stan	9326 Masonry Lane	Eads	TN	38910	No			
Thomas	John	102 Chrysler Ave	Detroit	MI	65100	Yes	333-44-5678	Engineer	$24.54
Ellis	Gene	127 Dop Road	Memphis	TN	38101	No			
Fortner	Bessie	316 Yaya Place	Germantown	TN	38139	Yes	444-55-6789	Gardener	$21.00
Bradshaw	Stephen	809 W Barton	Dumas	AR	72313	No			
						No			$0.00

Record: 11 of 11

FIGURE 24.2
A separate database table for members has only the relevant fields and is more efficient.

Members : Table

LastName	FirstName	Address	City	State	ZIP
Layton	Michael	123 Tina Marie Pky	Collierville	TN	38017
Cawein	Chris	409 Jackie Road	Boland	MS	10934
Sparks	Jeffrey	9534 SS North	Memphis	TN	38101
McFarland	Stan	9326 Masonry Lane	Eads	TN	38910
Ellis	Gene	127 Dop Road	Memphis	TN	38101
Bradshaw	Stephen	809 W Barton	Dumas	AR	72313

Record: 7 of 7

By thinking of the topic to which a table relates, you can determine more easily whether a particular piece of information belongs in the table. If the information results in wasted space for many records, the data belongs in a different table.

Data Normalization *Data normalization* is the process of eliminating redundant data within a database. Taking data normalization to its fullest extent results in each piece of information in a database appearing only once, although that's not always practical.

Consider the example of order processing. For each item a person orders, you need the item's number, description, price, order number, and order date, as well as the customer's name, address, and phone number. If you place all this information in one table, the result looks like the table shown in Figure 24.3.

FIGURE 24.3
Nonnormalized data produces a large, inefficient data table.

CustItem : Table

Itemno	Description	Orderno	OrderDate	Custno	Lastname	Firstname	Phone
1001	Silver Angelfish	101	9/4/94	1	Smith	Martha	555-3344
1003	Black Lace Ang	101	9/4/94	1	Smith	Martha	555-3344
1005	Pearl Gourami	102	9/5/94	2	Jones	Frank	555-9988
1010	Sunset Gouram	102	9/5/94	2	Jones	Frank	555-9988
1001	Silver Angelfish	103	9/5/94	3	James	Sydney	555-7765
1005	Pearl Gourami	104	9/9/94	1	Smith	Martha	555-4432
0		0		0			

Record: 1 of 6

As you can see, much of the data in the table is repeated. This repetition introduces two problems. The first problem is wasted space, because you repeat information. The second problem is one of data accuracy or currency. If, for example, a customer changes his or her phone number, you have to change it for all the records that apply to that customer—with the possibility that you will miss one of the entries. In the table in Figure 24.3, notice that Martha Smith's phone number was changed in the latest entry but not in the two earlier entries. If an employee looks up Martha Smith and uses an earlier entry, that employee would not find Martha's updated phone number.

A better solution for handling the data is to put the customer information in one table and the sales order information in another table. You can assign each customer a unique ID and include that ID in the sales order table to identify the customer. This arrangement yields two tables with the data structure shown in Figure 24.4.

With this type of arrangement, the customer information appears in only one place. Now, if a customer changes his or her phone number, you have to change only one record.

You can do the same thing to the items sold and order information. This leads to the development of four tables, but the organization of the tables is much more efficient. You can be sure that when information must be changed, it will change in only one place. This arrangement is shown in Figure 24.5. With the four-table arrangement, the Orders table and the Items Ordered table provide the links between the customers and the retail items they purchased. The Items Ordered table contains one record for each item of a given order. The Orders table relates the items to the date of purchase and the customer making the purchase.

FIGURE 24.4
Normalized customer and order tables eliminate data redundancy.

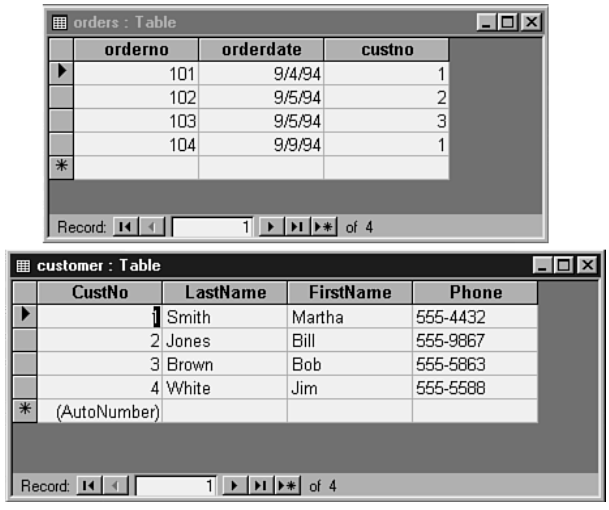
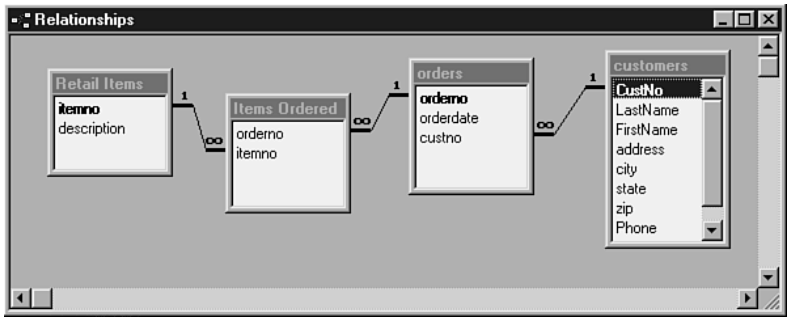


FIGURE 24.5
Complete normalization of the tables provides the greatest efficiency.



When information is moved out of one table and into another, you must have a way of keeping track of the *relationships* between the tables. You can do so through the use of data keys. For example, your Customers table has a field called `CustNo`. The Orders table also has a field called `CustNo`. These tables are *linked* through that field. If a program needs to obtain information about the customer who made a particular order, that customer's record can be located quickly in the Customers table via the common `CustNo` field.

Child and Lookup Tables Another way to handle data normalization is to create what is known as a child table. A *child table* is a table in which all the entries share common information that is stored in another table. A simple example is a membership directory; the family shares a common last name, address, and phone number, but each family member has a different first name. The table containing the common information is called the *parent table,* and the table containing the members' first names is the *child table.* Figure 24.6 shows a parent table and its related child table.

FIGURE 24.6
Parent and child tables are a form of data normalization.

Family Info : Table

FamilyID	LastName	Address	City	State	ZIP	Telephone
1	Kaywhine	1234 E. Main St.	Germantwon	TN	38138	901-555-7552
2	Thomas	102 Windham	Crawfordsville	AR	72202	870-555-7232
3	Carter	843 Three Lakes	Memphis	TN	38110	901-555-2329
4	Hartman	901 Poplar Ave.	Memphis	TN	38112	901-555-0111

Record: 5 of 5

Family Members : Table

FamilyID	FirstName	Birthdate
1	Chris	5/5/58
1	Jackie	3/2/62
1	Billy	12/25/84
1	Kimberly	4/2/88
1	David	5/1/91
2	John	3/29/27
2	June	9/20/29
3	Brendan	5/1/91

Record: 1

A *lookup table* is another way to store information to prevent data redundancy and to increase the accuracy of data entry functions. Typically, a lookup table is used to store valid data entries (for example, a state abbreviations table). When a person enters the state code in an application, the program looks in the abbreviations table to make sure that the code exists.

You also can use a lookup table in data normalization. If you have a large mailing list, many of the entries use the same city and state information. In this case, you can use a zip code table as a related table to store the city and state by zip code (remember that each zip code corresponds to a single city and state combination). Using the zip code table requires that the mailing list use only the zip code of the address, and not the city and state. During data entry, you can have the program check an entered zip code against the valid entries.

Rules for Organizing Tables Although no absolute rules exist for defining what data goes into which tables, here are some general guidelines to follow for efficient database design:

- Determine a topic for each table, and make sure that all data in the table relates to the topic.
- If several of the records in a table have fields intentionally left blank, split the table into two similar tables. (Remember the example of the employee and member tables.)
- If information is repeated in a number of records, move that information to another table and set up a relationship between the tables.
- Repeated fields indicate the need for a child table. For example, if you have `Item1`, `Item2`, `Item3`, and so on in a table, move the items to a child table that relates back to the parent table.
- Use lookup tables to reduce data volume and to increase the accuracy of data entry.
- Do not store information in a table if it can be calculated from data in other tables.

NOTE As stated previously, the guidelines for defining tables are not hard-and-fast rules. Sometimes, deviating from the guidelines makes sense.

Performance Considerations

One of the most frequent reasons for deviating from the guidelines just given is to improve performance. If obtaining a total sales figure for a given salesperson requires summing several thousand records, for example, you might find it worthwhile to include a Total Sales field in the salesperson table that is updated each time a sale is made. This way, when reports are generated, the application doesn't have to do large numbers of calculations, and the report process is dramatically faster. However, your program must ensure that the Total Sales field is consistently and accurately updated.

Another reason to deviate from the guidelines is to avoid opening a large number of tables at the same time. Because each open table uses precious resources and takes up memory, having too many open tables can slow down your application.

Deviating from the guidelines results in two major consequences. The first is increasing the size of the database because of redundant data. The second is the possibility of having incorrect data in some of the records because a piece of data was changed and not all the affected records were updated.

There are trade-offs between application performance and data storage efficiency. For each design, you must look at the trade-offs and decide on the optimum design.

Using Indexes

When information is entered into a table, records usually are stored in the order in which they are added. This order is the *physical order* or *natural order* of the data. However, you usually want to view or process data in an order different from the order of entry; that is, you want to define a *logical order*. You also frequently need to find a specific record in a table. Doing so by scanning the table in its physical order can be quite time-consuming.

An index provides a method of showing a table in a specific order. An *index* is a special table that contains a key value (usually derived from the values of one or more fields) for each record in the data table; the index itself is stored in a specific logical order. The index also contains pointers that tell the database engine where the actual record is located. This type of index is similar to the index in the back of this book. By using the book's index, you easily can look up key words or topics, because it contains pointers (page numbers) to tell you where to find the information.

Why Use an Index? The structure of an index allows for rapid data search and retrieval. If you have a table of names indexed alphabetically, you rapidly can retrieve the record for a specific name by searching the index. To get an idea of the value of such an index, imagine a phone book that lists the customer names in the order in which they signed up for phone service. If you live in a large city, finding a person's number could take forever, because you have to look at each line until you find the one you want.

A table can have a number of different indexes associated with it to provide different organizations of the data. For example, an employee table can have indexes on last name, date of birth, date of hire, and pay scale. Each index shows the same data in a different order, for a different purpose.

CAUTION

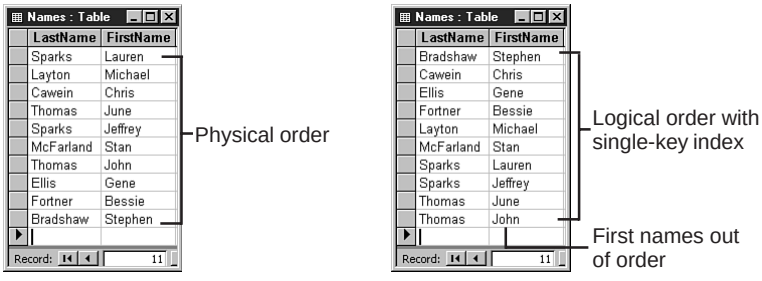
Although having many different views of the data may be desirable, keeping multiple indexes can take a toll on performance, because all indexes must be updated each time data changes. Once again, you must consider the trade-offs in the database design.

NOTE You also can create different views of the information in a table by sorting the records or by specifying an order using the `ORDER BY` clause of a Structured Query Language (SQL) statement. Even though indexes aren't used directly by the SQL engine, their presence speeds up the sorting process when an `ORDER BY` clause is present. You learn about this topic in detail in Appendix C, "SQL Summary." ■

▶ **See** "Setting the Sort Conditions," **p. 810**

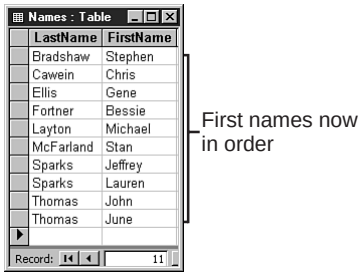
Single-Key Expressions The most common type of index is the *single-key index*, which is based on the value of a single field in a table. Examples of this type of index are Social Security number, zip code, employee ID, and last name. If multiple records exist with the same index key, those records are presented in physical order within the sort order imposed by the single-key index. Figure 24.7 shows the physical order of a Names table and how the table appears after being indexed on the last name field.

FIGURE 24.7
The physical and logical order of a table can be different. Logical order depends on an index.



Multiple-Key Expressions Although single-key expressions are valuable in presenting data in a specific order, imposing an even more detailed order on the table is often necessary. You can do so by using multiple-key indexes. As you can infer from the name, a *multiple-key index* is based on the values of two or more fields in a table. A prime example is to use last name and first name when indexing a membership list. Figure 24.8 updates the view of the table shown in Figure 24.7 to show how using the first name field to help sort the records changes the order of the table. As with single-key indexes, if the key values of several records are the same, the records are presented in physical order within the index order.

FIGURE 24.8
Multiple-key indexes further refine the logical order of a table.



CAUTION

Although this point might be obvious, I must stress that the order of the fields in the index expression has a dramatic impact on the order of the records in the table. Indexing on first name and then last name produces different results than indexing on last name and then first name. Figure 24.9 shows the undesirable results of using a first name/last name index on the table used in Figure 24.7.

FIGURE 24.9
An improper index field order yields undesirable results.

Using Queries

When you normalize data, you typically are placing related information in multiple tables. However, when you need to access the data, you want to see the information from all the tables in one place. To do so, you need to create recordsets that consolidate the related information from the multiple tables. You create a recordset from multiple tables by using an SQL statement that specifies the desired fields, the location of the fields, and the relation between the tables. One way of using an SQL statement is to place it in the `Database` object's `OpenRecordset` method, which you use to create the recordset. However, you also can store the SQL statement as a query in the database.

Using stored queries presents several advantages:

- You can use the SQL statement more easily in multiple locations in your program or in multiple programs.
- Making changes to the SQL statement in a single location is easier.

- Stored queries run faster than those that are handled by parsing the statement from code.
- Moving your application up to a client/server environment is easier.

▶ **See** "Defining SQL," **p. 794**

Implementing Your Design

The first step in implementing the database design is to create the database itself. One consideration, of course, is the type of database to be used. Visual Basic's native database environment is the Microsoft Jet database engine. Jet databases are commonly known as Access databases, as Microsoft Access also uses the Jet database engine. You can choose from three main methods of creating an Access database for use with Visual Basic. You can use any of the following:

- Programmatically, using Visual Basic's Data Access Objects (DAO)
- Using the Visual Data Manager application provided with Visual Basic
- Using Microsoft Access itself
- Using other third-party database management programs

Creating a database programmatically using Data Access Objects gives your program complete control over how the database is created and structured. This topic is discussed in detail in Chapter 26, "Using Data Access Objects (DAO)."

The other methods of creating a Jet database are explained in the following list and discussed in the subsequent sections:

- **Visual Data Manager.** Using this Visual Basic add-in, you can create databases, as well as create, modify, and delete tables, indexes, and relations within a database.
- **Microsoft Access.** This tool is probably the most widely used to create Jet databases. It provides the added advantage of enabling you to create queries and relations using a visual drag-and-drop interface.
- **Third-party programs.** Many other programs, both commercial and shareware, are available to manage Jet and other types of databases. Some are highly specialized, whereas others are general-purpose utilities much like Visual Data Manager.

Using Visual Data Manager

The Visual Data Manager application that comes with Visual Basic provides you with an interactive way of creating and modifying databases. You can run this application by selecting the Visual Data Manager item from Visual Basic's Add-Ins menu.

NOTE Visual Data Manager can work with Access (Jet), dBASE, FoxPro, Paradox, and ODBC databases, as well as text files. Typically, in Visual Basic applications, you use it to manipulate Access databases. ■

TIP Visual Data Manager is also one of the sample applications that can be found in the Visual Basic Samples. Examining this project can provide you with a tremendous education in creating database applications in Visual Basic.

Creating the Database File

The first step in creating a new database is to create the database file itself. This file provides a physical location for the rest of your work. To create this file in Visual Data Manager, perform the following steps:

1. Choose File, New to bring up a submenu that allows you to specify the type of database to create.
2. For the purpose of this discussion, create an Access (Jet) database by choosing the Microsoft Access item. This action brings up another submenu from which you can choose the version of Access database to create.
3. If you plan to share data with users on a Windows 3.1 system, you should choose the 2.0 version; otherwise, choose the 7.0 version. Figure 24.10 shows the different menu levels for creating a database.

   After you choose the type of database, you are presented with the Select Microsoft Access Database to Create dialog box. This dialog box allows you to choose a name and folder for your database.

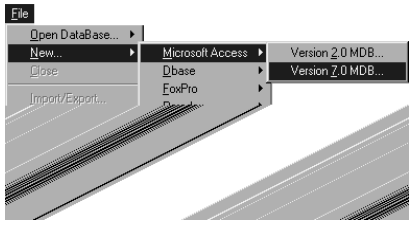


FIGURE 24.10
The menus allow you to choose the type and version of database to create.

4. Enter a name and select a folder for your database, and then click the Save button. This action takes you to the design mode shown in Figure 24.11.

The Visual Data Manager presents the database information in a tree-like view. This type of view allows you to see the tables and queries quickly in the database. It also allows you to open the view further to see the fields and indexes of a table as well as its properties. Finally, you can open the view all the way to see the properties of the individual fields.

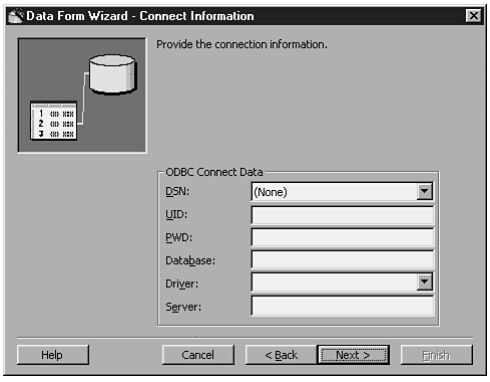


FIGURE 25.13
Complete all the information for your ODBC connection.

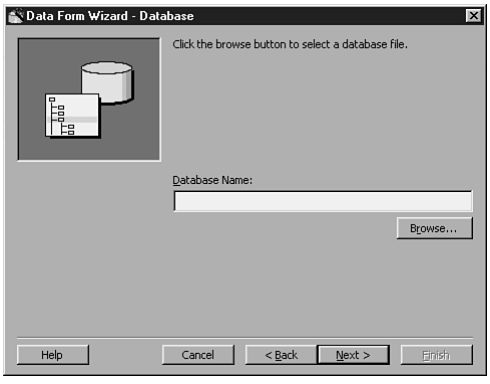


FIGURE 25.14
Using an Access database, all you need to indicate is the database path and filename.

Getting to the Source of Your Data

After selecting the database, you move to the Form screen of the Data Form Wizard (see Figure 25.15). This screen allows you to name the form, as well as choose the way you want the information to be displayed.

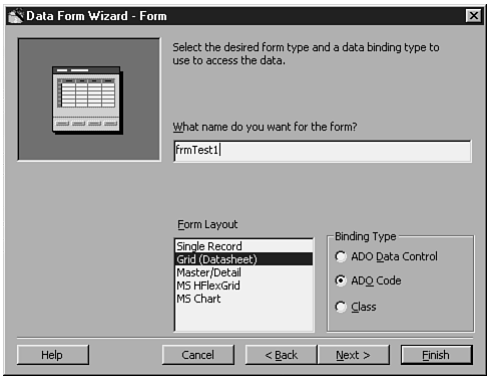


FIGURE 25.15
The Form screen allows you to specify how you want the form to be set up.

You can choose from among five types of data entry forms:

- **Single Record.** Allows you to edit the information in the recordset one record at a time. This is the classic data entry type of form.
- **Grid (DataSheet).** Allows you to edit multiple records at a time. This screen is similar to the recordset view in Access or an Excel spreadsheet.
- **Master/Detail.** Allows you to edit the information of a single parent record along with its associated child records. This type of form might be used to show information about an order along with all the items ordered.
- **MS HflexGrid.** Creates a grid layout using the new Microsoft Hierarchical FlexGrid control.
- **MS Chart.** Creates a chart based on the data.

Choosing the type of form to create not only affects the appearance of the form, but also determines what recordset(s) must be selected for the form. For a single record or grid form, you need to select only a single record source. For the Master/Detail form, you need to select two record sources. You really don't have to worry too much about this because the wizard guides you through this process. That's what wizards are for, right?

CAUTION

If you are creating a Master/Detail form, you first need to establish a relation between the tables you select. The relation information is used to keep the information synchronized.

For the sample project, name the form `frmTest1`. Select Grid (Datasheet) for the Form Layout.

Choosing the Binding Type

The standard Jet Data control, which has been around for a long time, uses Data Access Objects (DAOs). However, DAOs are on the way out and will eventually be replaced by the newer ActiveX Data Objects (ADOs). Evidence of this is the fact that in Visual Basic 6, the DFW creates only forms that use ADO. The Binding Type setting on the Form screen in Figure 25.15 allows three options for creating the data form:

- **ADO Data Control.** Creates a form with an ADO data control.
- **ADO Code.** Uses only code to access the database.
- **Class.** Creates a Class module that performs data access.

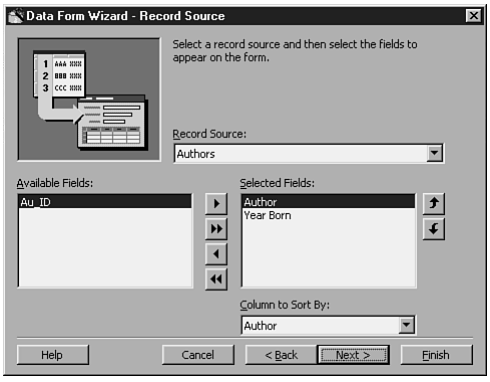
Any one of these methods you select uses the newer ActiveX Data Objects.

For our sample project, select ADO Code as the Binding Type.

Choosing Fields with the Data Form Wizard

After you select the database and the type of form, click Next and you see the Record Source screen, as shown in Figure 25.16. This screen provides a "friendly" way to choose the table or query to use for the form and the actual fields that you want to have included on the form.

FIGURE 25.16
You choose the record source and fields using simple combo boxes and lists.



To set up the fields for the form, you need to follow these steps:

1. Select a record source (table or query name) from the combo box.
2. Select the fields to include by clicking the field names in the Available Fields list. You can double-click a field to select it, or highlight the field and click the selection button (>).
3. Place the fields in the order you want by moving them in the Selected Fields list. You move a field by highlighting it and then clicking the up or down buttons. (This step is optional.)
4. Select the column on which to sort the recordset by choosing it from the Column to Sort By combo box. (This step is optional.)
5. Click the Next button to move to the next screen.

For our sample project, use the drop-down list box to select the `Authors` table. Use the technique described here to include the `Author` and `Year Born` fields in the Data form.

Control Selection

After selecting all the fields that you want on the form, you have some more choices to make—about how your form will look. Depending on the type of form you chose in the Form screen, several dialog boxes may appear. One such dialog box allows you to choose the buttons that you want to appear on your form; it is the Control Selection screen of the DFW, shown in Figure 25.17.

Table 25.3 lists the buttons that you can elect to have appear on your data form. Not all of these buttons are available on all types of forms.

After you answer the dialogs concerning form design, click the Next button, and you have the option of saving all your settings in a profile. You can later load this profile without having to go through all the previous screens.

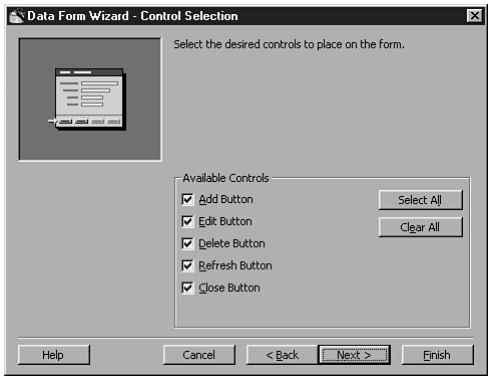


FIGURE 25.17
You can choose a number of command buttons to appear on your form.

Table 25.3 Command Button Controls and Their Functions

Available Controls	Function
Add	Adds a new record to the recordset and clears the data entry fields.
Edit	Allows the user to modify the currently selected record.
Update	Stores any changes made to the data entry fields to the database for the current record.
Delete	Deletes the current record.
Refresh	Causes the Data control to reexecute the query used to create it. This process is necessary only in a multiuser environment.
Close	Closes and unloads the data entry form.
Show Data Control	If you selected the Grid (Datasheet) form type and ADO Data Control Binding Type, this option includes a button that allows the user to see the underlying ADO Data control.

You are now ready for the final step of the DFW—actually creating your form. Click the Finish button to start the creation process. At this point, you can sit back and relax for a minute while the DFW does the work. When it is finished, your program has a new data form, and all you did was answer a few questions and make a few selections. Figures 26.18 through 26.20 show you several types of data forms that you can create with the DFW.

FIGURE 25.18
This standard grid data form was created by the Data Form Wizard.

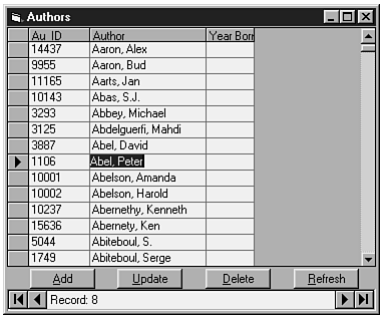
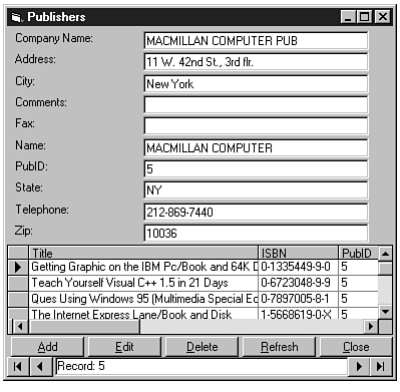


FIGURE 25.19
This more elegant FlexGrid data form also was created by the Data Form Wizard.

FIGURE 25.20
This Master/Detail data form was also created by the Data Form Wizard.



From Here...

In this chapter, you learned how to use the Data control and data-bound controls to quickly set up a database application that works with an existing database. If you want to learn more about related topics, check out the following:

- To learn about database design and normalization, see Chapter 24, "Database Basics."
- For more advanced ways that your programs can connect to databases, see Chapters 26, "Using Data Access Objects (DAO)," 27, "Using Remote Data Objects (RDO)," and 28, "Using ActiveX Data Objects (ADO)."
- To learn how to generate reports from information stored in databases, see Chapter 29, "Creating Reports."

CHAPTER 26

Using Data Access Objects (DAO)

In this chapter

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Considering Programs That Modify Multiple Records **587**

Understanding Other Programming Commands **590**

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In Chapter 25, "The Data Control and Data-Bound Controls," you learned how you can write a database application quickly by using the Data control and data-bound controls that come with Visual Basic. This chapter shows you that, by setting a few properties, you can create a nearly complete data entry screen. I say *nearly* complete because the Data control by itself cannot handle some additional functions of a database application without additional coding—for example, adding or deleting records or finding a specific record.

These additional functions introduce you to some of the programming that you can do in a database application. However, you can write an entire database application with just program commands and not use the Data control at all. When you use just the program commands, you work with Visual Basic's *Data Access Objects* (*DAO*).

In this chapter, you learn how you can use Visual Basic's Data Access Objects to create complete, robust data management applications. Data Access Objects act as a Visual Basic program's internal representation of *physical data* data stored in some type of database or data management engine. Think of the Data Access Objects as special types of variables. These "variables," however, represent data stored *outside* the program rather than information stored in the computer's memory while the program is running.

Introduction to DAO

Using the Data Access Objects and their associated program commands is more complex than using the Data control and bound controls but does offer greater programming flexibility for many applications. The Data Access Objects and programming commands also provide the basis for many of the actions of the Data control and the bound controls. Therefore, they help you understand the concepts behind the controls. As you saw in Chapter 24, even if you use the Data control, you may also need to write some programming code to augment its capabilities.

To demonstrate the similarities and differences between Data Access Objects and the Data control, this chapter teaches you how to build a data entry screen that works with the BIBLIO.MDB sample database (included with Visual Basic). Figure 26.1 shows the data entry screen that you will build in this chapter.

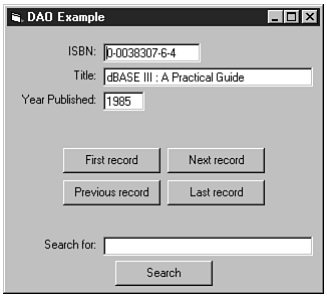


FIGURE 26.1
You can create this data entry screen by following this chapter's instructions.

A key reason for using program commands is the flexibility they give you beyond what is available with the Data control. You can perform more detailed input validation than is possible with

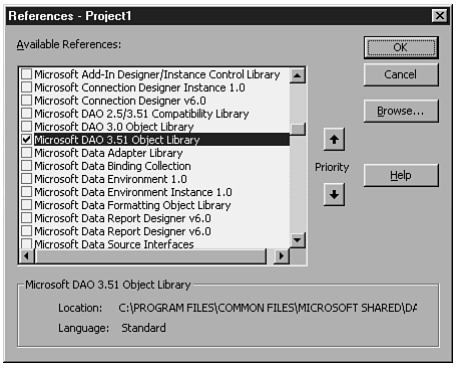
built-in database engine rules because program commands do not directly access the database. You also can cancel changes to your edited data without using transactions. In other words, your program can examine the input data *before* an attempt is made to enter the data into the database. The use of program commands also provides an efficient way to handle data input and searches that do not require user interaction. Examples are receiving data from lab equipment or across a modem, or looking up the price of an item in a table. Program commands enable you to perform transaction processing as well.

Setting Up a DAO Project

Before you can use any database capabilities (beyond the Data control and bound controls) in your program, you must specify one of the Data Access Object libraries in your program's references.

To set the program references, choose Project, References and then select one of the Microsoft DAO libraries from the References - ProjectName dialog box (see Figure 26.2).

FIGURE 26.2
Adding a reference to the DAO library makes these objects available to your program.



NOTE Visual Basic can include two basic Jet DAO libraries in an application. These external libraries are the Microsoft DAO 3.51 Object Library and the Microsoft DAO 2.5/3.51 Compatibility Library. If you plan to program for 32-bit clients only and use 32-bit Jet (Access 95/97) databases, select the 3.51 library. If you need to exchange data with 16-bit systems or Access 2.0 applications, use the 2.5/3.51 compatibility library.

Within a program, a database is opened as part of a *session* with the *database engine*. The database engine is represented within a Visual Basic program by the `DBEngine` object; you define sessions by creating one or more Workspace objects within the `DBEngine` object. By default, once a project contains a reference to a DAO library, the `DBEngine` object and a single Workspace object, known as `Workspaces(0)` (because it is the first member of the zero-based `Workspaces` collection), are automatically created. These default objects are sufficient for most DAO projects.

After the DAO reference has been set up, you can then open a database by using the Workspace object's `OpenDatabase` method. The terminology gets a little confusing here: To *create* a *Database object* in your program, you *open* an existing *database*. The `OpenDatabase` method is technically a method of a Workspace object, but the default Workspace object `DBEngine.Workspaces(0)` is assumed and can be omitted. Therefore, assuming a project contains only one Workspace object, these lines of code are equivalent:

```
Set dbTest = DBEngine.Workspaces(0).OpenDatabase("BIBLIO.MDB")
```

```
Set dbTest = OpenDatabase("BIBLIO.MDB")
```

Throughout this chapter, you'll work on a application that opens the sample database BIBLIO.MDB, which is included with Visual Basic. Follow these steps to begin the sample application:

1. Start Visual Basic, if necessary, and create a new Standard EXE project.
2. Change the name of `Form1` to `frmDAOTest`, and save the project.
3. To add a reference to the proper DAO library to the project, choose Project, References. The References – ProjectName dialog box appears (refer to Figure 26.2).
4. Scroll down to Microsoft DAO 3.51 Object Library and select the check box next to it.
5. Click OK to close the dialog box.

Once you have completed these steps, your project contains a reference to the Data Access Objects library. You therefore can use DAO in the application.

Opening an Existing Database

The first step in writing many data access programs is to set up a link to the database with which you want to work. If your application will work with a database that already exists, you need to create a Database object within the program and then use that object to create a link to the existing database. In effect, you are "opening the database" for use in your program. Most of the other Data Access Objects flow from that Database object.

Think of the Database object as your Visual Basic program's internal *representation* of a physical database, not the database itself. The Database object within the program is simply a window into the database.

Continuing the sample application, the following steps use the `OpenDatabase` method to create a Database object and set it up to work with the BIBLIO.MDB database:

1. In the form's General Declarations section, add this code to declare a form-level Database object variable:

   ```
   Dim dbTest As Database
   ```

2. Add the following lines of code to the form's `Load` event procedure. This code, which executes as the form loads, creates the Database object `dbTest` by opening the BIBLIO.MDB database:

```
Dim sDBLocation As String
sDBLocation = "c:\Program Files\Microsoft Visual Studio\VB98\biblio.mdb"
Set dbTest = OpenDatabase(sDBLocation)
```

These commands open a Jet database with the default options of read/write data access and shared access. The full syntax of the `OpenDatabase` method lets you specify whether the database should be opened exclusively (no other users or programs can access it at the same time), whether it should be opened in read-only mode (no updates are allowed), or, if you are connecting to a non-Access database, you can specify the database type.

You might, for example, want to use read-only mode for a lookup database (for example, a zip code database or a state abbreviations database that you include with your application but do not want the users to be able to modify). To open the database as read-only, change the `Set` statement to the form shown in the following line of code. The first parameter after the database name indicates whether the database is opened for exclusive access; the second parameter indicates whether read-only mode is to be used:

```
Set OldDb = OldWs.OpenDatabase("C:\ZIPCODE.MDB",False,True)
```

After you open the database, you have only created a link from your program to the database file itself. You still do not have access to the information in the database. To gain access to the information, you must create and open a Recordset object that links to data stored in one or more of the tables in the database.

Deciding Which Recordset Type to Use

When you create a recordset object to open a recordset in your program, you can access any entire table, specific fields and records from the table, or a combination of records and fields from multiple tables. Three types of recordsets are available in Visual Basic:

Recordset Type	Type of Data Contained
Table	All records in an entire physical table in a database.
Dynaset	Sets of pointers that provide access to fields and records in one or more tables of a database.
Snapshot	Read-only copies of data from one or more tables. They are stored in memory.

NOTE This chapter refers to tables, dynasets, and snapshots, but you should remember that they are all recordsets and can be accessed only by using the Recordset object. Specifically, all mentions of tables, dynasets, and snapshots actually refer to table-type recordsets, dynaset-type recordsets, and snapshot-type recordsets, respectively. Previous versions of Visual Basic supported objects that are now outdated: table objects, dynaset objects, and snapshot objects. ■

The following sections describe each type of recordset, point out some of the advantages and disadvantages of each, and demonstrate the commands used to access the recordset.

Using Tables

A *table* (table-type recordset) is a direct link to one of the physical tables stored in the database. Because all data in a database is stored in tables, using this type of recordset provides the most direct link to the data. Tables are also the only form of recordset that supports indexes; therefore, searching a table for a specific record can be quicker than searching a dynaset or snapshot.

When you are using tables, data is addressed or modified one table at a time, one record at a time. This arrangement provides very fine control over the manipulation of data. However, it does not give you the convenience of changing records in multiple tables with a single command, such as an action query.

Advantages of Using Tables The use of tables in your programs gives you several advantages:

- You can use or create indexes to change the presentation order of the data in the table during program execution.
- You can perform rapid searches for an individual record using an appropriate index and the `Seek` command.
- Changes made to the table by other concurrent users or programs are immediately available. You do not need to "refresh" the table to gain access to these records.

Disadvantages of Using Tables Of course, using tables in your programs also poses disadvantages:

- You can't set filters on a table to limit the records being processed to those that meet certain criteria.
- You can't use the `Find` commands on a table; the `Seek` command finds only the first record that meets its criteria. This implies that, to process a series of records in a range, you, the programmer, must provide a means to find the additional records.

You can usually overcome these disadvantages with programming, but the solutions are often less than elegant. This chapter discusses some of the workarounds in its coverage of the various methods for moving through a recordset and for finding specific records. These topics are covered later in this chapter.

▶ **See** "Positioning the Record Pointer," **p. 576**

Opening a Table for Use To open a table for the program to use, define a Recordset object and then use your Database object's `OpenRecordset` method to access the table. To specify that a table-type recordset is to be created, use the `dbOpenTable` constant in the method's parameters.

Follow these steps to create a table-type recordset named `rsTitles` in the sample application:

1. Add the declaration `Dim rsTitles as Recordset` to the General Declarations section.
2. Add the following line of code to the end of the form's `Load` event procedure:

```
Set rsTitles = dbTest.OpenRecordset("titles", dbOpenTable)
```

This command opens a table in a Jet database, with the default parameters of shared use and read/write mode. You can include optional parameters in the `OpenRecordset` method to open the table for exclusive use or to open the table in read-only mode. These options are summarized in Table 26.1.

NOTE When you specify the name of an existing table in the `OpenRecordset` method, the Jet engine creates a table-type recordset by default.

Table 26.1 Options Used to Modify the Access Mode of Tables

Option	Action
`dbDenyWrite`	Prevents others in a multiuser environment from writing to the table while you have it open
`dbDenyRead`	Prevents others in a multiuser environment from reading the table while you have it open
`dbReadOnly`	Prevents you from making changes to the table

Using Dynasets

A *dynaset* is a grouping of information from one or more tables in a database. This information is composed of selected fields from the tables, often presented in a specific order and filtered by a specific condition. Dynasets address the records present in the base tables at the time the dynaset was created. Dynasets are updateable recordsets, so any changes made by the users are stored in the database. However, dynasets do not automatically reflect additions or deletions of records made by other users or programs after the dynaset was created. Therefore, dynasets are less useful for some types of multiuser applications.

A dynaset is actually a set of record pointers that point to the specified data as it existed when the dynaset was created. Changes made to information in the dynaset are reflected in the base tables from which the information was derived, as well as in the dynaset itself. These changes include additions, edits, and deletions of records.

Advantages of Using Dynasets Some of the advantages provided by dynasets are as follows:

- Dynasets enable you to join information from multiple tables.
- You can use `Find` methods to locate or process every record meeting specified criteria.
- Dynasets enable you to limit the number of fields or records that you retrieve into the recordset.
- Dynasets make use of filters and sort order properties to change the view of data.

Disadvantages of Using Dynasets Dynasets do have some limitations:

- You can't use indexes with dynasets; therefore, you can't change the presentation order of a dynaset by changing the index or by creating a new one.

- A dynaset does not automatically reflect additions or deletions made to the data by other users or other programs. A dynaset must be explicitly refreshed or re-created to show the changes.

Setting Up a Dynaset To set up a dynaset for use within a program, you must define the Recordset object with the `Dim` statement and then generate the dynaset using the `OpenRecordset` method with the `dbOpenDynaset` parameter. When you are creating a dynaset, the key part of the `OpenRecordset` method is the SQL statement that defines the records to be included, the filter condition, the sort condition, and any join conditions for linking data from multiple tables.

The following code example illustrates how to create a dynaset by using a SQL statement that selects only specific records and that sorts the records in a specific order. These statements provide you access to the same information as you had by accessing the table directly with the previous code. The only difference is the type of recordset created.

```
Dim MyDB As Database
Dim MyRS As Recordset
Dim sSQL As String
Set MyDB = OpenDatabase("biblio.mdb")
sSQL = "SELECT * FROM titles WHERE title <= 'B' ORDER BY title"
Set MyRS = MyDB.OpenRecordset(sSQL, dbOpenDynaset)
```

If you want to include all records from one table in a dynaset in no particular order, you can omit the SQL statement and simply use the table name as follows:

```
Set rsTitles = dbTest.OpenDatabase("titles")
```

NOTE However, using a SQL statement is a good idea in case you want to modify the record selection criteria later.

When you create a dynaset, you can use any valid SQL statement that selects records. You can also specify options that affect the dynaset's behavior. Table 26.2 lists these options.

Table 26.2 Options Used to Modify the Access Mode of a Dynaset

Option	Action
`dbDenyWrite`	Prevents others in a multiuser environment from writing to the dynaset while you have it open
`dbReadOnly`	Prevents you from making changes to the dynaset
`dbAppendOnly`	Enables you to add new records but prevents you from reading or modifying existing records
`dbSQLPassThrough`	Passes the SQL statement used to create the dynaset to an ODBC database server to be processed

For example, the following code shows how to create a dynaset-type recordset that allows the users to read the information in the database only:

```
Set rsTitles = dbTest.OpenRecordset("SELECT * FROM titles",_
 dbOpenDynaset, dbReadOnly)
```

▶ **See** "Using SELECT Statements," **p. 796**

NOTE An *ODBC server* is a database engine, such as Microsoft SQL Server or Oracle, that conforms to the Open Database Connectivity (ODBC) standards. The purpose of a server is to handle query processing at the server level and return to the client machine only the results of the query. ODBC drivers, which are usually written by the vendor of the database engine, handle the connection between Visual Basic and the database server. An advantage of using ODBC is that you can connect to the information on the database servers without having to know the inner workings of the engine. ■

You can also create a dynaset from another dynaset. One reason for doing so is that you can use the `Filter` and `Sort` properties of the first dynaset to specify the scope of records and the presentation order of the second dynaset. By creating a second dynaset, you can create a subset of your initial data. The second dynaset is usually much smaller than the first, which allows faster processing of the desired records. In the following code, a dynaset is created from a customer table to result in a national mailing list. A second dynaset is then created, which includes only the customers living in Tennessee and sorts them by zip code for further processing.

```
Dim dbMarket As Database
Dim rsCustomers As Recordset
Dim rsTNCust As Recordset
Set dbMarket = OpenDatabase(sDBLocation)
Set rsCustomers = dbMarket.OpenRecordset("customers", dbOpenDynaset)
rsCustomers.Filter = "state = 'TN'"
rsCustomers.Sort = "ZIP5"
Set rsTNCust = rsCustomers.OpenRecordset(dbOpenDynaset)
```

You might wonder why, if you need the results in the second dynaset, you can't just create it from the base tables in the first place. The answer is that you can do so if your application needs only the second table. However, consider a member tracking system in which you want access to all your members (the creation of the first dynaset), and one of the functions of the system is to generate a mailing list for a particular region (the creation of the second dynaset). Because the pointers to all the required information are already present in the first dynaset, the creation of the second dynaset is faster than if it were created from scratch.

Using Snapshots

A *snapshot,* as the name implies, is a "picture," or copy, of the data in a recordset at a particular point in time. A snapshot is similar to a dynaset in that it is created from base tables, using a SQL statement, or from a QueryDef, dynaset, or another snapshot. A snapshot differs from a dynaset in that it is not updateable. The following line of code illustrates the creation of a snapshot-type recordset:

```
Set MyRS = MyDB.OpenRecordset(sSQL, dbOpenSnapshot)
```

As a general rule, use a snapshot whenever you want a set of data that isn't time sensitive; that is, it doesn't matter whether records in the underlying database are modified after the snapshot is created. The most frequent use of snapshots in a program is to generate reports or informational screens in which the data is static.

Advantages of Using Snapshots Snapshots provide you with the following advantages:

- You can join information from multiple tables.
- You can use the `Find` methods to locate records.
- Record navigation and recordset creation can be faster for a snapshot than for a read-only dynaset because a snapshot is a copy of the data, not a set of pointers to the data.

Disadvantages of Using Snapshots The primary disadvantage of using a snapshot is that it is not an updateable recordset. In addition, you can't use an index with a snapshot to help set the order of the data or locate specific records.

> **CAUTION**
> To avoid memory constraints, make sure that a snapshot returns only a small set of records.

Setting Up a Snapshot You can create a snapshot by defining a Recordset object with the `Dim` statement and then using the `OpenRecordset` method with the `dbOpenSnapshot` parameter to assign the records to the object. As with a dynaset, you can specify optional parameters in the `OpenRecordset` method. Table 26.3 summarizes these parameters.

Table 26.3 Options Used to Modify the Access Mode of a Snapshot

Option	Action
`dbDenyWrite`	Prevents others in a multiuser environment from writing to the snapshot while you have it open
`dbForwardOnly`	Enables only forward scrolling through the snapshot
`dbSQLPassThrough`	Passes the SQL statement used to create the snapshot to an ODBC database to be processed

Using a Forward-Only Recordset

A forward-only recordset is a special type of snapshot that allows only forward scrolling through its records. This means that the `MoveFirst`, `MovePrevious`, and `Find` methods do not work on the recordset. The advantage of using this type of recordset is that it is faster than a snapshot. However, the forward-only recordset should be used only in situations in which a single pass through the recordset is needed, such as in report generation routines.

To set up a forward-only recordset, you use the `OpenRecordset` method and specify the `dbOpenForwardOnly` constant as shown in the following line of code:

```
Set MyRS = MyDB.OpenRecordset(sSQL, dbOpenForwardOnly)
```

Placing Information Onscreen

Suppose that you have written a data entry screen using the Data control and bound controls. To display information onscreen, you simply draw bound controls and then set the appropriate data fields for the controls. The display of the information is automatic. If you use Data Access Objects, the process is only slightly more involved. You still use control objects (text boxes, labels, check boxes, and so on) to display the information, but you have to assign the data fields to the correct control properties with each record displayed.

For example, you must assign the contents of a field to a text box's `Text` property or a Label control's `Caption` property. When used in this manner, the control objects are typically referred to as *unbound controls*. One advantage of using unbound controls is that you can use any control to display data, not just the bound controls specifically designated for use with the Data control.

Accessing Information from Database Fields

Information in fields can be accessed through a recordset's `Fields` collection in one of several ways. For example, any of the following techniques would suffice for retrieving the contents of a field named `ThisField` in a recordset named `rsTest` and placing it into a text box named `Text1`:

- Use the field's ordinal position in the `Fields` collection: `Text1.Text = rsTest.Fields(0)` (assuming `ThisField` is the first field in the recordset)
- Use the field's name to retrieve it from the `Fields` collection: `Text1.Text = rsTest.Fields("ThisField")`
- Take advantage of the fact that the `Fields` collection is the default collection of a recordset: `Text1.Text = rsTest("ThisField")`
- Use the shorthand version of the preceding technique: `Text1.Text = rsTest!ThisField`

NOTE If a field's name contains spaces, you can enclose the entire name in square brackets, as in `Text1.Text = rsTest![longer field name]`.

Displaying Data in the Sample Program

Now you can enhance the sample program by having it actually display the data in the database. If you have followed the instructions so far, your program creates a Database object and a Recordset object by opening the BIBLIO.MDB database and its Titles table. Continue by writing a user-defined sub procedure that displays the ISBN, title, and year published of the current record, as shown in the following steps:

1. Add three text boxes named `txtISBN`, `txtTitle`, and `txtYear`.
2. Add associated Label controls to identify the text boxes.
3. Set the labels' `Caption` properties appropriately:

- `ISBN:`
- `Title:`
- `Year Published:`

Figure 26.3 shows the form with the text boxes in place.

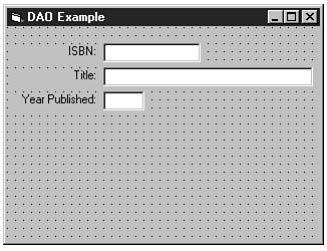


FIGURE 26.3
Use unbound controls in conjunction with Data Access Objects to display data in a database.

4. Create the following user-defined sub procedure in `frmDAOTest`'s Code window:

```
Sub ShowFields()
    TxtTitle.Text = rsTitles!Title
    TxtISBN.Text = rsTitles!ISBN
    TxtYear.Text = rsTitles![Year Published]
End Sub
```

5. Add the following lines of code to the end of the form's `Load` event procedure:

```
rsTitles.MoveFirst
Call ShowFields
```

NOTE Because the `Text` property is the default property of a text box, you do not have to include the property name in the assignment statement. My personal preference is to include the name for readability.

Positioning the Record Pointer

Because a database with only one record is fairly useless, a database engine must provide ways to move from one record to another within recordsets. Visual Basic provides six such techniques:

Technique	Description
`Move` methods	Changes the position of the record pointer from the current record to another record.
`Find` methods	Locates the next record that meets the find condition. `Find` methods work on dynasets and snapshots.
`Seek` method	Finds the first record in a table that meets the requested condition.

Technique	Description
`Bookmark` property	Identifies the location of a specific record.
`AbsolutePosition`	Moves the record pointer to a specific record position in the recordset.
`PercentPosition`	Moves the record pointer to the record property nearest the indicated percentage position in the recordset.

Each of these techniques has benefits and limitations, as described in the following sections.

Using the *Move* Methods

You can use the five different `Move` methods on any recordsets available in Visual Basic:

Move Method	Action
`MoveFirst`	Moves the record pointer from the current record to the first record in the opened recordset.
`MoveNext`	Moves the record pointer from the current record to the next record (the record following the current record) in the opened recordset. If no next record exists (that is, if you are already at the last record), the end-of-file (EOF) flag is set, and there will be no current record.
`MovePrevious`	Moves the record pointer from the current record to the preceding record in the opened recordset. If no previous record exists (that is, if you are at the first record), the beginning-of-file (BOF) flag is set, and there will be no current record.
`MoveLast`	Moves the record pointer from the current record to the last record in the opened recordset.
`Move` *n*	Moves the record pointer from the current record *n* records down (if *n* is positive) or up (if *n* is negative) in the opened recordset. If the move would place the record pointer beyond the end of the recordset (either BOF or EOF), an error occurs.

These commands move the record pointer to the record indicated based on the current order of the recordset. The current order of the recordset is the physical order, unless an index was set for a table, or a dynaset or snapshot was created with a particular order specified.

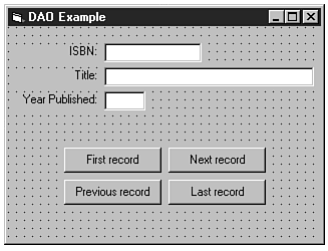
To enhance the sample project to show the use of the `MoveFirst`, `MovePrevious`, `MoveNext`, and `MoveLast` methods, follow these steps:

▶ **See** "Setting the Current Index in a Table," **p.581**

1. Add four command buttons named `cmdFirst`, `cmdPrevious`, `cmdNext`, and `cmdLast`.
2. Set their `Caption` properties as follows:
   - `First record`
   - `Next record`
   - `Previous record`
   - `Last record`

Figure 26.4 shows the form with the command buttons in place.

FIGURE 26.4
Add command buttons to enable the users to navigate through the recordset.



3. Add this code to the `Click` event procedure of `cmdFirst`:

```
rsTitles.MoveFirst
Call ShowFields
```

4. Add this code to the `Click` event procedure of `cmdPrevious`:

```
rsTitles.MovePrevious
Call ShowFields
```

5. Add this code to the `Click` event procedure of `cmdNext`:

```
rsTitles.MoveNext
Call ShowFields
```

6. Add this code to the `Click` event procedure of `cmdLast`:

```
rsTitles.MoveLast
Call ShowFields
```

When you run the project, you should be able to use the four command buttons to navigate the recordset.

The last `Move` method, `Move` *n*, lets you move more than one record from the current position. The value of *n* is the number of records to move in the recordset. This value can be either positive or negative to indicate movement either forward or backward in the recordset. The following line of code shows the use of this method to move two records forward from the current record:

```
rsTitles.Move 2
```

Using the *Bookmark* Property

Being able to return to a specific record after the record pointer moves or new records are added is often desirable. You can do so by using the `Bookmark` property of the recordset. The bookmark is a system-assigned string variable that is correlated to the record and is unique for each record in a recordset. To use a bookmark, simply create a string variable to "remember" the bookmark and set that variable to the value of the recordset's `Bookmark` property before the record pointer moves. When you need to move the record pointer back to that record, set the recordset's `Bookmark` property to the value of your bookmark variable. The following section demonstrates this technique while using the `Find` methods.

CAUTION

If you're working with a database type other than Jet, check the `Bookmarkable` property of the recordset you are using to see whether bookmarks are supported before you execute any methods that depend on the bookmarks.

Using the *Find* Methods

You can use the `Find` methods on dynasets and snapshots only. You can't use `Find` methods on table-type recordsets. (Because the sample program was created with a table-type recordset, you can't use the `Find` methods in the example.) The `Find` methods are used to locate records that meet specified criteria. You express the criteria in the same way that you specify the `Where` clause of a SQL command—except without the `Where` keyword. The four `Find` methods are as follows:

Find Method	Action
`FindFirst`	Starting at the *top* of the recordset, finds the first record in the recordset with the specified criteria
`FindNext`	Starting at the *current location* in the recordset, finds the next record down with the specified criteria
`FindPrevious`	Starting at the *current location* in the recordset, finds the next record up with the specified criteria
`FindLast`	Starting at the *bottom* of the recordset, finds the last record in the database with the specified criteria

After the `Find` method is executed, check the status of the recordset's `NoMatch` property. If `NoMatch` is `True`, the method failed to find a record that matched the requested criteria. If `NoMatch` is `False`, the record pointer is positioned at the desired record.

TIP You might want to set a bookmark prior to invoking one of the `Find` methods. Then, if a matching record is not found, you can return to the record that was current before the `Find` was attempted.

The `Find` methods work by scanning each record to locate the appropriate record that matches the specified criteria. The starting record and direction searched depend on which of the four `Find` methods you use. Depending on the size of the recordset and the criteria specified, this search operation can be somewhat lengthy. The Jet engine can optimize searches if an index is available for the search expression. If you are going to perform many searches, consider creating an index for the field or fields in the base table.

When a `Find` method is successful, the record pointer moves to the new record. If a `Find` method is not successful, the recordset's `NoMatch` property is set to `True` and the record pointer does not move. One way to use the `NoMatch` property is to write an `If` condition that checks the value.

Listing 26.1 shows the use of the `FindFirst` method to look for records based on user-defined criteria.

Listing 26.1 FINDTEST.TXT—Using *FindFirst* to Look for a Record

```
Private Sub cmdFindFirst_Click()
    Dim sCriteria As String
    Dim sBkmark As String

    'Build the criteria string
    sCriteria = "title like '*" & txtFind.Text & "*'"

    'Remember where we were in case Find fails
    sBkmark = rsTitles.Bookmark

    'Execute the Find
    rsTitles.FindFirst sCriteria

    'Check for success
    If rsTitles.NoMatch Then
        MsgBox "Record not found!"
        'If failed, return to last good record
        rsTitles.Bookmark = sBkmark
    End If

    'Fill the text boxes
    ShowFields

End Sub
```

TIP In many cases, re-creating a dynaset using the search criteria is faster than using the `Find` methods to process all matching records. You can also create a second filtered dynaset from the first dynaset by using the search criteria as the filter condition. The best technique depends on the amount of data, size of each record, as well as other factors. Try different approaches with your data to see what's best for a given situation.

Cannot bind… Error

When you use variables as the value to be compared to, you might encounter the error `Cannot bind name` *`item`* when you run the program. When the field and the variable you are comparing are string (or text) variables, surround the variable name with single quotation marks (`'`), as shown in the following sample code:

```
Dim sFindCrit As String, sFindStr As String
sFindStr = "Smith"
sFindCrit = "Lastname = '" & FindStr & "'"
rsTest.FindFirst FindCrit
```

For the sake of readability, you can also assign the single quotation mark to a constant and use that constant in your code.

In the same manner, surround a date variable with the pound symbol (#) to compare it to a date field. You don't need to include any additional symbols when comparing numbers.

Setting the Current Index in a Table

You can use an index with a table to establish a specific order for the records or to work with the `Seek` method to find specific records quickly. For an index to be in effect, the `Index` property of the table must be set to the name of an existing index for the table. An example of how to use a program command to set the current index follows:

```
rsTest.Index = "NameIndex"
```

The index specified for the table must be one that has already been created and is part of the indexes collection for the given table. If the index does not exist, an error occurs. The index is not created for you. To learn about creating a new index, see the section "Creating a New Index" later in this chapter.

NOTE An index does not change the actual order of records in a table; it simply changes the order in which they are retrieved from the table and the order in which the table's records are searched.

Using the *Seek* Method

Using the `Seek` method is the fastest way to locate an individual record in a table; however, it is also the most limiting of the record-positioning methods. The following list outlines the limitations of the `Seek` method:

- This method can be performed only on a table; you can't use it with a dynaset or snapshot.
- This method can be used only with an active index; the parameters of the `Seek` method must match the fields of the index in use.
- This method finds only the first record that matches the specified index values; subsequent uses do not find additional matching records.

How the *Seek* Method Works The `Seek` method consists of the method call, the comparison operator, and the values of the key fields. The comparison operator can be <, <=, =, >=, >, or <>. The key values being compared must be of the same data type as the fields in the controlling index. Although you are not required to include the same number of key values as there are fields in the index, you do have to include a key value for each field you want to search. These values must appear in the same order as the fields in the index and be separated by commas. Listing 26.2 illustrates the use of the `Seek` method twice. The first part of the listing shows how to use `Seek` with an index based on one field; the second part uses an index based on two fields.

Listing 26.2 SEEKTEST.TXT—Using the *Seek* Method to Find a Specific Record in a Table

```
Dim dbTest As Database, rsDealers As Recordset

Set dbTest = OpenDatabase("C:\MARKET\MARKET.MDB")
Set rsDealers = dbTest.OpenRecordset("Dealers", dbOpenTable)
```

continues

Listing 26.2 Continued

```
'************************
'* SEEKING A DEALER ID *
'************************
'  The IDIndex index is based on the DealerID field.

'Set the recordset's index to the ID index
rsDealers.Index = "IDIndex"

'Look for dealer number 9534
rsDealers.Seek "=", 9534

'Display information or "Not Found" message as appropriate
If rsDealers.NoMatch Then
   MsgBox "Not Found"
Else
   MsgBox rsDealers!LastName & ", " & rsDealers!FirstName
End If

'*************************
'* SEEKING A DEALER NAME *
'*************************
'  The NameIndex index is based on the
'    LastName and FirstName fields.

'Set the recordset's index to the name index
rsDealers.Index = "NameIndex"

'Look for dealer named "Barbara Austin"
rsDealers.Seek "=", "Austin", "Barbara"

'Display information or "Not Found" message as appropriate
If rsDealers.NoMatch Then
   MsgBox "Not Found"
Else
   MsgBox rsDealers!LastName & ", " & rsDealers!FirstName
End If
```

You must carefully plan for one behavior of the `Seek` method. When the `Seek` method uses the comparison operators `=`, `>=`, `>`, or `<>`, `Seek` starts with the first record for the current index and scans forward through the index to find the first matching occurrence. If the comparison operator is `<` or `<=`, `Seek` starts with the last record in the table and scans backward through the table. If the index has unique values for each record, this search order presents no problem. However, if duplicate index values exist for the key fields being specified, the record found depends on the comparison operator and the sort order of the index. Figure 26.5 shows a table of first and last names indexed on last name and then first name. The table on the left is indexed in ascending order; the table on the right is indexed in descending order. Table 26.4 shows the results of different `Seek` operations that can be performed on this table.

FIGURE 26.5
These tables show the difference between using ascending and descending order in an index.

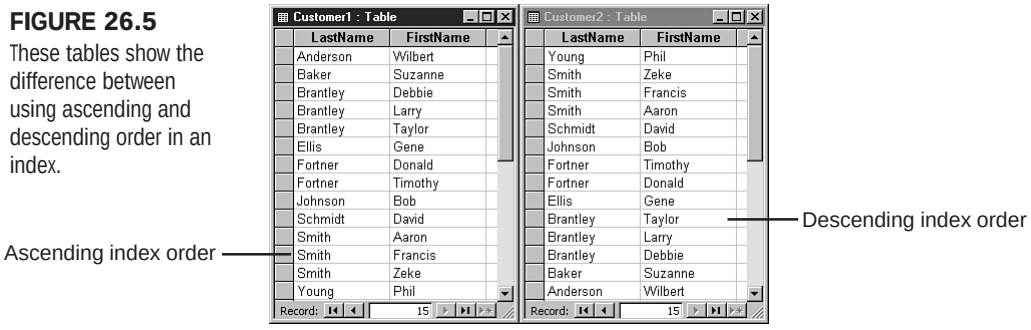


Table 26.4 Different *Seek* Comparison Operators and *Index* Sort Orders Yield Different Results

Seek Comparison Operator	*Index* Order	Resulting Record
`">="`, `"Smith, A"`	Ascending	Smith, Aaron
`"<="`, `"Smith, Z"`	Ascending	Smith, Francis
`">="`, `"Smith, A"`	Descending	Schmidt, David
`"<="`, `"Smith, Z"`	Descending	Smith, Zeke

Notice that you must also be careful when using the > ,< , >=, or <= operator on a descending index. The > (and >=) operator finds the record that occurs later in the index than the specified key value. For that reason, the "`>=", "Smith"` search on a descending index returns the record `Schmidt, David`. Similar behavior is exhibited by the < and <= operators. As you can see from the preceding example, you must use care when choosing both the index sort order and the comparison operator with the `Seek` method to ensure that the desired results are achieved.

As with the `Find` methods, if a `Seek` is successful, the record pointer moves. Otherwise, the recordset's `NoMatch` property is set to `True`, and the record pointer does not change.

Enabling a Sample *Seek* Now you can enhance the sample project to perform a `Seek`. Because the users shouldn't be expected to type an entire book title to find a match, you can use >= as the seek comparison. This means that even if `NoMatch` is false, indicating a successful `Seek`, you need to look at the current record to make sure it meets the users' criteria. Follow these steps:

1. Add a text box named `txtSearch` to the form.
2. Add a label to identify the text box, and set its `Caption` property to `Search for:`.
3. Add a command button named `cmdSeek`, and set its `Caption` property to `Search`.

   Figure 26.6 shows the form with the new controls added.

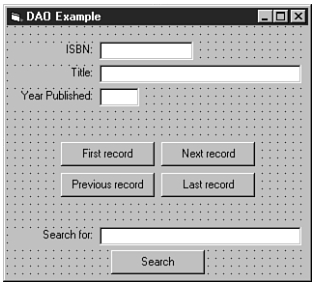


FIGURE 26.6
The Search button presents the users with an opportunity to enter search conditions.

4. Add the following code to the `Click` event procedure of `cmdSeek`:

```
Dim sBkmark As Variant, sSeek As String
rsTitles.Index = "Title"
sBkmark = rsTitles.Bookmark
sSeek = UCase(txtSearch.Text)
rsTitles.Seek ">=", sSeek
If rsTitles.NoMatch Then
    MsgBox "No match!"
    rsTitles.Bookmark = sBkmark
Else
    If UCase(Left(rsTitles!Title, Len(sSeek))) <> sSeek Then
        MsgBox "No match!"
        rsTitles.Bookmark = sBkmark
    End If
End If
ShowFields
```

Using the *PercentPosition* and *AbsolutePosition* Properties

In addition to the `Bookmark` property, the Recordset object has two other properties that you can set to establish the position of the record pointer. These properties are `PercentPosition` and `AbsolutePosition`.

The `PercentPosition` property specifies the approximate position in a recordset where a record is located. By setting this property to a value between 0 and 100, you cause the pointer to move to the record closest to that location. Setting the property to a value outside the range causes an error to occur. You can use the `PercentPosition` property with all three types of recordsets.

The `AbsolutePosition` property enables you to tell the recordset to move to a specific record. The value of the property can range from 0 for the first record in the recordset to 1 less than the number of records. Setting a value outside that range causes an error. Therefore, including error checking in the code used to set the `AbsolutePosition` property is a good idea. The `AbsolutePosition` property can be used only with dynasets and snapshots. The following code shows how you can use the `AbsolutePosition` and `PercentPosition` properties. Note the validation of the requested position; it is used to prevent errors:

```
'Move to the percent position specified
If fPct > 100 Then fPct = 100
If fPct < 0 Then fPct = 0
NewDyn.PercentPosition = fPct
 'Move to the absolute position specified
If lAbs > rsTest.RecordCount Then lAbs = NewDyn.RecordCount
If lAbs < 0 Then lAbs = 0
NewDyn.AbsolutePosition = lAbs
```

Using Filters, Indexes, and Sorts

Filters, indexes, and sorts are properties of the recordset object. You can set these properties using an assignment statement such as this one:

```
rsTest.Filter = "LastName = 'Smith'"
```

Filters, indexes, and sorts enable you to control the scope of records being processed and the order in which records are processed. *Filters* (which are available only for dynasets and snapshots) limit the scope of records by specifying that they meet certain criteria, such as "last name starts with *M*." *Indexes* (available only for tables) and *sorts* (available only for dynasets and snapshots) specify the order of a recordset based on the value of one or more fields in the recordset. For sorts and indexes, you can also specify ascending or descending sort order.

Setting the *Filter* Property

The `Filter` property is available only for dynasets and snapshots. Although the following discussion refers only to dynasets, the same statements hold true for snapshots. When set, the `Filter` property does not affect the current dynaset, but filters records that are copied to a second dynaset or snapshot created from the first.

You can specify the `Filter` property of a dynaset the same way you specify the `Where` clause of a SQL statement, but without the `Where` keyword. The filter can be a simple statement, such as `State = 'TN'`, or one that uses multiple conditions, such as `State = 'AR' AND Lastname = 'Smith'`. You can also use an expression, such as `Lastname LIKE 'S*'`, to find people whose last names begin with *S*. See the section "Setting Up a Dynaset" earlier in this chapter for an example of creating a new recordset by using the `Filter` property.

You can include added flexibility in your `Filter` conditions by using functions in the condition. For example, if you want to filter a dynaset of all states with the second letter of the state code equal to *L*, use the `Mid` function, as shown here:

```
rsTest.Filter = "Mid(State,2,1) = 'L'"
```

Using functions does work, but it is an inefficient way to filter a dynaset. A better approach is to include the condition in the query used to create the dynaset in the first place.

More About Filters

The `Filter` condition of the dynaset has no effect on the current dynaset—only on secondary dynasets created from the current one. The only way to "filter" the existing recordset is to move through the recordset with the `Find` methods. By setting the `Find` condition to your `Filter` condition, you process only the records you want.

If you work with only the filtered dynaset, creating the required dynaset using the appropriate SQL clause in the `OpenRecordset` method is more efficient.

Setting the *Sort* Property

As with the `Filter` property, the `Sort` property is available only for dynasets and snapshots. Although the following discussion refers only to dynasets, the same statements apply to snapshots. You can specify the `Sort` property by providing the field names and order (ascending or descending) for the fields on which the dynaset is to be sorted. You can specify any field or combination of fields in the current dynaset. The `Sort` condition is similar to the `ORDER BY` clause of a SQL statement. You can use the `Sort` property to create a recordset much like you used the `Filter` property in the preceding section. For example, the following statement specifies a sort order of last name followed by the birthdate:

```
rsTest.Sort = "LastName, Birthday"
```

CAUTION

When you are specifying a multiple field sort, the order of the fields is important. A sort on first name and then last name yields different results than a sort on last name and then first name.

You can also achieve the same results of a sorted dynaset in a more efficient manner by specifying the `ORDER BY` clause of the SQL statement used to create the dynaset.

Creating a New Index

In the earlier section "Setting the Current Index in a Table," you learned how to specify the index used in a database search. If the index you want does not exist, you can create it by using a few lines of code.

First, use the `CreateIndex` function of a `Table` object to create the new index object. Then add fields to the index object with its `Append` method, as in the following lines of code:

```
Dim Idx1 As Index
Dim Fld1 As Field
Set Idx1 = NewTbl.CreateIndex("Zip_Code")
Set Fld1 = Idx1.CreateField("Zip")
Idx1.Fields.Append Fld1
```

The preceeding lines of code set up a new index called "Zip Code." In order to use this index, you need to append it to the `Indexes` collection of the table and set the table object's `Index` property to the name of the index:

```
NewTbl.Indexes.Append Idx1
NewTbl.Index = "Zip_Code"
```

If your program needs an index, why not just create it at designtime so you don't have to worry about creating it at runtime? There are several reasons for not doing this:

- It takes time for the data engine to update indexes after records are added, deleted, or changed. If there are a large number of indexes, this process can be quite time-consuming. It may be better to create the index only when it is needed. Also, indexes take up additional disk resources; so many indexes on a large table can cause your application to exceed available resources.
- You are limited to 32 indexes for a table. Although this is a fairly large number, if you need more than 32, you must create some indexes as they are needed and then delete them.
- You may not be able to anticipate all the ways a user of your application wants to view data. By providing a method for creating indexes, specified by the user at runtime, you add flexibility to your application.

Of these reasons, the performance issue of updating multiple indexes is the one most often considered. To determine whether it is better to add the index at designtime or to create it only when you need it, set up the application both ways and test the performance of each.

NOTE Although it is desirable to limit the number of indexes your table has to keep current, it is advisable to have an index for each field that is commonly used in SQL queries. This is because the Jet engine (starting with version 2.0) employs query optimization that uses any available indexes to speed up queries. ■

Considering Programs That Modify Multiple Records

Some programs, or program functions, are meant to find one specific piece of information in a database. However, the vast majority of programs and functions work with multiple records as a group. There are two basic methods of working with multiple records:

Method	Definition
Program loops	Groups of commands contained inside a `Do...While`, `Do...Until`, or `For...Next` programming structure. The commands are repeated until the exit condition of the loop is met.
SQL statements	Commands written in Structured Query Language that tell the database engine to process records. SQL is covered in detail in Appendix C, "SQL Summary."

Using Loops

Most programmers are familiar with the use of `Do...While` and `For...Next` loops. When you are working with recordsets, all the programming principles for loops still apply. That is, you can perform a loop *while* a specific condition exists or *for* a specific number of records.

Another way of working with multiple records forms an *implied loop*. Most data entry or data viewing programs include command buttons on the form to move to the next record or previous record. When users repeatedly click these buttons, they execute a type of program loop by repeating the move events. Special considerations for this type of loop are what to do when you are at the first record, the last record, or if you have an empty recordset. The problem is that if you move backward from the first record, forward from the last record, or try to move anywhere in an empty recordset, an error occurs. Fortunately, the Jet database engine provides some help in this area. Some properties of the recordset can tell you when these conditions exist, as described in the following section.

You can use four main recordset properties to control the processing of multiple records in a recordset. Table 26.5 gives the definitions of these properties.

Table 26.5 Properties Used to Control Loop Processing

Property	Description
`BOF`	Beginning-of-file flag, indicates whether the record pointer is positioned before the first record (`BOF = True`) or not (`BOF = False`).
`EOF`	End-of-file flag, indicates whether the record pointer is positioned past the last record (`EOF = True`) or not (`EOF = False`).
`RecordCount`	Indicates the number of records in the recordset that have been accessed. This number gives a count of the total records in the recordset only after the last record is accessed (for example, by using `MoveLast`), unless the recordset in question is a table-type recordset.
`NoMatch`	Indicates that the last `Find` method or `Seek` method was unsuccessful in locating a record that matched the desired criteria.

You can use these properties to terminate loops or prevent errors. Consider the data entry form in Figure 26.3. To prevent an error from occurring when users clicks the Next Record button, use code that allows the move only if the recordset is not at the end of the file. The following code takes this possibility into account:

```
If Not rsTitles.EOF Then
        rsTitles.MoveFirst
        If rsTitles.EOF Then
            rsTitles.MoveLast
        End If
    End If
    Call ShowFields chuck
```

Alternatively, you can disable the Next button when you reach the end of the file. You can apply one of these principles to the Previous button and the `BOF` condition. You might also want to check the `RecordCount` property of a recordset and enable only the Add Record button if the count is zero.

After the `MoveNext` method is executed, the pointer may now be at the end of the file (EOF). If so, no current record exists. Therefore, if the end of the file is encountered, a `MoveLast` method is used to make sure the record pointer is positioned at the last record in the recordset. ■

Using SQL Statements

In addition to processing records with a program loop, you can use SQL statements to handle a number of functions that apply to multiple records. The following sections discuss two main types of functions:

- Calculation queries, which provide cumulative information about the requested group of records.
- Action queries that insert, delete, or modify groups of records in a recordset.

For a more in-depth discussion of the SQL language, see Appendix C, "SQL Summary."

Calculation Queries Calculation queries allow you to determine cumulative information about a group of records such as the total; average, minimum, and maximum values; and the number of records. They work by specifying calculation functions built-in to the SQL language. You can also specify the filter criteria for the records using the standard `WHERE` clause. For example, you can extract total sales for all salesmen in the Southeast region or the maximum price of a stock on a given day (assuming, of course, that the base data is in your tables).

Suppose you have a database table that contains records for fish sales. Each record has a code to identify the amount of the sale and the type of fish. Consider the following lines of VB code:

```
sSQL = "SELECT SUM([Price]) As GrandTotal FROM FishSales WHERE Fishcode = 1001"
Set rsTotal = dbFish.OpenRecordset(sSQL)
Msgbox "Grand Total = " & rsTotal("GrandTotal")
```

The key to understanding the example SQL statement is the `SUM` function, which adds each value of the `Price` field together. The returned recordset has a single field called `GrandTotal`, which contains the result.

In addition to `SUM`, there are several other SQL functions which return calculated values. For example, the following SQL statement could be used to calculate the minimum, maximum, and average price of fish from the table:

```
SELECT MIN(Price) As MinPrice, AVG(Price) As AvgPrice, MAX(Price) As MaxPrice
FROM FishSales
```

The calculation query produces a dynaset with a single record containing the results. Using a calculation query can replace many lines of program code that would be required to produce the same results. In addition, a query is usually faster than the equivalent program code because the calculation is performed by the database engine rather than your own Visual Basic code.

Action Queries Action queries operate directly on a recordset to insert, delete, or modify groups of records based on specific criteria. As with calculation queries, action queries perform the same work that would require several lines of program code. The following lists several types of action queries:

- **Updating a field value**—The SQL `UPDATE` statement can be used to change the value of multiple fields and multiple records, as in the following example:

  ```
  UPDATE FishSales SET Price=Price*2 WHERE FishCode=1001
  ```

  The sample `UPDATE` statement causes the value of the `Price` field to be doubled for each record where the value of the `FishCode` field is equal to 1001.
- **Deleting records**—The `DELETE` statement allows you to remove records from a table:

  ```
  DELETE From FishSales WHERE FishCode=1001 AND Price > 100
  ```

  Be careful when using the DELETE statement—if you leave out the WHERE clause, every record will be deleted!
- **Adding new records**—The `INSERT` statement allows you to specify the field values for a new record. The following example lists the new fields in a `Values()` clause in the same order as the destination table:

  ```
  INSERT INTO FishSales Values(1002,19.95)
  ```

  Note that if your table contains an `AutoNumber` field you do not specify a value in the `INSERT` statement.

In order to use an action query, you can just use the SQL statement as a parameter to the `Database` object's `Execute` method, as in the following example:

```
dbFish.Execute "INSERT INTO FishSales Values(1003,299.00)"
```

If your query will be executed repeatedly or contains parameters, you may want to create a `QueryDef` object containing the SQL statement:

```
Dim NewQry As QueryDef
Set NewQry = dbFish.CreateQueryDef("MyQueryDef","DELETE FROM FishSales")
NewQry.Execute
dbFish.DeleteQueryDef("MyQueryDef")
```

Notice that action queries do not return records, so you do not need any recordset objects in your code. Although the types of actions performed by such queries could be achieved by retrieving a recordset from the database and using methods such as `AddNew` and `Delete`, an action query is usually more efficient because it is handled by the database engine.

Understanding Other Programming Commands

So far in this chapter, you have learned how to find specific records and how to move through a group of records. However, in most programs, you also must add, modify, and delete records. The commands covered in the following sections apply only to tables and dynasets (remember that snapshots are not updateable).

Adding Records

To add a new record to a recordset, use the `AddNew` method. `AddNew` does not actually add the record to the recordset; it clears the copy buffer to allow information for the new record to be

input. After invoking AddNew, your program can populate the fields by treating them like variables. Finally, to add the record physically after you put data into the record's fields, use the Update method. The following lines of code illustrate this technique:

```
'Prepare a new record in the copy buffer
rsTest.AddNew

'Populate the new record's fields
rsTest!FirstName = "Casey"
rsTest!LastName = "Jones"

'"Save" the changes with Update
rsTest.Update
```

CAUTION

Because AddNew places information only in the copy buffer, reusing the AddNew method or moving the record pointer with any Move or Find method (before using the Update method) clears the copy buffer. Any information entered in the new record up to that point is therefore lost.

Editing Records

In a manner similar to adding a record, you use the Edit method to make changes to a record. The Edit method places a copy of the current record's contents into the copy buffer so that information can be changed. As with AddNew, the changes take effect only when the Update method is executed.

To edit a record, first provide a way for the users to locate the record that they want to modify. You can use one or more of the techniques described earlier in this chapter to accomplish this task. After you locate the record you want (and make it the current record), invoke the Edit method. Then you can populate the fields (most likely obtaining the new information from the users) and finally invoke the Update method. This technique is illustrated in the following lines of code:

```
rsTest.Edit
rsTest!FirstName = txtFirstName.Text
rsTest!LastName = txtLastName.Text
rsTest.Update
```

CAUTION

Because Edit only places information in the copy buffer, reusing the Edit method or moving the record pointer with any Move or Find method (before using the Update method) clears the copy buffer. Any information entered in the record is therefore lost.

Updating Records

As you learned in the previous two sections, you use the Update method in conjunction with the AddNew and Edit methods to make changes to the recordsets. The Update method writes

the information from the copy buffer to the recordset. In the case of `AddNew`, `Update` also creates a blank record in the recordset to which the information is written. In a multiuser environment, the `Update` method also clears the record locks associated with the pending `Add` or `Edit` method.

NOTE If you use Data controls to work with recordsets, the use of the `Update` method is not required. An update is automatically performed when a move is executed by the Data control.

Deleting Records

Deleting a record requires the use of the `Delete` method. After you locate the appropriate record (and make it current), invoking the recordset's `Delete` method permanently removes the record from the table. This method removes the record from the recordset and sets the record pointer to a null value. The `Delete` method is illustrated in this line of code:

```
RsTest.Delete
```

CAUTION

After you delete a record, it is gone without warning. You can recover the record only if you issued a `BeginTrans` command before you deleted the record, in which case you can use `RollBack` to recover the transaction. Otherwise, the only way to get the information back into the database is to re-create the record by using the `AddNew` method.

NOTE Deletions and changes to the database are made without confirmation by the users. If you want your program to have confirmation built in, you have to provide it in your code. The easiest way to do so is through the `MsgBox` function. With this function, you can provide a warning to the users and ask for confirmation.

Introducing Transaction Processing

Transaction processing enables you to treat a group of changes, additions, or deletions to a database as a single entity. This capability is useful when one change to a database depends on another change, and you want to make sure that all changes are made before any of the changes become permanent. For example, you have a point-of-sale application that updates inventory levels as sales are made. As each item is entered for the sales transaction, a change is made to the inventory database. However, you want to keep only the inventory changes if the sale is completed. If the sale is aborted, you want to return the inventory database to its initial state before the sale was started. Transaction processing is a function of the Workspace object and, therefore, affects all databases open in a particular workspace.

Visual Basic provides three methods for transaction processing. These methods perform the following functions:

Transaction Method	Function
`BeginTrans`	Starts a transaction and sets the initial state of the database.
`RollBack`	Returns the database to its initial state before the `BeginTrans` statement was issued. When `RollBack` is executed, all changes made after the last `BeginTrans` statement are discarded.
`CommitTrans`	Permanently saves all changes to the database made since the last `BeginTrans` statement. After the `CommitTrans` statement is issued, the transactions cannot be undone.

Listing 26.3 shows the `BeginTrans`, `RollBack`, and `CommitTrans` methods as they are used in an order entry application. The transactions are used in case a customer cancels an order prior to the completion of the order processing.

Listing 26.3 TRANSACT.TXT—Using Transaction Processing to Handle Multiple Changes to a Database as One Group

```
OldWs.BeginTrans
'**********************************************
'Perform loop until user ends sales transaction
'**********************************************
Do While Sales
'**********************************************
'Get item number and sales quantity from form
' Input Itemno,SalesQty
' Find item number in inventory
'**********************************************
   Inv.FindFirst "ItemNum = " & Itemno
'*************************
'Update inventory quantity
'*************************
   Inv.Edit
   Inv("Quantity") = Inv("Quantity") - SalesQty
   Inv.Update
Loop
'****************************************
'User either completes or cancels the sale
'****************************************
If SaleComp Then
   OldWs.CommitTrans
Else
   OldWs.Rollback
End If
```

From Here...

This chapter introduced you to Database Access Objects, which provide a way to work with databases from Visual Basic. Understanding DAO provides a good foundation for other data access technologies, such as RDO and ADO. The best way to learn more about DAO is to try some of the ideas discussed on the sample databases included with VB, such as the BIBLIO database. For newcomers, I suggest you make a backup copy of the sample database so you do not have to worry about destroying it.

Some of the topics mentioned in this chapter are covered in greater detail in other portions of the book. Refer to these chapters:

- For a recap of more fundamental database concepts, see Chapter 24, "Database Basics."
- To learn about a data access interface designed for client/server databases, see Chapter 27, "Using Remote Data Objects (RDO)."
- To find out about the method of data access that will eventually replace DAO and RDO, see Chapter 28, "Using ActiveX Data Objects (ADO)."
- The SQL language is discussed in more detail in Appendix C, "SQL Summary."

CHAPTER 27

Using Remote Data Objects (RDO)

In this chapter

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So far in the discussions of accessing databases, the focus has been on using PC-based databases. These types of databases include Access, FoxPro, dBase, and Paradox. However, Visual Basic is also a great tool for creating front ends for client/server applications. These types of applications are used to access data stored in database servers such as SQL Server and Oracle. Most of your front-end work—such as designing forms and writing code to process information—will be the same whether you are writing an application for a PC database or a client/server database. The key difference is in how you make the connection to the data.

This chapter discusses how your Visual Basic programs can easily access data stored in a variety of remote locations through the use of Remote Data Objects (RDO). You'll see how the addition of RDO to Visual Basic's repertoire makes short work of writing applications that need to work with remote data.

Database Access Philosophies

Before delving further into actually setting up applications that access client/server databases, you'll take a look at the difference in the philosophy of the two types of database access. In the PCdatabase world, information is accessed through the *database engine*, which is part of the application. For Visual Basic, the Jet engine is a part of your database applications. As you issue commands to retrieve information from the database, the commands are interpreted by the Jet engine and the processing of the commands is done locally on your PC. Regardless of whether the database file actually resides on your PC or is located on a file server, the database engine remains on your PC. The application itself contains the logic to directly access the database file. In the client/server world, this is not the case. Your application issues a request for information, usually in the form of a SQL statement. This request is passed to the database server, which processes the request and returns the results. This is true client/server computing, in which a database server does the actual processing of the request.

Client/server systems have a number of advantages over just sharing a database file. First, database logic is removed to a central, more maintainable location. For example, suppose you have a program that calculates sales tax based on your company's rules. In a client/server environment, the logic for this calculation process would be located on the database server. This means you can make changes to it in one place, without having to rewrite the client application. Other advantages include being able to distribute processing and separating the user interface design from the business logic.

Working with ODBC

One method used by Visual Basic to communicate with client/server databases is called *Open Database Connectivity*, or ODBC. ODBC is a component of Microsoft's *Windows Open System Architecture* (WOSA). ODBC provides a set of *application program interface* (API) functions, which makes it easier for a developer to connect to a wide range of database formats. Because of the use of ODBC standards, you can use the same set of functions and commands to access information in a SQL Server, Oracle, or Interbase server, even though the actual data-storage

systems are quite different. You can even access a number of PC databases using ODBC functions.

Understanding ODBC Drivers

ODBC drivers are the DLLs containing the functions that let you connect to various databases. There are separate drivers for each database type. For many standard formats, such as PC databases and SQL Servers, these drivers are provided with Visual Basic. For other databases, the ODBC driver is provided by the server manufacturer.

NOTE If you use ODBC in your application, make sure the appropriate drivers are distributed with your application. If you selected the Redistributable ODBC option when installing VB, an ODBC subdirectory should have been created in the Visual Basic program directory. Running SETUP.EXE installs ODBC drivers, although you still have to set up your data sources.

ODBC drivers can be one of two types: *single-tier* or *multiple-tier*. A single-tier driver is used to connect to PC-based database systems that may reside on either the local machine or a file server. Multiple-tier drivers are used to connect to client/server databases where the SQL statement is processed by the server, not the local machine.

Each ODBC driver you encounter must contain a basic set of functions, known as the *core-level capabilities*. These basic functions are as follows:

- Providing database connections
- Preparing and executing SQL statements
- Processing transactions
- Returning result sets
- Informing the application of errors

Setting Up an ODBC Data Source

Before you can use ODBC to connect to a database, you must make sure of two things:

- The ODBC drivers are installed on your system.
- You have set up the ODBC data source.

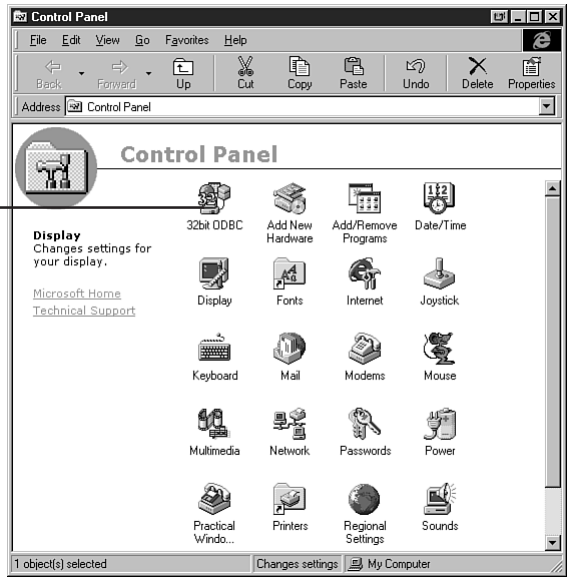
Both of these functions can be accomplished by using the ODBC Manager application. Also, the second function can be accomplished from code, by using the data access objects. Remember, an ODBC driver is used to connect to a *type* of database, for example, SQL Server. An ODBC Data Source is a configuration of an ODBC driver used to connect to a *specific database*, for example, Accounting Department Database.

NOTE On Microsoft Windows 95 and 98 systems, you will find the ODBC manager in the Control Panel, under the Settings item on the Start menu. The icon you are looking for is labeled "32-bit ODBC." You might also have an icon called "ODBC" if you have some older 16-bit programs.

NOTE To ensure that all readers can use the information presented here, the Access ODBC driver is used in all examples. Although this is a PC database, the methods used can also be applied to server databases. It is important to remember that connecting to an Access .MDB file via ODBC is different than connecting directly through the Jet engine.

Gaining Access to ODBC Drivers To set up the ODBC Data Sources on your system, you need to use the Windows ODBC Data Source Administrator. You will find this in the Control Panel, which is accessible by choosing the Control Panel item from the Settings submenu on the Start menu. The Control Panel is illustrated in Figure 27.1.

FIGURE 27.1
The ODBC Data Source Administrator is accessed by selecting the 32bit ODBC icon on the Control Panel.



The ODBC Administrator Dialog Box

If you see different dialog boxes than the ones pictured here when you click the 32-bit ODBC icon, don't panic. As with any product, Microsoft has produced several versions of ODBC. ODBC is included with many of its products, including Office and Visual Basic. Depending on the installation options you chose, you may or may not have the latest version. Older versions of ODBC do not have the tabbed dialog box style. Fortunately, ODBC is included with VB so you can install it during setup.

When you open the ODBC Manager, you see the ODBC Data Source Administrator dialog box, as shown in Figure 27.2. The Data Source administrator includes several tabs used to add data sources as well as new ODBC drivers.

As you might notice, the titles of the first three tabs in the dialog box end in the letters *DSN*. DSN is an abbreviation for *Data Source Name*. The DSN is the key that your program uses to identify an ODBC Data Source. ODBC takes care of mapping the DSN to the actual driver, server, and database file.

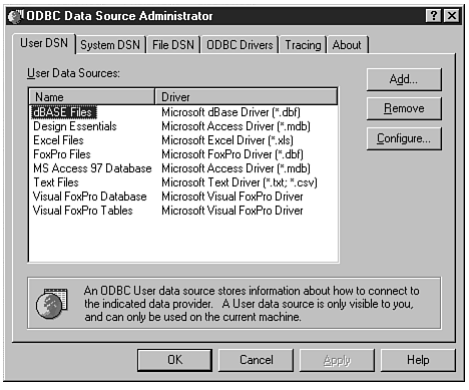


FIGURE 27.2
The Data Source Administrator dialog box allows you to configure ODBC data sources.

The ODBC Data Sources are divided into three types: user, system, and file. Although the purpose of all DSNs is essentially the same—to provide information about a specific data source—there are differences in where and when you can use each type:

- A System DSN, more applicable in Windows NT than Windows 95/98, is not associated with a particular user profile. This means that after the DSN has been set up, all programs and services running on the machine can access it. For example, if you are using Internet Information Server to connect to a database, you will probably be setting up a System DSN for the database.
- A File DSN stores DSN information in a text file. The text file is an INI file containing information about the database driver and location. It is not associated with a particular machine, so it can be on a network drive.
- A User DSN is the type you will probably use most often. User DSN information is stored in the Registry of the local machine. In Windows NT, each user DSN is associated with a specific user profile and invisible outside of it.

The remaining three tabs in the ODBC Data Source Administrator dialog box are used for informational and debugging purposes. The ODBC Drivers tab, shown in Figure 27.3, displays a list of the ODBC drivers installed on your machine.

The last tab, the About tab, is very similar to the ODBC Drivers tab. It lists the versions and files used by ODBC itself. You might find these two screens helpful in determining whether or not your users have the correct drivers installed.

Before moving on, notice the Tracing tab, pictured in Figure 27.4. This tab allows you to trace each call made by the ODBC Manager to the ODBC Drivers. Remember that ODBC is a means to connect to various databases via some common API functions. The Tracing options allow you to view those API calls. This is something you probably won't do very often, but it is nice to know about.

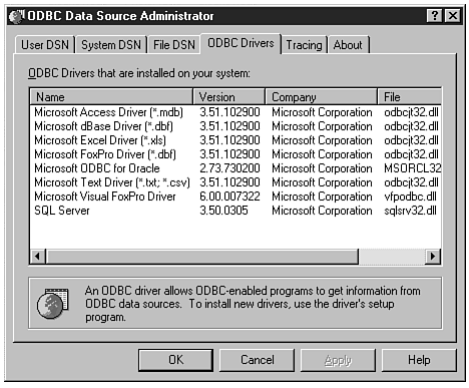


FIGURE 27.3
The ODBC Drivers tab tells you which drivers are installed on your system.

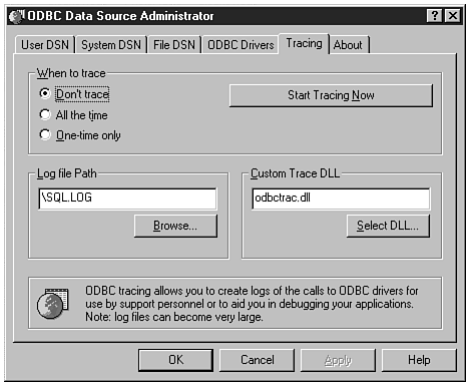


FIGURE 27.4
The Tracing tab of the ODBC Administrator is a low-level debugging aid.

Creating an ODBC Source with the ODBC Manager To set up a data source for use in your application, you need to know which driver to use and how to configure it. For example, you need to know the name of the SQL server or Access MDB file the data resides in. You also need to come up with a unique name to identify the data source.

Set up a sample data source now. Go to the User DSN screen and click the Add button to create a new data source. This presents you with the Create New Data Source dialog box, shown in Figure 27.5. In this first dialog box, you choose the ODBC driver that will be used to access the data.

After choosing the driver and clicking the OK button, you are presented with the Setup dialog box for the particular database type associated with the driver. Choose the Microsoft Access Driver and press the Finish button. You are presented with a dialog box like that in Figure 27.6.

In this dialog box, you provide a name in the Data Source Name box. This is the name you will use in your applications to refer to the data source. You can also choose to include a Description of the data source.

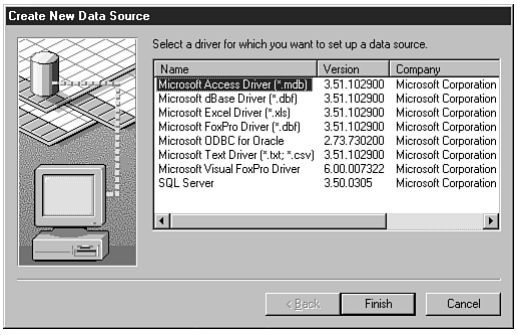


FIGURE 27.5
Selecting the ODBC driver is the first step to setting up a data source.

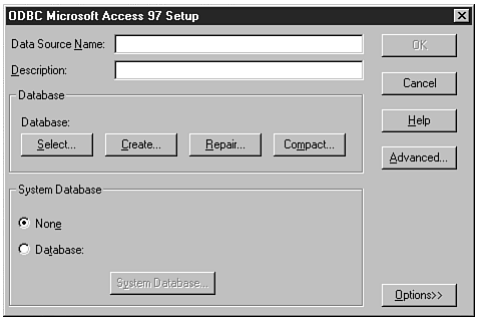


FIGURE 27.6
A Setup dialog box lets you specify the information necessary to connect to an ODBC data source.

After setting the name, you need to choose the actual database file or server you want to use with your program. For the Access driver, this is done by clicking the Select button of the dialog box. You are then presented with a Select Database dialog box (which is basically an open-file dialog box). Try it by choosing an MDB file on your PC. Figure 27.7 shows a data source called MyDSN linked to the biblio database that comes with Visual Basic.

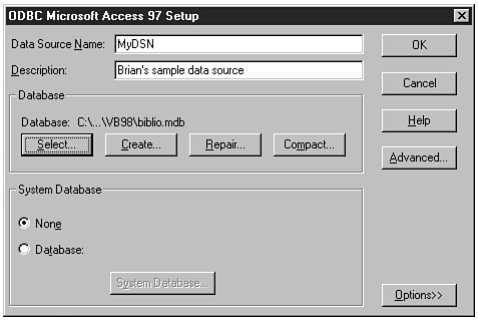
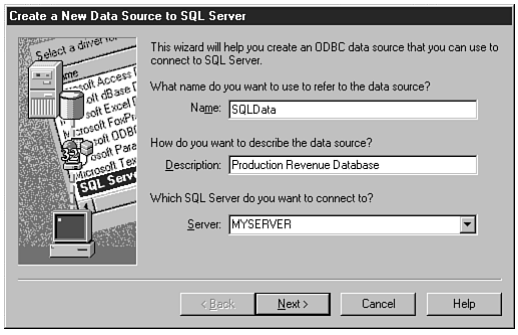


FIGURE 27.7
The Access dialog box allows you to select which MDB file you are going to be working with.

Keep in mind that the setup dialog boxes are driver dependent. In each case, however, you specify both a data-source name and the location of the data. Figure 27.8 shows the dialog box for Microsoft SQL Server.

FIGURE 27.8
The SQL Server dialog box requires you to specify the server where the information is located.



The DSN screens also give you the ability to Configure or Remove ODBC data sources. To modify a data source, select the data source and then click the Configure button. This presents you with the same dialog box that you used initially to set up the data source. To delete a data source, select it and then click the Remove button.

Using the DAOs to Create an ODBC Source You are not limited to setting up data sources interactively. There are times, such as application installation, where you might want to add a data source with code. For this purpose, you can use the `RegisterDatabase` method of the `DBEngine` object.

Here is the syntax of the `RegisterDatabase` method:

`DBEngine.RegisterDatabase` *`dbname`*`,` *`driver`*`,` *`silent`*`,` *`attributes`*

Table 27.1 defines the parameters used in the `RegisterDatabase` method.

Table 27.1 Parameters of the *RegisterDatabase* Method

Parameter	Definition
`dbName`	A user-definable string expression that specifies the data source name (for example, "MyDatabase").
`driver`	A string expression that indicates the installed driver's name (for example, `ORACLE`) as listed in the ODBC Drivers tab of the ODBC Administrator.
`silent`	`True` specifies that the next parameter (*`attributes`*) indicates all connection information. `False` specifies to display the Driver Setup dialog box and ignore the contents of the *`attributes`* parameter.
`attributes`	All connection information for using the ODBC driver. This parameter is ignored if *`silent`* is set to `False`.

The following code sample illustrates how the `RegisterDatabase` method is used to create a link to an Access database. Before attempting to use the Data Access Objects, remember to add the appropriate reference:

```
Dim sAttrib As String
    Dim sDriver As String

    sAttrib = "DBQ=D:\VB5\BIBLIO.mdb"
    sDriver = "Microsoft Access Driver (*.mdb)"
  DBEngine.RegisterDatabase "MyDSN", sDriver, True, sAttrib
```

After executing the preceding code, you can go back to the Data Source Administrator window and verify that a new User DSN has been added.

NOTE You can also use the `rdoRegisterDataSource` method of the `rdoEngine` to perform the registration task for Remote Data Objects. ■

Notice that, for the Access driver, the `DBQ` parameter indicates the name of the database file. To determine all the parameters required for a particular ODBC driver, you should create a connection with the ODBC Manager and then examine the settings in the Registry. You can find these under HKEY_USERS\Default\Software\ODBC\ODBC.INI. (To view the Registry, use Windows' REGEDIT utility.) To specify multiple parameters with the `RegisterDatabase` method, separate them with a semicolon.

The Remote Data Objects

Data access objects (DAO) are a layer on top of the ODBC API. Before the advent of *Remote Data Objects* (RDO) in Visual Basic, programmers would sometimes skip this layer by calling the ODBC API directly. The reason, of course, was to make their applications run faster. However, the ODBC API calls are much harder to use than the Data Access Objects. Remote data objects changed this by providing an interface to the ODBC API that uses the familiar operations of setting properties and calling methods. Because properties and methods are used in all Visual Basic programs, this made the access of ODBC databases much easier for developers to understand and accomplish.

Comparison of RDO to DAO

The remote data objects, or RDO, are very similar to the data access objects (DAO), which were covered in Chapter 26, "Using Data Access Objects (DAO)." This similarity not only makes RDO easier to understand, but it also makes the conversion of programs from PC databases to client/server databases much easier. In fact, after the connection to the data source is made, the same code statements that were used for DAO can be used to access the data using RDO. To give you a feel for the similarities between the RDO and DAO models, Table 27.2 lists a number of RDO objects and their corresponding DAO objects.

In addition, the `rdoResultset` object supports several types of returned sets of records, similar to the recordset types of the `Recordset` object. Table 27.3 summarizes these similarities.

Table 27.2 Some RDO Objects and Their DAO Counterparts

RDO Object	DAO Object
`rdoEngine`	`DBEngine`
`rdoEnvironment`	`Workspace`
`rdoConnection`	`Database`
`rdoTable`	`TableDef`
`rdoResultset`	`Recordset`
`rdoColumn`	`Field`
`rdoQuery`	`QueryDef`
`rdoParameter`	`Parameter`

Table 27.3 *rdoResultset* Types and the Corresponding *Recordset* Types

`rdoResultset` Types	`Recordset` Types	Definition
`Keyset`	`Dynaset`	Updatable set of records in which movement is unrestricted.
`Static`	`Snapshot`	Non-updatable set of records that were present when the set was created. Updates by other users are not reflected.
`Dynamic`	N/A	Similar to a `keyset`.
`Forward-only`	`Forward-only`	Similar to a static resultset or snapshot, but you can move forward only through the set of records. This is the default `resultset` type.

Notice that the remote data objects do not support any `rdoResultset` type that returns a table. This is because the remote data objects are geared to using SQL statements to retrieve subsets of information from one or more tables. You must set the order of the `rdoResultset` with the `Order By` clause of the SQL statement used to create the set. Also, because there is no table equivalent, RDO does not support indexes.

As you might expect with the similarity of the objects, there are methods of the RDO that are similar to the methods of the DAO. These methods and their respective objects are summarized in Table 27.4.

Table 27.4 RDO Objects Methods and Related DAO Methods

RDO Method	RDO Object	DAO Method	DAO Object
rdoCreateEnvironment	rdoEngine	CreateWorkspace	DBEngine
BeginTrans	rdoConnection	BeginTrans	Workspace
CommitTrans	rdoConnection	CommitTrans	Workspace
OpenConnection	rdoEnvironment	OpenDatabase	Workspace
RollbackTrans	rdoConnection	Rollback	Workspace
CreateQuery	rdoConnection	CreateQueryDef	Database
Execute	rdoConnection	Execute	Database
OpenResultset	rdoConnection	OpenRecordset	Database

Finally, the `rdoResultset` object and the `Recordset` object have the following methods in common:

- `AddNew`—Adds a new row (record) to the set.
- `Delete`—Removes the current row (record) from the set.
- `Edit`—Prepares the current row for changing the information in the row.
- `MoveFirst`—Moves to the first row of the set.
- `MoveLast`—Moves to the last row of the set.
- `MoveNext`—Moves to the next row of the set.
- `MovePrevious`—Moves to the previous row of the set.
- `Update`—Commits the changes made to the copy buffer to the actual record. The copy buffer is a memory location that contains the values of the record with which the user is working.

Accessing a Database with RDO

To further illustrate the similarities between the RDO and DAO models, the code in Listings 27.1 and 27.2 perform the same function on the "biblio" database. The difference between the two listings is simply the objects and methods used to create returned records. After the recordset or resultset is established, the remaining statements simply print each entry in the first field. In the RDO example, the ODBC data source `MyDSN` was created previously with the ODBC Manager.

NOTE To use the Remote Data Objects, you need to add a reference to the Microsoft Remote Data Object from the Project References menu.

Listing 27.1 RDOSAMPL.TXT—Accessing Information in an ODBC Data Source Using the RDO Methods

```
    Dim db As rdoConnection
    Dim rs As rdoResultset
    Dim sSQL As String

    Set db = rdoEngine.rdoEnvironments(0).OpenConnection("MyDSN")

    sSQL = "Select * From Titles"
    Set rs = db.OpenResultset(sSQL, rdOpenKeyset)

    rs.MoveFirst
    While Not rs.EOF
        Print rs.rdoColumns(0)
        rs.MoveNext
    Wend

    rs.Close
  db.Close
```

Listing 27.2 DAOSAMPL.TXT—Accessing the Same Information Using the DAO Methods

```
    Dim db As Database
    Dim rs As Recordset
    Dim sSQL As String

    Set db = DBEngine.Workspaces(0).OpenDatabase("D:\VB5\BIBLIO.MDB")

    sSQL = "Select * From Titles"
    Set rs = db.OpenRecordset(sSQL, dbOpenDynaset)

    rs.MoveFirst
    While Not rs.EOF
        Print rs.Fields(0)
        rs.MoveNext
    Wend

    rs.Close
  db.Close
```

Another thing you might want to explore with RDO is asynchronous execution of database operations. This means control is returned to your program *before* the database operation completes, as in the following example:

```
    Set db = rdoEngine.rdoEnvironments(0).[ic:ccc]
    OpenConnection("MyDSN", , , , rdAsyncEnable)
While db.StillConnecting = True
        Print "Connecting..."
  Wend
```

The constant `rdAsyncEnable` indicates asynchronous operation. The `while` loop keeps running until the connection is made and the `StillConnecting` property becomes `False`.

Using the RemoteData Control

If you want a faster way to create applications using ODBC data sources, you can use the *RemoteData control* (RDC). The RDC lets you set a few properties of the control, and then the RDC handles all the tasks of making the connections to the ODBC data source for you. In this way, the RDC automates the methods of the remote data objects in the same way that the data control automates the methods of the data access objects.

After setting up the RemoteData control, you can use the bound controls to display and edit information that is in the resultset created by the data control. The bound controls are set up the same way they are for use with the Data control—which was discussed in Chapter 25, "The Data Control and Data-Bound Controls"—except that the `DataSource` property of the bound controls points to a RemoteData control. After they are set up, the bound controls are updated with new information each time a new row is accessed by the remote data control.

Comparing the RDC and the Data Control

The remote data objects were compared to the data access objects in the earlier section "The Remote Data Objects"; now take a look at the similarities of the Data control and the RDC. As you might expect, many of the properties of the RDC have counterparts in the Data control. These properties and their functions are summarized in Table 27.5.

Table 27.5 Remote Data Control Properties Compared to Data Control Properties

RDC Property	Data Control Property	Purpose
`BOFAction`	`BOFAction`	Determines whether the beginning of file flag is set when the user invokes the `MovePrevious` method while on the first record.
`DataSourceName`	`DatabaseName`	Specifies the database containing the desired information.
`EOFAction`	`EOFAction`	Determines whether the end of file flag is set or if a new row (record) is added when the user invokes the `MoveNext` method while on the last record.
`ResultsetType`	`RecordsetType`	Determines the type of dataset created by the control.
`SQL`	`RecordSource`	The SQL statement that identifies the specific information to be retrieved.

Setting Up the RDC

Setting up the RDC for use in your program is also very similar to setting up the Data control. Before you can use the RDC, you must first add it to your project. You do this by using the Components dialog box, which you access by choosing the Components item from the Project menu. After you close the dialog box, the RemoteData control is added to your toolbox.

NOTE The RemoteData control is available only in the Enterprise Edition of Visual Basic. Also, if you did a custom installation of the Enterprise Edition and opted not to install the RemoteData control, it does not appear as one of the available controls in the Custom Controls dialog box. In this case, you need to reinstall that portion of Visual Basic.

To set up the RemoteData control, follow these steps:

1. Draw the RemoteData control on your form.
2. Set the `Name` and `Caption` properties of the RDC to values that have meaning to you.
3. Set the `DataSourceName` property. You can enter a value or choose one from the drop-down list.
4. Set the `SQL` property to a valid SQL statement that specifies the information you need.

As stated in step 3, you can choose the `DataSourceName` value from a drop-down list. This list contains every registered ODBC data source on your system. An example of this list is shown in Figure 27.9.

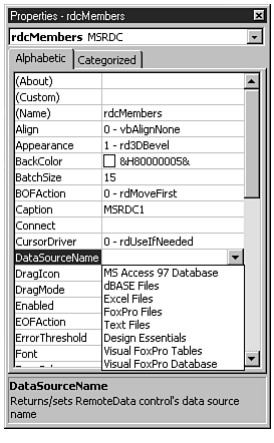


FIGURE 27.9
You can choose from a list of available ODBC data sources when setting the `DataSourceName`.

After you have set up the remote data control, you then can attach bound controls to it by setting the `DataSource` property. As shown in Figure 27.10, a drop-down list in the `DataSource` property contains the names of any remote data controls or data controls on the current form. After the `DataSource` property has been set, you can select the `DataField` property from a list, just as you did for the controls bound to a data control.

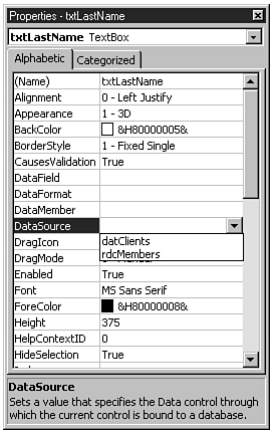


FIGURE 27.10
The `DataSource` property list contains all available data controls, remote or not.

From Here...

This chapter has given you a basic understanding of client/server applications. The chapter has also shown you how the Remote Data Objects and RemoteData control make it easier to access the ODBC databases that are part of many client/server programs. For more information on the topics touched on in this chapter, see the following:

- For a discussion of fundamental database concepts, see Chapter 24, "Database Basics."
- To learn about the data access method that will eventually replace DAO and RDO, see Chapter 28, "Using ActiveX Data Objects (ADO)."
- The SQL language is discussed in more detail in Appendix C, "SQL Summary."

CHAPTER 28

Using ActiveX Data Objects (ADO)

In this chapter

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Disconnected Recordsets **637**

Version 2.0 of ActiveX Data Objects (ADO) is the latest entry in to the VB data access arena. It provides a way for you to interact with various types of databases from your Visual Basic programs, ActiveX components, and Active Server Pages. This chapter introduces ADO and demonstrates some of its key features.

Introducing ADO

ActiveX Data Objects, or *ADO*, is the most recent method of data access that Microsoft has introduced. ADO is intended to replace DAO (Data Access Objects), the original method of Visual Basic database access, and RDO (Remote Data Objects), a fast alternative to DAO. As with either of these object models, ADO provides several options for accessing your data. In this section, you briefly look at the steps and strategies necessary to set up a connection to data using ADO.

Data Connection Methods

ADO provides the means by which your program code accesses a database. But how does ADO itself connect to a database? The answer is through an *OLE DB provider*. OLE DB is Microsoft's new lower-level database interface that provides access to many different kinds of data. There are OLE DB providers for both traditional databases (such as SQL server) as well as other sources like an e-mail server. The OLE DB provider exposes these databases to ADO, which in turn allows you to connect to the data in the following ways:

- **Data controls.** A Data control is a custom control that handles communication with the database. You simply set a few properties and "bind" some other controls to the Data control to display information.
- **Object interface.** When you add a reference to ADO, a new set of objects becomes available to your program. You can manipulate data directly from code without any controls or combine the use of objects with a Data control.

The Data control is quick and easy to set up, but using the object interface provides more power and flexibility. In this chapter, you examine both methods as they relate to ADO.

Installation

If the past is any indicator, by the time you read this chapter, Microsoft will have come out with patches and service packs for many of its products. Before you start using ADO, it is worth your while to download and install the latest version. At the time of this writing, Visual Basic 6.0 includes ADO 2.0, and Visual Basic 5.0 users can download version 1.5c. The Microsoft Data Access Components (MSDAC) package includes ADO files and documentation, the latest version of ODBC, and Remote Data Services. You can find the Web site at `http://www.microsoft/com/data/ado`.

TIP When you are installing the updated Data Access Components, select Custom Installation and make sure that you choose to install ADO documentation and the Access database driver.

In the References dialog box of Visual Basic, two entries are used with ADO: Microsoft ActiveX Data Objects 2.0 Library and Microsoft ActiveX Data Objects Recordset 2.0 Library. To use the ADO object examples in this chapter, make sure that you include the appropriate references, as pictured in Figure 28.1.

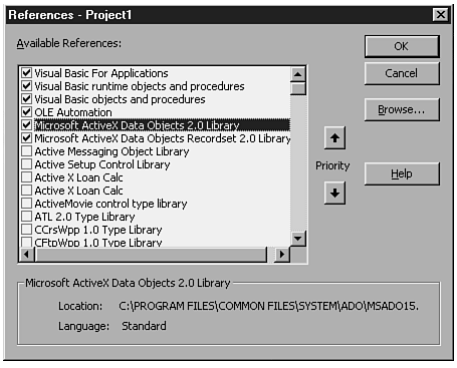


FIGURE 28.1
Choose Project, References to add references for ADO to your program.

The reference titled Microsoft ActiveX Data Objects 2.0 Library contains the full-featured ADO objects discussed throughout most of this chapter. The other reference contains only the Recordset object, intended for use with remote disconnected recordsets.

Setting Up a Data Source

When you use data in your program, that data has to come from a *data source*. A data source is a database that can be anything from a small Microsoft Access database to an IBM AS/400. Many different types of database products are available, and you can connect to almost all of them. Open Database Connectivity, or ODBC, is one vehicle that allows you to connect to a variety of data sources. You set up the ODBC database driver in Windows and then use it to access the database from Visual Basic.

To use the examples in this chapter, you have to create a data source for the database BIBLIO.MDB, which is included with Visual Basic. Start by clicking the icon labeled 32-bit ODBC in the Windows Control Panel. You then see the ODBC Data Source Administrator, as shown in Figure 28.2.

NOTE You also can create DSN-less connections. See the section "Making the Connection with ADO" later in this chapter.

To create a new data source, first click the Add button. BIBLIO.MDB is an Access database, so select Microsoft Access Driver and click Finish. A dialog box for the Access ODBC driver then appears. Click the Select button, and locate BIBLIO.MDB (usually in the Visual Basic application directory). Name the data source `BIBLIO`, and enter a description if you want. The completed configuration screen should look similar to Figure 28.3.

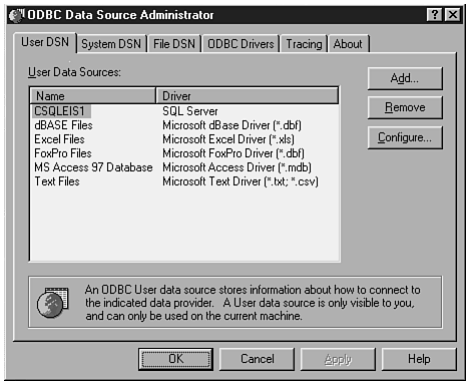


FIGURE 28.2
Using the ODBC Data Source Administrator, you can configure data source names (DSNs) that point to specific databases.

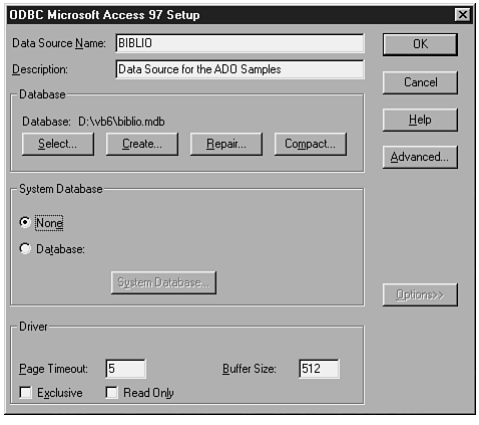


FIGURE 28.3
Using ODBC to connect to an Access database is somewhat different than using Jet, as discussed in Chapter 26, "Using Data Access Objects (DAO)."

Click OK to close the ODBC Data Source Administrator. Now that the ODBC data source has been configured, you can work with data in the BIBLIO data source by using ADO.

NOTE Although ODBC provides an easy way to set up a data source, you do not have to use ODBC to use ADO. There is also an ADO data provider for Jet databases that does not use ODBC.

Using the ADO Data Control

Visual Basic 6.0 includes a new Data control: the ADO Data control. This control serves the same purpose as the standard Data control that has been around for years, but it works with ADO.

As mentioned earlier, ADO can be used with controls, code, or both. ADO is a lot more flexible than DAO in this regard. Although a Data control can be used by itself, the most common use

of a Data control is to provide data to other controls on the form. You can take a standard control, such as a text box, and "bind" it to a Data control. The text box is then referred to as a *bound control*. Bound controls are linked to the database, and their contents reflect the current database record provided by the Data control.

NOTE If you have not read Chapter 25, "The Data Control and Data-Bound Controls," you may want to do so now. That chapter discusses the standard Data control as well as the concept of bound controls.

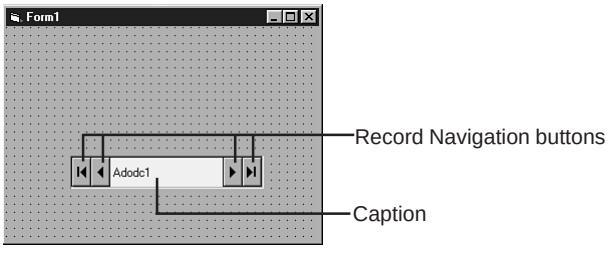
Setting Up the ADO Data Control

The easiest way to learn how to use a Data control is to create a sample project. In this section, you'll do just that as you learn about the ADO Data control. Begin by opening Visual Basic and starting a new Standard EXE project.

To use the ADO Data control, you must add it to the Visual Basic Toolbox. To do so, right-click in an empty area of the toolbox, select Components from the context menu, and add the Microsoft ADO Data Control 6.0 control.

Next, draw an instance of the ADO Data control on the form. If you have seen the standard

FIGURE 28.4
The ADO Data control links your program to an ADO data source.



Data control, the ADO Data control should look similar, as pictured in Figure 28.4.

Before you continue setting up the Data control, notice its initial appearance. The four arrow buttons, which look similar to those you might find on an audio CD player, are used to change the current database record. The caption, set by the `Caption` property, is for informational purposes and should be changed to something meaningful. The initial setting, `ADODC1`, is the default name of the first ADO Data control.

To connect to a database and retrieve data, you need to set several properties of the ADO Data control. Most of these properties are controlled through the Property Pages dialog box, as shown in Figure 28.5. To display this dialog box, right-click the ADO Data control and choose ADODC Properties from the context menu.

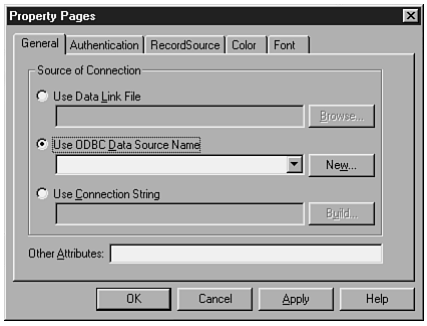


FIGURE 28.5
To set up the ADO Data control at designtime, use its Property Pages.

The Property Pages dialog box for the ADO Data control is divided into the following tabs:

- **General.** Specifies how the ADO Data control connects to the database.
- **Authentication.** Allows you to supply a username and password that the ADO Data control can use to connect to the database, if required.
- **RecordSource.** Defines what recordset the ADO Data control retrieves from the data source. Here, you can specify a table or stored procedure name, or an SQL query.
- **Color and Font.** Change the look of the ADO Data control.

Many of the options in these tabs can also be set from code. By setting the appropriate properties, you can link the ADO Data control to your database and use data-bound controls on your form to display the data.

Connecting the ADO Data Control to a Data Source

You already know that databases are made up of multiple tables and can contain a great deal of data. For example, the BIBLIO database includes one table that contains author information and another that contains a list of books written by those authors. When you think about working with data in a Visual Basic program, you generally do not plan to use every record in the database, but rather some smaller subset of the data that represents the information you want.

This subset of database information (or recordset) is defined by a *record source*, which is just a set of criteria that you specify. For example, suppose you want to query the database for the authors whose last name is *Smith*. In this example, the data source is the BIBLIO database, and the record source is the query that returns the set of records containing all the Smiths.

Anyway, the point of this discussion is to clarify what the ADO Data control represents to the rest of your program: a set of records resulting from a query against a database.

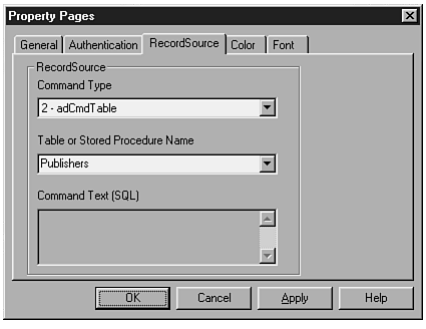
Making the Connection For the ADO Data control to access data, it has to first be able to connect to a database. You must set up the `ConnectionString` property of the ADO Data control to provide the necessary information. You can do so at runtime or designtime. The General tab of the Property Pages, shown earlier in Figure 28.5, provides three methods of building the connection string:

- **Use Data Link File.** This option allows you to load saved connection information from an MDL (Microsoft Data Link) file.
- **Use ODBC Data Source Name.** Here, you can select from one of the ODBC DSNs set up on your system. You can also click the New button to create a new DSN, just as you would from the Control Panel.
- **Use Connection String.** This option allows you to specify a connection string directly. Clicking the Build button brings up a wizard that helps you build the connection string.

Because you have already set up the BIBLIO data source, choose the Use ODBC Data Source Name option, and select BIBLIO from the drop-down list.

Setting Up the Record Source Now that you have told the Data control that it needs to connect to the BIBLIO data source, you need to tell it what specific data to bring back from that data source. At designtime, you do so by selecting the RecordSource tab of the Property Pages dialog box, as shown in Figure 28.6.

FIGURE 28.6
The `RecordSource` property tells the ADO Data control exactly what data to retrieve.



The ADO Data control acts like an ADO `Command` object, which you'll learn about in the upcoming section "The Command Object." You can use four types of commands to retrieve data:

- `adCmdText`—Runs an SQL query on the data source
- `adCmdStoredProc`—Calls a stored procedure on a database server
- `adCmdTable`—Specifies the name of a database table; used to return the entire table
- `adCmdUnknown`—Unknown command type

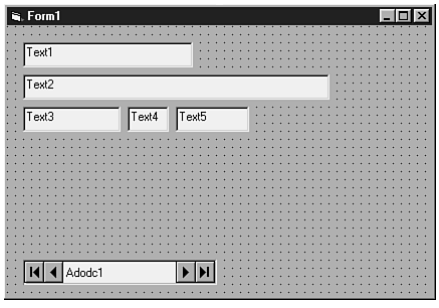
Depending on which command type you select, the appropriate text box becomes enabled, and you can enter the command. For the sample program that uses the BIBLIO database, select the entire `Publishers` table.

To select this table, first set the `CommandType` property to `adCmdTable` by selecting it from the drop-down list. The second drop-down box, Table or Stored Procedure Name, should then become enabled. Select the `Publishers` table from the list so that your settings look like those in Figure 28.6. Finally, click OK to close the dialog box and commit the changes.

Displaying Data

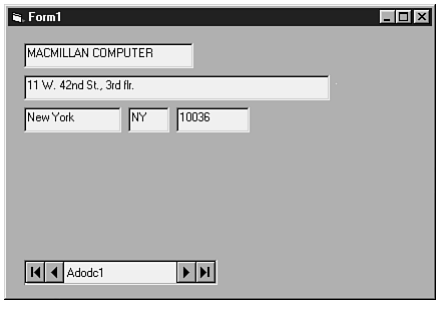
You have given the ADO Data control everything it needs to bring data into your program. However, most likely you'll want to display that data somehow so that the user can view, browse, and even edit it. You learned how to use a bound control in Chapter 25, "The Data Control and Data-Bound Controls." For the sample project, draw five text boxes on the form, as shown in Figure 28.7. These text boxes will display the publisher's name, address, city, state, and ZIP code.

FIGURE 28.7
You can bind text boxes to specific recordset fields.



Next, you need to bind each control to a data field. To do so, set the `DataSource` property of each text box to the name of the ADO Data control, `ADODC1`, and the `DataField` property to the appropriate field name. After you finish setting the `DataSource` and `DataField` properties for each text box, run the sample project. You should be able to browse through the database and view or edit information, as shown in Figure 28.8.

FIGURE 28.8
Although the completed sample project is somewhat crude looking, it is fully functional and requires no code.



As you navigate through the recordset using the buttons on the ADO Data control, each bound text box is automatically updated to display the contents of the current record. If you want to use bound controls to display more than one record at a time, you need to use a specialized control such as the DataGrid control, discussed later in the "Using the DataGrid Control" section.

Changing the Record Source from Code

As you have just seen, you can easily set up the Data control while in design mode. However, even in the simplest project, you usually need to use the Data control in a more dynamic fashion. Fortunately, you can set it up from code by following a few simple steps:

1. Set the `ConnectionString` property.
2. Set the `CommandType` and `RecordSource` properties.
3. Execute the `Refresh` method of the ADO Data control to retrieve the data.

As it is now, the ADO Data control in the sample application retrieves every record in the `Publishers` table. However, you can easily add code that changes the `RecordSource` property so that a new recordset is displayed.

Suppose, for example, you want to display only information on publishers whose address is in a certain state. You can write a simple SQL query to display these addresses, as in the following example:

```
Select * from Publishers where State='NY'
```

Rather than set up the query at designtime, though, add some code to the sample project so that it can occur during program execution. First, add a command button to the form. Change the caption to `State Lookup` and the name of the command button to `cmdState`. Place the following lines of code in the `Click` event of `cmdState`:

```
Dim sState As String
Dim sSQL As String

'BUILD SQL QUERY
sSQL = "Select * from Publishers"
sState = InputBox$("Enter State abbreviation:")
If sState <> "" Then sSQL = sSQL & " WHERE State ='" & sState & "'"

'UPDATE THE ADO DATA CONTROL
Adodc1.CommandType = adCmdText
Adodc1.RecordSource = sSQL
Adodc1.Refresh
```

Run the sample project again, and click the button. Enter `NY` and available records should change to include only those publishers in New York. You can verify this information by clicking the navigation buttons on the ADO Data control.

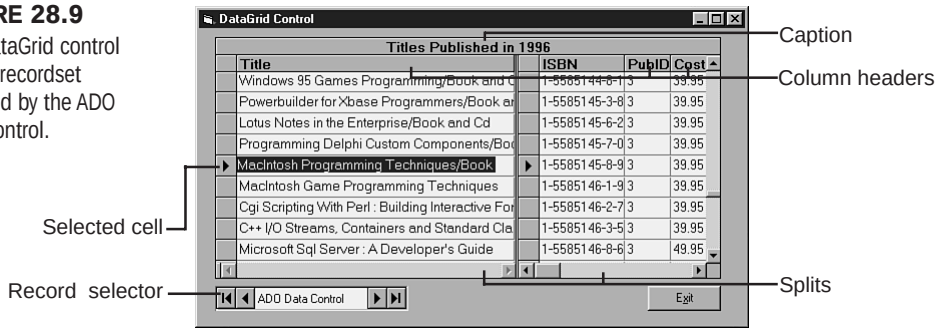
Using the DataGrid Control

Much of the information that computer programs deal with is presented in the form of a grid of columns and rows, like you would find on a spreadsheet. In fact, for many people, and many types of data, this "grid" is the preferred method of viewing information. The DataGrid control, a new control in Visual Basic 6.0, allows you to display data from a database in grid format. Depending on how the DataGrid is set up, the user can even edit the cells of the grid directly and change the underlying data.

You may be familiar with the DBGrid control from previous versions of Visual Basic. Unlike that control, the DataGrid control is designed for use with the newer ActiveX Data Objects (ADO). Instead of the older Data control, the DataGrid is bound to the new ADO Data control, discussed earlier in this chapter.

A sample use of the data grid is shown in Figure 28.9. This grid is set up to display a view of the `Titles` table of the `BIBLIO` sample database included with Visual Basic.

FIGURE 28.9
This DataGrid control uses a recordset provided by the ADO Data control.



The data grid is a fairly easy control to use, despite the fact that you not only have to understand how it works, but you also have to attach it to a database. Before you can use the DataGrid, however, you must add it to Visual Basic Toolbox. To do so, right-click in an empty area of the Toolbox, select Components from the context menu, and add the control called Microsoft DataGrid Control 6.0. Click OK to close the Components dialog box.

Getting Data into the Grid

To use the DataGrid, you have set up the grid to look the way you want and bind it to a data source. Binding the DataGrid is similar to working with other bound controls, as you can see in these steps:

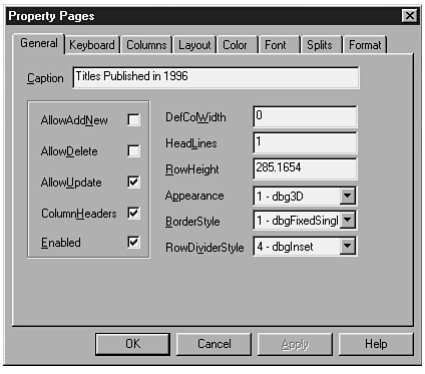
1. Draw an ADO Data control on the form with the DataGrid, and set it up as described earlier in the section "Using the ADO Data Control."
2. Display the Properties window for the DataGrid, and set the `DataSource` property to the name of the ADO Data control. (Notice that no `DataField` property exists, because unlike other controls, the DataGrid displays multiple fields.)
3. The DataGrid can configure its columns automatically based on the data source. Simply right-click the control, and choose Retrieve Fields from the context menu. The layout of the grid changes to include fields from the ADO Data control.
4. Customize the layout of the grid, and perform any desired manual configuration.

▶ **See** "Getting Acquainted with Bound Controls," **p. 550**

Setting Up the DataGrid

The DataGrid is a fairly complicated control and has many properties that control its behavior. As with many other controls, Property Pages provide an organized way to access these properties. To access a control's Property Pages, right-click the control, and choose Properties from the context menu. The Property Pages dialog box for the DataGrid is shown in Figure 28.10.

FIGURE 28.10
Most aspects of the DataGrid control are set up via the Property Pages.



In the following sections, you explore how you use each of the Property Pages to control the grid and examine the issues involved with interacting with a data source.

General Options The General Property Pages tab, shown in Figure 28.10, contains some options that control overall grid behavior. Other tabs, such as Columns and Layout, allow you to adjust properties of individual grid elements.

NOTE Look ahead to the section "Customizing the Grid's Layout" for information on the Columns and Layout tabs. "Customizing the Grid with Code" and "Splitting Up the Grid" cover other approaches to customizing the DataGrid control.

Some of the properties that affect the grid's appearance are listed here:

- The `Caption` property controls the title that appears at the top of the grid. Set it to an empty string if you do not want the title heading to appear at all.
- The `ColumnHeaders` property turns on or off the header row at the top of the grid. By default, the heading of a given column is the name of the database field displayed in that column, but as you will see, you can change the headings to suit your needs. The height of the column header row is controlled by the `HeadLines` property. Simply set `HeadLines` to an integer representing the desired height in number of rows.
- You can control the overall look of the DataGrid with the `Appearance` property. It has two settings, `dbgFlat` and `dbg3d` (the default), which cause the grid to be drawn with a flat or three-dimensional look, respectively.

- Use the `RowDividerStyle` to determine what type of line is drawn between each row of data. You can choose from several options, including turning off the row dividers completely. Note that the `RowDividerStyle` property does not affect the dividers of the record selectors.
- The `Enabled` property controls whether user interaction with the grid is allowed. If this property is set to `False`, the user cannot scroll, select cells, or modify data. However, the grid and some data still are visible on the screen.

In addition to the properties that control how the DataGrid control looks, the following three Boolean properties in the General tab control which data operations are allowed:

- `AllowAddNew`—Controls whether the user can add a new record to the recordset displayed in the data grid (`False` by default). If this property is set to `True`, a blank row is added to the end of the data so that the user can enter a new record. The record selector for the `AddNew` row is marked with an asterisk (`*`).
- `AllowDelete`—Controls whether the user can delete a record from the underlying recordset. To delete a row, use the record selector to highlight it, and then press the Delete key. This property is `False` by default.
- `AllowUpdate`—Controls whether the user can edit an existing record (`True` by default). Setting this property to `False` makes each cell in the grid act like a locked text box: You can select text using the mouse and copy it to the Clipboard, but you cannot change it.

Each of these three properties can be set at runtime or designtime. Setting all of them to `False` means that your grid will be read-only.

Keyboard Options Although you can select cells using the mouse, you might prefer using the keyboard because it allows you to perform operations much faster. The DataGrid has several properties that control keyboard behavior. You can set these properties in the Keyboard tab of the Property Pages or at runtime with code.

For example, the `AllowArrows` property determines whether the arrow keys can be used to navigate between cells on the DataGrid. If you set this property to `False`, the user has to use the Tab key or the mouse to put the cursor in a specific cell.

NOTE When you are editing a cell, the arrow key moves within the current cell. To put the grid in move mode, single-click a cell so that it is highlighted. You should then be able to use the arrow keys to move from cell to cell.

Handling the Tab key on any type of grid control presents a minor dilemma for programmers because the standard behavior is for the Tab key to cause the focus to move to the next control on the form. Fortunately, the DataGrid's `TabAction` property allows you to set up the Tab key for your specific needs. This property has three settings:

- `0 – dbgControlNavigation`—Pressing the Tab key while in the DataGrid moves the focus off the DataGrid to the next control in the form's tab order. In this case, the DataGrid acts like a standard control as far as Visual Basic is concerned.

- `1 - dbgColumnNavigation`—Pressing the Tab key moves to the next cell in the current row of the DataGrid. Pressing Shift+Tab moves to the previous cell. When you reach the last cell in the row, Tab moves out of the grid to the next control on the form. To move to a different row, you must use the arrow keys or mouse.
- `2 - dbgGridNavigation`—This setting by itself is not very different from `dboColumnNavigation`, but it allows you to set two other properties to further control the behavior of the Tab key: `TabAcrossSplits` and `WrapCellPointer`. Setting `WrapCellPointer` to `True` allows you to use the Tab key to move between rows on the grid. If `TabAcrossSplits` is set to `True`, then you can use the Tab or arrow keys to move between splits (sections) on the grid.

Splitting Up the Grid

Although a DataGrid generally has only one underlying set of data, you can split the grid into several sections. These sections, which are known as *splits*, behave much like sub-grids within a single DataGrid control. Refer to Figure 28.9 for an example of splits. The `Title` field is in a separate split from the other fields, allowing it to remain locked while you scroll horizontally through the other splits.

NOTE Even if a DataGrid contains multiple splits, you still have only one current record. Splits are not as complicated as they sound; just think of them as areas of the grid that can be formatted individually.

Editing the Grid at Designtime To add or remove splits at designtime, you must go into the grid's design-environment editing mode. To do so, right-click the DataGrid control as you would to bring up the Property Pages. However, instead of selecting Properties, choose Edit from the context menu. Nothing appears to happen, but if you right-click again in the DataGrid, you will notice that the items on the context menu change from Visual Basic's to those provided by the DataGrid. While you're in this design-environment editing mode, you can perform the following operations from the context menu:

- Insert and delete columns
- Resize columns
- Retrieve the field layout from the data source
- Clear the existing field layout
- Add and remove splits

Creating a New Split By default, the DataGrid has only a single split, `Split0`, as pictured in Figure 28.11. To add a split, right-click the DataGrid while in the previously described editing mode, and choose Split from the context menu. An additional section is then added to the grid (also shown in Figure 28.11).

After creating a new split, you can continue to use the context menu to delete and add columns to the splits on the DataGrid.

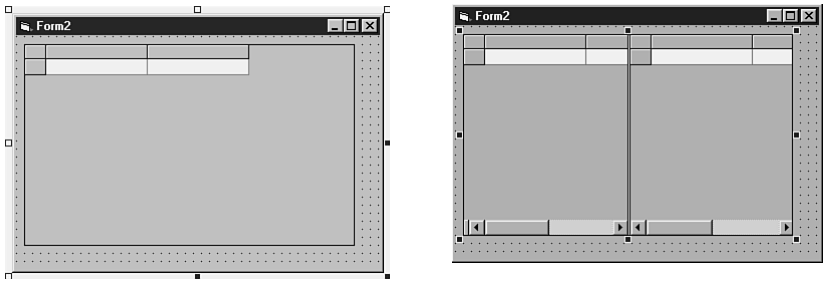


FIGURE 28.11
Here, you can see the DataGrid control before and after adding a new split.

Working with Split Properties Every time you add a split to a DataGrid, it is also added to the Split drop-down list on the Property Pages, as shown in Figure 28.12.

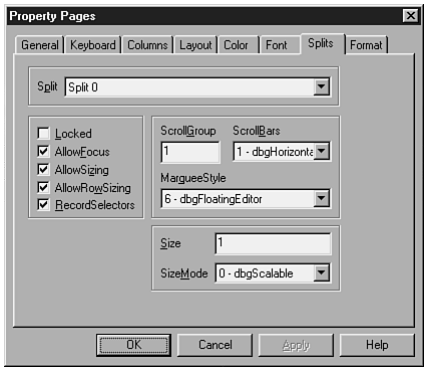


FIGURE 28.12
Using the Splits tab of the Property Pages, you can set properties for a specific section of the DataGrid.

As you create new splits, they are named consecutively: `Split0`, `Split1`, `Split2`, and so on. To specify settings for a split, select it from the Split drop-down list, and set the appropriate properties. Several of these properties are described here:

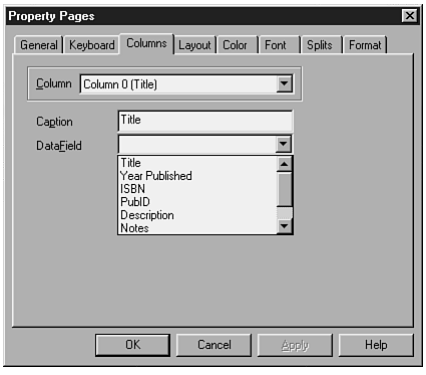
- `Locked`—When this property is selected, the user cannot enter text.
- `AllowFocus`—When this property is set to `False`, the selected split cannot receive the program focus.
- `AllowSizing`—This property allows the user to resize the width of a split during program execution.
- `AllowRowSizing`—This property can prevent the user from resizing rows at runtime.
- `RecordSelectors`—This property turns record selectors on or off for the specified split. If you also set the `RecordSelectors` property of the DataGrid, the most recent setting takes effect.

Customizing the Grid's Layout

Although having the grid configure itself automatically is a nice feature, most times you will want to change the default configuration. For example, you might want to set up two splits with

different columns. To do so, you need to set up the splits and then use the Column and Layout tabs of the Property Pages to customize the grid. The Columns tab controls the order of the data columns in the grid (see Figure 28.13).

FIGURE 28.13
You can reorder the columns manually if desired.



Working with the Columns tab is simple; just pick a column, and choose the Caption (column header) and the name of the data field.

NOTE If you do not enter a valid expression for the DataField, the column appears blank.

Whereas the Columns tab controls the data displayed, the Layout tab controls formatting of an individual column. To use the Layout tab, pictured in Figure 24.14, first select a column and split you want to work with. Then adjust the following properties:

- `Locked`—When this property is set to `True`, it prevents editing a column, even if the grid's General properties allow it.
- `AllowSizing`—This property, which is `True` by default, allows the user to resize a column at designtime.
- `Visible`—This property controls whether a column is seen on the grid. (However, if you don't need to display a column, the most efficient way to accomplish that is to eliminate it from your data source.)
- `WrapText`—This property determines whether the text in a column is displayed in multiple lines if it is longer than the column width. An example of the `WrapText` property in action is shown in Figure 28.15.
- `Button`—This property determines whether a drop-down button is displayed in the selected column for a highlighted field.
- `DividerStyle`—This property is similar to the `RowDividerStyle` property of the General tab, but it can be set for each column.

- `Alignment`—This property controls how values in a given column are aligned.
- `Width`—This property sets the width of the specified column. (An easier way to set column widths is to use the editing mode described earlier and resize them using the mouse.)

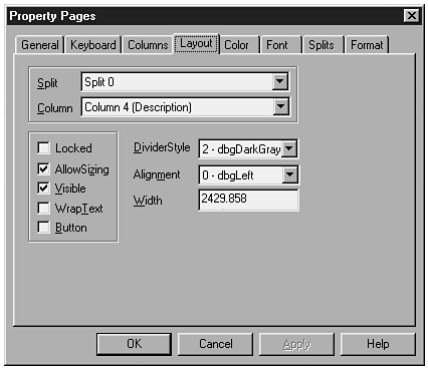


FIGURE 28.14
Here is the Layout tab of the DataGrid's Property Pages.

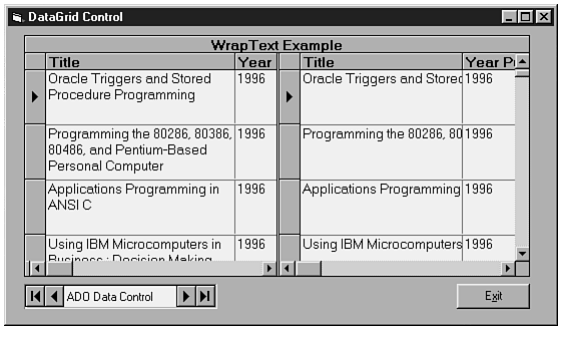


FIGURE 28.15
The leftmost split has the `WrapText` property set to True.

Customizing the Grid with Code

In learning about the DataGrid, you have concentrated on setting properties in the design environment. However, almost everything you have learned about the properties of the DataGrid can also be applied to the runtime environment. For example, if you want to set the `WrapText` property of the first column in the first split, use the following line of code:

```
datagrid1.Splits(0).Columns(0).WrapText  = True
```

Although you may have to navigate through a few levels of collections to get to the property you want, you will find that most properties can be changed with code.

Using ActiveX Data Objects

Working with the ADO Data control is useful to a point, but the real power comes into play when you use ADO objects in your Visual Basic code. The objects that make up the ADO object model are listed in Table 28.1.

Table 28.1 ActiveX Data Objects

Object	Description
`Recordset`	Contains the records that make up the results of a query
`Connection`	Allows control over the connection to the data source
`Command`	Executes database commands and queries with parameterized queries
`Error`	Retrieves errors from ADO
`Field`	Represents a piece of data in a recordset
`Parameter`	Works with the `Command` object to set up a parameter in a query or stored procedure
`Property`	Allows you access to ADO object properties

To use these ADO objects, you must add a reference to your project. To do so, choose Project, References. Place a check mark next to Microsoft ActiveX Data Objects 2.0 library and click the OK button. After referencing the object library, you can use the following prefixes to declare ADO objects:

- `ADODB`—This object library contains all the objects listed in Table 28.1.
- `ADOR`—This object library contains only the objects associated with a recordset (`RecordSet`, `Field`, `Property`). ADOR is included with IE 4.01, allowing developers to pass disconnected recordsets across the Internet.

In the following sections, you'll explore some of the properties, methods, and events of the ADO objects. A complete list of these elements is available in the Visual Basic Object Browser, which you can display by pressing F2.

Making the Connection with ADO

The `Connection` object is used to establish a connection to a data source. Its most important property is the `ConnectionString` property, which contains the information used to connect to a database. You control the state of the database connection with the `Open` and `Close` methods.

Opening and Closing a Connection

The first step in opening a connection is to create a new instance of the `ADODB.Connection` object, as follows:

```
Dim cn As ADODB.Connection
Set cn = New ADODB.Connection
```

After the object instance is created, all you have to do to establish a connection is provide the connection string and call the `Open` method. You can set the connection string in two ways, the first being to assign it to the `ConnectionString` property:

```
cn.ConnectionString = "DSN=BIBLIO"
cn.Open
```

You can also pass the connection string as part of the call to the `Open` method:

```
cn.Open "DSN=BIBLIO"
```

NOTE The connection string shown here is simple. For other data sources, your connection string may be longer and include additional information.

After you finish using a connection, call the `Close` method. As with most object variables, it is also a good idea to set them to `Nothing` to free up any used resources:

```
cn.Close
Set cn = Nothing
```

Using the *Execute* Method In ADO, you can accomplish the same goal in many different ways. Retrieving information is a perfect example. You can take your pick from the `Recordset`, `Command`, or `Connection` objects; they all have a method used to pull data into a recordset. The `Connection` object's `Execute` method allows you to run an SQL statement against a data source. If the SQL statement returns records, you can access them simply by assigning the return value of the `Execute` method to an ADO `Recordset` object.

Test the `Execute` method with a simple example. Start a new Standard EXE project, and add a reference to ADO. Then add a list box control to the form, and name it `lstAuthors`. Finally, place the following lines of code in the form's `Load` event:

```
Dim cn As ADODB.Connection
Dim rs As ADODB.Recordset

Set cn = New ADODB.Connection
cn.Open "DSN=BIBLIO"

Set rs = cn.Execute("Select * from Authors Where [Year Born] > 1943")

While Not rs.EOF
    lstAuthors.AddItem "Year Born: " & rs.Fields("Year Born") & vbTab _
                & "Name: " & rs.Fields("Author")
    rs.MoveNext
Wend

rs.Close
cn.Close
Set rs = Nothing
Set cn = Nothing
```

Run the program, and you should see results similar to those pictured in Figure 24.16.

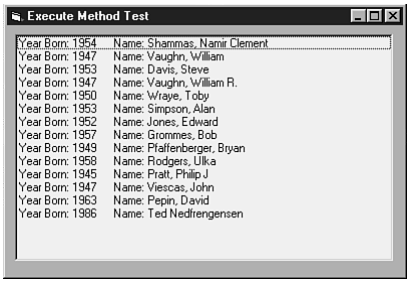


FIGURE 28.16
The results of a simple query were created with the `Execute` method of the `ADODB.Connection` object.

The `Execute` method of the `Connection` object returns a `Recordset` object, which is stored in the variable `rs`. Next, a `While` loop is used to move through the recordset, adding each author's name and birth year to the list box.

You can also use the `Execute` method to run SQL statements that do not return a recordset against the database, as in the following examples:

```
cn.Execute "Delete from Authors where Author = 'Jones, Amanda'"

cn.Execute _
"INSERT INTO AUTHORS ([Author],[Year Born]) Select 'Siler, Brian',1972"
```

The first statement deletes a record from the `Authors` table, and the second statement inserts a new record. (Remember, these examples were written for Access; in another database, the SQL syntax might be slightly different.)

Connecting Without a DSN So far in this chapter, you have used a simple connection string that specifies the BIBLIO data source name, which was set up previously in the ODBC Data Source Manager. If you do not want to depend on a DSN's being set up, you can establish a DSN-less connection by giving ADO more information in the `ConnectionString` property, as in the following examples for a Microsoft Access database:

```
cn.ConnectionString = _
"Provider=Microsoft.Jet.OLEDB.3.51;Data Source=d:\vb6\biblio.mdb"

cn.ConnectionString = _
"Driver=Microsoft Access Driver (*.mdb);DBQ=D:\VB6\biblio.mdb"
```

NOTE Even if you use a DSN-less connection, the appropriate drivers and support files still must be installed on the user's PC.

The preceding connection string names the driver rather than the DSN. For the Access driver, the DBQ parameter points to the database name. You can also specify other OLE DB providers, such as the following string used to connect to a Microsoft SQL Server:

```
"Provider=SQLOLEDB.1;Password=groovy:User ID=apowers:Location=SQLSRV1; _
database=employee"
```

As you can see from the preceding example, a connection string can contain many different types of information, including user ID, password, and default database name.

Working with Recordsets

Recordsets represent actual data from a database. A recordset has fields (such as Name and Phone Number) and values for those fields (such as John Smith and 555-1212). Each set of field values that go together makes up a single record, and all these records together make up a recordset.

An easy way to visualize a recordset is as a spreadsheet or grid: Fields are like column names, and the rows are the records. Recordsets are usually created as the result of a query on the database. You use recordsets in your program to retrieve and update data.

In ADO, a recordset is stored in a `Recordset` object. After a `Recordset` object is populated with data, you can perform the following operations on the data:

- Add new records
- Edit existing records
- Delete records
- Navigate the recordset (change the current record)

Creating a Recordset You have already learned how to create and populate a Recordset by using the `Execute` method of the `Connection` object. However, a `Recordset` object has its own methods and properties that can be used to retrieve data. As with all objects, to use these properties, you need to create a new instance of the `Recordset` object first:

```
Dim rs As ADODB.Recordset
Set rs = New ADODB.Recordset
```

Next, you can use properties of the object to specify the connection, record source, and recordset type.

To specify a data source for a `Recordset` object, set the `ActiveConnection` property equal to an ADO `Connection` object:

```
rs.ActiveConnection = cn
```

The line of code assumes that `cn` represents an open connection that points to a data source, as discussed earlier. Another way to select a connection is to set the `ActiveConnection` property to the connection string:

```
rs.ActiveConnection = "DSN=BIBLIO"
```

If you use a string value instead of a `Connection` object, the `Recordset` object opens its own connection to the database.

A `Recordset`'s `Open` method causes the recordset to be populated with data. To use the `Open` method, you must first set the `Source` property, which corresponds roughly to the `RecordSource` property of the ADO Data control. The code in Listing 28.1 creates a new `Recordset` object and then prints the data it contains.

Listing 28.1 ADOTEST.ZIP—Creating an ADO Recordset

```
Const sSQL = "SELECT * FROM Authors Where [Author] Like 'Q%'"
Dim cn As ADODB.Connection
Dim rs As ADODB.Recordset

'OPEN A CONNECTION
Set cn = New ADODB.Connection
cn.Open "DSN=BIBLIO"

'OPEN A RECORDSET
Set rs = New ADODB.Recordset
rs.ActiveConnection = cn
rs.Source = sSQL
rs.Open

'PRINT THE AUTHORS' NAMES
rs.MoveFirst
While Not rs.EOF
    Debug.Print "author = " & rs.Fields("Author")
    rs.MoveNext
Wend

'CLOSE EVERYTHING
rs.Close
Set rs = Nothing
cn.Close
Set cn = Nothing
```

The code in Listing 28.1 runs a SQL query that selects all the authors who have last names beginning with the letter *Q*.

NOTE The `Like` syntax of the SQL query in Listing 28.1 is specific to a Microsoft Access database. In a SQL Server environment, you might write the same statement as follows:

```
Select * from Authors where Author like "Q*"
```

Displaying Field Values To access data in the `Recordset` object, use the `Fields` collection. Table 28.2 lists the options you can use to refer to an individual field.

Table 28.2 Working with Field Values

Syntax	Example
Recordset.fields(*field name*)	rsPeople.Fields("LastName")
Recordset.fields(*index*)	rsPeople.Fields(2)
Recordset!*field name*	rsPeople!LastName

In the sample code, the *Recordset*.Fields(*field name*) syntax is used. However, for some purposes (such as when you do not know the field name), using the field index is more appropriate. Field indexes start at zero and end at one less than the number of fields in the recordset. The number of fields in a recordset is available through the Count property of the Fields collection. The following code sample prints each field name and then scrolls through the recordset printing each field value:

```
'PRINT THE FIELD NAMES
For i = 0 To rs.Fields.Count - 1
    Debug.Print rs.Fields(i).Name,
Next i
Debug.Print

'PRINT CONTENTS OF ALL FIELDS IN EACH RECORD
rs.MoveFirst
While Not rs.EOF
    For i = 0 To rs.Fields.Count - 1
        Debug.Print rs.Fields(i),
    Next i
    Debug.Print
    rs.MoveNext
Wend
```

This sample code uses two properties of the Field object: the Name and the Value properties. Notice that you do not have to explicitly specify the Value property because it is the default property.

Recordset Navigation After data has been retrieved into a Recordset object, you can access and update the values of fields in the current record. Think of the recordset as a long sequential file. At any given time, the current record is a pointer to a location within that file. To work with different records, you can use the following navigation methods to change the current record:

- MoveFirst—Moves to the first record, just after the beginning-of-file marker (BOF)
- MoveLast—Moves to the last record, just before the end-of-file marker (EOF)
- MoveNext—Moves to the next record after the current record (toward EOF)
- MovePrevious—Moves back to the record before the current record (toward BOF)
- Move—Moves forward or backward a specified number of records

BOF and EOF are properties that indicate the beginning and ending points of a recordset, respectively.

Navigation and the* CursorType *Property In the examples up to this point, you have seen only two methods used to navigate within a recordset: the MoveFirst and MoveNext methods. In Listing 28.1, you used a While loop to move forward through the records in an open recordset.

As a matter of fact, attempting to use MovePrevious or MoveLast with Listing 28.1 would cause an error, because it is invalid for the selected *cursor type*. A cursor in a recordset is like a cursor on a computer screen; it is a pointer to a current position.

Because you did not specify a value for the `Recordset` object's `CursorType` property, it was set to the default value of `adOpenForwardOnly`. The ramifications of the `CursorType` property are discussed shortly; but for now just remember that a "forward only" cursor does not support `MovePrevious` and `MoveLast` navigation methods.

Using Navigation Methods As an example of recordset navigation, you will create a project that uses the navigation methods. To get started, create a new Standard EXE project with a list box named `lstData`, three command buttons (`cmdPrevious`, `cmdNext`, and `cmdJump`), and a text box named `txtJump`.

The sample program runs a query against the BIBLIO database and then allows the user to execute the navigation methods to browse the recordset, much like you did with the Data control. The code for the sample project is shown in Listing 28.2.

Listing 28.2 ADONAV.ZIP—Using Recordset Navigation Methods

```
Option Explicit
Dim rs As ADODB.Recordset
Private Sub Form_Load()

    'FILL THE RECORDSET OBJECT RS
    Set rs = New ADODB.Recordset
    rs.CursorType = adOpenStatic
    rs.Source = "Select * from Publishers"
    rs.Open , "DSN=BIBLIO"
    DisplayCurrentRecord

End Sub
Sub DisplayCurrentRecord()
    Dim i As Integer
    Dim s As String

    If rs.BOF Then rs.MoveFirst
    If rs.EOF Then rs.MoveLast

    lstData.Clear
    For i = 0 To rs.Fields.Count - 1
        s = rs.Fields(i).Name & ": " & rs.Fields(i)
        lstData.AddItem s
    Next i
End Sub
Private Sub cmdJump_Click()
    rs.Move Val(txtJump)
    DisplayCurrentRecord
End Sub

Private Sub cmdNext_Click()
    rs.MoveNext
    DisplayCurrentRecord
End Sub

Private Sub cmdPrevious_Click()
    rs.MovePrevious
    DisplayCurrentRecord
End Sub
```

The use of the navigation methods in the sample project is straightforward. The only part that merits further explanation is the `DisplayCurrentRecord` function. Notice that it checks for `BOF` or `EOF` conditions before displaying the field names and values for the current record. This step is necessary because attempting to access the `Field` object without a current record would cause an error. The working project is pictured in Figure 28.17.

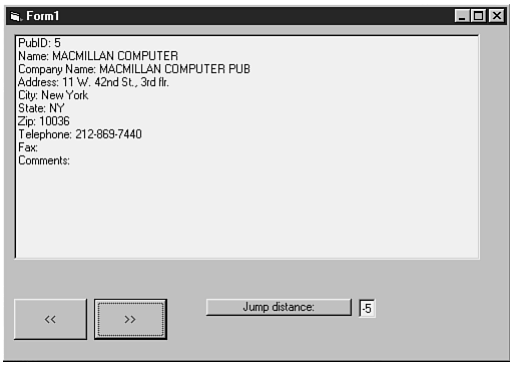


FIGURE 28.17
A sample program allows the user to browse a recordset.

Updating Data Now that you know how to get information into a `Recordset` object and display it, you can take the next step and change (or update) the information in the database. If your recordset has been set up appropriately, you can change database information easily. Simply navigate to the appropriate record, assign a new value to each field you want to change, and finally call the `Update` method, as follows:

```
rs.Fields("Author")="Simpson, Bart"
rs.Update
```

NOTE In DAO, you call the `Edit` method before changing the value of a field. In ADO, changing the field's value automatically turns on edit mode; there is no `Edit` method. You can query the `EditMode` property to determine whether the current record is being edited. ■

Setting the* LockType *Property By default, ADO recordsets are read only. Attempting to change a field value in a read-only recordset causes an error. To add, change, or delete records in an ADO recordset, you must set the `LockType` property to a different value than the read-only default. For example, setting the `CursorType` and `LockType` properties as follows creates an updateable Access recordset:

```
rs.CursorType = adOpenKeyset
rs.LockType = adLockOptimistic
```

You might wonder why the `LockType` property is important. The answer is that if you are editing records in a multiuser database, you have to be concerned with *record locking*. Record locking means preventing other users from trying to edit the same database record at the same time. Record locking is controlled with the `LockType` property, which has the following values:

- `adLockReadOnly`—Sets data in the recordset as read only
- `adLockPessimistic`—Provides pessimistic record locking, which means the record is locked while you are editing it
- `adLockOptimisitc`—Provides optimistic record locking, which means records are locked only when you call the `Update` method
- `adLockBatchOptimisitc`—Updates multiple records at a time with the `UpdateBatch` method

Why are the parameters named after attitudes (optimistic and pessimistic)? Because attempting to update a locked record causes an error in your program. You can be optimistic that a record will be available when you need to update it, or pessimistic and lock it for as long as you need it.

Viewing Others' Changes Another concern with multiuser databases is making sure the data in your recordset is as accurate as it needs to be. If you recall an earlier section, you know that the `CursorType` property can restrict recordset navigation. However, the main point of the different cursor types, listed in Table 28.3, is to control how your recordset is linked to the underlying data.

Table 28.3 The *CursorType* Property

Constant	Description
`adOpenForwardOnly`	This property is fast but allows only forward movement.
`adOpenKeySet`	Your program can see some of the data changes made by other users.
`adOpenDynamic`	Your program can see all the data changes made by other users.
`adOpenStatic`	This property provides a static picture of the database; you cannot see others' changes.

As you will find out from using ADO, not all cursor types are supported by all databases. For Access databases, the default `adOpenForwardOnly` cursor is intended for a quick read-only pass through the database, whereas the `adOpenKeySet` cursor is better suited for updates and more complex operations.

Adding New Data Adding new records to a `Recordset` object is similar to changing the content of existing records, but with one extra step:

1. Call the `AddNew` method.
2. Assign values to the fields.
3. Call the `Update` method.

The code in Listing 28.3 adds a new record to the `Authors` table in the BIBLIO database.

Listing 28.3 ADOTEST.ZIP—Adding a Record to an ADO Recordset

```
Dim cn As New ADODB.Connection
Dim rs As ADODB.Recordset

cn.Open "DSN=BIBLIO"

'OPEN A RECORDSET
Set rs = New ADODB.Recordset
rs.CursorType = adOpenKeyset
rs.LockType = adLockOptimistic
rs.Source = "Authors"
rs.ActiveConnection = cn
rs.Open

'ADD A NEW RECORD
rs.AddNew
rs.Fields("Author") = "King, Stevie"
rs.Fields("Year Born") = 1945
rs.Update
'NOTE: THE Au_ID field is an autonumber field,
'      it will be created automatically.

'DESTROY THE OBJECTS
rs.Close
cn.Close
Set rs = Nothing
Set cn = Nothing
```

The Command Object

When you are working with a set of data, most of the time you are working with properties and methods of the `Recordset` object. However, to retrieve that data, you will find that the ADO `Command` object is indispensable. It allows you to encapsulate a query or SQL stored procedure into a reusable object, which is especially ideal if you need to perform the operation multiple times. You can even store the parameters from your query or stored procedure in the object's `Parameters` collection, which means you don't have to worry about building an appropriate SQL string with code. After you set up a command object, you can change the parameters of the object and call it repeatedly.

For example, recall the SQL statement from Listing 28.1, which was used to select authors whose last names begin with the letter *Q*. Using Microsoft Access, you can create a generic query called `LetterLookup` by using the following SQL syntax:

```
PARAMETERS Letter Text;
SELECT *
FROM Authors
WHERE Author Like Letter+'*';
```

Running this query in Access prompts you for the `Letter` parameter and then displays the matching records. To run this Access query from VB code, you can use a `Command` object, as follows:

```
Dim cmd As New ADODB.Command
Dim parmTemp As ADODB.Parameter

Set cmd.ActiveConnection = cn
cmd.CommandText = "LetterLookup"
cmd.CommandType = adCmdStoredProc
Set parmTemp = cmd.CreateParameter("Letter", adChar, adParamInput, 1)
cmd.Parameters.Append parmTemp
cmd("Letter") = "Q"
Set rs = cmd.Execute
```

To use the `Command` object, you have to decide on the type of command it is (these types are listed earlier in the chapter) and specify the actual command. If any parameters are required, you can add them to the `Parameters` collection of the object. After you set up the `Command` object, simply call the `Execute` method to perform the command.

Disconnected Recordsets

If you have worked with DAO in the past, then you will find that ADO has new features that allow you to manipulate recordsets in ways that were never before possible. One new feature is the ability to create *disconnected recordsets*. This term means that you can have a recordset in memory that is independent of a database connection. While disconnected, the recordset acts as a standalone object, with all the usual methods and properties. What is even more amazing is that you can later reconnect the recordset and commit any changes made while the recordset was disconnected. As you will see shortly, disconnected recordsets are most useful on the Internet, because you do not always have a continuous connection to the database. In the following sections, you see how to handle these recordsets.

Creating a Disconnected Recordset

The key to creating a disconnected recordset is setting the `CursorLocation` property. It has two settings: `adUseClient` and `adUseServer`. To create a disconnected recordset (or *client-side cursor*), perform the following steps:

1. Set the `CursorLocation` property to `adUseClient`.
2. Populate the `Recordset` object.
3. Set the `ActiveConnection` property to `Nothing`.

Recall the example from Listing 28.2, which displayed publisher information in a list box. You can easily change it to use a disconnected recordset by changing the `Form_Load` event procedure, as follows:

```
Private Sub Form_Load()

    Set rs = New ADODB.Recordset
    rs.CursorLocation = adUseClient
    rs.CursorType = adOpenStatic
    rs.Source = "Select * from Publishers"
    rs.Open , "DSN=BIBLIO"
    Set rs.ActiveConnection = Nothing
    DisplayCurrentRecord

End Sub
```

The only changes from Listing 28.2 were to add two lines of code. You set the `CursorLocation` property so that records are stored on the client, and you disconnect the recordset by destroying its `ActiveConnection` object. However, I would bet that some skeptics in the audience need even more evidence that the recordset is indeed disconnected from the database. To prove this theory, run the sample project with the modification to create a disconnected recordset. When the first record is displayed on the screen, open Windows Explorer and temporarily rename the file BIBLIO.MDB to another name. Return to Visual Basic, and you will find that the program still functions normally. However, you cannot start the program a second time unless the database file exists.

Reconnecting a Recordset

Earlier, you learned how records are locked to prevent multiple users from "fighting" over the same record. Record locking takes on a different meaning when you use disconnected recordsets. If you are not connected to a database, then you are, in a sense, "checking out" the records, like you would check out books from a library. If you edit or change the data in the recordset, the changes are not reflected until you "check in" the records, or in database terms, perform a batch update to the database. Therefore, the type of record locking you have to use is known as *batch optimistic*.

Batch updates allow you to make multiple changes to a recordset and apply them to the underlying database at once with the `UpdateBatch` method. You can even make a change to a disconnected recordset, reestablish the connection, and update the database.

First, to use `UpdateBatch`, you must change the `Recordset` object's `LockType` property to use the `adLockBatchOptimisitc` record-locking method:

```
rs.LockType = adLockBatchOptimistic
```

After you retrieve a disconnected recordset, as in the preceding section of code, change one or more of the records by setting a new field value:

```
rs.Fields(0)= "Edited Field Value"
rs.MoveNext
rs.Fields(0)= "Another Edited Field Value"
```

Next, reestablish the connection by setting the recordset's `ActiveConnection` property to a new `Connection` object, as shown here:

```
Set cn = New ADODB.Connection
cn.ConnectionString = "DSN=BIBLIO"
cn.Open
Set rs.ActiveConnection = cn
```

Finally, execute the code that actually performs the database update:

```
rs.MarshalOptions = adMarshalModifiedOnly
rs.UpdateBatch
```

I hope you were watching closely because I just introduced a new property, `MarshallOptions`. This property determines whether the whole recordset is returned for updating or just the changed records, for the most efficient use of resources. The second line of code actually performs the update with the `UpdateBatch` method.

Uses of a Disconnected Recordset

Now that you know what a disconnected recordset is, you may be wondering why you would ever want to use one. In a traditional client/server environment, it might never be necessary. However, disconnected recordsets bring a whole new level of power to your Internet applications. Imagine being able to run a Visual Basic program inside a browser that communicates with your database server just as you would over a LAN. To build such a heavy-duty application, you need to break it up into the following components:

- **Internet client.** An ActiveX OCX or ActiveX Document that runs in Internet Explorer
- **Internet Server.** An ActiveX DLL component running on the Internet server

Creating an application that works in this manner involves understanding several fairly complex Microsoft products—coverage of which is beyond the scope of this chapter. However, if you understand a few key concepts (ADO and ActiveX components), you should be successful.

Microsoft offers a product called Remote Data Services (RDS), which acts as a link between Internet Information Server and Internet Explorer. The key to using RDS is its `DataSpace` object. You can create an instance of the RDS Data Space on the Internet client, as follows:

```
Set objRDS = CreateObject("RDS.DataSpace")
```

You can then use the RDS Data Space to create remote objects on a Web server:

```
Set objTest = objRDS.CreateObject("MyDLL.MyClass", _
"http://server.somewhere.com")
```

Notice the difference in the two calls to `CreateObject`. The first line of code creates a local object. The second line of code creates a remote object, `objTest`. This process is somewhat similar (but not exactly like) using DCOM to create an instance of an object on a remote machine, but then using the features of that object on a local machine.

The sample object `objTest` is an instance of an ActiveX DLL that runs on the Web server. After you create this instance, you can make method calls and pass data to and from it. The `ADOR` object library mentioned earlier is a minimal implementation of an ADO Recordset (the *R* stands for remote) designed for this type of use. You can create functions in your ActiveX DLL to pass ADOR recordsets to the Internet client, which can then return the changed records to the server.

From Here...

This chapter provided an introduction to ActiveX Data Objects (ADO), which Microsoft is positioning to replace older data access methodologies such as DAO and RDO. ADO allows you to not only perform the standard database operations (such as adds and deletes), but also add a wide range of new database capabilities to your programs. In addition to a powerful object interface, there are several ADO-enabled controls including the DataGrid and the ADO Data control. For related information, see the following chapters:

- To apply what you have learned to the Internet, see Chapters 31, "Active Server Pages," and 33, "Visual Basic and Other Uses of the Internet."
- To learn how to build reports based on your data, see Chapter 29, "Creating Reports."
- For more information on data binding, see Chapter 25, "The Data Control and Data-Bound Controls."

CHAPTER 29

Creating Reports

In this chapter

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Using Crystal Reports **653**

Despite the fact that online information systems always promise a "paperless" office, everyone likes to have printed reports. For some Visual Basic programmers, reporting has always been the most frustrating part of developing an application. If you create your own reporting functions using `Print` and other graphics methods, you tend to spend a lot of time and effort that could be better spent in other areas. At the other extreme is using a third-party reporting add-in, which is quicker to implement but raises a whole bunch of other issues, including additional cost and DLL distribution requirements.

In Visual Basic 6.0, Microsoft has added a new way to include reporting in your application: the Data Report. Data Reports enable you to easily display a print preview screen, with print and export buttons, from an ADO data source. All you have to do is provide the data and report layout. In addition to this new reporting tool, Visual Basic also supports Crystal Reports, a popular reporting tool that has been packaged with Visual Basic for quite some time now. Crystal Reports, a product of Seagate software, provides an easy way to graphically design and distribute reports.

In this chapter, you examine both of these reporting tools and learn how to use them in your applications.

Creating a Simple Report

The Data Report is known as an ActiveX Designer, meaning that it is a specialized ActiveX object that integrates into the VB environment. You saw another example of an ActiveX Designer, the IIS application, in Chapter 28, "Using ActiveX Data Objects (ADO)."

In this section, you'll create a sample Data Report based on a query of the BIBLIO database. To create this report, perform the following steps:

1. Set up the ADO recordset to be used by the report.
2. Add a `DataReport` object to the Visual Basic project.
3. Design the report by placing fields on the `DataReport` designer form.
4. Write code to display the report in the program.

Setting Up the Data Source

To begin the sample project, open Visual Basic and start a new Standard EXE project. The next step in creating the sample report has nothing to do with the report itself, but rather the data that goes into the report. Before you can design a report, you have to know what you are reporting. Therefore, you can build on the ADO knowledge you acquired from Chapter 28 and create a simple query that can be used for the `DataSource` property of the report.

▶ **See** "Setting up a Data Source," **p. 613**

Refer to Chapter 28 if necessary to perform these steps to create the query:

1. Add the reference for Microsoft ActiveX Data Objects to your project.
2. If you have not already set up the BIBLIO ODBC data source, do so now.

3. Declare form-level variables, `cn` and `rs`, to represent ADO connection and recordset objects.
4. Draw a command button, `cmdFill`, on the form and label it `Fill Recordset`.
5. Add code to the form's `Load` and `Unload` events to open and close a connection to the BIBLIO data source.
6. Add code to the button's `Click` event to populate the recordset with the following SQL query:

```
"Select * from Titles where [Year Published] >= 1996"
```

The complete code for the form up to this point is shown in Listing 29.1.

Listing 29.1 RPTDEMO.ZIP—Getting Some Sample Data for the Report

```
Dim cn As ADODB.Connection
Dim rs As ADODB.Recordset

Private Sub cmdFill_Click()
    Set rs = cn.Execute("Select * from Titles where [Year Published] >= 1996")
    MsgBox "Recordset populated."
End Sub

Private Sub Form_Load()
    Set cn = New ADODB.Connection
    cn.Open "DSN=BIBLIO"
End Sub

Private Sub Form_Unload(Cancel As Integer)
    rs.Close
    cn.Close
End Sub
```

The preceding query creates a recordset containing some records from the `Titles` table of the BIBLIO sample database. The records were limited to those titles published in or after 1996 to make things quicker because the table has a lot of records in it. When you click the command button, the recordset object `rs` is populated with the fields from the `Titles` table. Next, you add a `DataReport` object to the project and learn how to create a report from the sample recordset.

Adding a Data Report to Your Project

Now that you have data, the next step is to determine how to display that data on a report. First, you need to add a new `DataReport` object to your Visual Basic project. To do so, choose Project, Add Data Report. You should notice that several things happen immediately:

- A new `DataReport` object called `DataReport1` is added to the Project Explorer window.
- A new `DataReport` area is added to the Toolbox.
- The Report Designer window appears, as shown in Figure 29.1

NOTE In general, each `DataReport` object in your program represents a separate report. However, depending on the complexity of your reports, you might be able to manipulate the report enough from code to use a single `DataReport` object for multiple reports.

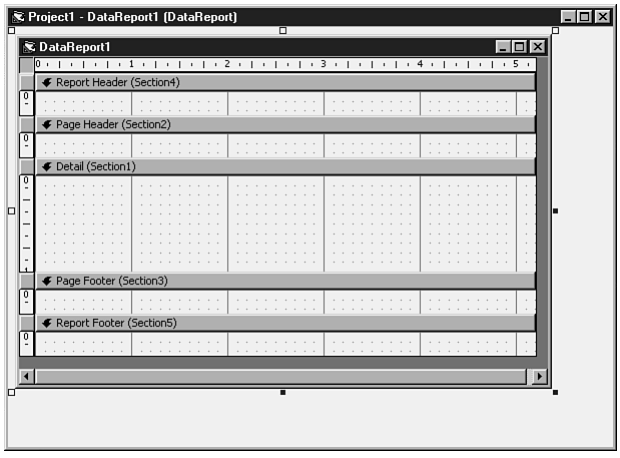


FIGURE 29.1
The Data Report allows you to manage the report layout visually.

Notice that a Data Report is divided into several sections, much like reports in Microsoft Access. These sections display the following types of information:

- **Report Header.** Information displayed once, at the top of the report
- **Page Header.** Information displayed at the top of every page
- **Detail Section.** The part of the report that is repeated for each record in the ADO data source
- **Page Footer.** Information displayed at the bottom of every page
- **Report Footer.** Information displayed at the end of the report

NOTE You can also add your own Group header/footer sections to a report so that you can display or calculate certain fields periodically throughout the report.

Note that each of these sections also has a section name (for example, `Section1`) so that you can access it from program code. To display the properties for an individual section in the Properties window, click the section's gray title bar. To display the properties for the `DataReport` object, click the square in the upper-left corner.

Setting Up the Data Report

While you are in design mode, use the Data Report Designer window to arrange report controls on the report, just as you would arrange custom controls on a form. The types of fields that you can place on a Data Report become available in your Toolbox when the `DataReport` object has focus. These fields are shown in Figure 29.2.

FIGURE 29.2
The elements that you can add to a Data Report are in a separate section of the Toolbox.

To add information to your report, you first draw the report control in the appropriate section of the report and then set its properties, just as you would with any other control. The controls that can be placed on a Data Report are shown in Table 29.1.

Table 29.1 Data Report Controls

Control Icon	Control Name	Description
	RptLabel	Specifies a label used to display text that is not data-bound, such as a column name or date printed
	RptTextBox	Displays the contents of a database field
	RptImage	Contains a picture or other graphic image, such as a company logo
	RptLine	Enables you to draw lines on the report—for example, to separate the different sections of the report
	RptShape	Enables you to draw a variety of shapes on the control to highlight information or provide other visual effects
	RptFunction	Allows you to place a field in the header or footer that contains one of several simple math functions, such as a total of all the values in a particular data field

Adding Fields to the Detail Section Continue with the sample project by placing some fields on the report. Draw a `RptTextBox` object in the Detail section of `DataReport1`, just as you would draw a normal text box on a form. Notice that it appears with the word `Unbound` in it, meaning that it has not yet been assigned a data field to display.

Press F4 to bring up the Properties window for the new text box. Change the name to something meaningful. For the example, rename the box `txtTitle`, because you will use the text box to display book titles. Next, enter the word `Title` in the `DataField` property to bind the

control to a data field. Close the Properties window. Notice that `Title` now appears on the text box.

Next, add two additional text fields named `txtDesc` and `txtYear` to the Detail section of the report using `Description` and `Year Published` for their `DataField` properties. Finally, resize the Detail section so that you don't have a lot of wasted space beneath the three text fields. The resulting form is pictured in Figure 29.3.

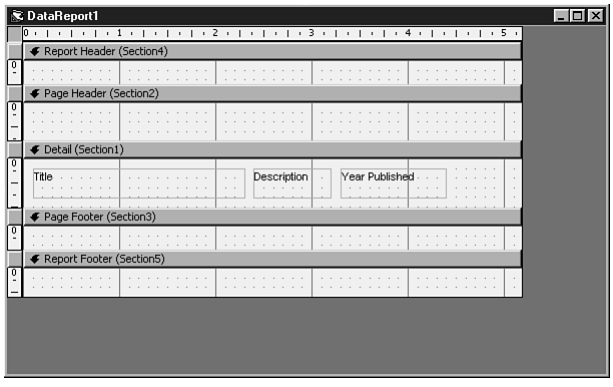


FIGURE 29.3
Setting up a report field is as easy as setting up a bound control.

Adding Header Information The three text box controls you just added appear in the Detail section of the report; they therefore will display information from the database. However, you also should add some fixed information in the header of the report to label these fields. To do so, you can simply add RptLabel controls to the appropriate sections of the report and set their `Caption` properties.

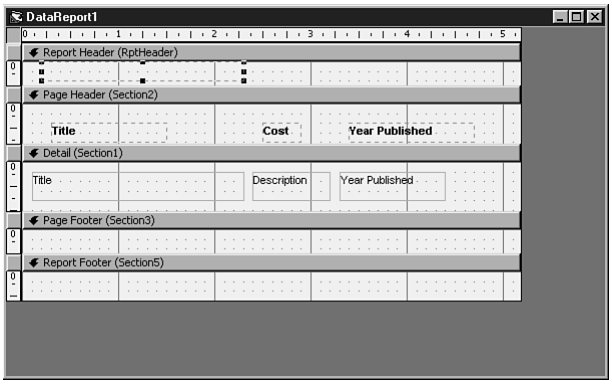
For the sample report, add three labels to the Page Header section. Make their captions `Title`, `Cost`, and `Year Published`. Arrange each label so that it describes the field below it in the Detail section.

Next, add a fourth RptLabel control to the report in the Report Header section. This field will display the name of the person who created the report, which will be set from Visual Basic code. Because you need to access this label control from code, the names of the section and the label control should be set to something meaningful. To change the `Name` properties of these two objects, do the following:

1. Select the RptLabel control, and change its `Name` property to `lblPerson` just as you would with a standard Label control. Also, change the `Caption` property to an empty string.
2. Click the gray bar at the top of the Report Header section, and press F4 to display the Properties window for this section.
3. Change the `Name` property of the section to `rptHeader`.

After you finish these steps, your Data Report should look like Figure 29.4. You are now finished with the report design.

FIGURE 29.4
Here, you can see the report layout for the sample project, after adding the header fields.



Displaying the Report

Now that you have determined how you want the report to look, you have to add a few lines of code to display the report. Add a second command button, `cmdReport`, to the form. Make the caption `Display Report`. Enter the code from Listing 29.2 in the command button's `Click` event procedure.

Listing 29.2 RPTDEMO—Showing the Report to the Users

```
Private Sub cmdReport_Click()
    Dim s As String
    s = "Prepared by Abe Froman"

    Set DataReport1.DataSource = rs
    DataReport1.Sections("rptHeader").Controls("lblPerson").Caption = s
    DataReport1.Show

End Sub
```

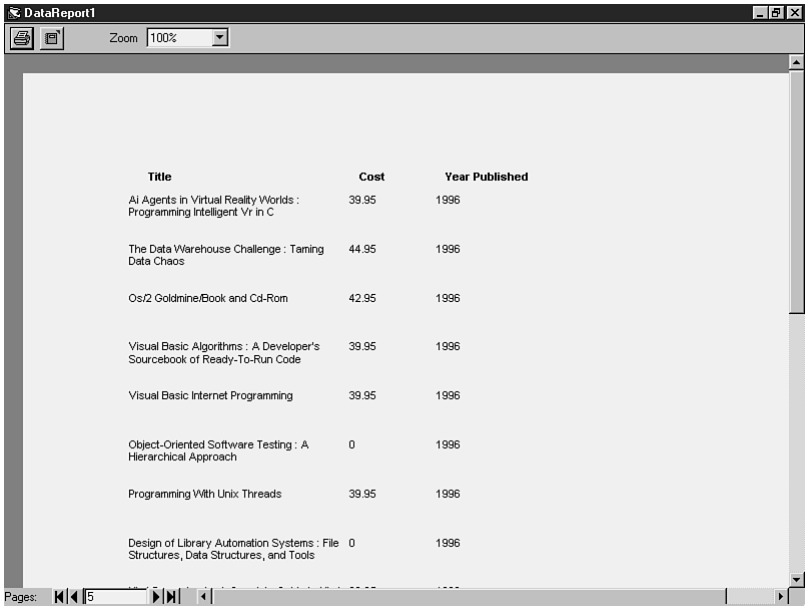
The code in Listing 29.2 sets the `DataSource` property of the `DataReport` object to the ADO recordset `rs`.

NOTE In this example, you use an ADO recordset as the data source. However, you can also use other types of data sources, such as a Data Environment, in which case you can set the `DataSource` property at designtime.

Next, the code sets the `Caption` property of the label control in the report header. Finally, the `Show` method is invoked, causing the report to be displayed.

To test the sample report, run the project and click the Fill Recordset button. After you see the message box stating that the recordset has been filled, click the Display Report button. The Data Report should appear on a separate form in Print Preview mode, as pictured in Figure 29.5.

FIGURE 29.5
The completed sample Data Report is shown here.



Enhancing Your Data Reports

In the preceding section, you learned how easily you can create a report using the Data Report Designer. The sample report ended up looking rather rudimentary, but it got the job done. As you may have noticed while building the sample, you can make many changes to the report fields, such as the `Font` property, that require no additional explanation. These options work just as they would in any other custom control. Simply apply your best artistic talents to make the report look like you want. However, the Data Report also has a few special features, some of which will be covered in the following sections.

Predefined Report Fields

As you saw in the example, the `DataReport` object enables you to programmatically access properties of report controls from code. For example, if you want to add a field that displays the date the report was created, you can set a label's caption to `Now` before displaying the report. However, you can achieve the same result in a much simpler way. The Data Report includes some predefined placeholders, which allow you to include several dynamic elements on a report. These items are listed in Table 29.2.

NOTE The `Title` property is also used to identify the report to printer dialogs.

Table 29.2 Predefined Placeholders on a Data Report

Code	Description
`%p`	Current page number
`%P`	Total number of pages
`%d`	Current date (short format); for example, 5/24/98
`%D`	Current date (long format); for example, Sunday, May 24, 1998
`%t`	Current time (short format); for example, 16:10
`%T`	Current time (long format); for example, 4:10:00 PM
`%i`	Report title (string stored in the `Title` property of the `DataReport` object)

To use one of these fields, simply place a `RptLabel` control on the report and set its `Caption` property to include the placeholder you want. For example, if you want to add a page number to the bottom of the page, draw a label in the Page Footer section and set its caption to the following string:

```
Page %p of %P
```

Run the report, and the Data Report automatically replaces the placeholders with the proper information, as shown in Figure 29.6.

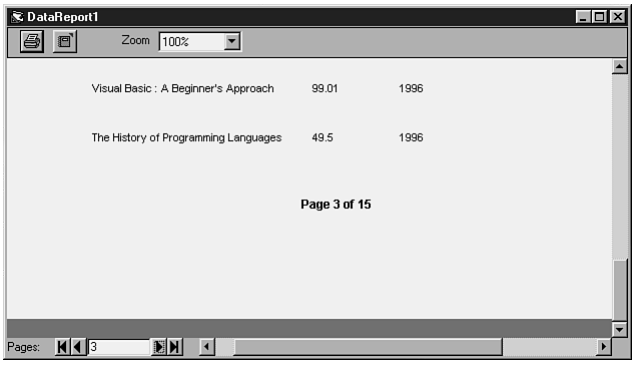


FIGURE 29.6
A page counter has been added to the sample report.

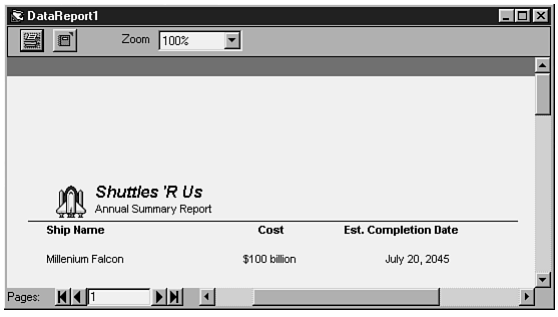
If you just want to use one of the placeholders by itself, without any of your own text, there is a quick way to add it to the report. Simply right-click the report, and choose Insert Control from the context-sensitive menu that appears. You can select from any of the predefined fields, as well as the other available report controls.

Adding Graphics

Graphical shapes and images do not add any functionality to your report, but they make it look nicer, so you can use them to highlight or visually organize certain information. Three controls allow you to add these elements: the RptImage, RptLine, and RptShape controls.

Pictures To add a picture to a report, first draw a RptImage control on the Report Designer window. Next, load a picture into the control by displaying the Properties window and clicking the ellipsis button next to the `Picture` property. Select a picture file just as you would for a standard Image or PictureBox control. Figure 29.7 shows a corporate logo in a report header that was added using the RptImage control.

FIGURE 29.7
You can add pictures to a Data Report by using the RptImage control.



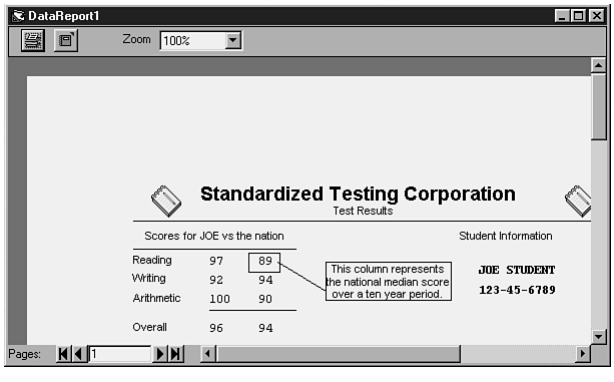
Although the RptImage control is similar to the standard Image control, it is a different control with its own set of properties. Some of the more notable differences are as follows:

- The `PictureAlignment` property allows you to position an image within the image control, similar to the way you can align text within the label control.
- More choices are available for the `BorderStyle` property in the RptImage control than with a standard Image control.
- The `SizeMode` property is more versatile than the Image control's `Stretch` property; it also allows a zoom setting in which the picture is magnified until it reaches the borders of the control.

Lines and Shapes In addition to adding pictures to a report, you can add lines and other shapes by using the RptLine and RptShape controls. These controls work similarly to the Line and Shape controls discussed in Chapter 19, "Using Visual Design Elements." Figure 29.8 shows a report that uses several lines and rectangles to highlight information.

▶ **See** "Using the Line and Shape Controls," **p. 426**

FIGURE 29.8
Adding shapes to the Detail section causes them to be repeated for each record.



Printing and Exporting

As you have seen, designing a report involves setting up the report data source and page layout. After you create a report, you have basically three ways to get the report to the users:

- Call the `Show` method to display a report onscreen in a print preview window. The users can browse the information and print a copy if desired.
- Execute the `PrintReport` method to bypass the preview screen and print directly to the printer. This method is useful if you are automating reports, or your program already displays the data and therefore a preview is not necessary.
- Use the `ExportReport` method to save the contents of the report to a file. This function can be used to create a Web page from your reports.

In an earlier example, you learned how to use the `Show` method to display the report on the screen. Calling one of the other two methods to choose a different option is just as easy.

Using the *PrintReport* Method In its simplest form, a call to the `PrintReport` method might look like this:

```
DataReport1.PrintReport
```

However, you can use several optional parameters to achieve more control over printing:

- `ShowDialog`—This parameter determines whether the Windows printer dialog box is shown, allowing users to cancel the operation or adjust printer settings. (This parameter is `False` by default.)
- `Range`—This parameter controls whether every page of the report is printed or just the pages you specify. The default setting is `rptRangeAllPages`, which causes every page to be printed.
- `PageFrom` and `PageTo`—If the `Range` parameter is set to `rptRangeFromTo`, these two parameters determine the starting and ending pages of the printed report.

The following line of code uses all the optional parameters so that only page 5 is printed:

```
datareport1.PrintReport True,rptRangeFromTo,5,5
```

Note that if the `ShowDialog` property is set to `True`, users can modify the page range or cancel the print job.

Using the *ExportReport* Method To export a report to an HTML or text file, use the `ExportReport` method. For example, the following line of code creates an HTML page containing your report:

```
datareport1.ExportReport "key_def_HTML","D:\Temp\MyReport.HTM",True,False
```

As with `PrintReport`, `ExportReport` has several optional parameters:

- `FormatIndexOrKey`—Identifies the format of the export file. Four available formats are stored in the `ExportFormats` collection, but the choice is basically between text or HTML.

- `FileName`—Indicates the full pathname of the file you want to create.
- `Overwrite`—Specifies a Boolean parameter (`True` by default) indicating whether to overwrite an existing export file. If this parameter's value is `False`, attempting to overwrite an existing file causes an error.
- `ShowDialog`—Determines whether the Export dialog box is shown to the users.
- `Range`, `PageFrom`, `PageTo`—Determine which pages in the report are exported. They work exactly like the corresponding parameters in the `PrintReport` method.

Note that in addition to being able to print and export with Visual Basic code, users can do so manually by using the buttons at the top of the print preview screen.

Function Fields

You have already seen how to add fields to a Data Report to display static information or values from a database. The Data Report also can include fields whose values are the result of performing a simple function on the data displayed in the report. These fields, known as function fields, are created using the rptFunction control in the Toolbox.

The data displayed in a Function control is determined by the setting of two properties: the `DataField` property, which is the field on which the function will be performed, and the `FunctionType` property, which may be set to the following values:

- `rptFuncSum`—Sum
- `rptFuncAve`—Average
- `rptFuncMin`—Minimum value
- `rptFuncMax`—Maximum value
- `rptFuncRCnt`—Row count
- `rptFuncVCnt`—Value count, or the number of rows that have a value
- `rptFuncSDEV`—Standard deviation
- `rptFuncSERR`—Standard error

The Function control performs one of the listed functions on multiple rows of data from a given column of the recordset and displays the result. For this reason, you must place a Function control in the Report Footer section, because all the report data must be processed before the function control can calculate its value.

NOTE You also can use Function controls in Group Footer sections, thus enabling you to create subtotals periodically throughout the report. For instructions on using Group Headers and Footers with the VB Data Environment Designer, see the Visual Basic Help file.

To demonstrate the Function control in action, consider a simple table that has only two columns: `SalesPerson` and `Revenue`. Figure 29.9 shows a report that uses the Function control to display the overall amount and average sales.

FIGURE 29.9
You can use the Function control to display averages, sums, and counts.

The Average and Sum functions were used on the Revenue field to create the two amounts at the bottom of the report in this figure.

Using Crystal Reports

Crystal Reports, a third-party reporting package included with Visual Basic, allows you to create reports from many different types of data sources. You can design and test reports graphically by using the Crystal Reports Designer. The report layout and other information are stored in a custom Crystal Reports file format with an .RPT extension. After you create a Crystal Report file, you can use any of the following methods to display your report for the user:

- The Crystal Reports control provides an easy way to integrate the finished reports into your Visual Basic program.
- Crystal Reports API calls allow you to access the Crystal Reports engine without using a custom control. All the API calls for Crystal Reports are located in a file called GLOBAL32.BAS, which should have been installed in your Crystal Reports program directory.
- The Crystal Reports Web Server, available in Crystal Reports Professional Edition, works with your Web server to deliver reports to an Internet client.

NOTE At the time of this writing, the latest version of Crystal Reports was Crystal Reports version 6.0. Visual Basic, however, includes an older version (4.6). To use this version of Crystal Reports, you must first install it. To install Crystal Reports, double click the executable Crystl32.exe in the folder \Common\Tools\Crysrept on Visual Studio CD 3. ■

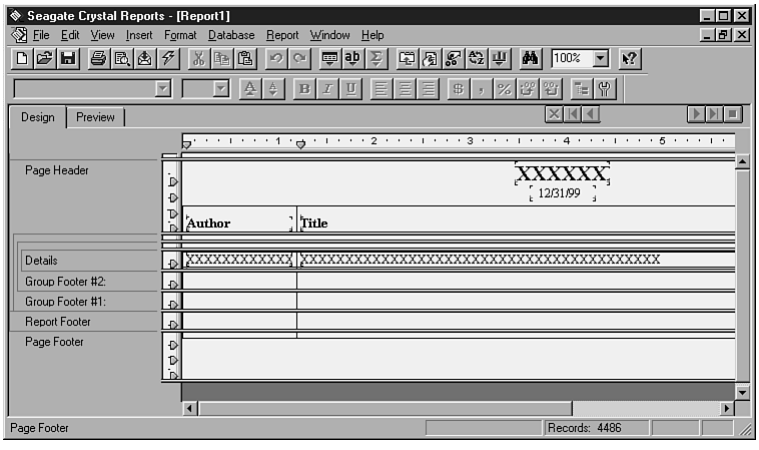
In the next few sections, you are introduced to the basic operation of Crystal Reports, and you step through the process of displaying a report with the Crystal Reports control.

Creating a New Report

Assuming that Crystal Reports was installed correctly, you should be able to access the Crystal Reports Designer by selecting Report Designer from Visual Basic's Add-Ins menu. The Crystal Reports Designer, shown in Figure 29.10, is a development environment for report files. Here, you can design new reports, edit existing reports, and even preview what the finished report will look like.

NOTE The executable to run the Crystal Reports Designer is CRW32.EXE. At the time of this writing, the install included with Visual Basic does not create an icon for the Crystal Reports Designer, so you will have to locate this file on your hard drive and manually create a shortcut if you want to open the Crystal Reports Designer from outside VB. (The default location is \Program Files\MS Visual Studio\Common\Tools\Reports.) If you have Crystal Reports version 6.0, a Start menu group and shortcut icon should have been automatically created.

FIGURE 29.10
The Crystal Report Designer is a separate application from Visual Basic. Use it to determine the layout of the fields on your report.



In Figure 24.10, notice the two tabs that control your view of the report: Design and Preview. While you are in Design mode, you can draw and arrange fields on the report. This process works just like drawing controls on a form; you place a report field on the page, setting the appropriate field name and other properties. If you switch to the Preview tab, Crystal Reports connects to the data source and populates the report with data.

To test this product, create a sample report from the BIBLIO database. First, open the Crystal Reports Designer and choose to create a new report by choosing New from the File menu. The Create New Report dialog box then appears, as shown in Figure 29.11.

As you can see, you can choose from several different types of reports. If you select one of the predefined report types, you use the Create Report Expert to create your report. The Create Report Expert organizes the report creation process into a series of steps, much like a wizard. You can also choose to create a custom report from scratch by clicking the Custom command button and making two selections from the bottom section of the dialog box: the report type and data source.

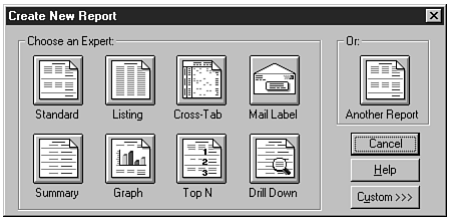


FIGURE 29.11
Crystal Reports allows you to design a report from scratch or with the help of an "expert." The data for your report can be retrieved through ODBC or one of the included drivers.

Creating a Report from Scratch To continue with the sample report from the BIBLIO database, click the Custom button to display the Choose Report Type and Data Type dialog box. Make sure that the Custom Report button is selected and click the Data File button. Next, specify the location of the BIBLIO.MDB Access database (it's usually in the Visual Basic program directory).

After you select the database file, the Insert Database Field dialog box, shown in Figure 29.12, should automatically appear. This dialog box, which is also available from the Insert menu, allows you to determine which fields are placed on the report.

FIGURE 29.12
To highlight multiple items in this dialog box, hold down the Ctrl key while clicking the field names.

For the example, select the `Author` field from the Authors table, and the `Title` field from the Titles table. (The BIBLIO database already contains appropriate links between the various tables.) Position the Insert Fields dialog box so that you can also see the main Crystal Reports Designer window. Then drag the selected fields from the Insert Fields dialog box to the Details section of the report. Position the fields so that your report looks like the one shown in Figure 29.13. Click Done to close the Insert Database Field dialog box.

Finally, test your report by clicking the lightning bolt button in the toolbar. Clicking this button activates preview mode, allowing you to see how the report will look with database records. To save the finished report, click the Save button or choose File, Save.

TIP Turn off the Save Data with Report option if you intend to programmatically display this report with new data every time. You can access this option by selecting File, Options and clicking the Reporting tab.

Creating a Report with the Create Report Expert Using the Create Report Expert is another way to create your report. From the Create New Report dialog box, simply click the type of report you want. The available selections are described here:

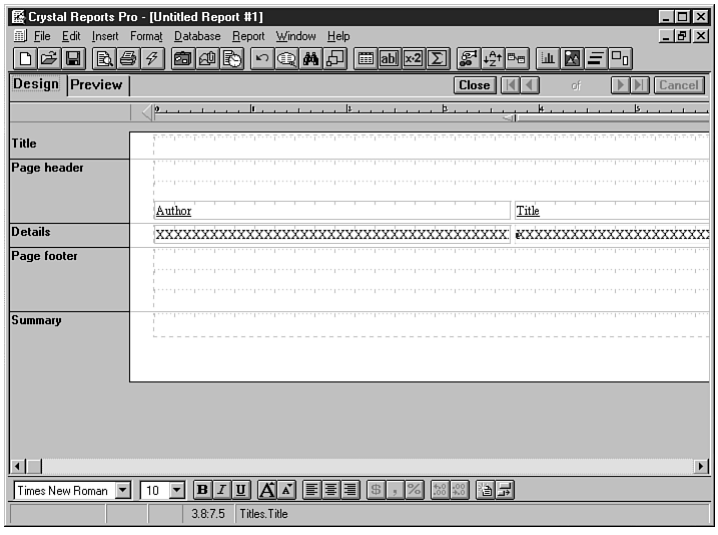


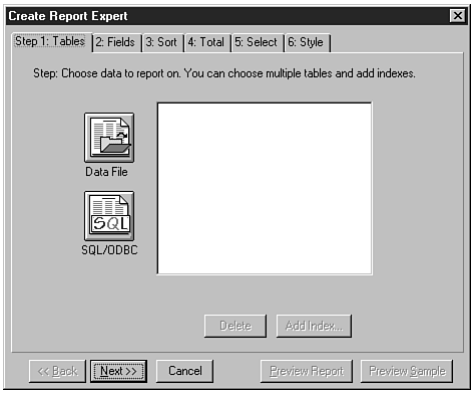
FIGURE 29.13
When you drag a database field to the Details section, Crystal Reports automatically adds a corresponding header label.

- **Standard.** This type of report is a standard report format of rows and columns. It often has summary information at the bottom of the columns. In the report, you also can group information according to certain criteria.
- **Listing.** This is a standard type of report in which data is presented in a list format. For example, an Employee List or a Customer List report would look best in this format.
- **Cross Tab.** A cross-tab report basically inverts the order of a standard columnar report. The columns of a cross-tab report are the records of a particular recordset. These reports are often used to obtain a quick summary view of a more complex set of data.
- **Mail Label.** You use these reports to create items such as mailing labels or name tags from the information in your database.
- **Summary.** This type of report summarizes data without showing the underlying details. Typically, data is broken into groups and the values in each group are summarized, but only the group totals—not the individual values in each group—are shown.
- **Graph.** This choice leads you through the creation of a Graph with step-by-step help from the Create Report Expert.
- **Top N.** This type of report shows only a specified number of the top records in the recordset. It can be used to show the top five salespeople in the company, for example.
- **Drill Down.** This type of report shows the supporting information or detail information for each record.

Figure 29.14 shows the first screen of the Create Report Expert, where you specify a data source. After completing this step, you are asked for each additional piece of information necessary to create the report.

When you are finished creating the report, you can still add or change report elements just as you would with a custom report.

FIGURE 29.14
The Create Report Expert has several tabs, each of which represents a step in the report-creation process.



Customizing Your Report

Even if you use the Report Expert to build your initial report layout, most likely you will want to make additional changes. Fortunately, Crystal Reports provides a myriad of options that allow you to customize a report to suit your individual needs. Although coverage of every feature of Crystal Reports is beyond the scope of this book, this chapter introduces two important concepts: adding a new field and controlling selection criteria.

Field Types As mentioned earlier, fields are arranged on the report just as custom controls are drawn on a form. From the Insert menu, you can choose from several different types:

- **Database Field.** Links contents to fields in the data source, much like bound controls.
- **Text Object.** Provides fixed text information, such as a report title.
- **Formula Field.** Displays the results of a formula (expression). This may be the result of performing an operation on one or more database fields.
- **Parameter Field.** Allows you to specify parameters that can be passed into the report, either programmatically or manually. These parameter fields can then be used in selection criteria and other formulas.
- **Special Field.** Automatically shows the current page, the date and time, and other useful information.

To add a field to your report, you simply select it from the menu and provide the necessary information to create the field. If you want to remove an existing field, select it and then press Delete. You can also right-click to open a context-sensitive menu, from which you can choose options to control field properties, such as content and formatting.

Adding a Selection Formula From the Report menu, you can change the selection formula for your report. A selection formula allows you to filter the displayed records from within Crystal Reports. It works much like the `WHERE` clause of a SQL statement but is in a slightly different format. The Record Selection Formula dialog box allows you to filter records by selecting applicable fields and their respective selection criteria. The criteria statement is automatically

generated by the dialog box. Figure 29.15 shows how the selection criteria have been changed to include only authors born during or after 1950.

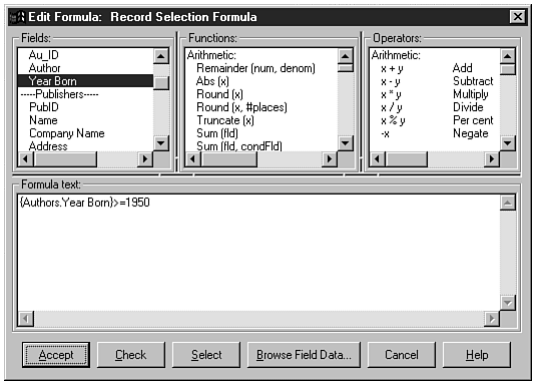


FIGURE 29.15 Using the Formula Editor window, you can build expressions involving fields, functions, and operators.

Note that changing the selection criteria within a report to limit records is far less efficient than changing the source recordset. If you modify the selection criteria, the report's underlying recordset still contains as many records as it did originally; the selection filter(s) only limits how many records are presented to the user in the report. In the example, the report would still contain all authors, even though it displays only the ones born since 1950.

Using the Crystal Reports Control

Once you complete the design of your report, you should have an RPT file saved on your hard drive. You can use this file in conjunction with the Crystal Reports control to display your report from within a Visual Basic application.

NOTE If you use a Crystal Report in your application, you have to distribute the report file plus all the support files required to run the report on another user's machine.

Because the Crystal Reports control is a third-party control, it is not available in Visual Basic's Toolbox by default. To add the control to your Toolbox, choose Project, Components or press Ctrl+T. Then select the Crystal Reports Control check box and click OK.

To demonstrate how the control works, use it to display the sample report created in the preceding section. First, start a new Standard EXE project, and add the Crystal Reports control to your Toolbox. Draw an instance of the Crystal Reports control on the form. Notice that it appears icon-sized, as pictured in Figure 29.16.

Specifying the Report File The key property that you need to specify is the `ReportFileName` property, which is the path to the RPT file you created in the Report Designer. If you plan to use the Crystal Reports control to display multiple reports, you probably should set this property at runtime, as in the following example:

```
CrystalReport1.ReportFileName = App.Path & "\Test.Rpt"
```

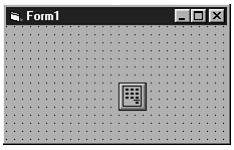


FIGURE 29.16
The Crystal Reports control is invisible while your program is running; reports are viewed in an independent window.

However, for the sample report, setting the `ReportFileName` property at designtime is sufficient. To do so, right-click the control and select Properties to display the Property Pages dialog box. On the General tab, shown in Figure 29.17, you can specify the location of the RPT file. You can also choose whether the report should go to the printer, a preview window, a file, or to an e-mail message.

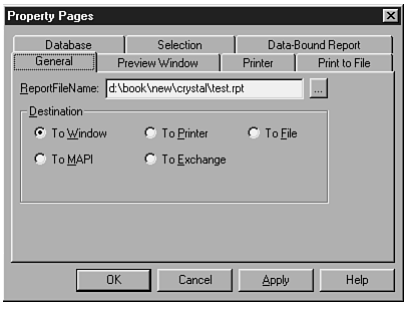


FIGURE 29.17
On the Property Pages dialog box, you can specify the report file and output destination.

Selecting the `ReportFileName` is the minimum setup for Crystal Reports. At this point, you can write the single line of code necessary to run the report and test it by running your program.

Setting Optional Properties Although only the `ReportFileName` is required for a report, you might want to use several optional properties with the report. The first of these properties is the `SelectionFormula` property. This property enables you to limit the number of records that are included in the report. The `SelectionFormula` property is similar to the `Where` clause of a SQL statement but uses its own particular format to enter the information. (This format is the same as that described in the earlier section "Customizing Your Report.") The following is an example of setting this property from code:

```
CrystalReport1.SelectionFormula = "{Authors.Year Born} >= 1955"
```

You also can use multiple expressions by including the `And` or `Or` operators.

CAUTION

If you enter a `SelectionFormula` when you're designing your report, any formula you enter in the `SelectionFormula` property of the Crystal Reports control provides an additional filter on the records.

Another optional property is `CopiesToPrinter`. This property enables you to print multiple copies of your report easily at one time. You can set this property to any integer value.

The final property you might need to set at runtime is `DataFiles`. This property is not available at designtime. It specifies the name of the database file to be used with the report. Now you might be thinking, "I told the report what file to use when I created it." That is true, but when you created the report, the database file was stored with a path based on your directory structure. And your path might not be the same as the directory structure of your users.

The `DataFiles` property is actually an array with the first element number of `0`. If you're using more than one database in your report, you need to set the value of each `DataFiles` array element. For most of your reports, however, you will be using only a single database. The following line of code shows you how to set the value of the `DataFiles` property for the database; this line assumes that the database file is in the same folder as your application:

```
rptMember.DataFiles(0) = App.Path & "\Members.mdb"
```

Displaying the Report Even after you add the Crystal Reports control to your form and set its properties, you still have to tell Crystal Reports when to print or display the report by adding a line of code. The report then prints using the report file and other properties that you set. If you have your report set up to preview onscreen, it appears in a window similar to the one shown in Figure 29.18. The following line of code uses the `PrintReport` method to run a report:

```
CrystalReport1.PrintReport
```

Note that even though the name of the method is `PrintReport`, it is sent to the destination you specified earlier.

NOTE You can also print a report by setting the `Action` property of the Crystal Reports control to `1`.

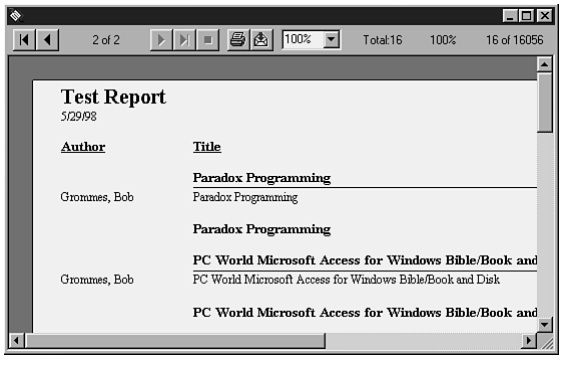


FIGURE 29.18
The desired report has been printed to the screen.

From Here...

In this chapter, you took a brief look at a new feature of Visual Basic 6.0, the Data Report. You walked through a simple report, examined some of the enhancements you can make to a report's appearance, and reviewed a few methods used to automate report printing and exporting. You also looked at an old favorite reporting tool, Crystal Reports. For more related information, see the following chapters:

- To learn how you can create reports by using Excel or Word, see Chapter 22, "Using OLE to Control Other Applications."
- If you want to learn more about databases in general, see Chapter 24, "Database Basics."
- For an introduction to retrieving data with ADO, see Chapter 28, "Using ActiveX Data Objects (ADO)."

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CHAPTER 30

Using VBScript

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This chapter begins a section on Visual Basic and the Internet. The Internet is one of the most talked-about topics in computers today. Although the Internet has been around a long time, until just a few years ago, it remained out of the public eye, used mostly by the academic world. However, today everyone seems to have an e-mail address and a Web site. In this book, you learn several methods of applying your VB knowledge to the Internet. This chapter serves as an overview of VBScript, a subset of Visual Basic that can be used to program the Internet.

Introduction to VBScript

The Visual Basic language comes in several flavors besides the "traditional" standalone development tool it has always been. One of those flavors is Visual Basic for Applications (VBA). Another flavor, not to be confused with VBA, is the Visual Basic scripting language, or VBScript. Descriptions of all three appear in Table 30.1.

Table 30.1 VB Versus VBA Versus VBScript

Language	Description
Visual Basic	Standalone development environment that allows you to compile executable files, ActiveX Controls, and DLLs.
VBA	The version of Visual Basic designed to be used within an application, such as Excel, Access, or Visio. Starting with Microsoft Office 97, VBA and VB share the same IDE.
VBScript	Small subset of the VB language interpreted by Internet Explorer, Internet Information Server, Microsoft Outlook, and the Windows Scripting Host.

The VBScript language itself does not have anywhere near the power of VB or VBA, nor does it have its own development environment. These limitations are by design, however. The strength of VBScript is not in the language itself, but how and where it can be used, such as the following:

- **Web pages**—Client-side VBScript code can be embedded in standard HTML, allowing Web pages to contain application-like functionality.
- **Active Server Pages**—Server-side VBScript code can be used in Active Server Pages, allowing Web pages to be generated and altered before returning content to a browser.
- **The Windows Scripting Host**—Visual Basic script code can be run from the DOS command line like a batch file, allowing you to automate certain tasks.

Enhancing the Internet with VBScript

VBScript was first introduced for use with the Internet. The Internet itself is a physical network of computers. However, when most people think of the Internet, they do not think about the network but about specific applications used with it. The following are some examples of these applications:

- **World Wide Web**—Interactive documents viewed in a Web browser. They can contain news, information, and programs to download to your computer.
- **E-mail**—Electronic mail, used to send messages to a specific individual.
- **Newsgroups**—Bulletin-board style discussion groups in which you can post questions and answers about a wide variety of topics.
- **Chat**—Live communication with others connected to the Internet in the form of typed messages, audio, or video.
- **File Transfer and Terminal Access**—Transfer of files (FTP) and remote access (Telnet) to a computer.

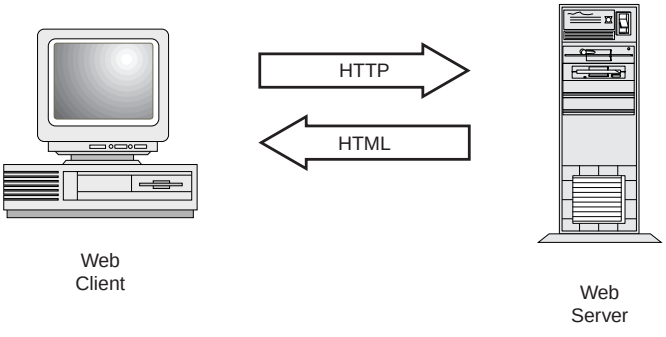
By far, the most popular use of the Internet is the World Wide Web. The idea for the World Wide Web come from Tim Berners-Lee as a way to aid his memory by inserting links into his documents. He eventually proposed a "global hypertext space" which would lead to today's web of millions of linked documents. A link not only provides a reference to a supporting document, it also allows the reader to "jump" directly to the supporting document—hence the term *hyperlink*. The hyperlinked documents form a "web" of information accessible to everyone on the Internet.

VBScript on the Web Server

You probably know from experience that the Web of today has evolved quite a bit from just a series of linked documents. Web sites contain rich multimedia elements and database-driven content, and can behave almost like standard applications. Arguably the most powerful improvements to the Web have been added to the Web server.

The Web server is the computer that delivers the requested Web pages to the browser. The concept of *requesting* a Web page is key to understanding what a Web server does. Many people make the mistake of thinking of Web pages as documents stored on file servers; this is not how the system works! The role of the Web server is pictured in Figure 30.1.

FIGURE 30.1
The Web server sends an HTML stream back to the browser in response to a request for a Web page.



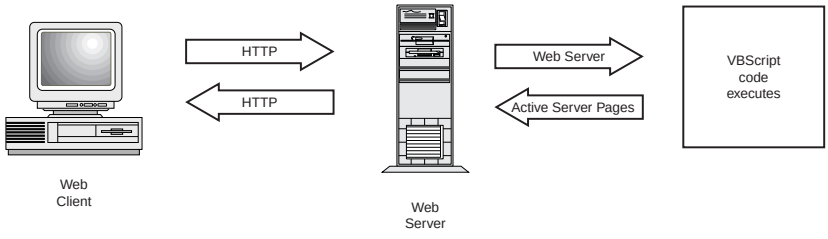
To further illustrate the difference, consider the real-world example of researching William Shakespeare at your local library. Upon entering the library, you can just go to the Shakespeare section and pick up a book, or you can ask the librarian to help you.

If you go get a book yourself, the library is acting like a file server in that you are simply accessing a file (book) stored in it. On the other hand, if you request that the librarian help you, he or she will use his or her own expertise by asking questions and offering suggestions. In this case, the librarian is acting like a Web server because he or she is controlling your access to the files (books).

NOTE The method by which browsers and Web servers talk to each other is known as the Hypertext Transfer Protocol, or HTTP.

Because all requests go through the Web server, the Web server can modify the information returned to the browser however it sees fit. One typical example is including database information in a Web page. This can be accomplished by executing a program on the server that handles database access and returns information in a format that the browser can understand. The way that Microsoft provides this technology to VB programmers is known as Active Server Pages, or ASP. ASP is illustrated in Figure 30.2.

FIGURE 30.2
Active Server Pages are HTML with script code that is executed on the server before the user sees the results.



ASP is an exciting and powerful Web technology, so much so that it has its own chapter in this book—Chapter 31, "Active Server Pages."

VBScript in the Browser

In addition to using VBScript on the Web server, VBScript code can be executed on the user's desktop. To understand how this works, you have to know a little about the language in which Web pages are written: HTML.

HTML, which stands for Hypertext Markup Language, consists of some formatting codes that allow an author to create hyperlinks and format the document. The HTML language is fairly easy to understand, even for newcomers, as illustrated in the following example:

```
<FONT SIZE = "+2"> This is a sample web Page! </FONT> <BR>
<B> I hope you enjoy it! </B> <BR><BR>
The following is a hyperlink:  <A HREF = "http://www.que.com"> Click me! </A>
```

HTML includes both the document text and formatting codes. A special viewer, known as a browser, interprets the formatting codes and displays the Web page. A browser displaying the preceding lines of HTML is shown in Figure 30.3.

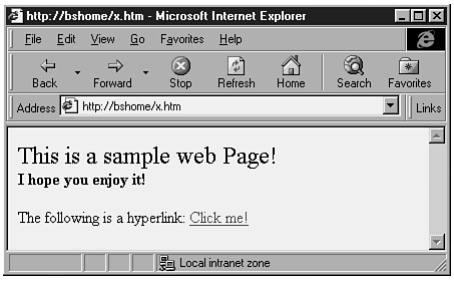


FIGURE 30.3
If you have used a personal computer in the last year or two, you have certainly encountered a Web browser.

A good VB programmer should have no trouble picking up HTML basics. The preceding example uses several formatting codes, or *HTML tags.* Most HTML elements have a starting point and an ending point, indicated by corresponding tags. For example, the `<B>` and `</B>` tags tell the browser that the text between them should be displayed in boldface format.

TIP Learn more about HTML by viewing the HTML code behind your favorite Web pages. To do so in Internet Explorer, right-click in an empty area of the page and choose View Source.

Many books and online references are available to help you learn more about HTML. For the purposes of this chapter, Table 30.2 lists some commonly used HTML elements.

Table 30.2 Common HTML Tags

Tag	Description
`<HR>`	Horizontal separator bar
` `	Line break
`<B>` and `</B>`	Boldface
`<I>` and `</I>`	Italics
`<U>` and `</U>`	Underline
`<CENTER>` and `</CENTER>`	Centers text
`<A HREF=`*`url`*`>` *`linktext`* `</A>`	Inserts a hyperlink (or "anchor")
`<IMG SRC=`*`imagefile`* `ALT=`*`tooltip text`*`>`	Inserts a GIF or JPEG image
`<HTML>` and `</HTML>`	Denotes start and end of a document
`<HEAD>` and `</HEAD>`	Start and end of document header
`<TITLE>` and `</TITLE>`	Page title located in the header
`<BODY>` and `</BODY>`	Denotes start and end of the body
`<TABLE>` and `</TABLE>`	Denotes start and end of a table

continues

Table 30.2 Continued

Tag	Description
`<TR>` and `</TR>`	Within the `<TABLE>` tag, indicates a row
`<TD>` and `</TD>`	Within the `<TR>` tag, indicates a column
`<FORM action=`*`url`*` method=`*`method`*` name=`*`name`*`>` and `</FORM>`	Denotes start and end of a form
`<INPUT type=`*`type`*` value=`*`value`*` name=`*`name`*`>`	Form Input element
`<FONT>` and `</FONT>`	Controls many aspects of the current font, including typeface and size

NOTE Internet Explorer 4.0 also includes support for DHTML, or *dynamic HTML*, which makes Web pages even more programmable by providing programmatic access to HTML tags.

The HTML codes listed in Table 30.2 are a small fraction of those available for use. In addition, codes can be nested in different ways to produce different results. Although HTML can do a lot of interesting things by itself, it lacks the power of a programming language. Other than jumping from one document to another and submitting forms, there are no real actions that you can take with standard HTML. However, you can script code to HTML to make Web pages a little more functional. Scripting languages such as VBScript and JScript are embedded in HTML and indicated by a special `<SCRIPT>` tag. The following example uses VBScript to display a message box:

```
<SCRIPT Language = "VBScript">
<!--
Dim nAnswer
nAnswer = MsgBox ("Would you like to visit my site?" ,vbYesNo,"Hello!")

If nAnswer = vbNo Then
    MsgBox "Well, then I will send you somewhere else!"
    Window.Location = "http://www.nowhere.com"
end if
-->
</SCRIPT>

<FONT SIZE = "+2"> This is a sample web Page! </FONT> <BR>
<B> I hope you enjoy it! </B> <BR><BR>
The following is a hyperlink:  <A HREF = "http://www.que.com"> Click me! </A>
```

The preceding HTML example contains a section of VBScript code added at the beginning. When the browser begins to parse the HTML in the Web page, it encounters the VBScript code and executes it. You will learn more details about using VBScript in your pages later in the chapter.

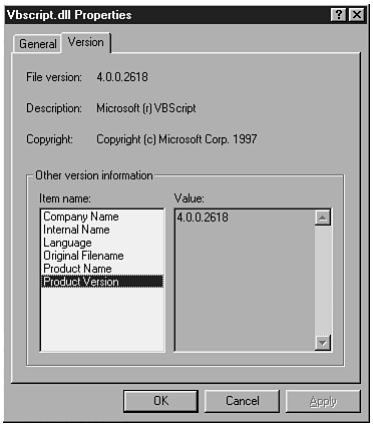
Tools Used with VBScript

To use VBScript, you need to have the right tools. The following sections provide a brief rundown of some items that make working with VBScript easier.

The VB Scripting Engine

The Script code is interpreted and executed by a *scripting engine*. The scripting engine for VBScript is a file named VBSCRIPT.DLL, located in the \Windows\System directory. VBScript is installed with one of the applications that use it, such as Internet Explorer, Outlook, Internet Information Server, or the Windows Scripting Host. However, a few different versions of VBScript have been released, and some of the examples in this chapter may not work with VBScript versions prior to 3.0. To determine the version you have installed, right-click the VBSCRIPT.DLL file in Explorer and choose Properties, as shown in Figure 30.4.

FIGURE 30.4
Make sure that you are using the latest VBScript engine by checking the properties of VBSCRIPT.DLL.



Another indication that your version of VBScript is old is an error when you attempt to use an intrinsic constant (such as `vbYesNo` in the earlier example), because these constants were not included in the first version. If you want to upgrade to the latest version of VBScript, visit the Web site at `http://www.microsoft.com/vbscript`. This site contains downloadable files for the latest scripting engines that you can place on your Web site, as well as documentation for the VBScript language.

Host Application

The applications with which you can use VBScript are also known as *hosts* for VBScript. The most common hosts are Internet Explorer and Internet Information Server. Outlook also uses VBScript as its macro language. In addition, Microsoft recently introduced the Windows Scripting host, which allows you to run VBScript code from a regular Windows platform such as Windows NT or Windows 95.

NOTE Internet Explorer hosts VBScript that runs on the user's desktop. VBScript does not currently run in Netscape Navigator. However, VBScript in Active Server Pages runs on Internet Information Server, allowing you to use VBScript to create browser-independent HTML or generate browser-specific pages on the fly.

Although the VBScript language works the same everywhere, each host application exposes a different set of objects to VBScript. So some of the statements that work in IE do not work in IIS and vice versa.

Text Editor

Many people who use VBScript with Web pages use a simple text editor to enter VBScript code because VBScript does not (yet) have its own integrated development environment. This means all the great IDE features you are used to in regular VB are not available. You have to be careful that what you enter is spelled and formatted correctly. Some more advanced text editors, such as HomeSite, help you with VBScript code entry by providing automatic color-coding and toolbar buttons for commonly used statements.

Although a text editor as simple as Notepad will work, I recommend one that shows you line numbers. When an error occurs in your code, Internet Explorer returns the line number, as shown in Figure 30.5.

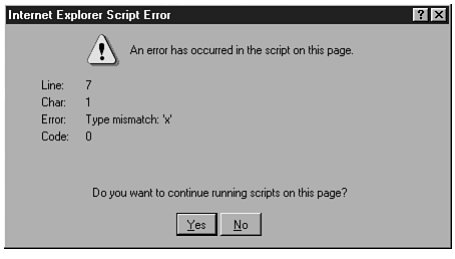


FIGURE 30.5
When an error occurs in your VBScript code, Internet Explorer displays the offending line number, which you can use to track down the error.

By leaving the text editor and browser open at the same time, you can easily switch back and forth between them. This is one way to debug VBScript: Edit and save the code, and then click the Refresh button on the browser to try again.

Advanced Web Tools

If you get tired of just using a text editor, you may want to try some of the more advanced Web tools, such as the following:

- **ActiveX Control Pad**—A free tool from Microsoft, really not that advanced, but it does provide a way to get class IDs for ActiveX controls.
- **Microsoft FrontPage**—A Web page creation application. FrontPage includes a Script Wizard, which creates VBScript code for you and makes working with ActiveX controls and events easy.

- **Visual InterDev**—Another Microsoft product, aimed more at developers of database-driven Web pages; it generates VBScript code for you.
- **Internet Client SDK**—Software development kit available for downloading from Microsoft; it provides samples, documentation, and utilities for working with the Internet.

The VBScript Language

When compared to standard VB, VBScript could almost be called "VB-Stripped" because it lacks so many functions. However, this is by design; the power of VBScript is in where it can be used and the objects it can access rather than in the language itself. Therefore, using VBScript will take some adjusting if you are used to Visual Basic.

Working with Variants Only

Perhaps the most striking difference between VB and VBScript is that all variables in VBScript are variants. The following statements are valid VBScript declarations:

```
Dim sLastName
Dim nCounter
Dim myArray(2,5)
```

VBScript does not allow a standard VB declaration with the `As` keyword. If you attempt to include one, you receive an error. The variant-only rule also applies to all variables used in subs and functions:

```
Function CalcInterest(P,R,T)
    CalcInterest = P * R * T
End Function
```

In the `CalcInterest` sample function, all the parameters and the return value are variants. The calling code could legally assign the string `"Hello"` to one of the parameters, although a type mismatch error would occur in the multiplication statement. For this reason, I strongly suggest adhering to the variable naming conventions you use in regular Visual Basic. You can also use the `Option Explicit` statement in the header of your Web page to require variable declarations.

Several functions in VBScript also can be used to determine the type of variable being stored in a variant. They are summarized in Table 30.3.

Table 30.3 Determining a Variable Type in VBScript

Function(s)	Purpose
`VarType(`*`varname`*`)`	Returns a constant
`TypeName(`*`varname`*`)`	Returns a description
`Is()`... functions	Checks for specific types and conditions

The following VBScript code displays the description of the type of each element in a variant array:

```
Dim varArray(5)
Dim i
varArray(1) = "This is a string"
varArray(2) = 123.456
varArray(3) = #12/25/1999#
varArray(4) = 10
varArray(5) = Null

For  i  = 1 to 5
  Msgbox "Array element " & i & " is of type " & TypeName(varArray(i))
Next
```

Notice also that the array example makes use of a `For` loop. In VBScript, a variable name cannot be placed after a `Next` statement in a `For` loop. Doing so causes an error.

Using Objects for Added Power

Although the VBScript language has definite limitations, keep in mind that you can use VBScript to communicate with external objects. These objects can be ActiveX DLLs that you write in regular Visual Basic or other automation objects installed on your system, such as Microsoft Excel or Word.

First, you create an instance of the object by using the `CreateObject` method:

```
Set objWord = CreateObject("Word.Application")
```

Next, you call methods and reference properties in the object:

```
objWord.Visible = True
objWord.Activate
objWord.Documents.Add
objWord.WordBasic.Insert "Here is some text"
```

Finally, when you are finished with the object, destroy the reference to it:

```
Set objWord = Nothing
```

NOTE In Chapter 31, "Active Server Pages," you discover `Server.CreateObject()`, which is used to create objects in an Active Server Page.

Learn more about creating your own custom objects in Chapter 16, "Classes: Reusable Components." After you create these objects, you can use them with the `CreateObject` function.

▶ **See** "Creating an ActiveX DLL," **p. 368**

When using your own objects with VBScript, you have to handle certain return values carefully because VBScript uses only variants. Most return values such as `Integer` or `String` work as you would expect with VBScript, but arrays require special attention. Examples of returning arrays and recordsets are described in Chapter 27.

Accessing the File System

To prevent harmful scripts from damaging the host computer, VBScript offers some special functions that replace the normal VB functions or perform the same activity in a different way. One major area of difference is in the handling of file access. The standard Visual Basic File input and output commands, as discussed in Chapter 21, "Working with Files," are not available in VBScript. Instead, all file access is provided through the methods and properties of special objects. The objects used in dealing with files are listed in Table 30.4.

Table 30.4 VBScript Objects Used for Working with Files

Object	Description
`File`	A file on the local machine
`Folder`	A folder (directory) on the local machine
`Drive`	A drive on the local machine
`TextStream`	An object that provides sequential read/write capability
`FileSystemObject`	An object that represents the entire file system, used to reference all the above objects

To perform file and disk operation, use a method or property of an object listed in Table 30.4. The most important object is the `FileSystemObject` object. You use VBScript's `CreateObject` function to create a reference to it, as in the following line of code:

```
Set objFs = CreateObject("Scripting.FileSystemObject")
```

Obviously, this object gives a malicious programmer a way to damage your system. For this reason, Internet Explorer displays a warning message when VBScript accesses external objects, as shown in Figure 30.6.

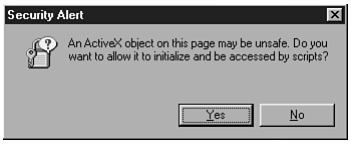


FIGURE 30.6
Internet Explorer has several security settings to prevent harmful scripts or controls from running on your computer.

The code in Listing 30.1 displays the last time a user visited a particular Web page. It keeps track of this information by creating a text file called LASTVISIT.TXT in the WINDOWS directory. Open the file in Internet Explorer and click the Refresh button several times to test it.

Listing 30.1 VBSFILES.HTM—Accessing the File System in Internet Explorer 4.0

```
<HTML>
<HEAD>

<SCRIPT Language = "VBScript">
<!--OPTION EXPLICIT
    Dim objfs    'FileSystemObject Object
    Dim objfile  'File Object
    Dim objTs    'TextStream Object

    Dim sInfoFile    'Path to the info file
    Dim sInfo        'Variable used to store information

    'Create a reference to the local file system
    Set objFs = CreateObject("Scripting.FileSystemObject")

    'Determine path to file in the windows directory
    sInfoFile = objFS.GetSpecialFolder(0) & "\LASTVISIT.TXT"

    'If file exists then read a line of text
    If objfs.FileExists(sInfoFile) Then
        Set objfile = objfs.GetFile(sInfoFile)
        Set objts = objfile.OpenAsTextStream(1) 'Reading = 1, Writing = 2
        sInfo = objts.ReadLine()
        objts.close
    Else
        sInfo = "You haven't visited this web site before!"
    End If

    'Write message to the browser window
    Document.Write sInfo & "<BR>"

    'Store new message in the file for next time
    sInfo = "Your last visit was <B>" & Now & "</B>. Welcome back!"
    Set objts = objfile.OpenAsTextStream(2) 'Reading = 1, Writing = 2
    objts.WriteLine(sInfo)
    objts.close

    Set objfs = Nothing

-->
</SCRIPT>
</HEAD>
</HTML>
```

Using VBScript in Internet Explorer

The following sections describe how to use client-side VBScript in your Web pages. VBScript can also be used on the server, as discussed in Chapter 27. Although server-side VBScript can be browser independent, client-side VBScript requires that the user have Microsoft Internet Explorer. Currently, Netscape users cannot run VBScript code. Remember to keep your audience in mind when using VBScript.

Events and Procedures

In standard Visual Basic, you respond to events by placing code in event procedures. You can also use event procedures in VBScript, although writing them is not as easy because the event procedure declarations are not provided for you.

As an example, consider the following HTML code, which creates two form elements, an input box and a button:

```
<INPUT Type="text" Name="txtLastName" Value="Smith" Size=20>
<INPUT Type="Button" Name="cmdCalculate" Value="Perform Calculation">
```

Because the preceding two form elements are named, all you have to do to create an event procedure is write a VBScript subroutine with the appropriate name and parameters. For example, by creating a VBScript subroutine called `cmdCalculate_OnClick()`, you can get IE to execute code in response to the button's `Click` event. The code in Listing 30.2 uses VBScript events in a simple interest calculator.

Listing 30.2 SIMPLEVBS.ZIP—Using VBScript to Access Web Page Elements

```
<HTML>
<HEAD><TITLE>Simple example of VBScript</TITLE></HEAD>

<SCRIPT Language = "VBScript">
<!--

Function CalcInterest(P,R,T)
    CalcInterest = P * R * T
End Function

Sub cmdCalculate_OnClick()
    Dim lPrincipal
    Dim dblRate
    Dim nYears
    Dim cInterest

    lPrincipal = CLng(txtPrincipal.value)
    dblRate = CDbl(txtRate.value)
    nYears = CInt(txtTime.value)

    cInterest = CalcInterest(lPrincipal, dblRate, nYears)

    MsgBox "Your Interest is " & FormatCurrency(cInterest)
End Sub
Sub txtRate_OnChange()
    If CDbl(txtRate.Value) > 1 Then txtRate.Value = txtRate.Value / 100
End Sub

-->
</SCRIPT>
<BODY>
<BR>

Enter Principal: <INPUT Type="Text" Name="txtPrincipal" Value="100000"><BR>
Enter Int. Rate: <INPUT Type="Text" Name="txtRate" Value="0.08"><BR>
```

continues

Listing 30.2 Continued

```
Time in Years: <INPUT Type="text" Name="txtTime" Value="20"><BR>

<INPUT Type="Button" Name="cmdCalculate" Value="Calculate Interest">

</BODY>
</HTML>
```

NOTE Listing 30.2 uses HTML form elements, which have a different set of events and properties. Note, for example, the use of the `Value` property instead of the `Text` property. However, as you will see in an upcoming example, you can also insert controls onto Web pages, which have a more familiar set of properties and events.

In the sample Web page in Listing 30.2, Internet Explorer knows which event procedure to run because the event procedure is named appropriately. However, you could just as easily specify a different `Click` event procedure by naming it in the button's HTML:

```
<INPUT Type="Button" Name="myButton" Value="Calculate" OnClick="MyProcedure">
```

This syntax is useful with images in Web pages. Consider the standard method of creating an image hyperlink:

```
<A HREF="http://www.newsite.com/"> <IMG SRC="myimage.gif"></A>
```

This approach works, but your only option is to jump to a new page. A more versatile method is to specify a `Click` event in the `IMG` tag. The `Click` event procedure could use VBScript code to move to the new site or perform whatever action you wanted:

```
<SCRIPT Language = "VBScript">
<!--

Sub ImageClicked()

  Window.Navigate ("http://www.newsite.com/")

End Sub

-->
</SCRIPT>

<IMG SRC="myimage.gif" OnClick="ImageClicked">
```

One easy way to find out the available events is to use the Script Wizard in Microsoft FrontPage. Simply insert the element you want in FrontPage and bring up the Script Wizard, which is shown in Figure 30.7.

In the previous example, you examined the `Navigate` method of Internet Explorer's `Window` object. This method causes Internet Explorer to open the specified URL. Another useful function is `document.write`, which writes HTML to the browser window:

```
<SCRIPT Language = "VBScript">
<!--
document.write "The current date and time is " & Now
-->
</SCRIPT>
```

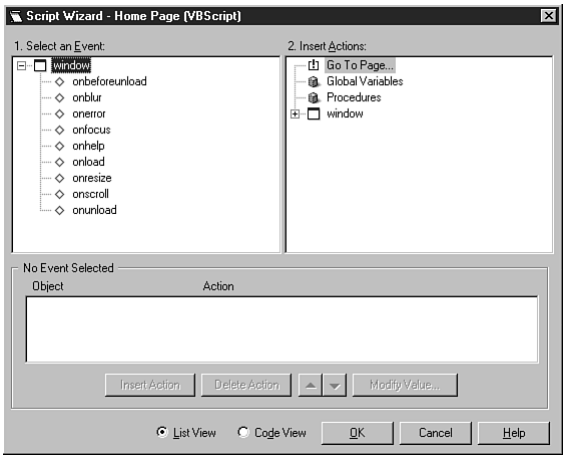


FIGURE 30.7
The Script Wizard provides a hierarchical view of events.

Look on the Microsoft Web site for a complete list of the objects and methods available in Internet Explorer.

Forms

Forms are HTML elements used to send information back to the Web server. The following is an example of an HTML form with two text boxes:

```
<FORM Action="formproc.asp" METHOD="POST" NAME="frmTest">
 Please enter your name and E-Mail address below:<BR>
 Name:  <INPUT Type=Text size=40 name=txtName>   <BR>
 Email: <INPUT Type=Text size=30 name=txtEmail>  <BR>
 <INPUT Type=Submit Name=cmdSend Value="Send Values to Server">
</FORM>
```

The Submit button tells the browser to send all the `<INPUT>` fields between the `<FORM>` tags to the Web server. The Web server (in this case, the Active Server Page formproc.asp) can then access each of these elements and put them in a database. However, before you submit the form to the server, you might want to use VBScript to validate or change the information. Listing 30.3 shows an example of validating form data with VBScript.

Listing 30.3 VBSFORM.ZIP—Modifying and Submitting a Form with VBScript

```
<HTML>
<HEAD><TITLE>Simple example of Forms</TITLE></HEAD>
<SCRIPT Language = "VBScript">
<!--
Sub submitform()
```

continues

Listing 30.3 Continued

```
    Dim nPos
    Dim sUserType
    Dim f

    Set f = Document.frmMain

    'Make sure name is not blank
    If Trim(f.txtName.Value) = "" Then
         Msgbox "Please enter your name and try again!"
         Exit Sub
    End if

    'Validate E-Mail Address Format
    nPos = Instr(f.txtEmail.Value,"@")
    If nPos = 0 Then
        Msgbox "Please use the format user@server.domain"
        Exit Sub
    End If

    'Classify user as business or other
    nPos = Instr(LCase(f.txtEmail.Value),".com")
    If nPos <> 0 Then '.com = commercial domain
        sUserType = "BUSINESS"
    Else
        sUserType = "OTHER"
    End If

    'Put user type in hidden form field
    f.txtUserType.Value = sUserType

    'Submit the form
    f.Method = "POST"
    f.Action = "formproc.asp"
    f.submit

End Sub
-->
</SCRIPT>

<BODY>

 Please fill out all fields below:<BR><BR>

<FORM NAME=frmMain>

 Name:  <INPUT Type=Text maxlength=20 size=20 name=txtName>   <BR>
 Email: <INPUT Type=Text maxlength=30 size=30 name=txtEmail>  <BR>

 <INPUT Type=Hidden name=txtUserType>

 <INPUT Type=Button OnClick=submitform Value="Continue">
</FORM>

</BODY>
</HTML>
```

CAUTION

Remember, VBScript does not run in Netscape Navigator, so you may want to perform validation tasks on the server.

In Listing 30.3, many of the form tasks are handled in VBScript instead of HTML. For example, the `ACTION` and `METHOD` parameters are left out of the form declaration. No submit button was provided because the form was submitted from VBScript code. Also, notice the hidden form field, which stores a value that the user did not enter. A sample run of the page in Listing 30.3 is shown in Figure 30.8.

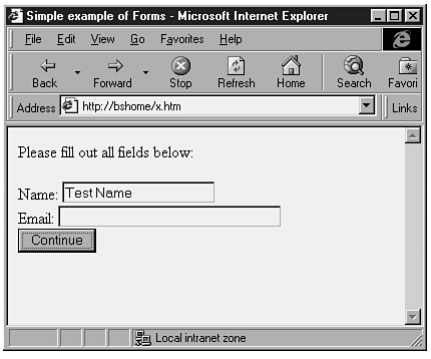


FIGURE 30.8
VBScript validates form data before submitting it to the Web server.

Using ActiveX Controls

In addition to creating objects with the `CreateObject` method, you can embed objects in your Web page by using the `<OBJECT>` tag. The `<OBJECT>` tag allows you to place ActiveX controls in a Web page. Your VBScript code can then access these objects, as in the list box example here:

```
<HTML>
<BODY>
<OBJECT id=lstmain classid=clsid:8BD21D20-EC42-11CE-9E0D-00AA006002F3
width=152 height=164>
<PARAM name=ScrollBars value=3>
<PARAM name=DisplayStyle value=2>
</OBJECT>

<SCRIPT Language = "VBScript">
<!--
    Dim i
    For i = 1 to 10
        lstMain.AddItem "Item " & i
    Next

    Sub lstMain_Click()
        Msgbox "You Clicked " & lstMain.List(lstMain.ListIndex)
    End Sub
```

```
-->
</SCRIPT>
</BODY>
</HTML>
```

The different parts of the `<OBJECT>` tag are as follows:

- `ID`—Indicates the name VBScript uses to identify the object, like the `Name` property in Visual Basic.
- `CLASSID`—Acts as a unique identifier from the Windows Registry that identifies the object.
- `CODEBASE`—Provides the URL for the OCX or CAB file used to download the object. In the example, the `ListBox` control is built into Internet Explorer, so the `CODEBASE` parameter is not needed.
- `height` and `width`—Indicate the size of the object.
- `PARAM` tags—Control behavior of an object, like the Properties window in Visual Basic.

The best way to insert ActiveX controls into a Web page is to do so in FrontPage and then copy the resulting HTML into your Web page. Figure 30.9 shows the list of ActiveX controls in FrontPage.

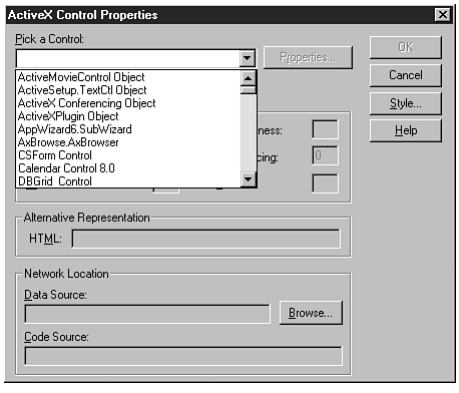


FIGURE 30.9
Class IDs can be determined by using FrontPage. The controls that begin with "Microsoft Forms" are built in, or intrinsic to, Internet Explorer and do not require downloading.

In Chapter 14, "Creating ActiveX Controls," you learned how to create your own ActiveX controls, which can be placed on a Web page. Using your own controls offers several advantages over plain VBScript and HTML, including the following:

- Full VB functionality is available.
- Your code cannot be easily viewed by the user, as with script code.

The Windows Scripting Host

In addition to VBScript's multiple uses on the Internet, Microsoft has also recently touted VBScript as a replacement for batch files. By installing the Windows Scripting Host, available

for free at `http://www.microsoft.com/scripting`, you can run VBScript commands from an MS-DOS Prompt window or the Windows Explorer. The VBScript code itself is created in a text editor and stored in a file with a VBS extension.

Running Scripts

The Windows Scripting Host actually installs two hosts that can run VBScript code: CSCRIPT.EXE, which is designed for use in an MS-DOS Prompt window, and WSCRIPT.EXE, which is designed for execution from Windows.

To demonstrate the difference, create a VBS file that uses the `WScript.Echo` method, as in the following example:

```
WScript.Echo "Hello, world!"
```

Executing the preceding statement with CScript causes `"Hello, world!"` to be printed in the MS-DOS Prompt window. WScript, on the other hand, presents the text in a message box.

The simplest way of executing a script is to supply the script file name as a parameter to either of the preceding executables:

```
CScript.exe d:\scripts\test.vbs
```

You can also just double-click a script file in the Windows Explorer. However, several command-line options are available for the Scripting host, as listed in Table 30.5. These options must be preceded by two forward slashes (`//`) in the command line.

Table 30.5 Scripting Host Parameters

Parameters	Description
`//B` and `//I`	Selects batch or interactive mode. Batch mode does not display any prompts.
`//logo` and `//nologo`	Controls display of Microsoft copyright information.
`//T:nn`	Determines a script timeout in seconds. The script is stopped if execution time exceeds the timeout value.
`//H:CScript`	Makes CScript the host associated with your script files.
`//H:WScript`	Makes WScript the host associated with your script files.
`//S`	Saves these options (for the current Windows user only).

You can also place the options in Table 30.5 in a WSH file. A WSH file is like a PIF file for batch files; it contains the options in INI file format:

```
[ScriptFile]
Path=D:\scripts\test.vbs

[Options]
Timeout=10
```

```
DisplayLogo=0
BatchMode=0
```

Any arguments passed to the script itself are included after the scripting host options and script filename. You can retrieve them by using the `Arguments` collection of the `Wscript` object:

```
Dim nCount
nCount = WScript.Arguments.Count
WScript.Echo "There are " & nCount & " arguments."

For i = 0 to nCount - 1
 Wscript.Echo WScript.Arguments(i)
Next
```

Useful Objects and Methods

The usefulness of any object library depends on the types of objects and methods it exposes to the programmer. Since the Windows Scripting Host is intended to replace or supplement batch files, it includes many useful features for accessing the operating system, including the following:

- Creating desktop shortcuts
- Mapping network drives
- Accessing the Registry
- Working with automation objects
- Working with NT 5.0 user accounts

You can download sample code to perform all the tasks in the preceding list, along with complete documentation for the Windows Scripting Host, from the Microsoft Web Site. Three main objects let you perform these tasks. You have already seen the `WScript` object in sample code. The `WScript` object is available directly from VBScript.

ON THE WEB

The Windows Scripting Host, along with documentation and examples, can be downloaded from the Microsoft Scripting Technology Web page at http://www.microsoft.com/scripting.

Two other objects, `Shell` and `Network`, must be referenced through `WScript` by using the `CreateObject` function. For example, the following script uses the `Run` method of the `Shell` object to run a program and wait for it to finish:

```
Dim WshShell
Set WshShell = WScript.CreateObject("WScript.Shell")
'first parameter is Window Style, second is Wait
WshShell.Run "notepad",1,True
MsgBox "Done!"
```

As you work with the Windows Scripting Host, you will see that it contains tremendous power to automate Windows-based tasks.

From Here...

This chapter introduced you to a way to extend your Visual Basic skills to the Internet. You can learn more about related topics in the following chapters:

- To see how to use VBScript on Web servers to activate your Web pages, see Chapter 31, "Active Server Pages."
- For more information on how to Web-enable your standalone Visual Basic applications, see Chapter 33, "Visual Basic and Other Uses of the Internet."

CHAPTER 31

Active Server Pages

In this chapter

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Database Access with Active Server Pages **697**

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Using Your Own ActiveX DLL with ASP **711**

The IIS Application Project **711**

As you move from page to page on the World Wide Web, you may wonder what sort of intelligence exists on the other end. For example, how does that online music store process orders submitted from its Web pages? How does the shipping company display your package status? The answer is that some type of program is running on the Web server, accepting input from you and dynamically generating Web pages with the results. In the UNIX world, these programs might be CGI scripts or C programs. However, Microsoft has recently entered this area with Active Server Pages, a Web-server component that allows you to use your Visual Basic knowledge to create powerful Web server scripts. This chapter introduces you to Active Server Pages and some of its many features.

Introduction to Active Server Pages

If you are developing an intranet or Internet application, Active Server Pages is definitely worth investigating. Active Server Pages (ASP) is a component of Microsoft's Web server software that allows you to embed server-side script code in Web pages. As you know, the Hypertext Markup Language (HTML), used to created pages on the World Wide Web, is by itself static content. You can enhance this content on the client side through the use of client-side script, Java applets, Dynamic HTML, or ActiveX controls. However, Active Server Pages is a server-side enhancement, because all the script code (usually VBScript) runs on the server. This means you can create Web sites that are dynamic and database-driven, yet return only standard HTML that is viewable in all browsers. A solution that uses Active Server Pages is ideal when your audience includes both Netscape and IE users or you want to avoid the issues associated with downloading applets or other client-side controls.

NOTE Microsoft's Web server product for the Windows NT operating system is called Internet Information Server (IIS). In addition, Microsoft Personal Web Server is available as a "lightweight" Web server for a desktop PC. The Active Server Pages component is built-in to both Web servers, which at the time of this writing were available for download in the NT/95 Option Pack. For a glimpse at some of the differences between these products, see the upcoming section "Virtual Directories."

Active Server Pages Versus Standard HTML

Internet Information Server identifies an Active Server Page by its .ASP extension. To create a new ASP file, you simply change the extension on an existing .HTM file or start a new text file in a text editor. The ASP file can contain either standard HTML or script code, but usually contains some of both. The script code is what makes an Active Server Page different from a standard HTML page.

Consider the URL, or Universal Resource Locator, that identifies documents on the Web. Here are two URLs, one for a standard Web page and the other for an Active Server Page:

```
http://www.mysite.com/mypage.htm
```

```
http://www.mysite.com/mypage.asp
```

A conventional URL (the first line) represents only a single static Web page. On the other hand, one Active Server Page (the second line) can produce many different Web pages in a user's browser, all from a single URL.

Think about how browsing works: through request-and-response communication between the browser and the Internet server. No matter what the Web server does, the end result is that a stream of HTML is returned to the browser in response to a request. When that request is for a standard .HTM file, it simply reads the file from the disk drive and passes it back to the browser. However, when the Internet server processes an .ASP file, it executes any embedded code during the process. This embedded script code can take different actions on the server, including generate the HTML that is returned to the browser.

For example, suppose you want to create a Web page that displays the time of day when it is requested. The time of day is dynamic and cannot easily be placed in a standard static HTML page. However, you can do this easily with an Active Server Page, such as the one shown in Listing 31.1.

Listing 31.1 ASPDEMO.ZIP—A Simple Active Server Page Displays the Date and Time

```
<HTML>
<BODY>

The Current date and time is
<%
   Dim sTime
   sTime = Now
   Response.Write(sTime)
%>

</BODY>
</HTML>
```

This ASP file in Listing 31.1 displays the current date and time. It contains a mixture of standard HTML and VBScript code. If you access the ASP file on your Web server, each time you press the browser's Refresh button, the server will execute the VBScript code, updating the date and time. However, if a user chooses to view the source in his browser, he will only see the resulting HTML:

```
<HTML>
<BODY>

The Current date and time is
7/5/1998 12:30:00

</BODY>
</HTML>
```

Notice that the server-side VBScript code is hidden from the user, because it is never sent back to the browser. Because the code runs on the server, it can access databases or use custom components, as shown in Figure 31.1.

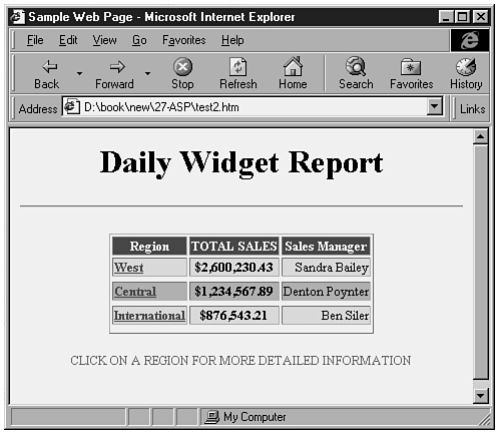


FIGURE 31.1
Server-side scripting allows you to create powerful Web sites.

Virtual Directories

Before you can jump right in and use Active Server Pages, you have to do a little Web server administration. As you know, the files on your Web site are located in a directory on the Web server hard drive—for example, C:\InetPub\wwwroot\financeinfo\. This path is known as the *physical directory*, because it points to an actual location on the server's hard drive. However, when a user on the Internet wants to access files in this directory, he uses an URL like `http://myserver/finance/Monthlyreport.htm`. How does Internet Information Server map the address in the URL to the appropriate physical directory? The answer is through the use of *virtual directories*.

In our example, the Web server knows that the virtual directory /finance is really the financeinfo subdirectory. Virtual directories act as an alias to real directories. Virtual directories, as well as many other important aspects of the Web server, are controlled with the Internet Service Manager. (Similarly, Personal Web Server is managed with Personal Web Manager.) Screenshots of Internet Service Manager and Personal Web Manager are shown in Figure 31.2.

Creating Virtual Directories for ASP Files The process of creating a virtual directory is simple. Follow these steps:

1. Use Windows Explorer or the MS-DOS prompt to create a new physical directory (for example, \Inetpub\wwwroot\test).
2. Open the Internet Service Manager, which should have been installed in a program group on your server.

NOTE IIS can be managed remotely if you have administrative authority on the Web server.

3. The process of creating a virtual directory differs slightly in different versions of the Internet Service Manager: Each version of this software is pictured in Figure 31.2.
   - Directories tab, and click the New button.
   - If you have IIS 4.0, right-click your Web site and choose New Virtual directory.
   - If you are using Personal Web Manager, click the Advanced icon and then the Add button.

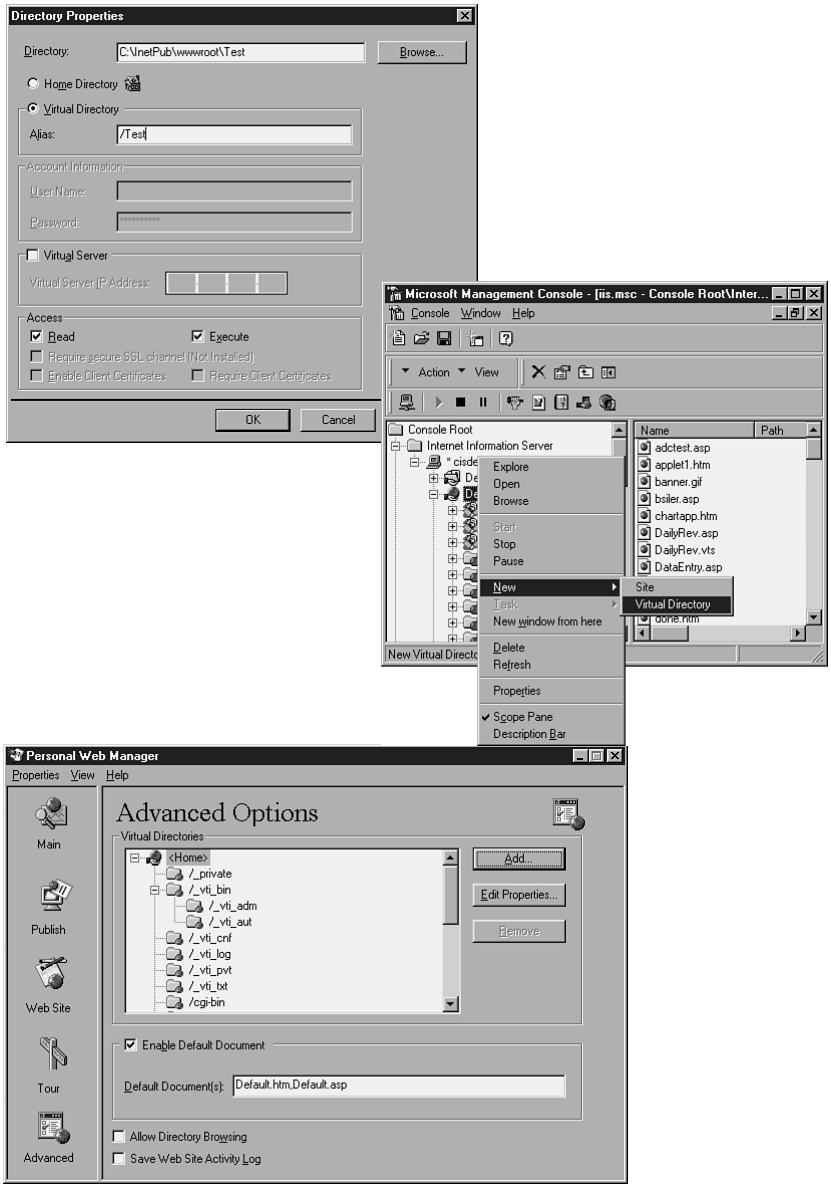


FIGURE 31.2
Internet Information Server 3.0, 4.0, and Personal Web Server have different administration tools.

4. Specify the physical directory (which you can find with the Browse button) and the virtual directory (also known as the *alias*). For your sample, enter `/test` as the alias for the new directory.
5. The next step is to set the appropriate permissions for the new directory. You should see several choices available:
   - Read permission allows users to read files from the virtual directory. In general, you should enable this permission on all of your virtual directories.
   - Script permission means that scripts can be executed from the virtual directory. You need to check this option if you intend to use ASP files in the directory.
   - Execute permission is script permission plus the ability to execute other programs. (Script permission was not a separate choice in IIS 3.0).
   - Write permission allows users to upload files to a directory.

   For this sample directory, you need to enable Read and Script permissions. (If you are using IIS 3.0, enable Read and Execute permissions.)
6. Press OK to close the new directory window. You are now ready to begin placing ASP files in the directory.

CAUTION

Because ASP code executes on your server, think very carefully about directory permissions. If you give a virtual directory Write and Execute permission, potentially anyone on the Internet could upload his own .ASP file and execute it on your server—a very dangerous situation!

That's it! Now that you have created the `/test` virtual directory, you can place ASP files in it and execute them from a browser. You create your first sample ASP file and use it with the /test virtual directory later in the section "Creating a Simple ASP File."

Applications and Sessions When designing a Web site, directory layout is important from an organizational standpoint, but with Active Server Pages it becomes even more important because the virtual directories represent *applications*. In our previous example, the /test directory and the files contained within it are considered to be an ASP application. Subdirectories underneath virtual directories are also part of the application. For example, if you use Windows Explorer to create a subdirectory underneath the /test directory, then the new directory is part of the test application.

When a user first accesses any page in an application, he initiates a new *session* with the application. As long as the user stays within the same application and keeps loading Web pages, he is "in" the same session. However, if the user jumps to another application, closes the browser, or stops browsing for an extended period of time then the Web server ends the session.

Why are these semantics important? As you will see, Active Server Pages contain objects and events that allow you to maintain state within a session. In other words, you can store session- and application-specific information on the server and share it between multiple ASP files.

Creating ASP Files

To create ASP files, you can use a text editor such as Notepad or a more advanced tool like Visual InterDev. In any case, your ASP file can consist of any mix of HTML and code. However, some of your pages will probably contain all code, while others will have only standard HTML. The code you write in an ASP file is script code, like the VBScript code discussed in Chapter 30, "Using VBScript."

In the following section, you create and experiment with a simple ASP file. Subsequent sections explore more involved issues in creating ASP files.

Creating a Simple ASP File

Using the same code shown earlier in Listing 31.1 and the virtual /test directory you created in the preceding section, you can create a basic ASP file and experiment with using it. Follow these steps:

1. Enter the following code in Notepad or another text editor:

```
<HTML>
<BODY>

The Current date and time is
<%
   Dim sTime
   sTime = Now
   Response.Write(sTime)
%>

</BODY>
</HTML>
```

2. Name the file THETIME.ASP and save it to the /test directory.
3. Open the file in your browser using the URL `http://myserver/test/thetime.asp`, where *myserver* is the name of your NT server or PC.

   If your code does not run but is instead displayed on the screen, make sure that the file has an .ASP extension and the virtual directory has the correct permissions.

NOTE Microsoft's Web server software allows you to specify default document names (usually DEFAULT.ASP and DEFAULT.HTM). This means a user does not have to carry the URL out to the file level—for example, `http://myserver/test/` automatically displays the DEFAULT.ASP or DEFAULT.HTM file, if it exists in the /test directory. ■

Using Server-Side Scripting Tags

When processing an ASP file, the Web server only executes the code designated as server-side script. All other parts of an ASP file are sent directly back to the browser. In your ASP files, the server-side code can be marked in a couple of different ways:

- Use the HTML `<SCRIPT>` tag with the `RUNAT=SERVER` option.
- Use `<%` and `%>` to mark the beginning and end of the server-side script. This syntax is shorter and is the one I recommend.

However you decide to mark the script, make sure to place it *within* the script delimiters, as in the following examples:

```
<SCRIPT LANGUAGE="VBSCRIPT" RUNAT="SERVER">
Dim i
For i = 1 to 10
    Response.Write ("This is line " & i & "<BR>")
Next
</SCRIPT>
```

The same code can also be marked with the shorter tags:

```
<%
Dim i
For i = 1 to 10
    Response.Write ("This is line " & i & "<BR>")
Next
%>
```

Notice that you do not need to specify a scripting language in the second example. This is because the default scripting language for ASP files is VBScript. However, the default scripting language is a configurable option, so you might want to place the following line at the beginning of each of your ASP files:

```
<%@ LANGUAGE="VBSCRIPT" %>
```

This line is a directive to the script engine that sets the default language to VBScript for the current ASP page. Although your script tags can be placed anywhere in the ASP file, there are a few restrictions:

- Certain directives and options, like the previous line of code and the `Option Explicit` statement, must be placed at the very beginning of the file, even before the `<HTML>` tag.
- If your page is used to redirect the user to another side, you cannot send any HTML back to the browser. (You get a demonstration of this in an upcoming section.)
- You cannot enter straight HTML inside the script tags, unless you use the `Response.Write` statement.

Also, keep in mind that the code you are entering is VBScript, not the full-featured Visual Basic language. There are some differences and limitations, as discussed in Chapter 30, "Using VBScript."

▶ **See** "Introduction to VBScript," **p. 666**
▶ **See** "The VBScript Language," **p. 673**

Simple but Dynamic Web Pages

Now that you know the basics, let's write another simple ASP file. At my office there is a computer named `cdtower` which, as you might have guessed, is attached to a tower of CD-ROM

drives. The purpose of the machine is to allow people on the LAN to connect and install software. However, because people are always swapping and borrowing CD-ROMs, it is hard to know at a given time which CD is in each drive. It would be great if there was a way to automatically keep track of the CDs on a Web page. Fortunately, with Personal Web Server and Active Server Pages, this task is very easy to accomplish.

You use VBScript's `FileSystemObject` to determine the volume labels of each drive on a computer. By placing this VBScript code in an ASP file where the code executes on the server, you can have the volume labels of the server's CD drives displayed on a remote browser. The code, shown in Listing 31.2, is fairly straightforward.

Listing 31.2 ASPDEMO.ZIP—VOLLABEL.ASP

```
<HTML>
<BODY>
<H1>Drive List</H1><HR>
<%
        Dim objFileSys
        Dim objDrives
        Dim objDrive

   'IGNORE DISK NOT READY ERRORS
   On Error Resume Next

        'CREATE REFERENCES TO FILE SYSTEM AND DRIVES COLLECTION
        Set objFileSys = Server.CreateObject("Scripting.FileSystemObject")
        Set objDrives = objFileSys.Drives

        'DISPLAY VOLUME LABELS
        For Each objDrive in objDrives
            if objDrive.DriveLetter > "C" Then
                Response.Write ("The CD in Drive " & objDrive.DriveLetter)
                Response.Write (" is " & objDrive.VolumeName & ". <BR> ")
             End If
        Next

        'CLEAN UP!
        Set objDrives = Nothing
        Set objFileSys = Nothing
%>
</BODY>
</HTML>
```

When a user accesses this page, the section of VBScript code executes on the Web server. The Web page in Listing 31.2 accomplishes its purpose, but leaves a lot to be desired in terms of formatting. It would appear neater if you used some HTML formatting codes, such as the `<TABLE>` tag. This can be easily accomplished by modifying the `Response.Write` statements. (As you probably have gathered by now, `Response.Write` is used in an ASP file to send HTML back to the browser.)

In your example, you display the `VolumeID` property of the `Drive` object. It would be nice to also display a more informative description. You can accomplish this by creating a custom function, `sDescription`, that returns a description for a given volume:

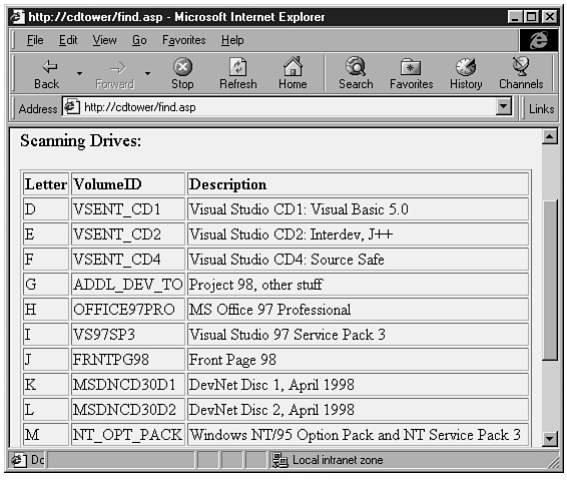
```
Function sDescription(sVolID)
  Select Case UCase(sVolID)
   Case "BACKUP0398"
     sDescription = "Backup of critical files 3/98"
   Case "DN_60ENUD2"
     sDescription = "Developer's Network CD #2"
   '
   ' Add more descriptions here
   '
     Case Else
     sDescription = "Unknown"
  End Select
End Function
```

You can create your own subroutines and functions in ASP files, just like Visual Basic. To create the `sDescription` function, simply enter the function at the top of the section of VBScript code. The scope of the function will be for the current ASP page; you can call it just like a standard VB function:

```
Response.Write sDescription(objDrive.VolumeName)
```

The final ASP page, with table and description enhancements, is shown in Figure 31.3.

FIGURE 31.3
An ASP file displays disk information.



Letter	VolumeID	Description
D	VSENT_CD1	Visual Studio CD1: Visual Basic 5.0
E	VSENT_CD2	Visual Studio CD2: Interdev, J++
F	VSENT_CD4	Visual Studio CD4: Source Safe
G	ADDL_DEV_TO	Project 98, other stuff
H	OFFICE97PRO	MS Office 97 Professional
I	VS97SP3	Visual Studio 97 Service Pack 3
J	FRNTPG98	Front Page 98
K	MSDNCD30D1	DevNet Disc 1, April 1998
L	MSDNCD30D2	DevNet Disc 2, April 1998
M	NT_OPT_PACK	Windows NT/95 Option Pack and NT Service Pack 3

Using Include Files

When you write VBScript code in Active Server Pages, you can create functions and subroutines at the beginning of your page and call them throughout the Active Server Page. You might, for example, create a subroutine that accepts a number and generates HTML based on the number:

```
Sub DisplayAmount(nAmount)
   Dim sHTML

   sHTML = "<FONT "
   If nAmount < 2000 Then sHTML = sHTML & "COLOR=RED"
   If nAmount > 4000 Then sHTML = sHTML & "COLOR=GREEN"
   sHTML = sHTML & ">"

   sHTML = sHTML & FormatCurrency(nAmount)
   sHTML = sHTML & "</FONT>"
   Response.Write sHTML
End Sub
```

The `DisplayAmount` subroutine accepts a numeric value and then colors and formats it based on the value itself. Procedures like this one would be very useful in many ASP files, but there is no way to declare this subroutine as public to all ASP files. You could cut and paste it into each file, but maintaining all the copies of it would become a chore. The answer to this problem is to move the function to a separate file and include it where necessary. To include other files in the current ASP file, use the `#INCLUDE` statement. Two example files are as follows:

```
<!—#INCLUDE VIRTUAL = "/test/formatfuncs.asp"—>

<!— #INCLUDE FILE="C:\Inetpub\wwwroot\test\formatfuncs.asp" —>
```

The first line of code uses the virtual directory to specify an include file. The next statement uses the physical directory. Either way, the end result is that the contents of `formatfuncs.asp` are inserted into the current ASP file before script execution. Some common uses of the `#INCLUDE` directive are to add footers at the bottom of each Web page, such as the company name or e-mail address.

Database Access with Active Server Pages

Suppose you want to publish the contents of a database on the Web. With ASP, you can use ADO objects in your VBScript code to access databases. As discussed in Chapter 28, "Using ActiveX Data Objects (ADO)," to access a database you first need to identify a *data source*. The actual database can be located on the Web server itself or on another machine, as long as you can connect to it via a data source.

When setting up data sources for use with ASP, you generally should use a System Data Source Name (DSN) rather than a User DSN. The System DSN allows the data source to be available to the Web server at all times, not just when a certain user is logged in.

▶ **See** "Setting Up a Data Source," **p. 613**

NOTE You can also use a DSN-less connection that does not require you to set up a data source. This is also discussed in Chapter 28. ■

In this section, the examples assume that the BIBLIO data source has been set up as described in Chapter 26, "Using Data Access Objects (DAO)."

▶ **See** "Setting Up a DAO Project," **p. 567**

NOTE If you have problems connecting to a Microsoft SQL Server data source using standard security on a different machine from the Web server, you might receive an error like `Connection Open error` in the function `CreateFile()`. This means that the NT account making the connection (usually the `I_USR` account) does not have sufficient authority on the NT SQL server.

Querying a Database

With what you have read up to this point, you have all of the knowledge necessary to run an ADO database query and display the results in a Web page. However, even a small database like BIBLIO.MDB has many records. Therefore, you need to provide some way to query the database for just the records that the user wants to see, which of course means you need to accept user input.

Setting Up a Sample Query Page The `<FORM>` tag built in to the HTML language allows user input to be sent to the Web server. Let's set up an HTML form, DBQUERY.HTM, that allows the user to enter an author's name to search for. Simply enter the HTML code in Listing 31.3 and save it on the Web server.

Listing 31.3 ASPDEMO.ZIP—DBQUERY.HTM is a Standard HTML Form

```
<HTML><BODY>
<H1>Biblio Database Search</H1><HR>

<FORM ACTION=dbsearch.asp METHOD=POST>

Enter Author to search for:
<INPUT TYPE=TEXT NAME=txtSearch>
<INPUT TYPE=SUBMIT VALUE="Begin Search">

</FORM>

</BODY></HTML>
```

NOTE An HTML form consists of different types of `<INPUT>` tags, which appear in the user's browser as data entry fields. The contents of these fields are sent to the Web server when the user "submits" a form.

Note that the code in Listing 31.3 is not an ASP page. It contains no VBScript statements and has the standard .HTM extension. It simply submits an HTML form to an ASP page called DBSEARCH.ASP. The purpose of DBSEARCH.ASP, shown in Listing 31.4, is to perform the actual search.

Writing DBSEARCH.ASP is fairly easy, as well. You basically have three things to do:

1. Retrieve the value the user wants to search for from the form field `txtSearch` and use it to build a query.

2. Execute the query using ADO to obtain a recordset.
3. Send the contents of the recordset back to the user's browser.

The code for DBSEARCH.ASP, shown in Listing 31.4, uses the `Like` statement in the SQL query.

Listing 31.4 ASPDEMO.ZIP—DBSEARCH.ASP Performs the Database Search

```
<HTML><BODY>
<%
   Dim cn
   Dim rs
   Dim sSQL
   Dim sSearchString

   'GET THE SEARCH STRING FROM THE FORM
   sSearchString = Request.Form("txtSearch")

   If sSearchString = "" Then
      Response.Write ("No search string entered!")
      Response.End
   End If

   'CONNECT TO THE DATABASE AND PERFORM THE SEARCH
   Set cn = Server.CreateObject("ADODB.Connection")
        cn.Open "DSN=BIBLIO"

   sSQL = "SELECT * FROM AUTHORS WHERE AUTHOR LIKE "
   sSQL = sSQL & "'" & sSearchString & "%' ORDER BY AUTHOR"

   Set rs = cn.Execute(sSQL)

%>
<TABLE BORDER=1>
<TR>Author's Name</TR>
<%

   'DISPLAY THE RESULTS IN A TABLE
   While Not rs.EOF
      Response.Write ("<TR><TD>")
      Response.Write rs.Fields("Author")
      Response.Write ("<TD></TR>")
                rs.MoveNext
   Wend

   rs.Close
   cn.Close
   Set rs = Nothing
   Set cn = Nothing
%>
</TABLE>
</BODY></HTML>
```

After you have created DBQUERY.HTM and DBSEARCH.ASP, you should be able to open the URL for DBQUERY.HTM, enter a few letters of the alphabet, and have the matching records displayed in the browser (see Figures 31.4 and 31.5).

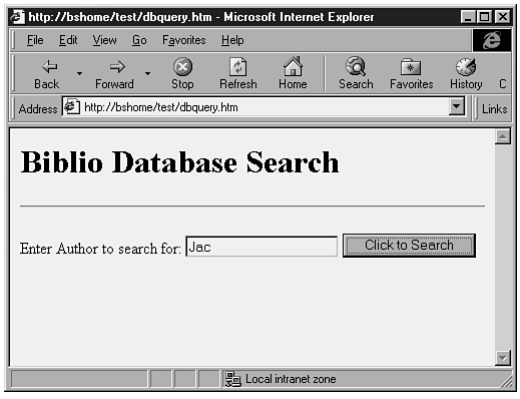


FIGURE 31.4. This page contains a standard HTML form that allows the user to enter a value and post it to an ASP page for processing.

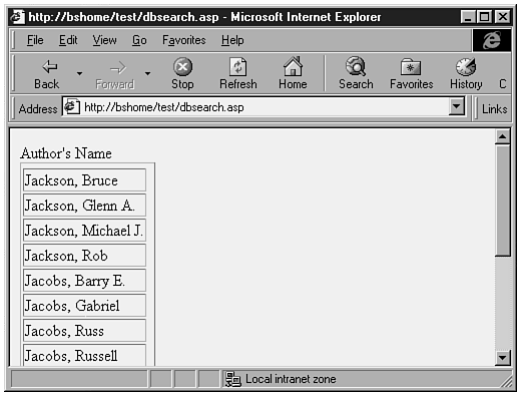


FIGURE 31.5 VBScript code on the server returns the contents of a recordset in the form of an HTML table.

NOTE In your database search example, you used separate ASP and HTM files. You could have just as easily combined the two files into a single ASP file. The only change you would need to make would be to have the form action refer to the same page. You might also want to use an `if` statement to check for the form value to see if you need to display the results:

```
<% If Request.Form("txtSearch") <> "" Then DisplayResults %>
```

The preceding line of code assumes that you have written a custom function, `DisplayResults`, to execute the query. ■

Displaying Data with Drill-Down Links The code in Listings 31.3 and 31.4 uses an HTML form field to retrieve the search criteria from the user. The user must first type a value into a text box and press a button. However, many times it is more convenient to use hyperlinks to

perform database navigation. For example, suppose you want to allow the user to click an author's name in the list of authors to display the books by that author. You can do this very easily by generating hyperlinks for each author. To generate these hyperlinks, modify the `While` loop code from Listing 31.4 as follows:

```
'DISPLAY THE RESULTS IN A TABLE
While Not rs.EOF
   Response.Write ("<TR><TD><A HREF=author.asp?id=")
   Response.Write rs.fields("AU_ID") & ">"
   Response.Write rs.Fields("Author")
   Response.Write ("</A><TD></TR>")
             rs.MoveNext
Wend
```

Run a search, and each author's name in the resulting list should appear as a hyperlink to a new ASP file, AUTHOR.ASP. If you choose View Source in your browser, you will see that each hyperlink is unique:

```
<A HREF=author.asp?id=16061>Jackson, Bruce</A>
```

The preceding line of HTML passes a parameter `id` to the ASP page AUTHOR.ASP. If you click the hyperlink, the browser will ask the server for this URL:

```
http://bshome/test/author.asp?id=16061
```

Note that the URL includes the `id` parameter, which is separated from the base (or target) URL by a question mark. If there were additional parameters, they would be separated by an ampersand (&). The syntax for using parameters in a URL is as follows:

```
http://targetURL ? parm1name=parm1value & parm2name=parm2value &
parm3name=parm3value etc...
```

The collection of parameters in an URL is also known as the query string and can be retrieved with the `QueryString` collection of the `Request` object:

```
If Request.QueryString("id") = "" Then Response.Write "No ID entered!"
```

As with the `Request.Form` example in Listing 31.4, the value passed to an ASP page in the query string can be retrieved and used in a database query:

```
      sSQL = "SELECT Title FROM [Title Author], [Titles] "
sSQL = sSQL & " WHERE [Title Author].ISBN = [Titles].ISBN "
sSQL = sSQL & " and [Title Author].AU_ID=" & Request.QueryString("id")
```

As an exercise, create AUTHOR.ASP using the preceding query. Except for the database field names, the structure of the ASP file should be identical to that in Listing 31.4.

Updating Information in a Database

Displaying data with ASP is useful, but at some point you also need to add or edit information. The previous section described two ways to get input from a client's browser to an ASP page:

- Posting with HTML forms
- Adding parameters to the URL querystring

Both of these methods are useful and appropriate in certain cases, but using the `POST` method with HTML forms is much more versatile. In the examples shown so far, you have only used the `TEXT` input field. However, there are many types of HTML form elements that can be used, such as radio buttons, drop-down boxes, and free-form text areas. One type of field that is very useful when dealing with database updates is a `HIDDEN` form field. A hidden form field is like a text field, but the user cannot see it or change its value. This type of field can be generated from an ASP page and sent down to the browser. When the user submits a form, the value of a hidden form field is sent back to the server with the other form fields.

Revisit the example in Listings 31.3 and 31.4 and add edit capability for the author's name and birth year. In addition, you will consolidate all of the functionality from the previous example into subroutines in a single ASP page:

- `AskForAuthors` takes the place of DBQUERY.HTM.
- `GetAuthorList` replaces DBSEARCH.ASP.
- `DisplayEditScreen` is a new procedure, which displays a form that allows you to edit an author's information.
- `UpdateDBInfo` changes the database.

The code for the new ASP page, AUTHOREDIT.ASP, is shown in Listing 31.5.

Listing 31.5 ASPDEMO.ZIP—ASP Page Allowing Searching and Editing

```
<HTML><BODY>
<%
Dim cn
Dim rs
Dim sSQL
Const MYASPNAME="authoredit.asp"

Sub AskForAuthors()

   Response.Write ("<H1>Biblio Database Search</H1><HR>")
   Response.Write ("<FORM ACTION=" & MYASPNAME & "?mode=search METHOD=POST>")
   Response.Write ("Enter Author to search for:")
   Response.Write ("<INPUT TYPE=TEXT NAME=txtSearch>")
   Response.Write ("<INPUT TYPE=SUBMIT VALUE=""Click to Search"">")
   Response.Write ("</FORM>")

End Sub

Sub GetAuthorList()

   'CONNECT TO THE DATABASE AND PERFORM THE SEARCH
   Set cn = Server.CreateObject("ADODB.Connection")
        cn.Open "DSN=BIBLIO"

   sSQL = "SELECT * FROM AUTHORS WHERE AUTHOR LIKE "
   sSQL = sSQL & "'" & Request.Form("txtSearch")
   sSQL = sSQL & "%' ORDER BY AUTHOR"
   Set rs = cn.Execute(sSQL)
```

```
   'DISPLAY THE RESULTS IN A TABLE
   Response.Write("<TABLE BORDER=1><TR>Author's Name</TR>")
   While Not rs.EOF
      Response.Write ("<TR><TD><A HREF=" & MYASPNAME & "?id=")
      Response.Write rs.fields("AU_ID") & "&mode=dispedit>"
      Response.Write rs.Fields("Author")
      Response.Write ("</A><TD></TR>")

                rs.MoveNext
   Wend

   rs.Close
   cn.Close
End Sub

Sub DisplayEditScreen()

   'CONNECT TO THE DATABASE AND GET THIS AUTHOR'S INFO
   Set cn = Server.CreateObject("ADODB.Connection")
        cn.Open "DSN=BIBLIO"

   sSQL = "SELECT * FROM AUTHORS WHERE AU_ID= " & Request.QueryString("id")
   Set rs = cn.Execute(sSQL)

   'GENERATE THE HTML FORM
   Response.Write ("<H1>Edit Author Information</H1><HR>")
   Response.Write ("<FORM ACTION=" & MYASPNAME & "?mode=updatedata
METHOD=POST>")

   Response.Write ("Name:<INPUT TYPE=TEXT NAME=txtName")
   Response.Write (" VALUE='" & rs.Fields("Author") & "'><BR>")
   Response.Write ("Year Born:<INPUT TYPE=TEXT NAME=txtYear")
   Response.Write (" VALUE='" & rs.Fields("Year Born") & "'><BR>")
   Response.Write ("<INPUT TYPE=HIDDEN NAME=AuthorID VALUE=")
   Response.Write (rs.Fields("AU_ID") & ">")

   Response.Write ("<INPUT TYPE=SUBMIT VALUE=""Update Info"">")
   Response.Write ("</FORM>")

End Sub

Sub UpdateDBInfo()

   'CONNECT TO THE DATABASE
   Set cn = Server.CreateObject("ADODB.Connection")
        cn.Open "DSN=BIBLIO"

   'BUILD SQL UPDATE STATEMENT
   sSQL = "UPDATE AUTHORS SET Author='" & Request.Form("txtName") & "',"
   sSQL = sSQL & "[Year Born]=" & Request.Form("txtYear")
   sSQL = sSQL & " WHERE AU_ID=" & Request.Form("AuthorID")
   cn.Execute(sSQL)
```

continues

Listing 31.5 Continued

```
   'DISPLAY A MESSAGE
   Response.Write ("<H1> Information Updated!</H1>")
   AskForAuthors
End Sub



Select Case Request.QueryString("mode")
   Case "search"
      GetAuthorList
   Case "dispedit"
      DisplayEditScreen
   Case "updatedata"
      UpdateDBInfo
   Case Else
      AskForAuthors
End Select

Set rs = Nothing
Set cn = Nothing
%>
</TABLE>
</BODY></HTML>
```

NOTE When working with user input, be wary of the quote character. You might need to write a function to manipulate quotes in a form field before using the field value in a SQL statement.

Listing 31.5 is a single ASP file, yet it generates four distinct HTML screens. The query string parameter `mode` determines what action the ASP page performs.

The ASP Objects

Active Server Pages has several built-in objects accessible from script code. So far, you have seen some examples of the `Response` and the `Server` objects. In this section, you explore these objects in a little more detail and give examples of their uses. The objects are as follows:

- `Session`
- `Response`
- `Request`
- `Server`
- `Application`

Managing Security with the *Session* Object

As alluded to earlier, IIS has features that allow your ASP application to retain information between pages. You can, for example, have a form where the user selects a country from a list and then submits that value to an ASP page. The ASP page can store this value on the server so it is available to other ASP pages. This is accomplished through the use of *Session variables.* Session variables are declared and accessed like a collection. To create a session variable, simply give it a name and value:

```
Session("Country")="United States"
```

One frequent use of ASP session variables is to manage security. When database information is on the Internet, you probably do not want everyone in the world to be able to update it. Additionally, you might want to restrict access so that only certain people can see certain information. If you want to add security to your Web site, the obvious solution is to display some type of login page so that only valid users can get into your site. Your login page can be a simple HTML form with fields for user name and password. The form submits these values to an ASP file that checks the user name and password for validity.

But even if you add such a login page, how do you prevent users from simply entering the URL they want and bypassing the login screen? The answer is to use session variables. Suppose you have an ASP file, REPORT.ASP, that you want to secure. You can add a simple `If` statement at the top of the page to verify that a session variable has been set:

```
<%
   If Session("UserName")="" Then
      Response.Write "You are not logged in!<BR>"
      Response.End
   End If

   Response.Write ("Welcome, " & Session("UserName"))
%>
```

The `If` statement checks the contents of a session variable called `UserName` and ends the response from the Web server if the value is empty. In other words, the contents of REPORT.ASP after the `If` statement are available only to users who have the session variable `UserName` set to a value.

TIP If you have multiple pages that you want to secure, use an include file to make the security check easier to maintain.

To validate a user login and set the `UserName` session variable, you need to write some ASP code. This code, shown in Listing 31.6, checks the information from the login form and sets the session variable if the user's password is correct.

Listing 31.6 ASPDEMO.ZIP—CHECKUSER.ASP Verifying Logins Against a Database

```
<%
   Dim cn
   Dim rs
   Dim sCheckName
   Dim sCheckPW

   'CLEAR SESSION VARIABLE
   Session("UserName")=""

   'GET USERNAME AND PASSWORD FROM THE FORM
   sCheckName = Request.Form("txtusername")
   sCheckPW = Request.Form("txtpassword")

   'IF THEY DIDN'T ENTER ANYTHING THEN RETURN TO LOGIN PAGE
   If sCheckName = "" then Response.Redirect "login.html"

   'CHECK USER PASSWORD IN THE DATABASE
   Set cn = Server.CreateObject("ADODB.Connection")
        cn.Open "Driver=Microsoft Access Driver
(*.mdb);DBQ=C:\data\security.mdb"
   sSQL = "SELECT * FROM UserList WHERE UserName='" & sCheckName & "'"
   Set rs = cn.Execute(sSQL)

   'IF THEY AREN'T IN DATABASE THEN RETURN TO LOGIN PAGE
   If rs.EOF Then
      rs.Close
      cn.Close
      Response.Redirect "login.html"
   End If

   'IF PASSWORD DOESN'T MATCH THEN RETURN TO LOGIN PAGE
   If UCase(rs.Fields("Password")) <> UCase(sCheckPW) Then
      rs.Close
      cn.Close
      Response.Redirect "login.html"
   End If

   rs.Close
   cn.Close

   'PASSWORD IS VALID! - SET SESSION VARIABLE
   Session("UserName")=sCheckName

   'GO ON TO REPORT PAGE
   response.redirect "report.asp"

%>
```

The code in Listing 31.6 makes use of the `Response.Redirect` command, which redirects the user's browser to a new URL. Unless he or she enters a valid user name and password, he or

she is continuously redirected back to the login page. If this were a real application, you might want to have a counter that alerts an administrator after a certain number of failed attempts.

CAUTION

The type of security described here can be thought of as *application-level* security. It does not provide *network-level* security. For example, someone could use specialized hardware to listen to the network transmissions to and from the Web server—much like tapping a telephone line—to determine your password. To prevent this kind of spying, you need to investigate a secure connection using the `https` protocol.

Because a browser operates on a request-and-response basis, the user does not really establish a continuous connection with the Web server. Therefore, the server has no real way of knowing when the connection is broken, so a session will timeout after a certain number of minutes. You control this with the `TimeOut` property of the `Session` object:

```
Session.TimeOut = 60
```

Executing the previous statement causes the timeout to be set to 60 minutes. After 60 minutes of inactivity, the server ends the user's session, destroying any session variables. You can also purposely end a session with the `Abandon` method, as in the following line of code:

```
Session.Abandon
```


Controlling Output with the *Response* Object

Another useful object in Active Server Pages is the `Response` object. You have already been introduced to `Response.Write`, which is used to send HTML or other text back to the browser.

The *Response.Write* Statement

You can build a string in the `Response.Write` statement by using the string concatenation operator (&), as in the following example:

```
<%
Response.Write ("Hello, " & Session("USERID") & "<BR>")
%>
```

NOTE You can also use the short script tags and the equals sign (=) to send the contents of a variable back to the browser, as in the following example:

```
Hello, <% =Session("USERID") %><BR>
```

I prefer using the `Response.Write` method, but this short form is good when you need to embed a simple value in your HTML. ■

In addition to standard HTML, you can use `Response.Write` to generate client-side script from the server. For example, consider the following segment of ASP code:

```
<%
sString = "This is an ASP variable"
Response.Write (vbCrLf & "<SCRIPT LANGUAGE=VBScript>" & vbCrLf)
```

```
Response.Write ("Msgbox " & Chr(34) & sString & Chr(34) & vbCrLf)
Response.Write ("</SCRIPT>" & vbCrLf )
%>
```

The preceding code actually generates VBScript statements that will be executed by the browser. The `Response.Write` statements execute on the server, causing `<SCRIPT>` tags and code to be sent back to the browser. In other words, you use code in an ASP page to generate code for the browser. This might seem confusing at first, but if you type in the example and view the source in the browser, it will make more sense. Also, note that you paid particular attention to quotes and carriage returns in the client code, just as if you had entered it manually.

One use of server-generated client script is to control an ActiveX object embedded in a Web page. For example, your ASP page could contain the `<OBJECT>` tag for a list box or other control, plus the dynamically generated statements to add specific data items to it.

The *Response* Object and Other Methods In the security example, you learned about two other methods of the `Response` object: `Redirect` and `End`. The `End` is used to end the current response to the client, as in this example:

```
<H1> Here is some HTML the browser will see! </H1>
<% Response.End %>
<H1> but the browser will never see this! </H1>
```

The `Redirect` method is used to ask the browser to move to a new URL, as in the following example:

```
<% Response.Redirect ("http://www.callsomeonewhocares.com/" %>
```

The previous line of code only works if no HTML has been returned. In other words, if you attempt to use `Response.Redirect` after a `Response.Write`, an error occurs.

One property of the `Response` object that you should have mentioned in the security section is the `Expires` property. As you might know, the browser stores everything it reads from the Internet temporarily on your hard drive. This group of temporary files is known as the *cache*. Certain files, such as graphic images, are ideal for storing in the cache. Others, such as the login page (with name and password), are not. You set the `Expires` property to the number of minutes you want the page to remain in the cache. For the security page, you would probably want to set it to zero, as in the following example:

```
Response.Expires = 0
```

The `Response` object is also used to send cookies to the user's browser. Cookies work like session variables but are stored on the client PC. (IIS actually uses cookies to help maintain the session IDs.) Cookies are useful when you want to save personal settings on a user's hard drive and retrieve them later. However, cookies are not guaranteed to be available—a lot of users consider them an invasion of privacy so they disable them. To send a cookie to the user's browser, simply assign a value as you would with a session variable:

```
Response.Cookies("MYCOOKIE") = 1234
```

A similar `Cookies` collection used with the `Request` object is used to retrieve cookie values.

Retrieving Data with the *Request* Object

The `Request` object allows ASP code to access everything about an incoming browser request. You already know that you can use the `Request` object to get the value of a parameter in an URL by using the parameter name with the `QueryString` property. Like many other collections, `QueryString` has a `Count` property and an index which allow you to iterate through the values:

```
Dim n
For n = 1 to Request.QueryString.Count
   Response.Write ("Parameter " & n & "Value = " & Request.QueryString(n) &
"<BR>")
Next
```

You can also receive information from HTML forms with the `Form` collection of the `Request` object. For example, if you have a form field name `txtLastName`, you can display the value submitted with the following code:

```
Response.Write "You entered " & Request.Form("txtLastName")
```

As you can see, a lot of the information in the `Request` object is accessed through collections. You can use a `For Each` loop to list all of the objects in a collection. Listing 31.7 displays all of the information in the `Request.Servervariables` collection.

Listing 31.7 ASPDEMO.ZIP—VARIABLES.ASP Lists the Contents of the *ServerVariables* Collection

```
<%@ LANGUAGE="VBSCRIPT" %>
<HTML>
<HEAD><TITLE>Variables</TITLE></HEAD>
<BODY>
<HR>
<H1 align="center">Server Variables</H1>
<%
For Each item in Request.ServerVariables
%>
<STRONG><%=item%></STRONG>=<%=Request.ServerVariables(item)%><BR>
<%
Next
%>
</BODY>
</HTML>
```

Create a new ASP file on your Web server, VARIABLES.ASP. Enter the code from Listing 31.7 and load the page in your browser. You should see a list of all the server variables, as shown in Figure 31.6.

NOTE You could add more `For...Each` loops to Listing 31.2 to show what is contained in other collections, such as the `Request.Form` collection, and use it as a debugging tool.

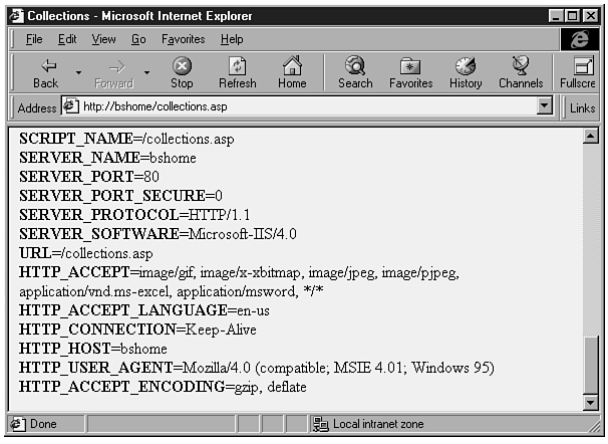


FIGURE 31.6
The Server variable `HTTP_USER_AGENT` allows you to determine a user's browser type.

The *Server* Object

The primary use of the ASP `Server` object is to create objects on the Web server so your ASP application can access them. You have already seen how to create an ADO connection object:

```
Set cn = Server.CreateObject("ADODB.Connection")
```

You can also create objects from classes that you compile into an ActiveX DLL, as you will see shortly.

As an alternative to the `Server.CreateObject` statement, you can embed an `<OBJECT>` tag in your ASP file with the `RUNAT` option set to `Server`:

```
<OBJECT RUNAT="Server" ID=cn PROGID="ADODB.Connection"></OBJECT>
```

Either syntax creates an `ADODB.Connection` object on the Web server. However, the `<OBJECT>` tag cannot be used inside the script tags.

The *Application* Object and GLOBAL.ASA

Earlier in this chapter, you discovered how the directory layout is used to identify ASP applications. This is important if you want to program the `Start` and `End` events associated with applications and sessions. To write procedure code for these events, you place a special file called GLOBAL.ASA in the ASP application's root directory. The GLOBAL.ASA can contain code for these events, as in the following example:

```
Sub Session_OnStart()
   Dim x
   Set x = Server.CreateObject("ADODB.Connection")
   Set Session("CONNECTION") = x

End Sub
```

You can use the GLOBAL.ASA file to add a Web page hit counter, close and open databases, or any other activity that needs to occur when a user starts and exits your application.

Using Your Own ActiveX DLL with ASP

You can do a lot by using VBScript code in an Active Server Page, but VBScript of course lacks the power of full-blown Visual Basic, not to mention all of the IDE features you may be used to. However, by using the `Server.CreateObject` function, you can create instances of your own ActiveX DLL's on an ASP page.

First, create and test your ActiveX DLL in a normal Visual Basic environment. Then, you need to install and register the DLL on the Web server so it can be used from an ASP page. Creating an ActiveX DLL is covered in more detail in Chapter 16, "Classes: Reusable Components."

▶ **See** "Creating an ActiveX DLL," **p. 368**

Once you have created your ActiveX DLL, install it on the Web server. If you already have the Visual Basic runtime files installed on the Web server, installation of your DLL may be as simple as copying the DLL over and running `REGSVR32` to register it.

After the DLL is installed and registered, you can create an object from a class in the DLL with the `Server.CreateObject` statement:

```
Set objVariable = Server.CreateObject("MyProject.MyClass")
```

After an object has been created, you can access it from the current ASP page. To pass it along to another page, you can store it in a session variable, like the GLOBAL.ASA example in the previous section.

Using ActiveX DLLs with ASP is very simple, just access the methods and properties from VBScript:

```
Response.Write objVariable.GetUserData("Smith")
```

VBScript only uses variants, so be careful when declaring functions in your DLL. Arrays and other data types do not always work the same as they would in standard Visual Basic. You should create a small test function in your DLL so that you will be familiar with the VBScript limitations.

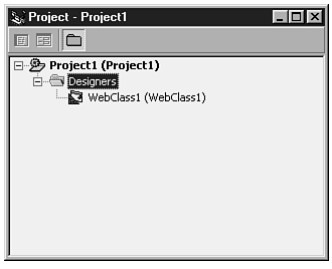
The IIS Application Project

A new project type in Visual Basic 6.0 is the IIS Application. An IIS Application is a special type of ActiveX DLL that works on a Web server to process requests from the client and return HTML to the user's browser. Does this sound similar to what an ASP page does? Well it should. IIS applications allow you to access many of the same objects (`Server`, `Response`, `Request`, and so on) as an ASP page and are themselves hosted in an ASP page. As a matter of fact, an IIS application works in a similar way to what was covered in the last section regarding calling an ActiveX DLL from an ASP page. The difference is that an IIS Application is set up specifically to deal with the Web; although an ActiveX DLL project contains a standard VB class module, an IIS Application project contains a *WebClass*.

Creating an IIS Application

To start an IIS application, open Visual Basic and choose IIS Application from the list of available project types. A new project is created with a single object, `WebClass1`, shown in Figure 31.7.

FIGURE 31.7
An IIS application is a specialized type of ActiveX DLL that runs on the Web server.

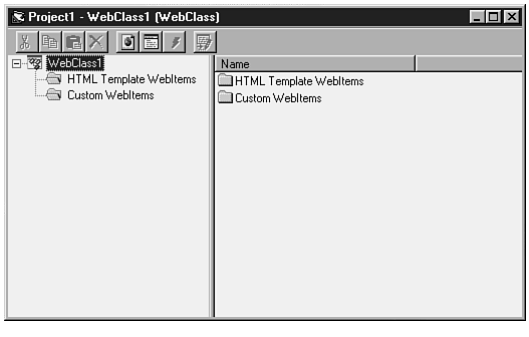


Notice that `WebClass1` is not a form or standard class module, but an *ActiveX Designer*. ActiveX Designers help you create specific kinds of ActiveX components and are integrated right into the VB development environment. In an IIS application, the WebClass designer takes care of a lot of "low level" work for you in working with HTML. In fact, when you finally compile your IIS Application DLL, much of the VB code you write will be talking to the WebClass DLL.

Because the Web is inherently document-based, an IIS application depends on files being in their proper locations. Therefore, it is very important to save the IIS project before you start doing anything. Go ahead and create a separate directory for the application, such as C:\IISDemo, and save the project files.

As with forms, `WebClass1` has both a code view and a design view. Open the design view by right-clicking the WebClass and selecting View Object. You then see the screen shown in Figure 31.8.

FIGURE 31.8
A WebClass can contain two types of WebItems.



As you can see, a WebClass contains *WebItems*. There are two different types of WebItems, which you'll learn about shortly:

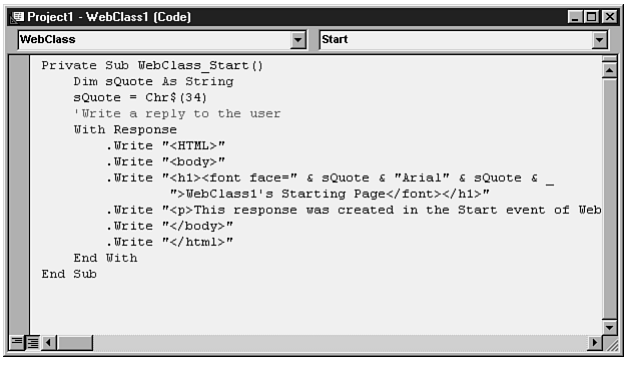
- HTML Template WebItems—A WebItem based on an HTML template file that already exists
- Custom WebItems—A WebItem created totally in code

So what is a WebItem? Well, it is nothing but code (remember this is just an ActiveX DLL) and because this is a server-based application there is no visual interface. WebItems provide a way to connect Visual Basic program events to the document-based world of HTML.

Running an IIS Application

Before you go any further, look at the code for the WebClass. Right-click the class name in the Project Explorer window and choose View code. You should see the default code for the WebClass's `Start` event, as shown in Figure 31.9.

FIGURE 31.9
The WebClass' `Start` event provides an initial HTML screen via the familiar `Response` object.



Go ahead and run the project by clicking the VB Start button or pressing F5. Remember, because IIS applications are Web server-based like ASP, you need to have a Web server running to use and debug them.

NOTE The examples discussed in this chapter were created with Visual Basic, Personal Web Server, and Transaction Server (included with PWS) running on the same machine.

Each time you run your IIS Application in the VB IDE, Visual Basic generates an ASP file and attempts to launch it in Internet Explorer. The first time you run a new IIS Application, you will see a message like that in Figure 31.10, which asks you for the virtual directory name.

FIGURE 31.10
Visual Basic automatically creates a virtual directory and ASP file to host your WebClass.

When the application runs, you should see the HTML screen provided by the WebClass's `Start` event. If you look in the project directory, you might notice that Visual Basic has created an ASP file that creates an instance of your WebClass. By now, you should understand a little bit more about how an IIS application works—kind of like an ASP file but with all of the Web activity accessible through the Visual Basic environment. In the next section, you learn more about what a WebClass can do by adding WebItems to it. For now, stop the project in Visual Basic and return to design mode.

WebClass Instancing

Open the Code window again and note the standard events available for a WebClass. Put `Debug.Print` *`eventname`* statements in each of them and run the project again. Watch the sequence of events:

1. When you start the project, the browser is launched. The ASP file loaded by the browser contains a `Server.CreateObject` statement, which creates an instance of the WebClass, causing the `Initialize` event to fire.
2. The ASP file also makes a request for a Web page to the WebClass, causing the `BeginRequest` event to fire.
3. The WebClass's `Start` event fires (much like the `Form_Load` event) causing HTML to be sent back to the browser.
4. When all the HTML has been sent to the browser, the request has been satisfied so the `EndRequest` event fires.
5. The `Terminate` event fires, causing the instance of the WebClass to be destroyed.

Step 5 in the preceding list should have at least caused you to raise an eyebrow. Why was the WebClass created and then immediately destroyed? The answer is because the `StateManagement` property of the WebClass was set to `wcNoState`. This means if you set a local variable or property in the `Start` event of the WebClass, it would not be available on successive calls. If the `StateManagement` property was set to `wcRetainInstance` then each call to the WebClass from the ASP page would be to the same instance, and you could store state information.

However, there is a deeper issue here than just setting a property. It is more a philosophy of how you write applications. The connection-less nature of the Web is more suited to transaction-based processing instead of state-based processing. When working with transactions, you really don't care about communicating with the same instance of an object because you pass all the information needed to complete a transaction along with each call to the object.

Most of us tend to write code that depends on an object's being in a certain state—for example, you will set a bunch of properties on an object and then later call a method on the object that uses those properties:

```
x.AccountID = 123456
x.AccountHolder = "Stephanie and Brent"
```

```
x.Amount = "$20.00"
x.DepositMoney
```

In these lines of code, `x` represents an instance of an ActiveX component that handles bank account functions. The last line is a method call to `DepositMoney`, which presumably requires the other account information to work. This code depends on repeated access to the same object. Another way to write this, in which all of the information is passed to the object, is as follows:

```
x.DepositMoney(123456,"Stephanie and Brent","$20.00")
```

Of course, this example is very simple, but think about a more complex example where you were repeatedly calling functions on the object. In the first example, you would have to have access to the same instance of the object `x`, but in the second example it does not matter. Although the second example looks like more work, if you can write code that is state-independent, you can use tools like Microsoft Transaction Server to pool object connections and create a very "scalable" application.

Using an HTML Template WebItem

To learn how HTML templates work with a WebClass, first create the following simple HTML template, TEST.HTM:

```
<HTML>
<BODY>
<H1> This is a test page </H1>
<BR>
<A HREF=http://www.somewhere.com> Link to somewhere! </A>

<IMG SRC=guestbook.gif>

</BODY>
</HTML>
```

There is nothing special about TEST.HTM, until you import it into the project. To do this, open the Designer window for `WebClass1`, right-click `WebClass1`, and choose Add HTML Template. Select TEST.HTM from the File dialog box. Your Designer window should now look like the one in Figure 31.11.

NOTE It is a good idea to import an HTML template from *outside* the project directory, because Visual Basic will automatically save a copy of the template (with subsequent changes) in the project directory. ■

After importing an HTML file, it becomes a WebItem.

Creating a Template Event In the right pane of the Designer window, you see a list of all the HTML tags in the template file that can be connected to Visual Basic events. The new WebItem itself is also given a name, `Template1`.

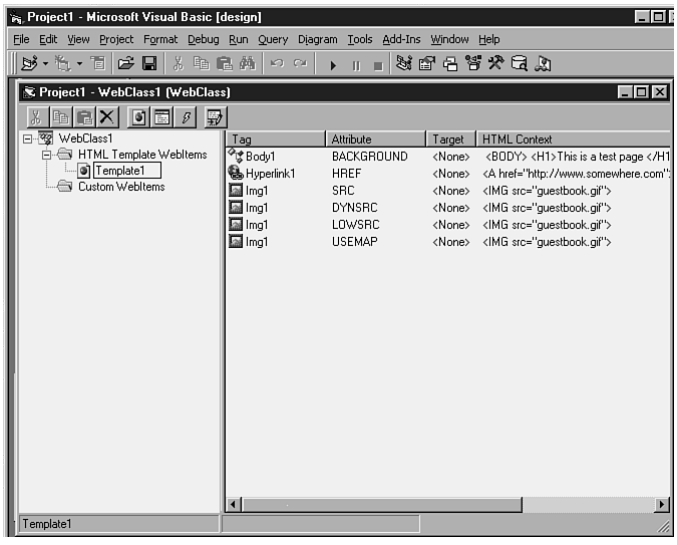


FIGURE 31.11
When you add an HTML template to a WebClass, you are presented with all of the HTML tags in the template that can be connected to VB events.

By way of comparison, think about what happens when you add a TextBox control to a standard Visual Basic form. You are in effect placing an object (the text box) in a container (the form). After you draw the text box, you can access all of its properties and events from the form's Code window. Similarly, `Template1` is an object in your WebClass, much like the text box object on a form.

The only difference between the events in a text box and those in a WebItem is that WebItem events are not automatically available from the Code window. You first have to go through the process of connecting HTML tags to program events.

Try it with your sample program. Remember the hyperlink in the template to `www.somewhere.com`? When you imported the template, it was given the name `Hyperlink1`. Right-click it and choose Connect to Custom Event. A new event appears in the Designer window, also called `Hyperlink1`. Double-click the event name and the Code window opens in the `Template1_HyperLink1` event. This new event is fired whenever a user clicks the hyperlink. Enter the following `Response.Write` statement so that the event procedure looks like this:

```
Private Sub Template1_Hyperlink1()
    Response.Write "<BR> You clicked me!<BR>"
End Sub
```

Next, run the project. When the first page loads, change the filename at the end of the URL (something like `Project1_WebClass1.ASP`) to the template filename, TEST.HTM, and press Enter. The template page loads. If you choose View Source, you might notice that the hyperlink no longer points to `www.somewhere.com` but instead to an event in the WebClass. Click the hyperlink and you should see the words *You Clicked Me* displayed in the browser. You have just seen how a hyperlink in an HTML file can be connected to a Visual Basic program event.

Sending a Template to the Browser By default, a WebClass's `Start` event sends a few lines of HTML back to the browser. You can also send templates back to the browser, such as the sample just created, by using the `WriteTemplate` method. Open the `Start` event of the WebClass and replace the default lines of code with the following line:

```
Me.Template1.WriteTemplate
```

Run the application and the template based on the file TEST.HTM should be the first thing you see. Notice that the browser is not redirected to TEST.HTM, but instead the HTML from the template file is passed back during the `Start` event.

The `WriteTemplate` method can be very useful when combined with the `ProcessTag` event. This event can be used to dynamically generate HTML content, similar to the way you use `Response.Write` statements in an ASP page to generate HTML on-the-fly. It works by searching for tags within your template (much like HTML tags but with a special prefix) and replacing them with whatever information you choose.

To demonstrate this, again bring up the template file TEST.HTM. (Make sure to bring up the file in the project directory, not the original import file.) Add the following line to the template somewhere in the body of the document and save it:

```
<WC@mytag>My Information</WC@mytag>
```

The preceding line of code contains a "customized" tag, `<WC@mytag>`. During execution of the `WriteHTMLTemplate` method, each time the WebClass encounters a tag with the `wc@` prefix, the `ProcessTag` event is fired. The tag name (`mytag`) and contents (`My Information`) are passed to the event and can be modified before being sent to the browser:

```
Private Sub Template1_ProcessTag(ByVal TagName As String, TagContents As String,
SendTags As Boolean)

If TagName = "WC@mytag" Then

    TagContents = "<B> Here is some new information </B>"

End If

End Sub
```

Using a Custom WebItem

The other type of WebItem that can be added to the WebClass is a *custom WebItem*. The events in a custom WebItem are just like the ones in an HTML Template WebItem, and you have the option to add your own custom events that can be raised from a Web page. However, there is no template in a Custom WebItem. It exists only in your VB code, as a set of event procedures. You can connect items in an HTML Template WebItem to a Custom WebItem with a few simple steps:

1. Right-click the WebClass's name in the Project Explorer window and choose View Object. The Designer window appears.

2. Again, right-click the WebClass name in the Designer window and choose Add Custom WebItem.
3. Select an HTML tag name in an HTML Template WebItem and connect it to the custom WebItem.
4. Write code for the events as described in the previous section.

As you might have realized from the examples, using WebClasses is a little more complex than standard ASP pages. However, they exist in the Visual Basic environment, which opens up a new realm of possibilities.

From Here...

In this chapter you learned about Active Server Pages, one way to apply your knowledge of Visual Basic to the Internet. To read about other Internet topics, see the following chapters:

- To learn how to create ActiveX controls that can be used on a Web page, see Chapter 14, "Creating ActiveX Controls."
- If you want to quickly migrate a Visual Basic program to the Internet, see Chapter 32, "ActiveX Documents."
- To find out about other Internet topics, see Chapter 33, "Visual Basic and Other Uses of the Internet."

CHAPTER 32

ActiveX Documents

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You probably are aware that many things are happening with the Internet these days. In particular, the World Wide Web has gained enormous popularity. It seems that everywhere you turn, everyone has a Web site—from car manufacturers to charitable organizations to the guy next door. Internet stuff is everywhere. And although just having a static Web page used to be acceptable, more and more people and organizations are providing dynamic content on their pages. These interactive Web pages do a lot more than just display fixed information. Seeing Web pages that act like applications is commonplace now, and several tools are available to help you create such pages.

When you first look at creating interactive content, the process can appear daunting. I know it did for me. More often than not, the concern I hear is not "Can I do this?" but "What's the best way to do this?" When you try to think of ways to program for the Web, dozens of terms may come to mind: Perl, CGI, Active Server Pages, VBScript, and Java, to name a few. The ActiveX documents discussed in this chapter are not necessarily the best choice for all occasions, but they do make Internet programming accessible to VB programmers.

Understanding ActiveX Documents

Because ActiveX documents are perfect for use on the World Wide Web, this chapter will begin with a quick refresher course. You probably have become familiar enough with Web pages to know that they are basically just document files. Web files are similar to Word documents except that they are written in a special format: HTML (which stands for Hypertext Markup Language). Just as Word is the viewer for DOC files, a Web browser (such as Netscape or Internet Explorer) is used to view HTML files. HTML files on the Internet have an address, or *URL* (Uniform Resource Locator), that is used to locate a specific document.

The Web began as just a bunch of linked documents. However, a static document cannot produce the level of interactivity you see today. Two things about the Web have made this change possible:

- The way Web pages are retrieved
- Browser enhancements

The Hypertext Transfer Protocol, or HTTP, is the means by which your browser and the Web server communicate. The browser simply requests an URL and then displays the returned HTML stream.

Notice that I use the word "requests"; this is an important concept. Requesting a file is very different from opening one on your hard drive—hence the need to have a protocol. Think of this process as being similar to your asking a friend to send you a document via e-mail. With this process, unlike your opening a document on your hard drive, your friend could edit the document before sending it or send you a completely different document. In a similar manner, logic can be placed on the Web server to modify the returned document based on any number of criteria, including information from user.

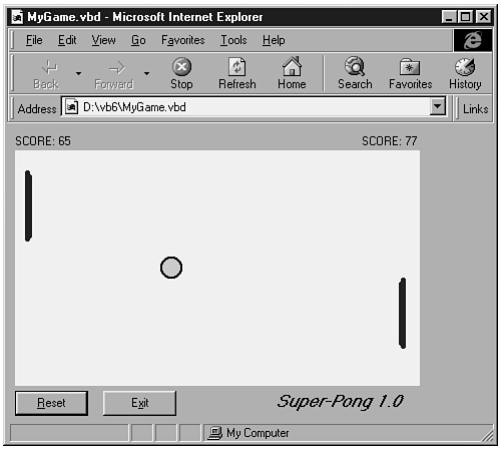
On the browser side, the returned HTML stream has evolved quite a bit since the Web's first days. In addition to formatted text and graphics, Web pages can include script code and Java applets. These advances were made possible by the increasing complexity of the Internet browser, which has evolved to support all these embedded objects. ActiveX documents, discussed in this chapter, are applications downloaded to the client's desktop by Internet Explorer (IE).

What Is an ActiveX Document?

Put in simplest terms, an ActiveX document is an application that runs inside a container, such as Internet Explorer, instead of running as a standalone program. An example of such an application is shown in Figure 32.1.

NOTE Even though you can use an ActiveX document inside Internet Explorer, you must have all the required runtime DLLs installed on the client machine.

FIGURE 32.1
This simple ActiveX document is running in Internet Explorer.



The "document" portion of the name comes from the analogy to word processing documents or spreadsheets. These files contain data but must be accessed by a program in order to be viewed or edited. For example, you can create a document in Word and store it in a file. If you pass the file along to another user, that user can't do anything with it unless he or she has a copy of Word. An ActiveX document works much the same way. You can create an ActiveX document and store it in a file. If you pass the file to someone else, that person must have a program capable of supporting ActiveX documents before being able to use the file.

Fortunately, several containers support ActiveX documents, including Internet Explorer, Microsoft Office 97 binders, and the Visual Basic IDE. Your users can run your program inside one of these container applications.

What Are the Advantages of Using ActiveX Documents?

The primary reason to use ActiveX documents in Visual Basic is to create Internet-enabled applications. Creating ActiveX documents provides a number of advantages over creating Internet applications by other means. Some of these advantages include the following:

- You do not have to learn another programming language to create the documents. All your Visual Basic expertise can be applied to ActiveX documents.
- You can design your Internet application by using the Visual Basic design environment. This process is much simpler than the code-and-test method that you have to use with some other languages.
- You also have access to Visual Basic's rich debugging environment for testing your code and fixing any problems that arise.
- By using the Hyperlink object, you can easily navigate to other pages from the browser. These pages can be other ActiveX documents or any Web address.

So, Visual Basic makes creating an ActiveX document easy, but why would you want to create one in the first place? Why not just create a standard application? The answer, in a word, is "Internet." ActiveX frees you of the complications involved with the older means of distributing an application. If your program is a standard EXE, then you must send installation diskettes to all the users. ActiveX documents, on the other hand, can be set up on a Web server so that they are downloaded automatically when a user opens the Web page. Codes embedded in the Web page tell Internet Explorer to download a cabinet (CAB) file containing your application and all necessary components. This Web-based approach makes it simpler to maintain your code and to keep everyone running the same version.

Of course, using ActiveX documents over the Internet does have some disadvantages. The main disadvantages are as follows:

- At the time of this writing, only Microsoft's browser, Internet Explorer, supports ActiveX. Therefore, if your audience is the whole Internet (versus a corporate intranet, for example), you may want to investigate a server-side approach, such as using Active Server Pages.
- Even though Internet Explorer handles downloading your application, it still has to be "installed" on the client PC—with all the proper support files. Every time you create a new version of your ActiveX document, the users need to update a local copy, which may be time consuming on a slow Internet connection.

Creating Your First ActiveX Document

Creating an ActiveX document is similar to creating standard applications in Visual Basic. In this chapter, you will re-create the loan payment calculator example from Chapter 2, "Creating Your First Program," but this time as an ActiveX document. To create a document, follow this basic sequence of events:

1. Start a new ActiveX document project.
2. Create the user interface for the application.
3. Write the code to perform the application's tasks.
4. Test and debug the application.
5. Use the Package and Deployment Wizard to create an Internet download setup.

Obviously, several details are involved in each of these steps, but you can see that the process is something you are familiar with. To walk through the process of creating an ActiveX document, you will create a mortgage calculator like the one you created in Chapter 2. Using this same application will illustrate the similarities between creating an ActiveX document and a standard Visual Basic program.

NOTE The preceding steps refer to creating an *application*. Because an ActiveX document is an interactive application as opposed to a static file, such as a word processing document, the term *application* is often used to refer to an ActiveX document.

Starting an ActiveX Document Project

The first step toward creating an ActiveX document is to start your project. You do so by selecting New Project from the File menu. The New Project dialog box then appears (see Figure 32.2). From this dialog box, select the option to create an ActiveX Document EXE by double-clicking the icon. This action starts a new project containing a single User Document, `UserDocument1`. Double-click the object in the Project Explorer window and you should see the blank designer screen, as shown in Figure 32.3.

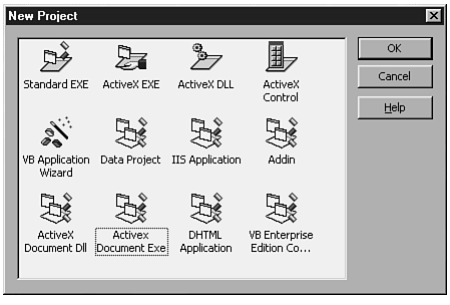


FIGURE 32.2
The New Project dialog, which can be displayed by pressing Ctrl+N, sets up the initial project configuration.

NOTE If the UserDocument is not displayed automatically, double-click the UserDocument object in the Project window to display it.

Notice that the UserDocument designer looks a lot like a form designer without a border. As a matter of fact, it is also like the UserControl object that you use to create ActiveX controls. You create the user interface for the ActiveX document here, just like with a form. (For more information about creating ActiveX controls, see Chapter 14, "Creating ActiveX Controls.")

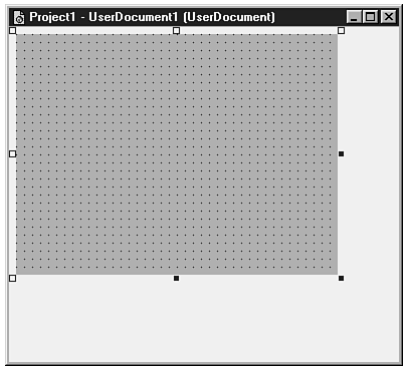


FIGURE 32.3
ActiveX documents run inside a container and therefore do not have title bars, borders, and other features of independent windows.

After you create the project, you can change the properties of the project and the UserDocument to descriptive names, as listed in Table 32.1. To access the properties of the project, choose Properties from the Project menu. You can access the properties of the UserDocument from the Properties window (by choosing View, Properties Window). After you set the properties, save the files of the project by clicking the Save button on the toolbar. You then have to specify names for each of the new files.

Table 32.1 Project and UserDocument Properties

Property	Setting
Project Type	ActiveX EXE
Project Name	ActXCalc
Project Description	ActiveX Document Loan Calculator
UserDocument Name	CalcDoc

Document Filenames

You save the source code of ActiveX documents in a text file much the same way you save a form. The description of the UserDocument object and any controls is stored along with the code of the document in a file with the extension .DOB. This is similar to the FRM file of a form. If the interface has any graphical components, they are stored in a DOX file, similar to the FRX file for forms. When you compile your ActiveX document, you create either an EXE or DLL file, along with a VBD file. The VBD file is the one accessed by Internet Explorer. This VBD file is the "document" part of the file, similar to a DOC file from Microsoft Word.

Creating the Interface of the Document

You create the interface of your ActiveX document by drawing controls on the UserDocument object, just as you would draw them on the form of a standard program. You can use almost any

Visual Basic control in the creation of your document. The only exception is that you cannot use the OLE container control as part of an ActiveX document. Another restriction is that an ActiveX document cannot contain embedded objects, such as Word or Excel documents.

CAUTION

If you use custom controls in your document, you need to check licensing and royalty requirements before distributing the controls.

To create the interface of the sample application, you need to add four Label controls, four TextBox controls, and one CommandButton to the UserDocument.

The Label controls should have the following settings for the `Name` and `Caption` properties:

Name	Caption
`lblPrincipal`	`Principal:`
`lblTerm`	`Term (Years):`
`lblInterest`	`Interest Rate (%):`
`lblPayment`	`Monthly Payment:`

All four text boxes should have their `Text` properties deleted so that the text boxes appear empty when the document is first shown. The text boxes should be named `txtInterest`, `txtPayment`, `txtPrincipal`, and `txtTerm`.

The command button of the document should have the `Name` property set to `cmdCalculate` and the `Caption` property set to `Calculate Payment`.

After you add the controls to the document, your UserDocument should look like the one in Figure 32.4.

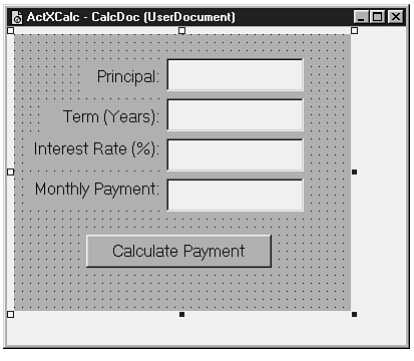


FIGURE 32.4
The Document calculator looks similar to the LoanCalc program created earlier.

Adding Code to the Document

After you create the interface of the document by using Visual Basic controls, you are ready to write the code that makes the document perform a task. As with the forms in a standard program, you write code for events of the controls in the document. All code work is done in the Code window. You can access the Code window by double-clicking a control or by clicking the View Code button in the Project window. For the sample application, you need to enter the code from Listing 32.1 in the `Click` event of the command button.

Listing 32.1 CALCDOC.DOB—Placing Code in the *Click* Event to Run the Calculation

```
Private Sub cmdCalculate_Click()

    Dim m_Principal As Single, m_Interest As Single
    Dim m_Payment As Single, m_Term As Integer
    Dim m_fctr As Single

    m_Principal = Val(txtPrincipal.Text)
    m_Interest = Val(txtInterest.Text) / 1200
    m_Term = Val(txtTerm.Text)
        m_fctr = (1 + m_Interest) ^ (m_Term * 12)
    m_Payment = m_Interest * m_fctr * m_Principal / (m_fctr - 1)
    txtPayment.Text = Format(m_Payment, "Fixed")

End Sub
```

Although the code in Listing 32.1 exists in a UserDocument object, it works just like code inside a form. First the values entered by the user are retrieved from the text boxes and stored in local variables. Next the code calculates the payment and displays the results in the text box `txtPayment`.

Testing Your ActiveX Document

After entering the code and saving your document, you are ready to test the code. Testing an ActiveX document is a little different than testing a standard program because the document must run inside another application. To determine what type of application runs when you start the project, display the Debugging tab of the Properties dialog box. This dialog box has several options, as you can see in Figure 32.5.

The default option in the Debugging tab, Start Component, allows the code in the component to determine the manner in which it starts. If you have Internet Explorer installed, and you start an ActiveX Document project, this default setting causes the application to be loaded automatically into Internet Explorer. Try it now with the sample project. Simply press F5 or click the VB Start button, and you should see the Web version of the Loan Calculator appear, as shown in Figure 32.6.

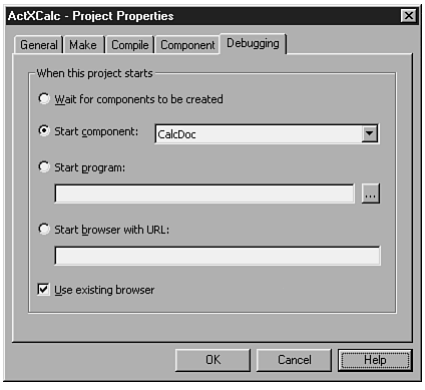


FIGURE 32.5
Use the Debugging tab of the Properties dialog box to select whether an ActiveX document starts in the browser or another application.

If you want to open the ActiveX document manually, choose Wait for Components to Be Created from the Debugging tab. In this case, Visual C`sic only starts the project; you must open the document in Internet Explorer. To open an ActiveX document manually, follow these steps:

1. Run your document by pressing F5 or clicking the VB Start button on the toolbar. (Note that Visual Basic does not display the user interface of your program.)
2. Minimize Visual Basic and start Internet Explorer.
3. From IE's File menu, choose Open. In the resulting Open dialog box, you can enter the name of the file to be opened by IE.
4. Specify the path and name of your ActiveX document. The name is the value of the `Name` property of the UserDocument object, followed by a .VBD extension. If you are running your document within VB, the file is located in the same folder as Visual Basic. For a typical installation, the path is C:\Program Files\DevStudio\Vb.
5. Click the OK button in the Open dialog box to load your document. The CalcDoc document is shown running in Internet Explorer in Figure 32.6.

NOTE If you click the Browse button in the Open dialog box to find the file, remember to change the Files of Type selection from HTML files to All Files.

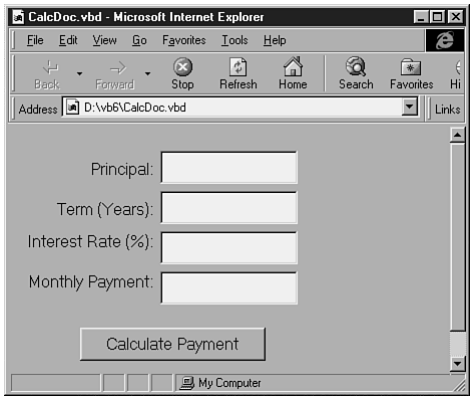


FIGURE 32.6
Internet Explorer can host an ActiveX document.

You can also open your ActiveX documents inside your own custom Web page. If you want to see how your HTML looks with the ActiveX document, simply choose Start Browser with URL and enter the URL of your Web page. (Note that if you select this option you must ensure that your Web page includes the necessary code to display the ActiveX document.) In addition, you can use the Start Program option if you want to test your ActiveX document in another application.

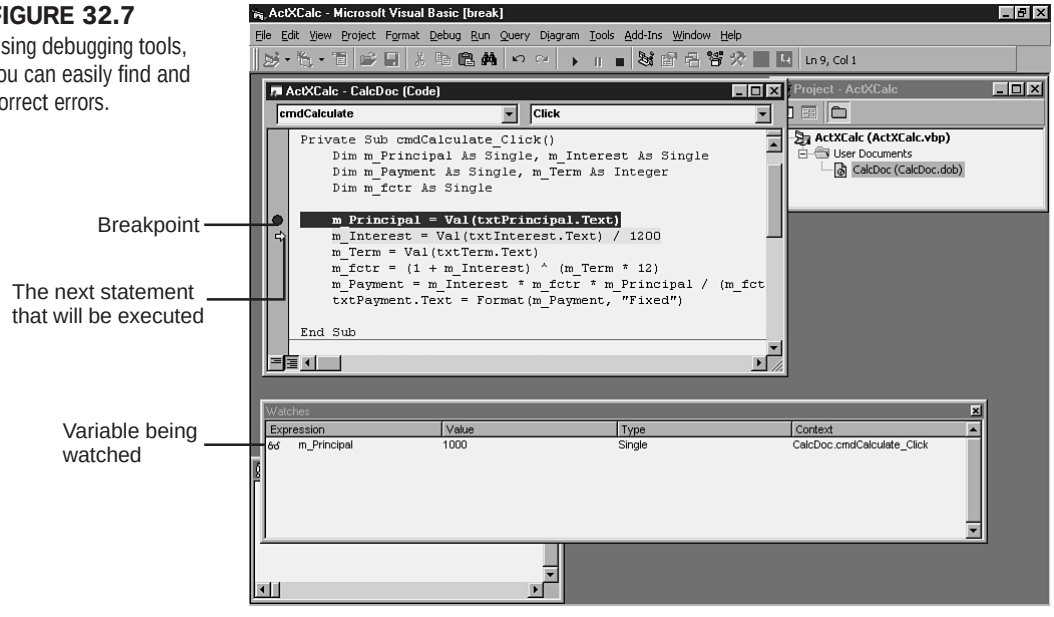
If your code doesn't perform like it should, you can use all of Visual Basic's debugging tools to track down and eliminate errors. (Debugging is discussed in detail in Chapter 9, "Visual Basic Programming Fundamentals.") You can set breakpoints in your code, set "Watches" to observe the values of variables, and step through the code line by line to locate an error. Figure 32.7 shows a typical debugging session.

▶ **See** "Debugging Your Programs," **p. 173**

CAUTION

Terminating your program without closing Internet Explorer may cause errors in IE. Therefore, you should close and restart IE each time you run your document. Note that closing IE does not stop the ActiveX document project in Visual Basic.

FIGURE 32.7
Using debugging tools, you can easily find and correct errors.



Compiling Your Document

After you finish testing and debugging your document, you can compile the document for distribution. To start the compilation process, select Make from Visual Basic's File menu. In the resulting Make dialog box, you can specify the name and location of the EXE or DLL file. The name of the VBD file is based on the `Name` property of the UserDocument object. This file is placed in the same folder that you specified for the EXE file.

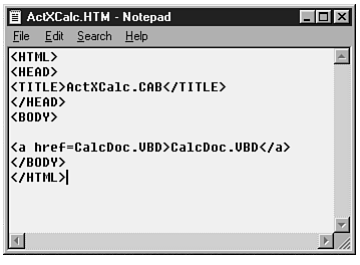
After compilation, your document can be used in any of the programs that handle ActiveX documents. As you learned previously, Internet Explorer is one such program; the Office 97 Binder is another. To access an ActiveX document with the Binder, start the Binder and then select Add from File from the Section menu. This action opens a dialog box that enables you to specify the file to be loaded. Here, you specify the name and location of your VBD file and then click the OK button to load the document.

If you want to put your ActiveX document on the Internet, you first need to run the Packaging and Deployment Wizard with the Internet Package option. The wizard creates a Package subdirectory that contains the following:

- A CAB file containing all the required components and DLL files
- The VBD file that is used to open the document in Internet Explorer
- A Support directory in case you need to rebuild the CAB file manually
- A sample HTML file, pictured in Figure 32.7, that shows you how to include your document on a Web page

▶ **See** "Packaging ActiveX Components" **p. 788**

FIGURE 32.8
You can copy the `HREF` line from the sample HTML file to your own Web pages.



Exploring the UserDocument Object

Just as a form is the main part of a standard program, the UserDocument object is the key part of an ActiveX document. The UserDocument provides the canvas for all the controls that make up the user interface of the document. As you can do with a form, you can place controls on the UserDocument, or you can use graphics methods and the `Print` method to display other information directly on the document. This capability provides great flexibility in the design of your documents and the manner in which you present information to the user.

Understanding the Key Events of a UserDocument

Although the UserDocument is similar to a form in many respects, it also has some key differences. For example, several key properties, methods, and events are supported by a UserDocument but are not supported by a form, and vice versa. The reason for these differences is the different nature of the objects themselves: A form is independent, whereas a UserDocument is always in a container.

The main events of a form that are not supported by the UserDocument object are the `Activate`, `Deactivate`, `Load`, and `Unload` events. The UserDocument, on the other hand, supports the following events that are not supported by a form:

- `AsycReadComplete`. Occurs when the container holding the document has finished an asynchronous read request.
- `EnterFocus`. Occurs when the ActiveX document receives focus.
- `ExitFocus`. Occurs when the ActiveX document loses focus.
- `Hide`. Occurs when the user navigates from the current ActiveX document to another document.
- `InitProperties`. Occurs when the document is first loaded. However, if any properties have been saved using the `PropertyBag` object, the `ReadProperties` event occurs instead.
- `ReadProperties`. Occurs in place of the `InitProperties` event if items are stored in a `PropertyBag` object. This event also occurs as the document is first loaded.
- `Scroll`. Occurs when the user uses the scrollbar of the container in which the ActiveX document is running.
- `Show`. Occurs when the user navigates from another document to the ActiveX document.
- `WriteProperties`. Occurs as the program is about to be terminated. This event happens right before the `Terminate` event, but it occurs only if the `PropertyChanged` statement has been used to indicate that a change has occurred in a property's value.

Creating and Storing Properties for a UserDocument

Despite the similarities between the UserDocument and a form, in some ways the UserDocument is much more similar to a UserControl than a form. All three objects—the form, the UserControl, and the UserDocument—enable you to create properties and methods to extend their capabilities. However, only the UserControl and the UserDocument have the capability to use the `PropertyBag` object. The `PropertyBag` object, along with some special events, is used to store values of public properties so that settings are preserved between sessions.

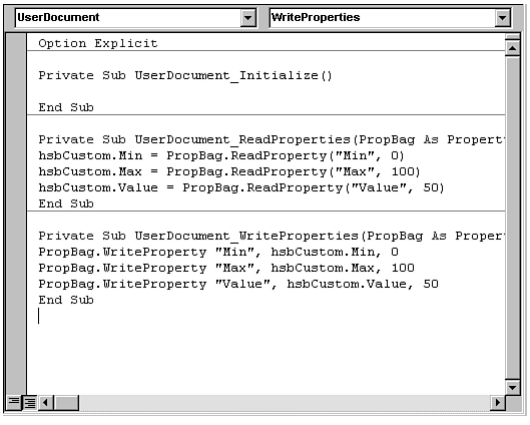
Because the process for creating and saving properties was discussed in detail in the coverage of ActiveX controls, I won't repeat the details here (see Chapter 14, "Creating ActiveX Controls"). However, a quick recap may help you remember the steps involved. To create and store properties for the UserDocument, you need to do the following:

1. Create a property by using the `Property Let` and `Property Get` procedures. You can create the shell of the property by using the Add Procedure dialog box, which you can access from the Tools menu of Visual Basic.
2. To indicate that the value of a property has changed, place the `PropertyChanged` statement in the `Property Let` procedure of each property whose value you want to store.
3. To store the values of the property, use the `WriteProperty` method of the `PropertyBag` object to output the values of the changed properties. The code for this method is placed in the `WriteProperties` event of the UserDocument.
4. To retrieve the values of the property, use the `ReadProperty` method of the `PropertyBag` object to output the values of the changed properties. The code for this method is placed in the `ReadProperties` event of the UserDocument.

▶ **See** "Adding Properties" **p. 331**

The result of the code for handling these tasks in a sample document is shown in Figure 32.9.

FIGURE 32.9
Use the `ReadProperty` and `WriteProperty` methods to retrieve and store public properties of the UserDocument.



Working with the Methods of the UserDocument

In addition to the different events that UserDocument supports, the UserDocument also supports two key methods that a form does not: `AsyncRead` and `CancelAsyncRead`. The `AsyncRead` method enables the document to request that its container read in data from a file or URL. As the name implies, the read is performed asynchronously. As you can imagine, the ability to read a file asynchronously comes in handy when you're working with the Internet. For example, you might write a data viewer application that retrieves information from a server. The `AsyncRead` method requires that you specify the file (or information) to be read and the type of information that is being read. The three supported data types are summarized in Table 32.2.

Table 32.2 Types of Data Supported by the *AsyncRead* Method

Constant	Description
`vbAsyncTypeFile`	The data is contained in a file created by Visual Basic.
`vbAsyncTypeByteArray`	The data is a byte array containing retrieved data.
`vbAsyncTypePicture`	The data is stored in a Picture object.

The `CancelAsyncRead` method is used to terminate an asynchronous read prior to its completion.

As an example, add an asynchronous read to the ActiveX Document Loan Calculator. Before adding code for the `AsyncRead` method, set up the project as follows:

1. If you have not already done so, create the sample project described in the preceding sections.
2. Open the `CalcDoc` UserDocument object, and add two new controls to the form: a second command button and an Image control.
3. Name the command button `cmdGetPic`, and name the Image control `imgMain`.
4. Find the path to a picture file on your hard drive or intranet that you can use for this test. In the example, I use D:\Pictures\Brian.BMP.
5. Add the `AsyncRead` code to the `Click` event of the command button, as follows:

   ```
   Private Sub CmdGetPic_Click()
        AsyncRead "d:\pictures\brian.bmp", vbAsyncTypePicture, "MyPicture"
   End Sub
   ```

   The code simply initiates a download of the picture BRIAN.BMP to the client machine. In this case, I specified an exact file path on a local hard drive, but you can also use a URL just as easily—for example, `http://myserver/mypicture.gif`.
6. Add the following code to the `AsyncReadComplete` event of the user document to put the downloaded picture into the Image control:

   ```
   Private Sub UserDocument_AsyncReadComplete(AsyncProp As AsyncProperty)

   MsgBox "The picture download has finished with status " &
   AsyncProp.StatusCode
   Set imgMain.Picture = AsyncProp.Value

   End Sub
   ```

   The `AsyncReadComplete` event fires after the picture is downloaded, in which case a message box is displayed and the picture (stored in the parameter `AsyncProp`) is displayed in the Image control.

NOTE If you are loading an image from the Web (with the `http://` syntax), Internet Explorer may cache it locally. To make the most of the cache, you can add an optional parameter to the end of the `AsyncRead` call to control when and if the cache image is used. For a list of the settings of this parameter, see the `AsyncRead` method topic in the online help file.

In the sample, note that only one asynchronous download is happening. If you initiate multiple downloads, you can use the `PropertyName` property to determine which object is passed to the `AsyncReadComplete` event. In this case, the value of that property is `MyPicture`.

In addition to starting an asynchronous read and detecting when it completes, Visual Basic 6 now allows you to monitor its progress through the `AsyncReadProgress` event. Several properties are passed to this event, allowing you to display the download progress to the user. For example, you may want to display a status bar with the number of bytes downloaded or inform the user as connections are made and downloads are started.

Using the Hyperlink Object in Your Document

One object of extreme importance in ActiveX documents is the Hyperlink object. This object is accessed through the `HyperLink` property of the UserDocument object. It has no properties and only three methods. However, the Hyperlink object is what enables an ActiveX document to call another ActiveX document or to navigate to a Web site. The three methods of the Hyperlink object are the following:

- `NavigateTo`. This method causes the container that holds the ActiveX document to jump to a file or URL specified in the method. You use this method to move from one ActiveX document to another.
- `GoBack`. This method performs a hyperlink jump to the previous document in the history list of a container. If the container does not support hyperlinking or no items appear in the history list, an error occurs.
- `GoForward`. This method is the counterpart of the `GoBack` method. `GoForward` causes the container to move to the next document in the history list. If no more documents are available, an error occurs.

NOTE A container such as Internet Explorer, which supports hyperlinking, executes on its own the jump specified in a `NavigateTo` method. A container such as Office 97 Binder, which does not support hyperlinking, starts a hyperlink-capable program to process the jump.

The following lines of code show example uses of the `Navigate` method:

```
UserDocument.Hyperlink.NavigateTo "MyDoc.VBD"
UserDocument.Hyperlink.NavigateTo "http://www.mysite.com"
```

The first line of code loads another ActiveX document in the same directory, while the second example directs the container to an Internet site.

Using the ActiveX Document Migration Wizard

So far, you have learned how to create an ActiveX document from scratch. But, if you are like me, you have a lot of time and effort invested in creating standard Visual Basic applications. Can you capitalize on the work you have already done, short of using cut and paste to bring in pieces of a program?

Fortunately, the answer is yes. Visual Basic provides a tool called the ActiveX Document Migration Wizard that can help you convert forms from an existing application to UserDocument objects for an ActiveX document. The key word here is "help." The wizard does not create a complete ActiveX document directly from your standard application. Instead, the wizard does the following:

- Copies the properties of the forms to new user documents.
- Copies menu items from the source forms to the new user documents.
- Copies all controls from the source forms, retaining their relative positions on the forms. All control properties are retained. Note that OLE container controls and embedded OLE objects are not copied.
- Copies the code from the form event procedures to the corresponding procedures in the user document, including all event procedures associated with the component controls.
- Comments out code statements that are not supported by ActiveX documents, such as `Load`, `Unload`, and `End`.

Although the ActiveX Document Migration Wizard can do a lot of the work of converting a document for you, it cannot handle some processes. Therefore, you have to do some coding work before you can compile and distribute your document.

First, you need to remove unsupported events, such as `Load` and `Unload`. Although the wizard comments out the `Load` and `Unload` statements, it does not do anything with the event procedures code. If you use these events to initialize the properties of a form or its controls, you may want to move some of the code from the `Load` event to the `Initialize` event of the UserDocument. Likewise, you may want to move some of the code from the `Unload` event to the `Terminate` event of the UserDocument.

You also need to make sure that you do not reference any nonexistent objects. For example, if you migrate a form to a UserDocument, any references to the form by name (for example, `Form1`) are invalid.

Running the ActiveX Document Migration Wizard

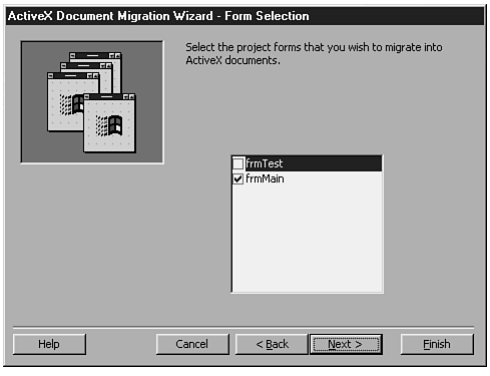
To run the ActiveX Document Migration Wizard, you need to make sure that it is available in Visual Basic. You make the wizard available by selecting it from the Add-In Manager dialog box, which you can access by choosing Add-In Manager from the Add-Ins menu. After you add the wizard to the Visual Basic IDE, you can run it by choosing ActiveX Document Migration Wizard from the Add-Ins menu.

The following steps describe the process of converting the forms of a project into ActiveX documents:

1. Open the project whose forms you want to convert. The wizard works correctly only from within the project.
2. Start the ActiveX Document Migration Wizard. You first see the introductory screen, which explains a little of what the wizard will and will not do for you. Click the Next button to proceed.

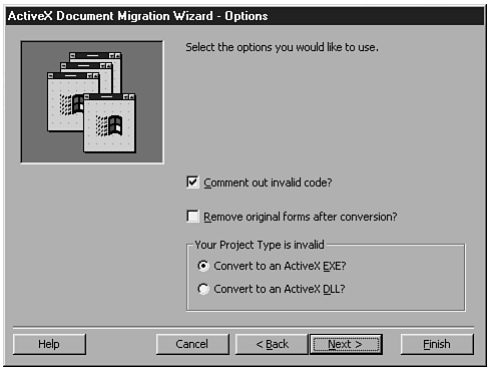
3. From the screen shown in Figure 32.10, select the forms from the current project that you want to convert to ActiveX documents. All the forms of the current project are shown in the forms list. You can select any form by clicking the check box next to the form name. Multiple selections are allowed. After you make your selections, click the Next button to move to the next part of the process.

FIGURE 32.10
Select your forms from the list in the wizard.



4. Use the Options page of the ActiveX Document Migration Wizard (shown in Figure 32.11) to control how the wizard processes the forms you have selected. The three options enable you to do the following:
   - Choose to comment out invalid code. This option comments out statements such as `Load`, `Unload`, or `End` that are not supported by ActiveX documents.
   - Remove original forms after conversion. This option removes the forms from the current project after the conversion is made. Typically, you do not check this option because you want to keep your original project intact.
   - Choose whether to convert your project to an ActiveX EXE or ActiveX DLL project. The option defaults to ActiveX EXE. (ActiveX DLLs are used for creating shared components rather than applications.)

FIGURE 32.11
Select the options that are appropriate to your needs.



After you make your choices, click the Next button to proceed to the final page of the wizard.

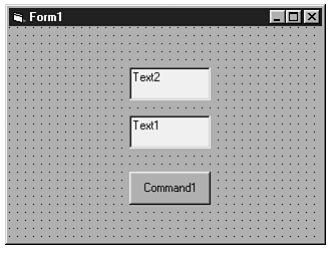
5. Choose whether you would like to see a summary report after the wizard's part in the conversion is completed. After you make your selection, click the Finish button to begin the conversion. The summary report, shown in Figure 32.12, describes which additional activities you need to perform to complete the conversion process.

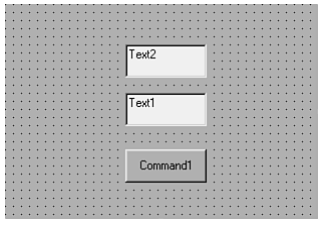
FIGURE 32.12
The ActiveX Document Migration Wizard uses a summary report to guide you through the rest of the conversion process.

Looking at the Results of the Wizard's Work

After the ActiveX Document Migration Wizard finishes its work, it places the newly created UserDocument objects in the same project as the original forms. The document source files are stored in the same folder as the original form files and are given similar names, with the appropriate extension. For example, a form stored in the file FRMTEST1.FRM would create a UserDocument stored in the file DOCTEST1.DOB. As you learned previously, the controls of the form are copied to the UserDocument, and their relative positions are preserved. Figure 32.13 shows both the original form and the resulting UserDocument.

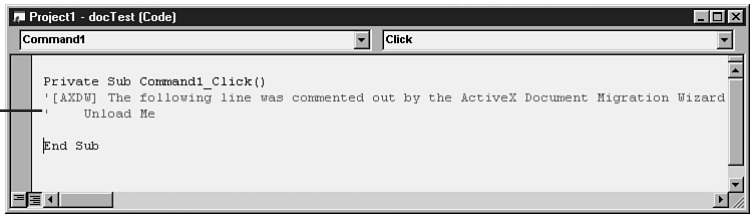
FIGURE 32.13
The UserDocument and the original form have the same user interface.





Also, as I stated previously, most of the code from your original form is copied over to the UserDocument. Invalid code is commented out and identified by the ActiveX Document Migration Wizard. (This result assumes that you chose to comment out invalid code on the Options page of the wizard.) Figure 32.14 shows an example of this process.

FIGURE 32.14
Invalid code is identified by the `[AXDW]` mark in a comment statement.



Creating a More Complex Document

Obviously, only so much room is available on a UserDocument object. Therefore, you are limited in the amount of information that can be displayed in a single document. In this regard, a single document is like an application with a single form. However, you can create additional documents as part of your project and then navigate among the various documents. You can also include standard forms in the applications that you create with ActiveX documents. In the following sections, you look at the details involved in using multiple documents and forms in your ActiveX document–based application.

Programming Additional Documents

To use additional documents in your ActiveX application, you need to create the additional documents and then provide a mechanism for moving back and forth between the documents. This process is somewhat different than moving between forms in a standard program because the UserDocument object does not support the `Load` and `Unload` statements, or the `Show` and `Hide` methods that are available to forms.

To add another document to your project, you first need to add another UserDocument object to the project. You do so by choosing Add User Document from the Project menu. This action places a second (or third, fourth, and so on) document in your project, under the UserDocuments folder. As with the first document you created, you need to specify a name for the document.

The next step requires you to draw the interface of the additional document and add the code that enables it to perform its tasks. This process is the same as the one you used to create the original document.

Now for the tricky part. Because you cannot use the `Show` method to display a document (as you can with forms), how do you get back and forth between the various documents in your application? The answer is to use the `NavigateTo` method of the Hyperlink object. The `NavigateTo` method instructs a container application to go to a particular file or URL and load the page. If the file is an ActiveX document, it gets processed just like your original page.

To move from your first document to your second, you need to run the `NavigateTo` method as shown in the following line of code:

```
Hyperlink.NavigateTo App.Path & "\docnav2.vbd"
```

The `App.Path` property specifies the path to the current document. By using this path as the basis for locating the second document, the document can be loaded without incident, provided that the documents are stored in the same directory. Figures 32.15 and 32.16 show the two pages of a sample document loaded in Internet Explorer. To get from the second document back to the first, you use the `NavigateTo` method again. For both documents, the method is used in code that responds to an event. The event is typically the `Click` event of a command button.

When you move to the second document of the application, notice that the Back button of Internet Explorer is enabled. You can use this button to move back to the first document. However, you should provide a direct link using the `NavigateTo` method because the first document may not always be the previous document in the history list. Also, if the first document has scrolled out of the history list, using the `NavigateTo` method is the only way to get to the document again.

Using and Displaying Forms from the Document

In addition to working with more than one document, you can work with standard forms in your ActiveX document applications. To use a form in a project, you create it the same way you would create a form for a standard project—draw the interface of the form and write the code to perform tasks. To display the form from your document, use the `Show` method. Then, to remove the form, use the `Unload` statement.

▶ **See** "Visual Basic Building Blocks," **p. 39**

Although forms can be part of your application, they are not handled the same way as documents. Forms are not contained within the application that contains the ActiveX document. Forms are independent of the container, as shown in Figure 32.17.

From Here...

This chapter introduced you to the world of ActiveX documents. You learned how these documents enable you to easily create applications that can run inside Internet Explorer or other ActiveX-enabled container applications. You also learned about the similarity between the UserDocument object and the forms of a standard application.

This chapter also touched on some other topics related to the creation of ActiveX documents that are covered in more detail in other chapters. To learn more about these topics, see the following chapters:

- To learn more about designing and creating forms, see Chapter 3, “Visual Basic Building Blocks.”
- To learn more about debugging your programs, see Chapter 9, “Visual Basic Programming Fundamentals.”
- To learn more about creating ActiveX controls, see Chapter 14, “Creating ActiveX Controls” and Chapter 15, “Extending ActiveX Controls.”
- To find an alternative way to create an Internet application, see Chapter 31, “Active Server Pages.”

CHAPTER 33

Visual Basic and Other Uses of the Internet

In this chapter

Adding Browser Functionality to Your Application **742**

Programming E-Mail **747**

Using the Internet Transfer Control **751**

Most chapters in the Internet portion of this book focus on how you can use Visual Basic to take Web pages beyond standard HTML. Although Web pages might be the most popular way to use the Internet, you can do a lot more with Visual Basic and the Internet, such as the following:

- Integrate the Web browser into your application
- Send and receive e-mail messages
- Transfer files with the Internet Transfer Control

Although this list in no way exhausts the ways you can use Visual Basic with the Internet, these topics are relevant and useful to many developers. This chapter provides a practical introduction to each of the topics.

Adding Browser Functionality to Your Application

Often you might want to integrate Internet browsing into an otherwise standard Visual Basic program. For example, you might provide a list of links to documentation and other support Web pages. By adding just a few lines of code, you can have your application automatically launch the user's browser and open the correct page. You can also add a browser control to your application, which allows the user to peruse Web pages inside a window contained on a Visual Basic form. Either method provides an easy way to use the functionality of a Web browser in your VB applications.

Creating a Browser on a Form

The simplest way to add the contents of a Web site to your application is to use the WebBrowser control, which is installed with Internet Explorer 4.0. First, add the control to a Standard EXE project by choosing Components from the Project menu and selecting Microsoft Internet Controls. Next, draw a WebBrowser control on a form at the size you want.

To make the WebBrowser control work, you only need to write a single line of code, as in the following example:

```
WebBrowser1.Navigate "http://www.quecorp.com/"
```

The WebBrowser control's `Navigate` method causes the WebBrowser control to connect to the specified URL and retrieve a Web page, as shown in Figure 33.1.

Because the WebBrowser is a control inside your Visual Basic program, it does not automatically contain all of the toolbars and other controls associated with Microsoft Internet Explorer. However, you can easily add your own command buttons or custom functions to make the WebBrowser control navigate to the sites you want.

FIGURE 33.1
With the WebBrowser control, you can add a live Web page to your form.

As you know, Web pages can contain graphics and other items, which can take a while to download. All of this happens asynchronously within the browser control while the rest of your VB program continues as normal. However, it would be nice to know when the Web page has been completely displayed. Notice that the sample form in Figure 33.1 includes a list box that displays the status of the browser. This was coded by using a just a few properties and events of the WebBrowser control:

- The `Busy` property is a Boolean property that is `True` if the browser is in the process of communicating with the Web server. The sample in Figure 33.1 used a Timer control to repeatedly check this property and update the list box.
- The `Stop` method is just like the Stop button on Internet Explorer. It could be used to stop the WebBrowser control from displaying the page if it is taking too long.
- The `DocumentComplete` event is fired by the WebBrowser control when the Web site is completely displayed. This event does not fire if the WebBrowser control's `Visible` property is set to `False`.

Listing 33.1 provides the code necessary to create the sample shown in Figure 33.1.

Listing 33.1 BROWSER.ZIP—Using a WebBrowser Control

```
Private Sub cmdNavigate_Click()

    WebBrowser1.Visible = False
    WebBrowser1.Navigate txtURL.Text
    tmrMain.Enabled = True

End Sub

Private Sub tmrMain_Timer()

    If WebBrowser1.Busy = True Then
        lstStatus.AddItem "Working..."
```

continues

Listing 33.1 Continued

```
    Else
        WebBrowser1.Visible = True
        tmrMain.Enabled = False
    End If

End Sub

Private Sub WebBrowser1_DocumentComplete(ByVal pDisp As Object, URL As Variant)

    lstStatus.AddItem "Document display completed."

End Sub
```

Launching the Browser from Your Application

In addition to using the WebBrowser control, you can launch the Web browser as a separate program. This allows the user more freedom because he can resize the browser window and use all of its built-in features. An additional advantage is that you do not have to take up screen real estate on your own forms with an embedded browser control.

Creating an Internet Shortcut The first step to launching Web sites from an application is to understand the simple concept of an URL (Uniform Resource Locator) file, also known as an Internet shortcut. Internet shortcuts are like regular Windows shortcuts, but they point to a Web site rather than an executable file. Double-clicking an Internet shortcut opens your browser and navigates to the Web site represented by the shortcut.

An Internet shortcut is just a plain text file (actually it's an INI file) containing the URL of the Web site. The structure is as follows:

```
[InternetShortcut]
URL=http://www.que.com/
```

The Favorites list in Microsoft Internet Explorer is actually just a bunch of URL files. If you find the Favorites directory on your hard drive, you should be able to see these .URL files. Because the structure of a URL file is so simple, it is very easy to create one from Visual Basic. You can use the INI file functions discussed in Chapter 21, "Working with Files," or just create a standard text file:

```
Open "C:\TEMP.URL" For Output As #1
Print #1, "[InternetShortcut]"
Print #1, "URL=http://www.somewhere.com"
Close #1
```

These four lines of code create an Internet shortcut called TEMP.URL. After it's created, you should be able to click the shortcut icon to launch a Web site.

▶ **See** "Using INI Files," **p. xxx** (Ch 21)

Launching an Internet Shortcut There are a couple of ways to launch an Internet shortcut from Visual Basic. You can use an API call or shell out to another program, which opens the browser for you.

The Windows API call `ShellExecute` executes the program associated with the .URL extension. If everything has been set up properly, the associated program should be your default browser. As with all API calls, you first have to declare them.

▶ **See** "Using API Calls in Visual Basic," **p. 452**

The following code segment launches the site using the `ShellExecute` API and the file C:\TEMP.URL:

```
Const SW_SHOWNORMAL = 1
Dim lRetVal As Long 'RETURN VALUE
Dim lWindow As Long 'BROWSER HWND
lRetVal = ShellExecute(lWindow, "open", "C:\Temp.URL", "", "", SW_SHOWNORMAL)
```

NOTE `ShellExecute` and `FindExecutable` are API calls that can be used to determine which program is associated with a certain file extension and then launch the program. They are not limited to use with Internet shortcuts, which is why many of the parameters in the example are left blank. ■

Using the `ShellExecute` API to launch a Web site is easy, but there is even an easier method. Windows has a program called RUNDLL32.EXE, which is used to call functions in a DLL. To demonstrate, go to an MS-DOS Window (or the Start menu, Run prompt) and enter the following command line:

```
rundll32.exe shdocvw.dll,OpenURL c:\temp.url
```

This command has the same effect as double-clicking the Internet shortcut file. You can easily use Visual Basic's `Shell` function to call the command from code:

```
Shell "rundll32.exe shdocvw.dll,OpenURL c:\temp.url", vbNormalFocus
```

Although the API method seems like a more elegant solution, using RUNDLL32 works just as well. As a matter of fact, if you examine the `InternetShortcut` key in the Windows Registry (under `HKEY_CLASSES_ROOT`), you'll find that this is exactly how Windows launches Internet shortcuts.

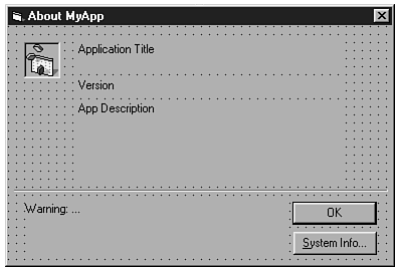
An Enhanced About Box To demonstrate how launching a Web site can work, we will create an About box with a Web site link. An About Box is a form (usually accessed through the About menu) that displays information about your program. Visual Basic includes an About box template, which is the basis for our project.

Follow these steps to create the About box example:

1. Create a new Standard EXE project in Visual Basic.
2. Click the Add Form button, or choose Project, Add Form. The Add Form dialog box appears.

3. Select About dialog and click Open. A new form should be added to your program that looks like the one shown in Figure 33.2.

FIGURE 33.2
Visual Basic includes a standard About Box form.



4. Decrease the size of the App Description label, `lblDescription`, so that you can fit an additional Label control on the form. (Changing the `Height` property to about 550 should do it for this example.)
5. Draw the new Label control beneath `lblDescription` and call it `lblURL`.
6. Open the Properties window for `lblURL` and make the following changes:
   - Set the `ForeColor` property to light blue.
   - Open the Font dialog box and turn on the `Underline` property.
   - Set the `Caption` property to the URL of a Web site—`www.quecorp.com` for this example.

   After you perform the preceding steps, your label should look like an Internet hyperlink.
7. Add the code shown in Listing 33.2 in the label's `Click` event. This code opens the URL.

Listing 33.2 INETDEMO.ZIP—Launching a Web Site from a Form

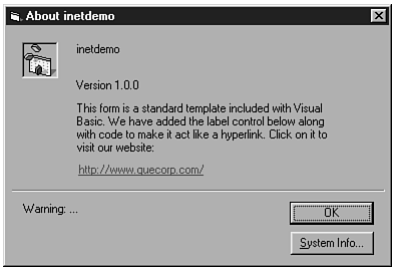
```
Private Sub lblURL_Click()
    Dim nFile As Integer

    'WRITE A TEMP URL FILE
    nFile = FreeFile
    Open App.Path & "\TEMP.URL" For Output As #nFile
    Print #nFile, "[InternetShortcut]"
    Print #nFile, "URL=" & lblURL.Caption
    Close #nFile

    'LAUNCH THE BROWSER
    Shell "rundll32.exe shdocvw.dll,OpenURL " & App.Path & "\temp.url", _
           vbNormalFocus

    'DELETE THE TEMP FILE
    Kill App.Path & "\TEMP.URL"

End Sub
```

To test this program, you need to display the About form and click the URL. Traditionally, an About box is displayed when the user selects the About menu item. However, for testing purposes, you can put the following statement in the `Load` event of `Form1`:

```
frmAbout.Show
```

The enhanced About box is shown in Figure 33.3.

FIGURE 33.3
A properly formatted label control acts as a "fake" hyperlink.



Programming E-Mail

It seems as though almost everyone these days has an e-mail address. Although e-mail is ideal for the type of personal communications used in regular mail, it has the added benefit of being able to transfer files and other information. For example, a Visual Basic program where I work pulls information from a database, stores it in a spreadsheet, and then sends the spreadsheet to the appropriate people. All of this happens automatically every morning without any human intervention. To perform such automation tasks, you need a method of interacting with e-mail from Visual Basic.

One such method is OLE Messaging (also known as Microsoft Active Messaging and Collaboration Data Objects). OLE Messaging is an object-oriented interface to Windows Messaging. When you install some versions of Microsoft Outlook or Exchange, a file called OLEMSG32.DLL is installed in your Windows System directory.

NOTE The e-mail tools included with Visual Basic are the MAPI controls and the MAPI API. These are still available, but they are not as easy to use as OLE Messaging.

To use OLE Messaging, you have to add a reference to this DLL by selecting the Active Messaging Object Library on the References dialog box (choose Properties, References) as shown in Figure 33.4.

After adding the reference, press F2 to bring up Visual Basic's Object Browser. You can view all of the objects, properties, and methods included with the reference.

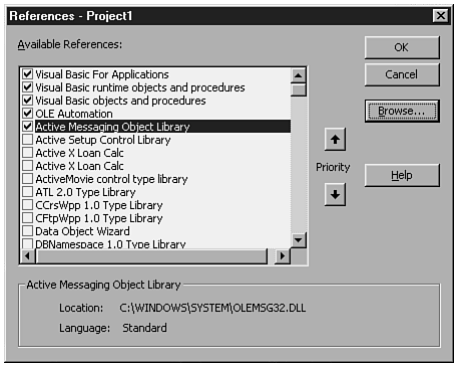


FIGURE 33.4
To use Active Messaging, you must have OLEMSG32.DLL installed on your system.

ON THE WEB

The examples in this section were created using Microsoft Outlook. Documentation for Active Messaging is available on Microsoft's Web site:

`www.microsoft.com/ithome/resource/exchange/active/default.htm`

Microsoft also has expanded Active Messaging functionality in Microsoft Exchange Server 5.5 well beyond messaging and has renamed it *Collaboration Data Objects* (*CDO*). For more information, visit the following Web site:

`www.microsoft.com/exchange/guide/papers/cdo.asp`

Logging on to E-Mail

The first step in working with e-mail from Visual Basic is to start a messaging *session*. The session represents a connection between your Visual Basic program and the e-mail system. To start a session, you have to create a new session object and then call the `Logon` method, as in the following example:

```
Dim objSession As Object
Set objSession = CreateObject("MAPI.Session")
objSession.Logon
```

When you start Microsoft Exchange or Outlook interactively, you might have to enter a user name, profile name, or password, depending on how your PC is configured. In the previous code example, we did not provide any of these parameters, so executing these statements would cause the e-mail system to prompt for any necessary logon information.

To create any kind of automated e-mail processing program, you need to avoid having dialog boxes appear. To do this, you must provide additional parameters to the `Logon` method:

```
objSession.Logon "Your Profile Name", , False, False
```

The first two parameters in the previous line of code are the profile name and profile password. If your profile is set up so that it does not need a password, you can leave the password parameter blank, as in the example.

NOTE You can create a profile in the Mail and Fax Control Panel applet or from the Tools, Services menu in Outlook.

The third parameter, `ShowDiag`, is a boolean value which determines whether any dialog boxes should be shown during e-mail logon. If this parameter is set to `True`, the user will see the logon prompt even if you have provided all of the necessary parameters. For automatic, unattended logon, you need to set this property to `False`.

The final optional parameter, `NewSession`, determines whether a new session is created during the logon process even if one already exists. By setting this parameter to `False`, you can cause Active Messaging to share an existing e-mail session. In other words, if you already have Outlook open, then Active Messaging does not have to repeat the logon process.

Sending a Message

The great thing about Active Messaging is that messages and other objects are represented using the familiar collections syntax. We have already discussed collections in several other chapters, so you should be familiar with adding and removing objects in a collection. As with many other collections, the collection's `Add` method can be used to create objects in two ways: to return an object reference or with parameters specifying object properties.

▶ **See** "Creating Classes That Contain Collections," **p. 373**

To send a message with Active Messaging, you need to perform the following steps:

1. Add a new Message object to the Messages collection of the Inbox.
2. Set the message text, subject, and add files to the `Attachments` collection.
3. Add the recipients' names (and/or addresses) to the `Recipients` collection.
4. Resolve recipients' names to determine their actual addresses.
5. Call the `Send` method to send the message.

The code to perform all of the preceding steps is both short and easy to understand:

```
' ... Assume we have already logged on

    'Add a new message to the Inbox
    Set objMessage = objSession.Inbox.Messages.Add

    'Set the subject and body text
    objMessage.Subject = "Test Message"
    objMessage.Text = "This is a test, repeat only a test message!"

    'Add an attachment
    objMessage.Attachments.Add "Monthly Report", , ActMsgFileData, _
          "C:\MyReport.XLS"

    'Add a recipient to the list
    objMessage.Recipients.Add "bsiler@bigfoot.com", , ActMsgTo
    objMessage.Recipients.Resolve
```

```
'Send The Message
objMessage.Send
```

As you can see from the example, Active Messaging uses collections to manage `Message`, `Recipient`, and `Attachment` objects. The code sample first sets up a new `Message` object and then invokes the `Send` method to send the message. All of the methods and properties of these objects are listed in the OLEMSG32.DLL file and can be viewed in the Object Browser.

The only thing that might be somewhat confusing is the concept of resolving the recipient names. In your e-mail system you have an address book. Resolving simply means taking a friendly name from the address book (for example, "Dad at Work") and converting it to the actual address that the e-mail server uses (`SMTP:jsmith@somewhere.com`).

Accessing the Contents of a Message

We have just seen how to send an e-mail message with Active Messaging. You can also use the `Messages` collection to access unread (or read) messages with Visual Basic code. One possible use for this feature would be to send out an e-mail with a specific subject and then have a program automate replies to the e-mail or store the responses in a database. For example, consider the following code:

```
For Each objMessage In objSession.Inbox.Messages
   If objMessage.Unread = True Then
       If Instr(objMessage.Subject, "Catalog Request") Then
              ProcessMessage objMessage.Text
       End If
   End If
Next objMessage
```

The sample code uses a `For Each` loop to iterate through each message in the `Messages` collection. If a message has not been read (indicated by the `Unread` property) and the subject contains some specific words, a user-defined function `ProcessMessage` is called. The `ProcessMessage` function, which accepts the message text as a parameter, can do any number of things with the message, including initiate a reply or add the contents of the message to a database table.

Working with e-mail messages is easy, because each message is represented as an independent object with properties and methods. You can use a `For Each` loop to browse the `Messages` collection and process them as desired. The following few lines of code print the subjects of all unread messages that were sent after 7/4/1998:

```
For Each objMessage In objSession.Inbox.Messages
        If objMessage.Unread = True And objMessage.Submitted = False Then
           If objMessage.TimeSent >= "7/4/98" Then
                 Debug.Print objMessage.Sender, objMessage.Subject
           End If
       End If
Next objMessage
```

The code sample uses a series of `If` statements to determine if the current message is unread, has been submitted, and has been sent on or later than July 4, 1998.

TIP Using an interface such as Active Messaging might make your program more error prone because of the uncontrollable user interaction. For this reason, I suggest creating user-defined functions with error handling for each task you want to perform (logging on, sending a message, and so on).

In this section, we have given you a glimpse into the Active Messaging Library. To discover the full list of available properties and methods, use Visual Basic's Object Browser or see the help file ACTMSG.HLP included in the download file.

Using the Internet Transfer Control

Another Internet feature of Visual Basic is the Internet Transfer control. This control allows you to establish a connection to another computer and transfer files. It is Microsoft's attempt to make it easy to use two Internet protocols: HTTP and FTP. HTTP, or Hypertext Transfer Protocol, is the means by which a Web browser communicates with a Web server. If you have transferred information across the Internet, you may already be familiar with the File Transfer Protocol (FTP). In this section, we'll look at a sample use of both protocols.

Retrieving HTML

When you access a Web page normally, the browser uses the `GET` command (defined by the HTTP protocol) to ask the Web server for a document. For example, if you open the URL `http://www.food.com/peanuts.html`, the browser establishes a connection with the machine at the address `www.food.com` and then sends the command `GET /peanuts.html`. The HTML is returned to the browser over the connection as plain text, and the browser uses its own logic to parse and format it appropriately.

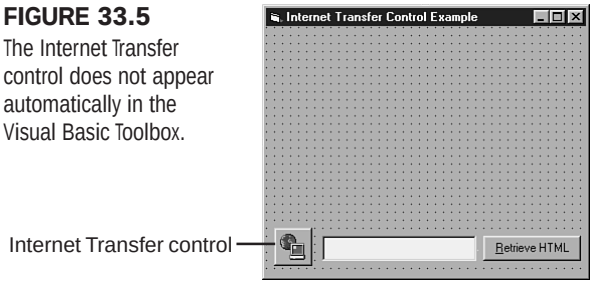
When you use the Internet Transfer control with the HTTP protocol, you can retrieve HTML for processing by your own program. For example, you could periodically query a Web site for stock information. Your VB program could then save the stock information in a SQL database for other users to view. In other words, the Internet Transfer control can be used to automatically collect data from a Web site.

As an example, we will use the Internet Transfer control to retrieve HTML and print it on a form. To create the sample project, perform the following steps:

1. Open Visual Basic and create a new Standard EXE project.
2. Display the Project Components dialog box and add a reference to Microsoft Internet Transfer Control 6.0.
3. Draw an instance of the Internet Transfer control on the form. Note that this control will appear as an icon no matter how large you draw it.
4. Add a text box named `txtURL` and a command button named `cmdRetrieve`.

After completing these steps, your form should look like the one shown in Figure 33.5. You are now ready to add code to the sample project.

FIGURE 33.5
The Internet Transfer control does not appear automatically in the Visual Basic Toolbox.



The Internet Transfer control has one event, the `StateChanged` event. The purpose of this event is to notify your program when different activities are happening. For example, the control is in one state when it is connecting to the Web server and in another when it is retrieving HTML. The current state is indicated by the `State` parameter of the event procedure. Enter the code for our sample program's `StateChanged` event, which is shown in Listing 33.3.

Listing 33.3 INETDEMO.ZIP— Retrieving Raw HTML from a Web Server

```
Private Sub Inet1_StateChanged(ByVal State As Integer)

    Select Case State

        Case 12 'icResponseCompleted
            stemp = Inet1.GetChunk(100)
            While stemp <> ""
                Me.Print stemp;
                stemp = Inet1.GetChunk(100)
            Wend
            Me.Print

        Case 11 'icError
            MsgBox Inet1.ResponseInfo, vbCritical, "ERROR!"

    End Select

End Sub
```

Our code only handles two states, the `icResponseCompleted` state and the error state. The `icResponseCompleted` state indicates that the control has finished receiving a response from the Web server. The Internet Transfer control's `GetChunk` method is used to retrieve the response text from the buffer 100 bytes at a time and print it on the form.

NOTE A complete list of states and their meanings is in the online documentation article entitled "StateChanged Event."

Although the `StateChanged` event contains the main portion of code for this sample program, you still need to add code to the `Click` event of `cmdRetrieve` to initiate the request. The code in Listing 33.4, uses the `Execute` method of the Internet Transfer control to issue an HTTP command.

Listing 33.4 INETDEMO.ZIP—The *Execute* Method

```
Private Sub cmdRetrieve_Click()

    Inet1.protocol = icHTTP
    Inet1.Execute CStr(txtURL), "GET /"

    While Inet1.StillExecuting
        DoEvents
    Wend

    MsgBox "Done!"

End Sub
```

After entering the code in Listing 33.4, run the program and enter a test URL in the text box. Click the button and the HTML should be displayed on the form, as shown in Figure 33.6.

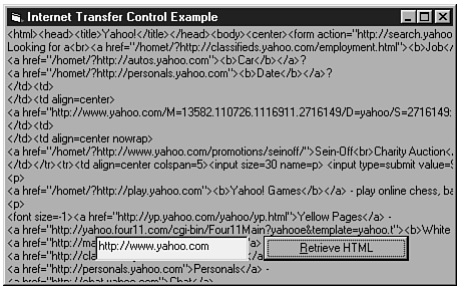


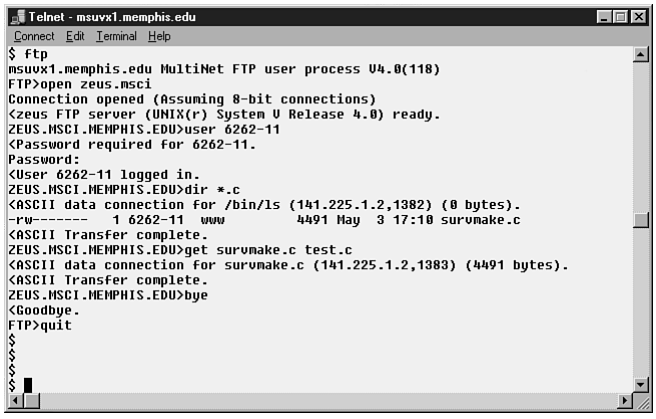
FIGURE 33.6
The Internet Transfer control can be used to retrieve HTML from a Web site.

In our sample program, we just printed the results on the form. To work with the HTML as a string, you need to store it in a string variable or label control. When the download is complete, you can easily search the HTML for the information you want using standard string functions.

Transferring Files

FTP, the Internet's File Transfer Protocol, has been around a lot longer than the World Wide Web. As with the Web, FTP involves both a client and a server machine. Although in recent years FTP clients have become graphical, the standard implementation of the FTP client is text based, like the one shown in Figure 33.7.

FIGURE 33.7
A sample FTP session on the Vax VMS system.



If you have used a DOS prompt, then you can understand how FTP works. FTP allows you to change the current directory, display a file list, and copy files—just like you would at a DOS prompt. The major difference is that you are browsing a directory structure on a remote machine. The commands are also slightly different. FTP's `get` and `put` commands are used to retrieve and send files to and from the remote machine.

Because FTP is a standard protocol used on many platforms (UNIX, Windows, AS/400, and so on), it is ideal for transferring data between machines. The Internet Transfer control provides an easy way to do this from Visual Basic. In this section, we will create a simple program that retrieves a file from an FTP server.

To begin, let's build on the example from the previous section. Create the sample project as described, adding an additional command button, `cmdGetFile`. The code for `cmdGetFile` is shown in Listing 33.5.

Listing 33.5 INETDEMO.ZIP—Using FTP with the Internet Transfer Control

```
Private Sub cmdGetFile_Click()
    Me.Cls
    Inet1.protocol = icFTP
    Inet1.UserName = "anonymous"
    Inet1.Password = "guest@"
    Inet1.Execute "ftp.microsoft.com", "pwd"
    While Inet1.StillExecuting
        DoEvents
    Wend

    Inet1.Execute , "dir *.txt"
    While Inet1.StillExecuting
        DoEvents
    Wend

    Inet1.Execute , "GET dirmap.txt c:\dirmap.txt"
    While Inet1.StillExecuting
```

```
        DoEvents
    Wend

    MsgBox "Done!"

End Sub
```

The code in Listing 33.5 uses the Internet Transfer control to perform three FTP commands:

- `pwd`—Prints the current working directory on the remote machine
- `dir`—Lists files on the remote machine
- `get`—Downloads a file from the remote machine to the client machine

Notice that after each of these commands we use a `While` loop to determine if the Internet control has finished executing the command before attempting to executing a new command. The code in the `StateChanged` event should cause the responses from the `pwd` and `dir` commands to be printed on the form. The final command, `get`, transfers a text file from the FTP server to the local hard drive. This example could be used for performing automated data retrieval from a remote system, or pulling a daily weather map or other image from your favorite Web site.

From Here...

In this chapter, we have given you a small taste of a few Internet topics outside of the usual Web arena. The best place to learn about the Internet is of course on the Internet, but if you want to find out more about the Visual Basic concepts used in this chapter see the following other chapters:

- If you want to learn the basics of using the Windows API, see Chapter 20, “Accessing the Windows API.”
- To learn more about INI and text files, see Chapter 21, “Working with Files.”
- To find out about controlling other OLE interfaces like Active Messaging, see Chapter 22, “Using OLE to Control Other Applications.”

PART VIII

Appendixes

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APPENDIX A

Introduction to the Development Environment

In this chapter

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Visual Basic's *Integrated Development Environment* (*IDE*), which is the interface of Visual Basic itself, contains a number of tools that you can use as you develop your applications. The IDE underwent a major overhaul between versions 4.0 and 5.0 of Visual Basic; however, the interface for Visual Basic 6.0 is much the same as its predecessor. In this appendix, you'll take a quick look around the interface and learn about some of its features.

Understanding the Environment's Key Features

Since version 5.0, Visual Basic has sported a Multiple Document Interface (MDI) environment. If you are unfamiliar with MDI, you can compare it to having multiple documents open in Microsoft Word. Each document is contained in a child window, which is, in turn, contained within the main parent window. As with other MDI applications, such as Word or Excel, you can choose to have the child document fill the whole window or have multiple windows visible simultaneously.

TIP If you are not already using a big monitor (17 inches or larger) at high resolution, get one. You need a lot of screen space to use Visual Basic's interface most effectively. I recommend a screen resolution of 800×600 as a minimum, or 1024×768 if your video card (and eyes) can support it.

You can edit more than one project in the same Visual Basic session. Therefore, you don't have to close one project in order to open and make changes to another. This capability is convenient if you are developing projects that interact with each other because you can save and compile all projects in a group with a single menu option.

Another relatively new feature is dockable toolbars and windows. Now a window can be floating in the middle of the screen or docked along one of the edges. Dockable windows include the toolbars and windows with small title bars, such as the Toolbox.

In addition to the window management enhancements, Visual Basic offers some useful tools to make code entry easier. Microsoft calls them *Auto List Member* and *Auto Quick Info*; you will call them *fantastic*. If you have trouble remembering, for example, MessageBox constants, control properties, or even the parameters to your own functions, the code editor assists you with completing the information automatically while you type. For example, as soon as you press the Spacebar after a `MsgBox` function call, you are presented with the parameters in a ToolTip-like format with a drop-down box of the available constants.

TIP When you are presented with the drop-down box mentioned in the preceding paragraph, you don't have to use the mouse to select an item. Just keep typing (or use the arrow keys) until the list item you want is highlighted; then press the spacebar, comma (,), Enter, or Tab, and continue with your program.

Starting Up

When you start Visual Basic, you see the New Project dialog box, shown in Figure A.1. This dialog box has the following three tabs:

- **New.** Lets you choose one of several types of projects to create.
- **Existing.** Allows you to browse for a project that's already been created and saved.
- **Recent.** Presents you with a list of projects that have been worked on previously. The most recent projects are listed first.

FIGURE A.1
The New Project dialog box's New tab lets you select from several types of projects to create.

NOTE There is another version of the New Project dialog box. You'll see this version when Visual Basic is already running and you select File, New Project from the menu system. This version of the New Project dialog box is similar to the one pictured in Figure A.1, but does not have the Existing and Recent tabs.

If you choose to create a new project, Visual Basic creates the appropriate project template for you, based on your selection from the New Project dialog box. You can choose to create one of these project types:

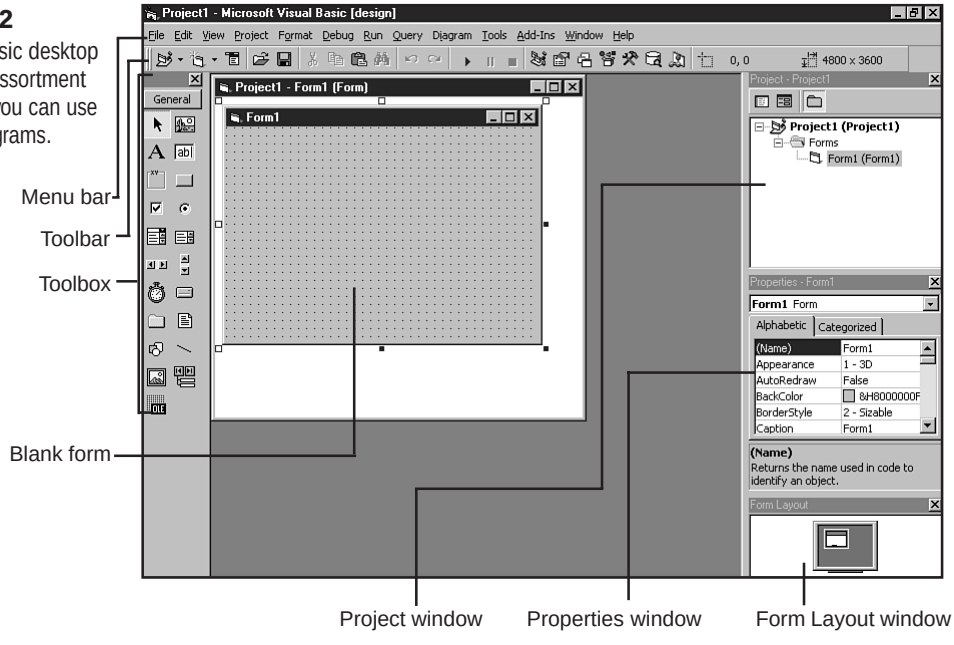
- **Standard EXE.** You use this type of project to create a standard Windows program (EXE file). You will probably use this type of project most often.
- **ActiveX EXE.** This automation server performs tasks as part of a multiple-tier application. The end result is a program that contains public classes that can be accessed by other programs or can run by itself. This server previously was called an *OLE automation server*.
- **ActiveX DLL.** This remote automation program is created as a DLL. ActiveX DLLs cannot run alone; however, because an ActiveX DLL runs in-process, it is faster than an out-of-process ActiveX EXE.
- **ActiveX Control.** With this option, you can create your own custom controls (OCXs). You can use them in your Visual Basic programs or in any ActiveX-capable application.

- **VB Application Wizard.** If you want something quick and generic, this option builds the skeleton of an application (similar to a word processor template). You can then customize the application to suit your needs.
- **Data Project.** This type of project includes the shell of a data-enabled application. You can customize the components to quickly develop a program that works with databases.
- **IIS Application.** This option creates a project that can be used in conjunction with Windows NT's Internet Information Server (IIS) to run in a Web-based environment.
- **Add-in.** This type of program provides additional functionality to Visual Basic itself. An example of an add-in is the Visual Data Manager.
- **ActiveX Document DLL.** This type of project creates a DLL that can be used by applications running within Microsoft Internet Explorer.
- **ActiveX Document EXE.** This type of project creates an application that can run inside Microsoft Internet Explorer.
- **DHTML Application.** This option creates the framework of a Dynamic HTML application, which can be run in a Web browser.

The Visual Basic Work Area

After you select the project type from the New Project dialog box, you are presented with the design environment. Here you do the work of actually creating your masterpiece application. The basic design environment is shown in Figure A.2. Visual Basic probably looked like this figure when you started it for the first time.

FIGURE A.2
The Visual Basic desktop provides an assortment of tools that you can use to create programs.



As you can see, Visual Basic shares a lot of elements with other Windows programs. The toolbars and menus look similar to those in Office 97. A few of the menu items are the same: File, Edit, Help, and others.

Using the Menu Bar

Many programmers want to find quick keyboard shortcuts for frequently used tasks. As with other Windows programs, the menus at the top of the Visual Basic screen can be displayed by holding down the Alt key while pressing the appropriate underlined character in the menu bar. After the initial menu is displayed, you can simply press the underlined character of a menu item to select it. For example, press Alt+F to open the File menu, and then press P to choose the Print command.

Visual Basic also offers several shortcut keys that let you bypass the menu entirely. Most of them are listed to the right of their respective menu items. For example, in the View menu, you might notice F2 to the right of Object Browser. This means that you can see the Object Browser by pressing F2. Although I have listed some quick shortcuts in Table A.1, a quick perusal of the menus would definitely be worth your while.

Table A.1 Shortcut Keys

Menu Item	Shortcut Key	Description
Edit, Cut	Ctrl+X	Removes the selected text or control from its current location and copies it to the Clipboard.
Edit, Copy	Ctrl+C	Makes a copy of the selected text or control on the Clipboard, but does not remove it from its original location.
Edit, Paste	Ctrl+V	Pastes the contents of the Clipboard to the active form or code window.
Edit, Undo	Ctrl+Z	Undoes the last change.
Edit, Find	Ctrl+F	Finds a piece of text. (You must be in an edit window to use this command.)
File, Open	Ctrl+O	Opens a project.
File, Save	Ctrl+S	Saves the current file.
File, Print	Ctrl+P	Displays the Print dialog box, from which you can print the current form or module or the entire application.
View, Project Explorer	Ctrl+R	Shows the Project Explorer window (if it's not already displayed).
View, Properties Window	F4	Shows the Properties window (if it's not already displayed).

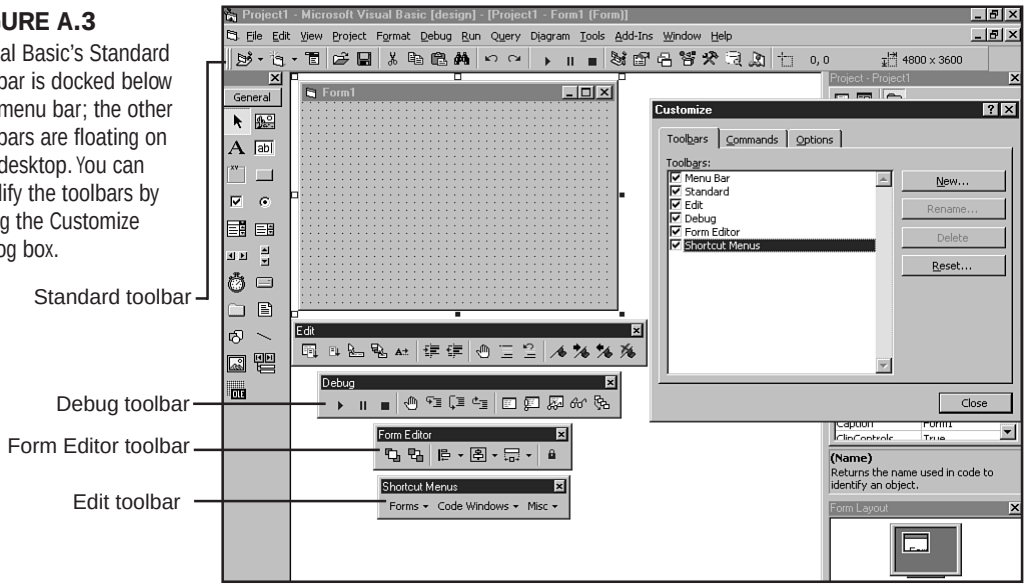
TIP Experimentation is encouraged. In addition to the preceding list, Visual Basic includes some not-so-obvious tricks such as Ctrl+Y (to delete a line of code), which is apparently an homage to WordStar.

Accessing Functions with the Toolbars

Visual Basic's *toolbars* provide you with quick access to some of the functions you will use most often. Four toolbars are available (see Figure A.3):

- **Standard.** The Standard toolbar is displayed by default and offers quick access to frequently used functions.
- **Debug.** The Debug toolbar has buttons for use when you're debugging your programs.
- **Edit.** The Edit toolbar's buttons are handy when you're writing code.
- **Form Editor.** The Form Editor toolbar contains buttons that help you tweak the appearance of controls on your forms.

FIGURE A.3
Visual Basic's Standard toolbar is docked below the menu bar; the other toolbars are floating on the desktop. You can modify the toolbars by using the Customize dialog box.



The Standard toolbar is the only one displayed the first time you start Visual Basic. You can specify which toolbars are displayed by choosing View, Toolbars or by right-clicking any visible toolbar. Any of them can be free-floating or "docked" just below the menu bar; their startup positions will be the same as the last time you exited Visual Basic. Choosing View, Toolbars, Customize allows you to modify the existing toolbars, or even create your own.

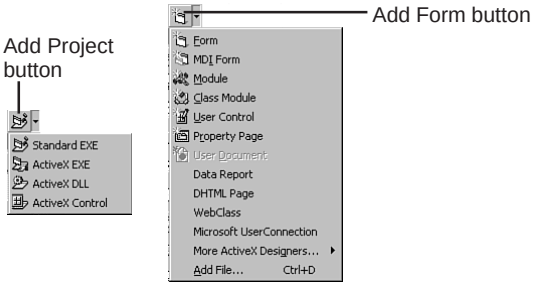
Visual Basic's toolbars follow the standard used by the latest generation of programs in that they provide you with *ToolTips*. A ToolTip is a little yellow box that pops up if you let the mouse pointer hover over a button for a few seconds; it contains a description of the underlying button's function.

TIP ToolTips can also display the value of a variable in a code window. Use this feature by letting the mouse pointer hover over a variable name while in break mode. This feature is a real time-saver if you are used to setting up a watch or printing values in the Immediate window.

Display all the toolbars as explained in the preceding paragraph, and move the pointer over the buttons to familiarize yourself with them. Remember that you can always use the ToolTip feature when you're unsure which button is which.

Two of these buttons require special attention. The Add Project button and the Add Form button both invoke drop-down lists of items (see Figure A.4). If you select one of these items, the default item for the button changes to the type of item that you selected.

FIGURE A.4
Drop-down buttons allow you to specify the type of project or file to be added.



The Add Project button allows you to add a project to the desktop. It can be one of the following four types:

- Standard EXE
- ActiveX EXE
- ActiveX DLL
- ActiveX Control

The Add Form button lets you add any of the following pieces to your current project:

- Form
- MDI form
- Module
- Class module
- User control
- Property page
- Existing files

You learn about most of the other buttons on the toolbar a little later. However, two special areas on the toolbar deserve mentioning. At the far right of the toolbar are two blocks, with each containing a pair of numbers. These two blocks show the position and size of the form or

control with which you are working. The two numbers in the first block indicate the horizontal and vertical positions, respectively, of the upper-left corner of the current object, as measured from the upper-left corner of the screen (if the current object is a form), or of the current form (if the current object is a control). The two numbers in the second block show the horizontal and vertical dimensions, respectively, of the current object. These numbers are not visible, however, when you are editing in a code window.

NOTE Both the position and dimension information are given in *twips*. A twip is a unit of measure that Visual Basic uses to ensure that placement and sizing of objects is consistent on different types of screens. A twip is equal to 1/20 of a printer's point; approximately 1,440 twips make up a logical inch (the amount of screen space that would take up one inch when printed).

Let me add one final note about the toolbars. If you don't like having them located at the top of the screen, you can move any of them by clicking the double bars at the left edge and dragging to a new location. You can park a toolbar against any other edge of the desktop or leave them floating in the middle, as shown in Figure A.5.

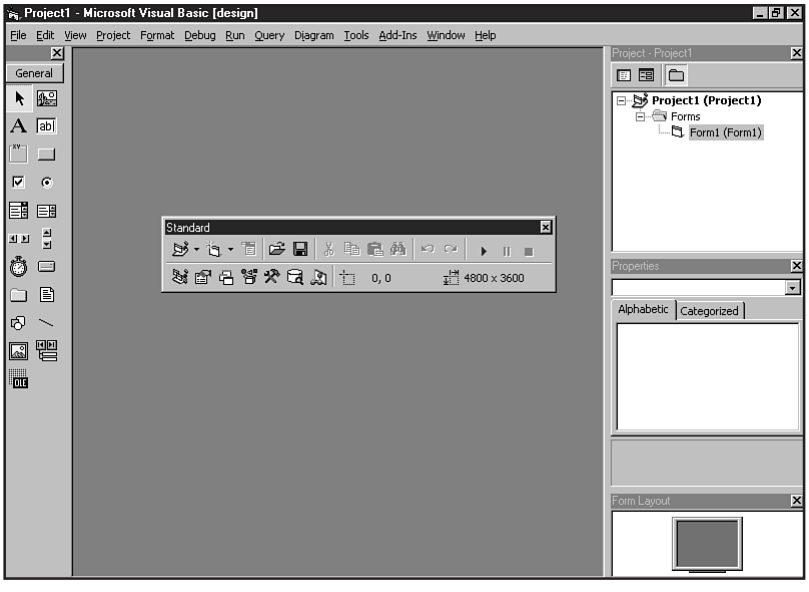


FIGURE A.5
Even the standard toolbar can float freely on the desktop.

Organizing Visual Basic's Controls

The controls that are used in Visual Basic are the heart and soul of the programs that you create. The controls allow you to add functionality to your program quickly and easily. You can find controls that allow you to edit text, connect to a database, retrieve file information from a user, or display and edit pictures.

Obviously, with all these controls available, you need a way to keep them organized. This is the function of the *Toolbox* (see Figure A.6). This Toolbox contains buttons representing the controls that are available for use in your program. (A list of the basic set of Visual Basic 6 controls is contained in Table A.2.) Clicking one of the control "tools" allows you to draw a control of that type on a form. Double-clicking a tool places a default-sized control of that type in the center of the current form. Clicking the Pointer tool in the upper-left of the Toolbox cancels a pending control-drawing function and restores the mouse pointer's normal functionality.

FIGURE A.6
The basic control set is available when you first start Visual Basic. The Toolbox can be moved around onscreen to a location that is convenient for you.

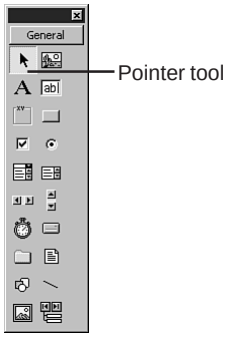


Table A.2 Standard Visual Basic Controls

Control Name	Function
PictureBox	Displays a graphic image.
Label	Displays text that the users cannot directly modify.
TextBox	Displays text that the users can edit.
Frame	Provides a method for grouping controls. (To group controls in a frame, select the frame with a single-click first; then draw a control in it.)
CommandButton	Allows the users to initiate a program action. Can include an icon, caption, and ToolTips.
CheckBox	Displays or allows input of a two-part choice, such as Yes/No or True/False.
OptionButton	Displays or allows a choice among multiple items. (Also known as a radio button.)
ComboBox	Allows the users to select an entry from a list or enter a new value.

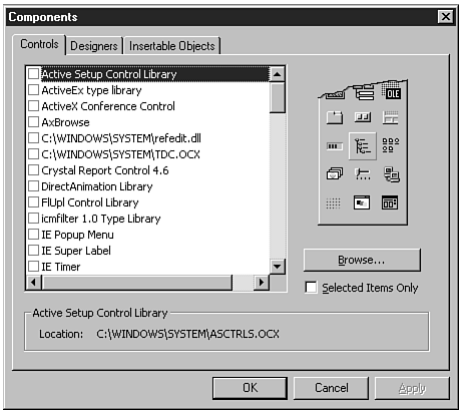
continues

Table A.2 Continued

Control Name	Function
ListBox	Displays a list of items from which the users can select one or more entries.
HscrollBar (Horizontal Scrollbar)	Produces a numerical value based on the scrollbar's horizontal position.
VscrollBar (Vertical Scrollbar)	Same as above but vertical. Note the scrollbars behave like standard Windows scrollbars.
Timer	Provides a means for an action to be taken after passage of a certain amount of time.
DriveListBox	Displays and allows users to choose from available disk drives on the computer.
Dir ListBox	Displays and allows users to choose from available subdirectories on a drive.
FileListBox	Displays and allows users to choose from available files in a directory.
Shape	Displays geometric shapes on the form.
Line	Displays lines on the form.
Image	Displays a graphic image. Similar in appearance to the picture control but different functionality.
Data	Provides a link to database files.
OLE	Provides a way to link to OLE servers.

You can add other controls to the Toolbox by choosing Project, Components. This action brings up the Components dialog box (see Figure A.7). In this dialog box, you can choose any additional controls (OCXs) that have been installed on your system. If you choose to add a control to the Toolbox, it appears in the Toolbox after you click the OK or Apply button.

FIGURE A.7
You can add controls to the Toolbox by using the Components dialog box.



TIP You can also access the Components dialog box by right-clicking the Toolbox and then selecting the Components item from the pop-up context-sensitive menu.

By default, all the components for your project appear in the Toolbox in one big group. However, if you use a lot of controls, managing all of them can be very difficult. To help with this problem, Visual Basic allows you to add tabs to the Toolbox. (It has one tab, General, by default.) To add a tab, right-click the Toolbox, select Add Tab from the pop-up context-sensitive menu, and give the new tab a name. You can then move controls from one tab to another and group your controls in the way that is most convenient to you. Figure A.8 shows the Toolbox with a Grid Controls tab added to it.

FIGURE A.8
A handy feature in Visual Basic 6 enables you to group control tools using custom tabs in the Toolbox.

The Canvas of Your Programs

The windows you design in your Visual Basic programs are known as *forms*. You can think of the form as an artist's canvas. You use elements in the Toolbox to "draw" your user interface on a form.

The form is part of the desktop and is your primary work area for creating the user interface. If you look closely at the form in Figure A.9, you might notice that the form has dots on it. These dots form a grid whose purpose is to help you position controls on the form; it is invisible when your program is running. You can control the spacing of the grid dots by choosing Tools, Options and selecting the appropriate options on the General tab of the resulting dialog box. You can also choose not to display the grid at all. The default grid is 120 by 120 twips. I prefer to make the grid smaller (60 by 60 twips), which allows me more precise control over the placement of objects on my form. This tighter grid is illustrated in Figure A.10.

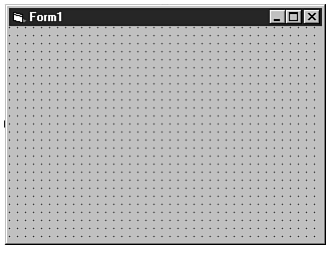


FIGURE A.9
When you are designing a form in Visual Basic, a grid is available to help you easily line up controls.

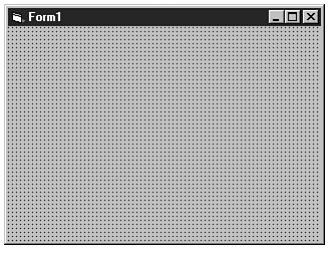


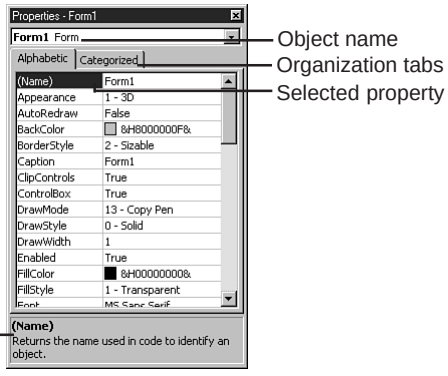
FIGURE A.10
Making the grid smaller gives you tighter control over the way objects are placed on your forms.

Controlling Your Forms and Controls

The *Properties window* is an important part of the Visual Basic desktop. It shows all the available properties for the currently selected form, control, or module (see Figure A.11). If the Properties window isn't visible, first select the object(s) whose properties you want to view or change, and then press F4. You can also view this window by choosing View, Properties Windows, or by right-clicking an object and choosing Properties from the context-sensitive menu that pops up.

Properties determine how a form or control looks and how it behaves in a program. The Properties window lists all of the currently selected object's properties that can be changed at *designtime*, as opposed to *runtime* properties, which can be changed only during program execution. Many properties can be changed either at designtime or at runtime.

FIGURE A.11
The Properties window, shown here in its undocked state, provides an easy way to change the properties that govern the appearance and behavior of objects.



An example of a property is the `Caption` property of a Label control. You can change it by simply typing `Hello World` in the `Caption` field in the Properties window (a designtime change) or by adding a statement in your code like `Form1.Label1.Caption = "Hello World"` (a runtime change).

The Properties window has two tabs on it. These tabs allow you to group the properties either alphabetically or by logical categories. Another improvement to the Properties window is that it now includes a description of the selected property in a pane at the bottom. Having this information helps you avoid much of the need to look up properties in the Help system.

NOTE For convenience, the `Name` property of any object appears at the top of the list of properties rather than in its proper alphabetical order.

NOTE Many controls have an entry labeled (Custom) in the Properties window. Clicking the ellipsis (...) next to this entry brings up a special Property Page dialog box containing all the designtime properties for that control in an easy-to-modify format.

Using the Project Window

Another window on the desktop is the *Project window*, as shown in Figure A.12. This window shows a list of all the forms, code modules, and other components that are used in your program. If you want to view a form or code module, double-click it here during designtime, or click it once and click the View Object or View Code button.

NOTE One way to think of a project is as a group of related files. The project brings together all the files needed to create your program.

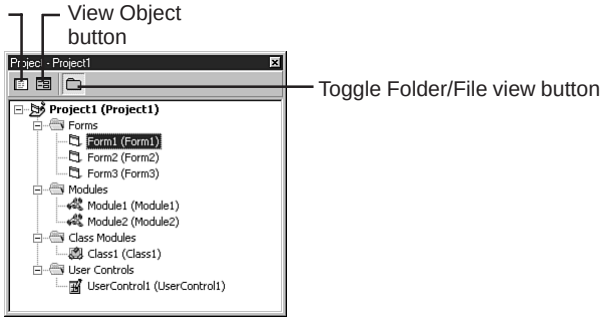


FIGURE A.12
The Project window, shown undocked, shows the different types of files that make up the open project(s).

When you save a project, you're basically saving a list of the various files that make up a project. The project file itself is stored with a default extension of *.VBP* (Visual Basic Project). Several other types of files make up the components of the projects. Some of the more common types are listed in Table A.3.

Table A.3 Visual Basic File Types

File Type	Extension
Visual Basic Form	.FRM
Code Module	.BAS
Class Module	.CLS
User-Created Control	.CTL
ActiveX Document Form File	.DOB

The Project window uses an outline list to show you not only the forms and code modules in the open project(s), but also any class modules, user-defined controls, or property pages. You can view your project in two ways. The folder view, which you can access by clicking the left button, displays the parts of your project organized by category. On the other hand, clicking the rightmost button lists the elements of your project based on their associated filenames.

Where Work Gets Done

The final piece of the desktop is one or more *Code windows*. In Code windows, you do all the entry and editing of program code that allows your programs to actually perform tasks (see Figure A.13). Each form has its own associated Code window. A project can also contain a couple of types of standalone Code windows known as *modules*. To access a Code window, you can double-click a form or one of its objects, or you can click the View Code button in the Project window while the appropriate object is highlighted.

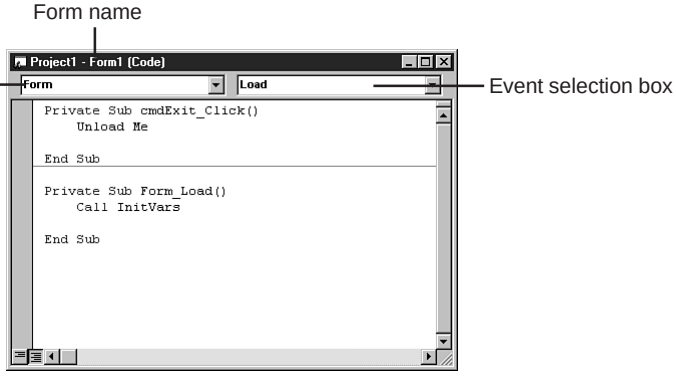


FIGURE A.13
The Code window is the place where you enter and edit the instructions that perform the work of your program.

Customizing Your Environment

As you've learned, the Visual Basic development environment is highly customizable. Most of the windows and toolbars in Visual Basic can be placed at the edges of the main program window, or they can float anywhere on the screen. You can position and resize the windows to fit your preferences; the next time you start Visual Basic, the environment will be as you left it. Figure A.14 shows you one way the development environment can be rearranged.

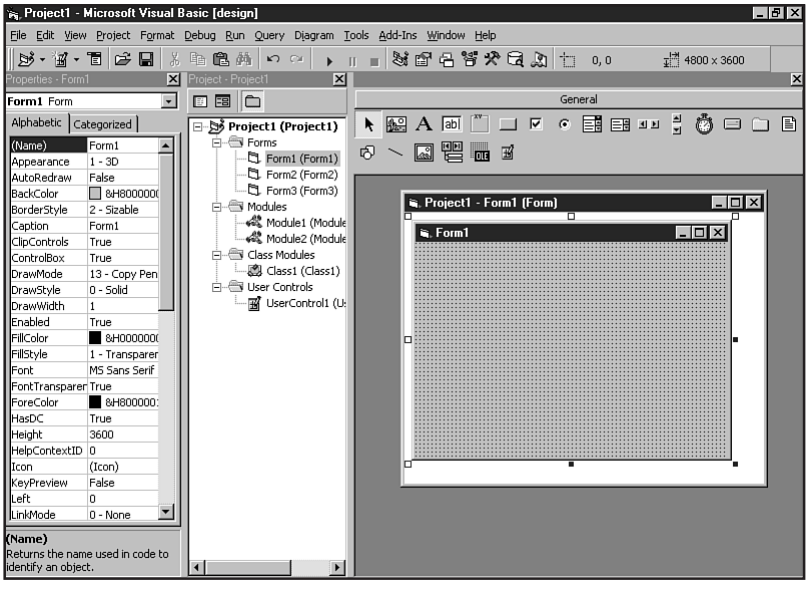


FIGURE A.14
The various pieces of Visual Basic's development environment can be arranged in many ways.

APPENDIX B

Packaging Your Applications

In this chapter

Compiling Your Program **776**

Packaging a Standard EXE Project **778**

Packaging ActiveX Components **788**

After you complete your program, it is time to move it out of the VB development environment so that others can use it. The first step is to compile the source code. The objective here is to create an EXE file (or DLL/OCX depending on the project type) that can be distributed to other machines. After compiling, you can create installation files for the program by using the Package and Deployment Wizard. The purpose of this wizard is to package your program and all necessary support files so that it will run on a machine that does not have Visual Basic installed. If your program is a Standard EXE project, the Package and Deployment Wizard provides a setup program that the users can execute. Typically, they can insert a CD or diskette and run SETUP.EXE. In addition to creating installs for Standard EXE projects, the Package and Deployment Wizard can also be used with ActiveX controls or other ActiveX components. This appendix discusses compiling your program and then steps you through the process of using the wizard to create an application package.

NOTE The Package and Deployment Wizard replaces the Application Setup Wizard from earlier versions of Visual Basic.

Compiling Your Program

The first step toward distributing your program is to compile it. All you have to do is select File, Make. This menu item lists the project name and the proper file extension for the type of program you are creating. For a Standard EXE or ActiveX EXE, the file extension is .EXE. For an ActiveX DLL, the file extension is .DLL, and for the ActiveX control, the file extension is .OCX. After you select Make, the Make Project dialog box appears; this dialog box allows you to specify the name and location of the target file. Visual Basic then does the rest of the work.

If any errors that prevent a successful compile are encountered, you have to correct them and compile again. Any time you make changes to the program code after you have compiled it, you need to compile and distribute your project again. Although Visual Basic handles the actual compilation with no intervention, you do need to make a few decisions in the *projectname* Project Properties dialog box. The Compile and Make tabs of this dialog box are also available through the Options button on the Make Project dialog box.

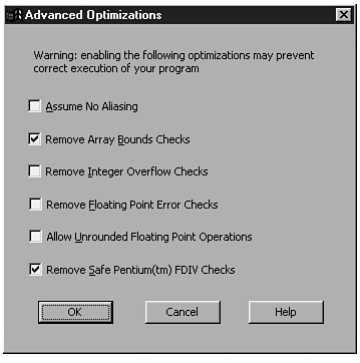
Optimizing Your Code

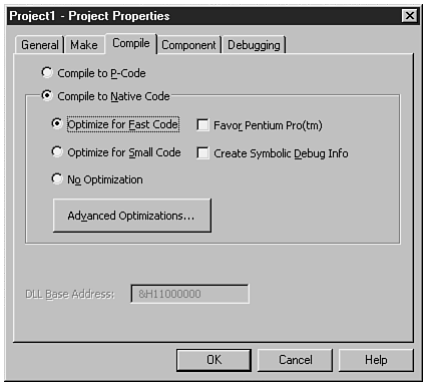
The first choice to make is whether to compile to P-code or native code. P-code is the way Visual Basic programs have been compiled since version 1, whereas compiling to native code was a new option with Visual Basic 5.0. Native code is optimized for the processor chip and runs faster than P-code, but it produces a larger executable file. If you choose to compile to native code, you also need to make a decision about compiler optimization. You can choose to have the compiler try to create the smallest possible code, the fastest possible code, or not perform any optimization. You also have the option of compiling your program specifically for the Pentium Pro processor.

TIP You should compile using native code, since speed is more of a concern than using up a few extra bytes of hard disk space.

To choose the compiler options, you need to click the Compile tab of the Project Properties dialog box (see Figure B.1). To squeeze every last bit of speed out of VB, you may want to also look at the Advanced Optimizations dialog box, also shown in Figure B.1. As you can see, Microsoft put these options in here with a "use at your own risk" warning. However, I usually check Remove Array Bounds Checks—because the program code itself should do this—and Remove Safe Pentium™ FDIV Checks—which turns off software correction for the infamous Pentium chip bug. If you want to play safe, making choices in the Advanced Options dialog box should probably be the last thing you do.

FIGURE B.1
To optimize the output of the Visual Basic compiler, visit the Advanced Optimizations dialog box.





Setting the Project Name, Title, and Icon

Another important step when compiling your code is to make sure that the project name and title are set to meaningful values. By default, Visual Basic assigns a generic name to your project, such as Project1. Even if you change the target filename from the Make Project dialog box, you still need to change the project name and title internally. If you have written an ActiveX component, such as an ActiveX DLL with a public class, you already know the importance of the project name and have probably already set it to a meaningful value. The project title is also important because it may appear in the Windows task list or an error dialog box. These name and title fields are located in the General and Make tabs of the Project Properties dialog box, respectively.

NOTE Generally, there is no reason why you need the project title and name to be different. If no project title is specified, VB automatically changes the project title to match the project name.

Before distributing an application, you should also select an icon from the Make tab of the Project Properties dialog box. Although an icon is not critical, using one is an easy way to make your application appear more professional. All you have to do is assign an icon to a form and then select the form name from the Icon drop-down box.

Preparing to Create a Setup Program

After you successfully compile your application, test the compiled version on your own computer to make sure that it runs outside the Visual Basic IDE. For a Standard EXE project, run the executable from the Windows Explorer. For an ActiveX component, attempt to use the component in a Visual Basic project or Web page. Before distributing the application to multiple users, you also need to perform more thorough testing on a PC other than your own.

I also suggest compiling your project to a different directory than the one you have been using. Doing so may help you discover any additional files (for example, INI files or bitmaps) that you have programmed the application to access. After you have made a note of these files and created a working compiled application, you are ready for the next step—using the Package and Deployment Wizard.

Packaging a Standard EXE Project

Even though you may have just compiled your code into an executable file, that executable file cannot run on its own. Users of your program must have some VB runtime files (for example, DLLs) properly installed first. In the days of VB 3.0, sometimes copying the file VBRUN300.DLL and copying your EXE were the only steps required. Today, the mere presence of a required DLL file is usually not enough; more often than not, it must also be registered in the Windows Registry.

On the bright side, the setup utility included with Visual Basic has improved in quality with each successive release. The latest incarnation of this utility, now known as the Package and Deployment Wizard, is the best yet. It has a totally redesigned interface that includes some additional customization features not present in previous versions. The purpose of this wizard is to “package” your program with the required support files so that it can be installed from a disk, directory, or the Internet—just like any off-the-shelf program.

Creating a Standard EXE Package

A shortcut to the Package and Deployment Wizard should have been installed with VB. The main screen, pictured in Figure B.2, is the starting point for creating installation routines for any type of Visual Basic project. This section focuses on the steps for a Standard EXE project. If you want to use this section as a step-by-step example, you first need to create a simple Standard EXE project and then save and compile it. Then start the Package and Deployment Wizard.

FIGURE B.2
The most important option on the first screen of the Package and Deployment Wizard is the Package button, which builds an installation package for your application.

Select a Project File The first thing you have to do in the Package and Deployment Wizard is select a project file (.VBP file) by using the Browse button. Then click the Package button to begin the process.

NOTE If you have not yet compiled your project, you get a message asking whether you would like the wizard to compile it for you. You cannot proceed unless you have a compiled file. I usually compile in the Visual Basic IDE because compiling here adds an extra step. ■

Select a Package Type After reading information from your VBP file, the wizard presents the Package Type screen, shown in Figure B.3. From this dialog box, you can select the Package Type to create. Remember that *package* is just another word for a set of files used to install your application.

NOTE If you see the Packaging Script screen instead of the Package Type screen, simply choose None and click Next. This screen only appears if you have previously saved a set of package instructions. ■

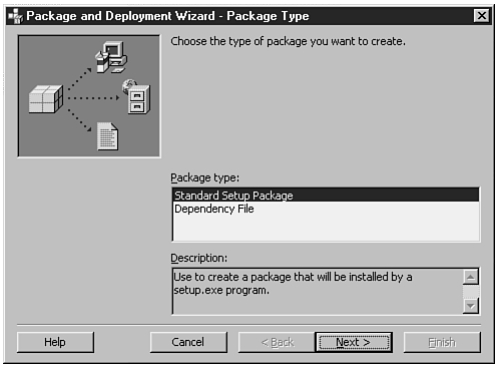


FIGURE B.3
The valid package types for a Standard EXE project are a standard setup package and a dependency file.

Note that if you choose the dependency file package type, the wizard does not actually create a working installation program. A dependency file holds information about all the files required by your program, for the purpose of including the installation of your project within the installation of another project. Unless you are creating a single setup for a bunch of projects, you should select the Standard Setup Package Option. If you are following along, do that now and click Next.

Assign a Package Folder The next thing the Package and Deployment Wizard needs from you is the location of a package folder. The package folder is the directory in which the wizard creates your installation files. You can enter the name of a new directory if you do not want to place installation files in an existing directory. By default, a new folder called Package is created in the same directory as your project file.

Select Files to Include After you select a package folder, you are presented with the Included Files screen, shown in Figure B.4. The Included Files screen lists the files that will be part of the installation package and allows you to add additional files. If you have additional files to distribute, such as INI or BMP files used by your program, you can add them to the list by using the Add button. ToolTips indicate whether a specific file was manually added or is required by another file.

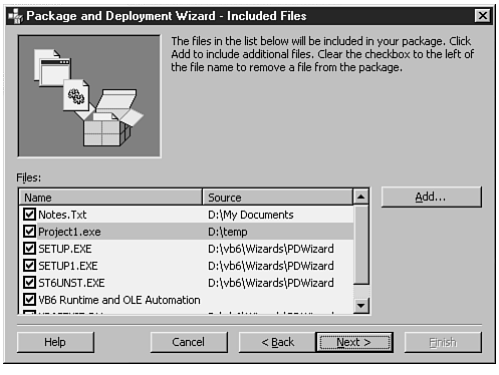


FIGURE B.4
The check box indicates that an item (and its dependent files, if known) will be included in the installation package.

Suppose you want to add another Visual Basic EXE, DLL, or OCX file to your project. Perhaps you have separated your application into multiple projects; for example, you may have created an "Administration module" EXE for managing login IDs. If you have not created a package for each of the other projects, you may see the Missing Dependency Information dialog box, which is shown in Figure B.5.

The reason for the warning message is to make sure your installation works. For example, if you decide to include additional EXEs, you also need the DLLs and OCXs required by those EXEs. You can either generate the dependency information with the Package and Deployment Wizard or just ignore this message if you know that no special files are required. If you click any check boxes on this screen (which I do not recommend), the wizard does not ask you about that file's dependency information ever again.

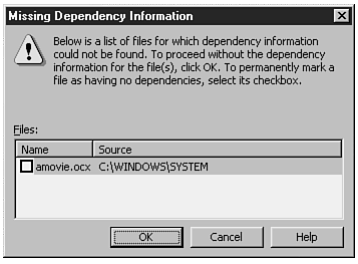


FIGURE B.5
This warning message indicates that the wizard could not find a dependency (DEP) file for the selected item.

Select Cab Options The next step in the Package and Deployment Wizard is to choose the type of CAB files you wish to create. The Cab Options screen, shown in Figure B.6, allows you to group the installation CAB files according to your distribution media. If you plan to install from a network server or CD-ROM, choose the Single cab option. Choose Multiple cabs if you plan to use floppy diskettes.

NOTE In previous versions of Visual Basic, installation files were compressed and renamed with an underscore to save space. The latest version of Visual Basic uses the CAB format (short for cabinet). CAB files (which are similar to ZIP files) contain compressed versions of your installation files. You can manipulate these compressed files from the MS-DOS command prompt by using the `EXTRACT` utility or from Windows with the `CabView` utility.

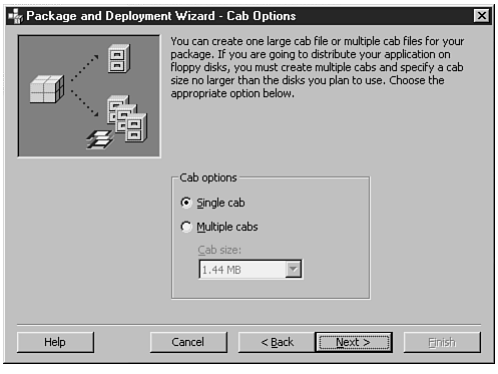


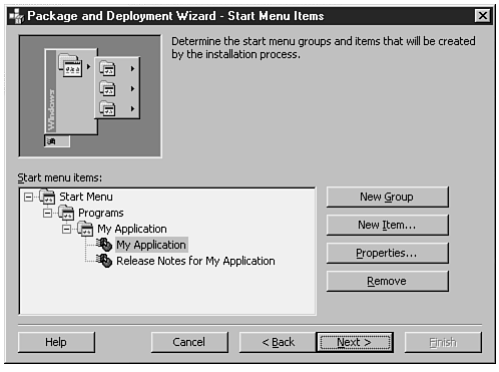
FIGURE B.6
You can compress all the installation files into a huge CAB file or multiple smaller CAB files.

At this point, you have given the Package and Deployment Wizard the most critical information for installing a Standard EXE project. The remaining screens, which were not available in earlier versions of Visual Basic, allow you to further customize the installation routine.

Assign an Installation Title Click the Next button on the Cab Options screen, and you see the Installation Title screen. The Installation Title screen, not pictured here, allows you to specify a title for the installation program, such as `Executive Reporting System`. The title is then displayed in the background as the setup program runs.

Set Up Shortcuts and Program Groups Another new setup feature in Visual Basic 6 is the Start Menu Items screen, pictured in Figure B.7. The Start Menu Items screen gives you control over the shortcut icons and program groups created by the setup routine. In previous versions of Visual Basic, the wizard simply created a single shortcut to your project's main executable.

FIGURE B.7
Your installation routine can create multiple shortcuts and program groups.



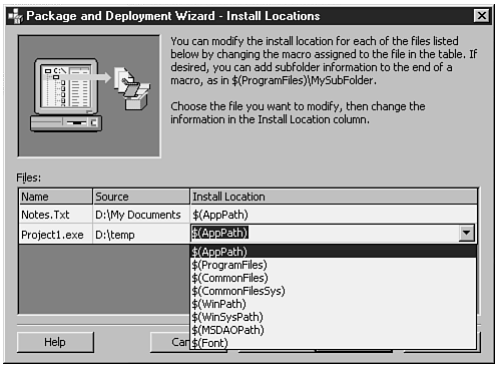
Use the New Group and New Item buttons to add additional program groups and shortcuts to your installation. Each button presents a dialog box for you to enter a description and other information. For example, you might want to create a shortcut to the application release notes or a URL file that takes the users to your Web site. In this case, click the New Item button. Select the target file from the list of included files and enter the title for the new shortcut icon.

NOTE The Properties button performs a different function depending on whether you have a group or item selected. For items, you can edit the file, title, and working directory. For NT program groups, you can determine whether they are created as Common (available from the Start Menu of all user accounts) or Private (available to the current user only).

Assign Installation Locations After you finish setting up Start menu items for your application, click Next and another customization dialog box, Install Locations, appears. Use this screen, shown in Figure B.8, to view and change the directories in which application files are installed.

Some files, such as DLL and OCX files, are traditionally placed in the Windows System directory. Likewise, the application executable file is usually copied to a directory that users choose during installation. Because these directories vary from machine to machine, the Package and Deployment Wizard uses macros to represent them.

FIGURE B.8
You can customize the location of any installed file.



You can think of macros, indicated by the `$(macroname)` syntax, like tokens that the setup routine replaces with the actual directory path for a given machine. Consider, for example, the Windows System directory, which is usually C:\Windows\System in Windows 95 and C:\WINNT\SYSTEM32 in Windows NT. In addition, selecting a custom path during Windows setup causes the Windows System directory to be something unusual like D:\MyWin95\System. However, the `$(WinSysPath)` macro locates the system directory on any PC.

Mark Any Shared Components The next dialog box, Shared Files, allows you to mark certain files in your installation as shared components. Shared components are typically DLLs or other files used by multiple programs. For example, if you have 10 Visual Basic programs installed on a user's machine, they all "share" the MSVBVM60.DLL runtime file. If a file is marked as shared, it is not removed during the uninstall process, unless no other applications are using the file. Visual Basic takes care of selecting shared files, and the Windows Registry keeps track of the applications that use them. Generally, you should accept the default settings on the Shared Files screen (see Figure B.9).

NOTE Setting the main executable file as shared, although not its intended purpose, removes two warning messages regarding replacing an existing file. The messages are contradictory (such as `Cancel Setup?` followed by `Continue Setup?`) and probably would confuse some users. By marking the file as a shared component, you tell the setup program that the users do not need to be prompted before overwriting the file. ■

NOTE You can remove (or uninstall) applications by choosing Add/Remove programs from the Windows Control Panel. ■

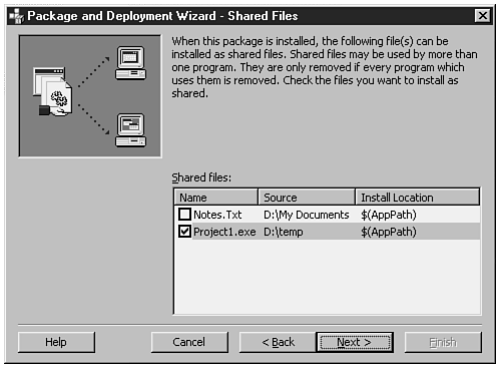


FIGURE B.9
Shared files can be left behind after an application is removed.

Save Your Script Finally, after the Package and Deployment Wizard has all the information it needs, you see the Finished screen. If you have made many changes to the standard options, you can name your packaging script something meaningful for future use. Otherwise, just click Finish, and your installation files are created.

TIP After you save a script file, the next time you package an application, you will see the Packaging Script screen. You can load an existing script or select `None` to start fresh. To delete or rename a script, choose Manage Scripts from the initial screen.

After installation files have been created, you see a Packaging Report, as shown in Figure B.10.

FIGURE B.10
The Packaging Report lets you know where the wizard put the installation files.

Finish the Packaging Process When you close the Packaging Report window, you return to the main screen. The packaging process is now complete, and you should be able to test your installation by running SETUP.EXE from the Build Folder.

When you're creating a setup for several different users, test your installation thoroughly to make sure that all the necessary components are included. Testing on your own PC is not sufficient because you already have the required DLLs and OCXs.

TIP One method of ensuring that your installation includes all the right parts is to try it on a test machine that contains nothing but the operating system. This situation can be tricky because each test of the installation changes the test machine. I suggest getting software that allows you to restore a PC from an image file so that you can test with a variety of software configurations.

A Closer Look at the Setup Process

You've just seen the process by which you create a set of setup files, also known as a *package*. It is probably a safe bet to assume that most computer users are already familiar with the concept of installing, or setting up, an application. Who hasn't spent 30 minutes watching the bar graph crawl by during a slow setup routine? From a user's viewpoint, the setup program performs a simple function. However, for troubleshooting purposes, the developer needs to realize that a lot more is going on than just copying files to the destination PC. In the following sections, you will look at the files created by the Package and Deployment Wizard and at what happens during the setup process.

Installation Files The steps you used to create a Standard EXE setup package in the previous sections create two new folders on your hard drive:

- **Package folder.** Contains the compressed installation files in CAB format, the Setup Executable, the dependency file, and a setup control file, SETUP.LST. You copy (or deploy) the contents of the Package folder to your distribution location.
- **Support folder.** Contains the decompressed installation files. You do not need to distribute this folder with your application.

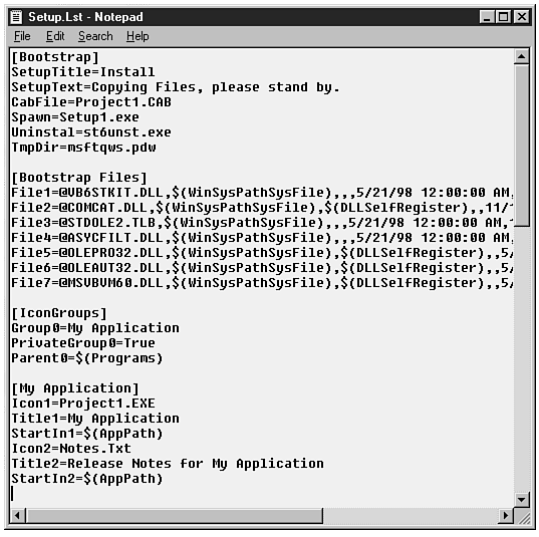
NOTE If you are creating an ActiveX component setup, additional files are created. You learn about ActiveX in later sections.

One of the files created by the Setup Wizard, SETUP.LST, is the controlling file for the entire setup process. You can view SETUP.LST in a text editor, as shown in Figure B.11.

The SETUP.LST File Don't let the cryptic lines of text in the SETUP.LST file intimidate you; the structure of the file is actually fairly straightforward. It contains all the information necessary to control the installation of a Standard EXE project. Take a brief step-by-step look now at how SETUP.LST is used:

1. When SETUP.EXE is executed by a user, the files in the `[BootStrap Files]` section of SETUP.LST are copied, decompressed, and registered on the destination machine. This process may require rebooting if certain critical files are out of date. Because the VB runtime files may not be present, SETUP.EXE must be written in a language capable of running without them.

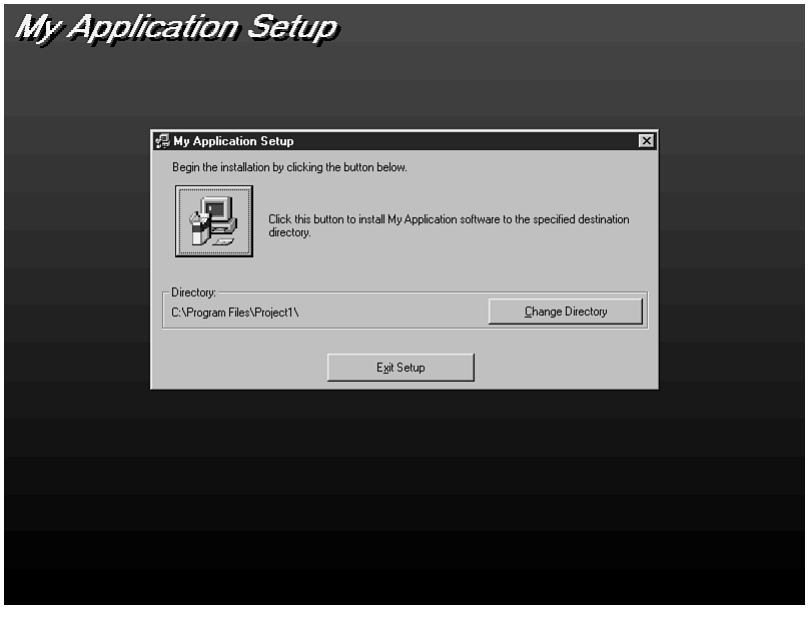
FIGURE B.11
The choices you made in the Packaging and Deployment Wizard are reflected in the SETUP.LST file.



These few files are the minimum files necessary to run a Visual Basic program, specifically SETUP1.EXE, which does most of the work in setting up your application. This is the main purpose for SETUP.EXE, which is basically a "wrapper" for SETUP1.EXE. SETUP1.EXE comes with VB and is included automatically by the wizard in your CAB file.

2. SETUP1.EXE displays a welcome screen and asks the user to choose a destination directory for the application, as you can see in Figure B.12.

FIGURE B.12
The user can choose a destination folder for your application.



NOTE If you do not want the user to have the option of specifying a destination folder, add the line `ForceUseDefDir=1` to the `[Setup]` section of SETUP.LST. To specify a different default directory, change the `DefaultDir` line.

3. If the user chooses to continue, the program creates the application directory and begins copying files. The files to be copied are listed in the [Setup1 Files] section of SETUP.LST. You may notice that for each file in the [Setup1 Files] section there is a long list of parameters. These parameters give the setup routine information about each individual file, such as the destination directory and version number.

CAUTION

The version number of your program is very important. If you do not increment the version number in the Project Properties dialog box, Setup assumes the user already has the correct version, so it does not need to copy over it. If you are having problems, view the installation log file to see which files were actually copied.

4. When SETUP1.EXE finishes copying files, it attempts to register some of them. Whether a file needs to be registered is determined by one of the SETUP.LST parameters, typically `(DLLSelfRegister)` or `$(EXESelfRegister)`.

NOTE If you need to register a file manually, use the REGSVR32 utility included with Visual Basic. You can register ActiveX EXEs with Windows by running them with the command-line parameter `/REGSERVER`.

5. SETUP1.EXE creates the shortcut icons for your program. The program group names are listed in the `[IconGroups]` section.
6. The major actions taken by the setup program (copying, registering, and so on) are saved in a log file in the application directory. This log file is used by the uninstall program but can also be a useful troubleshooting tool.

Rebuilding a CAB File As you may have noticed, all your installation files are compressed into one or more CAB files. If you make even a minor change to your program, you need to recompile the project and place the new executable in the CAB file. For this reason, the Package and Deployment Wizard places a second, decompressed, copy of the installation files in the Support directory. It also creates a batch file named after your project, such as PROJECT1.BAT. If you want to update your installation package without going through the wizard again, you can use this batch file.

To rebuild your CAB file, place the new EXE in the Support directory. Then double-click the batch file. A new CAB file is built in the Support directory and must be copied over the existing CAB file in the Package directory.

Customizing Setup Even though you can customize SETUP.LST to a great extent, a standard Setup Wizard installation still might not be suitable for your needs. For example, you may want to create your own "wrapper" program around SETUP.EXE to perform other functions. You could temporarily map a network drive to the installation server, run SETUP.EXE, and then

disconnect the drive after installation. If you emailed this program to the users, they would not have to worry about connecting to the right network drive. Another possibility would be storing each user's date of installation in a database. As with SETUP.EXE, you might have to write this program so that it would run without the VB6 runtime files.

If you want to run a setup program other than SETUP1.EXE, you can still use Microsoft's SETUP.EXE to install the VB6 runtime DLLs. To do so, replace the SETUP1.EXE program in the Support directory with your own program and rebuild the CAB file. You can also remove the `[Setup1 Files]` section from SETUP.LST entirely if your setup program doesn't need it.

NOTE Microsoft includes the source code for SETUP1.EXE with Visual Basic. If you want view this code, open the project SETUP1.VBP in the Wizards\PDWizard\setup1 directory. If you need to make any changes, first make a backup copy of the original files.

Successful Setups

Installing a Visual Basic application can become a real headache if you have a lot of users. For a client/server application, chances are you will also need to install database drivers and set up data sources, which is an extra step. Even Internet setups, which are supposed to be handled automatically by Internet Explorer, may run into complications and require tinkering with the security settings.

I think that most people would agree that users of an application should not be forced to jump through hoops just to install it. A good goal to have is a single setup process that does everything as quickly and efficiently as possible. To reach this goal, you may have to get creative and go beyond the standard Setup Wizard approach, but your application will look more professional in the end.

The way to save yourself troubleshooting time later is to thoroughly test your installation. As mentioned earlier, a test machine that can be reset from a file image is a useful tool. You should test your application with different operating systems, test upgrades versus fresh installations, and test the interaction of your application with other software packages.

Packaging ActiveX Components

In the preceding sections, you learned about using the Package and Deployment Wizard with a Standard EXE project. For ActiveX components, such as an ActiveX control (OCX file) or an ActiveX DLL, the process is similar, but some options are specific to these project types.

Internet Download

With an ActiveX component, you still have the option of creating a Standard installation that can be executed explicitly by the users. However, you also can create a package for Internet download. In this case, the Internet Explorer browser handles installation. To specify an Internet installation package, choose Internet Package from the Package Type screen, as shown in Figure B.13.

Another important decision to make is which of the required files to include in your CAB file.

FIGURE B.13
If you are creating an ActiveX control for Internet Explorer, you need to create an Internet installation package.

For users to install your ActiveX component, they also need to have all the necessary Visual Basic DLL files. By default, the wizard creates a package that tells the browser to download VB runtime files from a Microsoft Web site. In other words, when users hit your Web site, your ActiveX component is copied from the CAB file on the site, but the remaining DLLs come from Microsoft.

If your Internet connection is unreliable, slow, or not connected all the time, you may want to include the Visual Basic runtime files in your CAB file. You can also specify multiple smaller CAB files on your own server for speed purposes. You can select these options in the Components dialog box, as pictured in Figure B.14.

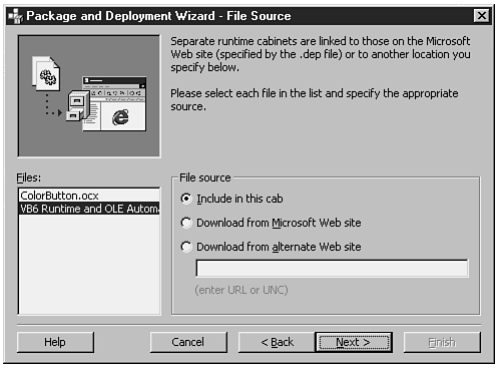


FIGURE B.14
You can specify the download location for a file by single-clicking it and entering the URL or network path.

Scripting Options

If you are creating a package for an ActiveX component that will be used on a Web page, you need to make sure it is marked Safe for Scripting and Initialization, as shown in Figure B.15.

FIGURE B.15
The Safety Settings dialog box determines the safety level at which an object is registered on users' PCs.

Safe for Scripting means that the object can be accessed from a scripting language, such as VBScript, without harming the user's computer. Safe for initialization means that someone can create an instance of your object without harming the user's computer. As an example, suppose you created an ActiveX control with a method that deletes files. Your Web pages might use this method responsibly, but someone else could use your control with their own VBScript code to perform malicious activities. Of course, in order for you to use your own control, these options need to be enabled, so make sure and put a lot of thoughts into the methods and properties you make available.

▶ **See** "Installing Your Control over the Internet" **p. 316**

▶ **See** "Using VBScript," **p. 665**

Files Created for the Internet

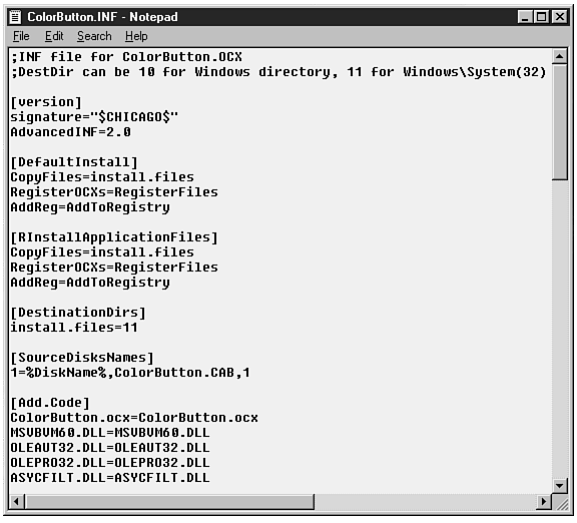
The Package and Deployment Wizard creates a different kind of CAB file for Internet packages. As you may recall, a Standard installation package includes a SETUP.EXE file for the users to run. An Internet package, however, does not include a setup program because Internet Explorer handles the installation. Inside the CAB file is an INF file that tells Internet Explorer which files to install. A sample INF file is shown in Figure B.16.

If you are creating an ActiveX control, IE also creates a sample HTM file. This file includes HTML code that you use to place the ActiveX control on one of your own Web pages:

```
<OBJECT ID="UserControl1"
CLASSID="CLSID:9A15C6AE-CB22-11D1-BE62-10005A75B6DB"
CODEBASE="Project1.CAB#version=1,0,0,0">
</OBJECT>
```

These few lines of HTML code are all you need to embed your ActiveX object in a Web page. Note that the object's unique class ID and version number are provided. Internet Explorer uses this information and the information in the INF file to determine whether it needs to download and install the ActiveX component. This is one of the strengths of ActiveX and Internet Explorer: You can place updated controls on your Web server and have them installed automatically on client PCs.

FIGURE B.16
The INF file tells Internet Explorer which project files to install and where to get them.



From Here...

In this appendix, you explored how to use the Setup Wizard to create an installation program for your users. You also looked behind the scenes to find out what happens when an application setup executes and how to customize it. For additional information about setup-related topics, see the following chapters:

- To learn about creating ActiveX Controls, see Chapter 14, “Creating ActiveX Controls.”
- To find out how to create an ActiveX document, see Chapter 32, “ActiveX Documents.”

APPENDIX C

SQL Summary

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Optimizing SQL Performance **825**

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In several of the earlier chapters on working with databases, you saw how SQL statements were used to determine what information would be available in a recordset. This chapter explains how to create those SQL statements and how to do much more with SQL. The examples in this chapter all use an Access database, but the techniques of using SQL are applicable to many database formats. In fact, SQL statements are the cornerstone of working with many database servers, such as Oracle or SQL Server.

There are two basic types of SQL statements that are covered in this chapter: data-manipulation language (DML) and data-definition language (DDL). Most of the chapter deals with DML statements, and, unless a statement is identified otherwise, you should assume that it is a DML statement.

Defining SQL

Structured Query Language (SQL) is a specialized set of programming commands that enable the developer (or end user) to do the following kinds of tasks:

- Retrieve data from one or more tables in one or more databases.
- Manipulate data in tables by inserting, deleting, or updating records.
- Obtain summary information about the data in tables, such as totals; record counts; and minimum, maximum, and average values.
- Create, modify, or delete tables in a database (Access databases only).
- Create or delete indexes for a table (Access databases only).

SQL statements enable the developer to perform functions in one line or a few lines of code that would take 50 or 100 lines of standard BASIC code to perform.

What SQL Does

As the name implies, Structured Query Language statements create a query that is processed by the database engine. The query defines the fields to be processed, the tables containing the fields, the range of records to be included, and, for record retrieval, the order in which the returned records are to be presented.

When retrieving records, a SQL statement usually returns the requested records in a *dynaset*. Recall that a dynaset is an updatable recordset that actually contains a collection of pointers to the base data. Dynasets are temporary and are no longer accessible after they are closed. SQL does have a provision for the times when permanent storage of retrieved records is required.

NOTE The Microsoft SQL syntax used in this chapter is designed to work with the Jet database engine and is compatible with ANSI SQL (there are, however, some minor differences between Microsoft SQL and ANSI SQL). In addition, if you use SQL commands to query an external database server such as SQL Server or Oracle, read the documentation that comes with the server to verify that the SQL features you want to use are supported and that the syntax of the statements is the same.

The Parts of the SQL Statement

A SQL statement consists of three parts:

- **Parameter declarations**—These are optional parameters that are passed to the SQL statement by the program.
- **The manipulative statement**—This part of the statement tells the Query engine what kind of action to take, such as `SELECT` or `DELETE`.
- **Options declarations**—These declarations tell the Query engine about any filter conditions, data groupings, or sorts that apply to the data being processed. These include the `WHERE`, `GROUP BY`, and `ORDER BY` clauses.

These parts are arranged as follows:

```
[Parameters declarations] Manipulative statement [options]
```

The parameters declaration section is where you define any parameters used in the SQL statement. Any values defined in the parameters declaration section are assigned before the SQL statement is executed.

Most of this chapter uses only the manipulative statement and the options declarations. Using these two parts of the SQL statement, you can create queries to perform a wide variety of tasks. Table C.1 lists four of the manipulative clauses and their purposes.

Table C.1 Parts of the Manipulative Statement

Statement	Function
`DELETE FROM`	Removes records from a table
`INSERT INTO`	Adds a group of records to a table
`SELECT`	Retrieves a group of records and places the records in a dynaset or table
`UPDATE`	Sets the values of fields in a table

Although manipulative statements tell the database engine what to do, the options declarations tell it what fields and records to process. The discussion of the optional parameters makes up the bulk of this chapter. In this chapter, you first look at how the parameters are used with the `SELECT` statement and then you apply the parameters to the other manipulative statements. Many of the examples in this chapter are based on the sales-transaction table of a sample database that might be used to manage an aquarium business.

The following discussions of the different SQL statements show just the SQL statement syntax. Be aware that these statements can't be used alone in Visual Basic. The SQL statement is always used to create a `QueryDef`, to create a dynaset or snapshot using the Execute method, or as the `RecordSource` property of a data control. This section explains the part of a SQL statement. Later in the appendix, the "Using SQL" section explains how these statements are actually used in code.

NOTE A `QueryDef` is a part of the database that stores the query definition. This definition is the SQL statement that you create.

Using *SELECT* Statements

The `SELECT` statement retrieves records (or specified fields from records) and places the information in a dynaset or table for further processing by a program. The `SELECT` statement follows this general form:

```
SELECT [predicate] fieldlist FROM tablelist [table relations]
     [range options] [sort options] [group options]
```

NOTE In my demonstrations of code statements, words in all caps are SQL keywords, and italicized words or phrases are used to indicate terms that a programmer would replace in an actual statement—for example, *`fieldlist`* would be replaced with `Lastname, Firstname`. Phrases or words inside square brackets are optional terms.

The various components of the preceding statement are explained in this chapter. Although a SQL statement can be greatly complex, it also can be fairly simple. The simplest form of the `SELECT` statement is shown here:

```
SELECT * FROM Sales
```

Defining the Desired Fields

The `fieldlist` part of the `SELECT` statement is used to define the fields to be included in the output recordset. You can include all fields in a table, selected fields from the table, or even calculated fields based on other fields in the table. You can also choose the fields to be included from a single table or from multiple tables.

The `fieldlist` portion of the `SELECT` statement takes the following form:

```
[tablename.]field1 [AS alt1][,[tablename.]field2 [AS alt2]]
```

Selecting All Fields from a Table The *, or wild-card parameter, is used to indicate that you want to select all the fields in the specified table. The wild card is used in the `fieldlist` portion of the statement. The statement `SELECT * FROM Sales`, when used with the sample database you are developing, produces the output recordset shown in Figure C.1.

Selecting Individual Fields from a Table Frequently, you need only a few fields from a table. You can specify the desired fields by including a field list in the `SELECT` statement. Within the field list, the individual fields are separated by commas. In addition, if the desired field has a space in the name, as in `Order Quantity`, the field name must be enclosed within square brackets, [].The recordset that results from the following `SELECT` statement is shown in Figure C.2. A recordset created with fields specified is more efficient than one created with the wild card (*), both in terms of the size of the recordset and speed of creation. As a general rule, you should limit your queries to the smallest number of fields that can accomplish your purpose.

```
SELECT [Item Code], Quantity FROM Sales
```

FIGURE C.1
Using * in the `fieldlist` parameter selects all fields from the source table.

SELECT * FROM Sales

Refresh | Sort | Filter | Close

Custno	SalesID	Item Code	Date	Quantity	Orderno
854	JTHOMA	1028	8/1/94	2	1
854	JTHOMA	1077	8/1/94	1	1
854	JTHOMA	1076	8/1/94	5	1
1135	CFIELD	1041	8/1/94	5	2
1265	JBURNS	1096	8/1/94	5	3
1265	JBURNS	1005	8/1/94	5	3
583	RSMITH	1076	8/1/94	1	4
583	RSMITH	1059	8/1/94	3	4
583	RSMITH	1029	8/1/94	4	4
1037	MNORTO	1027	8/1/94	5	5
1037	MNORTO	1082	8/1/94	3	5
1578	KMILLE	1022	8/1/94	4	6
1578	KMILLE	1098	8/1/94	2	6
1578	KMILLE	1053	8/1/94	1	6

☑ AllowAddNew ☑ AllowDelete ☑ AllowUpdate

Right Click for Data Control Properties

FIGURE C.2
This recordset results from specifying individual fields in the `SELECT` statement.

SELECT [Item Code], Quantity FROM Sales

Refresh | Sort | Filter | Close

Item Code	Quantity
1028	2
1077	1
1076	5
1041	5
1096	5
1005	5
1076	1
1059	3
1029	4
1027	5
1082	3
1022	4
1098	2
1053	1

☑ AllowAddNew ☑ AllowDelete ☑ AllowUpdate

Right Click for Data Control Properties

Selecting Fields from Multiple Tables As you might remember from the discussions on database design in Chapter 24, "Database Basics," you normalize data by placing it in different tables to eliminate data redundancy. When you retrieve this data for viewing or modification, you want to see all the information from the related tables. SQL lets you combine information from various tables into a single recordset.

To select data from multiple tables, you specify three things:

- The table from which each field is selected
- The fields from which you are selecting the data
- The relationship between the tables

Specify the table for each field by placing the table name and a period in front of the field name (for example, `Sales.[Item Code]` or `Sales.Quantity`). (Remember, square brackets must enclose a field name that has a space in it.) You also can use the wild-card identifier (*) after the table name to indicate that you want all the fields from that table.

To specify the tables you're using, place multiple table names (separated by commas) in the `FROM` clause of the `SELECT` statement.

The relationship between the tables is specified either by a `WHERE` clause or by a `JOIN` condition. These elements are discussed later in this chapter.

The statement in Listing C.1 is used to retrieve all fields from the Sales table and the Item Description and Retail fields from the Retail Items table. These tables are related by the Item Code field. Figure C.3 shows the results of the statement.

FIGURE C.3
Selecting fields from multiple tables produces a combined recordset.

SQL Statement

Refresh | Sort | Filter | Close

Custno	SalesID	Item Code	Date	Quantity	Orderno	Item Description	Retail
854	JTHOMA	1028	8/1/94	2	1	Checker Barb	2.6
854	JTHOMA	1077	8/1/94	1	1	Black Ghost	3.5
854	JTHOMA	1076	8/1/94	5	1	Green Discus	1.6
1135	CFIELD	1041	8/1/94	5	2	Black Neon Tetra	2.35
1265	JBURNS	1096	8/1/94	5	3	Water Rose	1.55
1265	JBURNS	1005	8/1/94	5	3	Blue Gourami	1.6
583	RSMITH	1076	8/1/94	1	4	Green Discus	1.6
583	RSMITH	1059	8/1/94	3	4	Emperor Tetra	1.2
583	RSMITH	1029	8/1/94	4	4	Marbled Hatchetfish	2.65
1037	MNORTO	1027	8/1/94	5	5	Zebra Danio	1.6
1037	MNORTO	1082	8/1/94	3	5	Snakeskin Gourami	2.4
1578	KMILLE	1022	8/1/94	4	6	Striped Headstander	2.3
1578	KMILLE	1098	8/1/94	2	6	Hornwort	1.45
1578	KMILLE	1053	8/1/94	1	6	Sailfin Molly	1.85

☑ AllowAddNew ☑ AllowDelete ☑ AllowUpdate

Right Click for Data Control Properties

NOTE The listing shows an underscore character at the end of each of the first three lines. This is used to break the lines for the purpose of page-width in the book. When you enter the expressions, they need to be on a single line.

Listing C.1 SALES.TXT—Selecting Fields from Multiple Tables in a SQL Statement

```
SELECT Sales.*, [Retail Items].[Item Description], _
    [Retail Items].Retail  _
    FROM Sales, [Retail Items]  _
    WHERE Sales.[Item Code]=[Retail Items].[Item Code]
```

NOTE You can leave out the table name when specifying fields as long as the requested field is present only in one table in the list. However, it is very good programming practice to include the table name, both for reducing the potential for errors and for readability of your code.

Creating Calculated Fields The example in Listing C.1 has customer-order information consisting of the item ordered, quantity of the item, and the retail price. Suppose that you also want to access the total cost of the items. You can achieve this by using a *calculated field* in the `SELECT` statement. A calculated field can be the result of an arithmetic operation on numeric fields (for example, `Price * Quantity`) or the result of string operations on text fields (for example, `Lastname & Firstname`). For numeric fields, you can use any standard arithmetic operation (+, -, *, /, ^). For strings, you can use the concatenation operator (&). In addition, you can use Visual Basic functions to perform operations on the data in the fields (for example, you can use the `MID$` function to extract a substring from a text field, the `UCASE$` function to place text in uppercase letters, or the `SQR` function to calculate the square root of a number). Listing C.2 shows how some of these functions can be used in the `SELECT` statement.

Listing C.2 TOTPRICE.TXT—Creating a Variety of Calculated Fields with the *SELECT* Statement

```
'****************************************
'Calculate the total price for the items
'****************************************
SELECT [Retail Items].Retail * Sales.Quantity FROM _
       [Retail Items],Sales  _
       WHERE Sales.[Item Code]=[Retail Items].[Item Code]
'*****************************************************************
'Create a name field by concatenating the Lastname and
'Firstname fields
'*****************************************************************
SELECT Lastname & ', ' & Firstname FROM Customers
'*****************************************************************
'Create a customer ID using the first 3 letters of the Lastname
' and Firstname fields and make all letters uppercase.
'*****************************************************************
SELECT UCASE$(MID$(Lastname,1,3)) & UCASE$(MID$(Firstname,1,3))  _
   FROM Customers
'*************************************************************
'Determine the square root of a number for use in a data report.
'*************************************************************
SELECT Datapoint, SQR(Datapoint) FROM Labdata
```

In the listing, no field name is specified for the calculated field. The Query engine automatically assigns a name such as `Expr1001` for the first calculated field. The next section, "Specifying Alternative Field Names," describes how you can specify a name for the field.

Calculated fields are placed in the recordset as read-only fields—they can't be updated. In addition, if you update the base data used to create the field, the changes are not reflected in the calculated field.

NOTE If you use a calculated field with a data control, it is best to use a label control to show the contents of the field. This prevents the user from attempting to update the field and causing an error. You could also use a text box with the locked property set to `True`. (You can learn more about the Data control and bound controls by reviewing Chapter 25, "The Data Control and Data-Bound Controls.") If you use a text box, you might want to change the background color to indicate to the user that the data cannot be edited.

Specifying Alternative Field Names Listing C.2 created calculated fields to include in a recordset. For many applications, you will want to use a name for the field other than the one automatically created by the query engine.

You can change the syntax of the `SELECT` statement to give the calculated field a name. You assign a name by including the `AS` clause and the desired name after the definition of the field (refer to the second part of Listing C.3). If you want, you can also use this technique to assign a different name to a standard field.

Listing C.3 CUSTNAME.TXT—Accessing a Calculated Field's Value and Naming the Field

```
'*********************************************
'Set up the SELECT statement without the name
'*********************************************
Dim NewDyn As RecordSet
SQL = "SELECT Lastname & ', ' & Firstname FROM Customers"
'****************************************
'Create a dynaset from the SQL statement
'****************************************
NewDyn = OldDb.OpenRecordset(SQL)
'***********************************
'Get the value of the created field
'***********************************
Person = NewDyn.Recordset(0)
'*************************************************************
'Set up the SELECT statement and assign a name to the field
'*************************************************************
SQL = "SELECT Lastname & ', ' & Firstname As Name FROM Customers"
'****************************************
'Create a dynaset from the SQL statement
'****************************************
NewDyn = OldDb.OpenRecordset(SQL)
'***********************************
'Get the value of the created field
'***********************************
Person = NewDyn.Recordset("Name")
```

Specifying the Data Sources

In addition to telling the database engine what information you want, you must tell it in which table to find the information. This is done with the `FROM` clause of the `SELECT` statement. Here is the general form of the `FROM` clause:

```
FROM table1 [IN data1] [AS alias1][,table2 [IN data2] [AS alias2]]
```

Various options of the `FROM` clause are discussed in the following sections.

Specifying the Table Names The simplest form of the `FROM` clause is used to specify a single table. This is the form of the clause used in this statement:

```
SELECT * FROM Sales
```

The `FROM` clause can also be used to specify multiple tables (refer to Listing C.1). When specifying multiple tables, separate the table names with commas. Also, if a table name has an embedded space, the table name must be enclosed in square brackets, [] (refer to Listing C.1).

Using Tables in Other Databases As you develop more applications, you might have to pull data together from tables in different databases. For example, you might have a ZIP code database that contains the city, state, and ZIP code for every postal code in the United States. You do not want to have to duplicate this information in a table for each of your database applications that requires it. The `SELECT` statement lets you store that information once in its own database and then pull it in as needed. To retrieve the information from a database other than the current one, you use the `IN` portion of the `FROM` clause. The `SELECT` statement for retrieving the ZIP code information along with the customer data is shown in Listing C.4.

Listing C.4 GETCUST.TXT—Retrieving Information from More than One Database

```
'*************************************************************
'We are working from the TRITON database which is already open.
'*************************************************************
SELECT Customers.Lastname, Customers.Firstname, Zipcode.City, _
    Zipcode.State  FROM Customers, Zipcode IN USZIPS  _
    WHERE Customers.Zip = Zipcode.Zip
```

Assigning an Alias Name to a Table Notice the way the table name for each of the desired fields was listed in Listing C.4. Because these table names are long and there are a number of fields, the `SELECT` statement is fairly long. The statement gets much more complex with each field and table you add. In addition, typing long names each time increases the chances of making a typo.

To alleviate this problem, you can assign the table an alias by using the AS portion of the FROM clause. Using AS, you can assign a unique, shorter name to each table. This alias can be used in all the other clauses in which the table name is needed. Listing C.5 is a rewrite of the code from Listing C.4, using the alias CS for the Customers table and ZP for the Zipcode table.

Listing C.5 ALIAS.TXT Using a Table Alias to Cut Down on Typing

```
'*****************************************************
'We use aliases to make the statement easier to enter.
'*****************************************************
SELECT CS.Lastname, CS.Firstname, ZP.City, ZP.State  _
    FROM Customers AS CS, Zipcode IN USZIPS AS ZP   _
    WHERE CS.Zip = ZP.Zip
```

Using *ALL*, *DISTINCT*, or *DISTINCTROW* Predicates

In most applications, you select all records that meet specified criteria. You can do this by specifying the ALL predicate in front of your field names or by leaving out any predicate specification (ALL is the default behavior). Therefore, the following two statements are equivalent:

```
SELECT * FROM Customers
SELECT ALL * FROM Customers
```

There might be times, however, when you want to determine the unique values of fields. For these times, use the DISTINCT or DISTINCTROW predicate. The DISTINCT predicate causes the database engine to retrieve only one record with a specific set of field values—no matter how many duplicates exist. For a record to be rejected by the DISTINCT predicate, its values for all the selected fields must match those of another record. For example, if you are selecting first and last names, you can retrieve several people with the last name Smith, but you can't retrieve multiple occurrences of Adam Smith.

If you want to eliminate records that are completely duplicated, use the DISTINCTROW predicate. DISTINCTROW compares the values of all fields in the table, whether or not they are among the selected fields. For the sample database, you can use DISTINCTROW to determine which products have been ordered at least once. DISTINCTROW has no effect if the query is on only a single table.

Listing C.6 shows the uses of DISTINCT and DISTINCTROW.

Listing C.6 DISTINCT.TXT—Obtaining Unique Records with the *DISTINCT* or *DISTINCTROW* Predicates

```
'******************************
'Use of the DISTINCT predicate
'******************************
SELECT DISTINCT [Item Code] FROM Sales
```

```
'********************************
'Use of the DISTINCTROW predicate
'********************************
SELECT DISTINCTROW [Item Code] FROM [Retail Items], Sales  _
     [Retail Items] INNER JOIN Sales  _
     ON [Retail Items].[Item Code]=Sales.[Item Code]
```

Setting Table Relationships

When you design a database structure, you use key fields so that you can relate the tables in the database. For example, you use a salesperson ID in the Customers table to relate to the salesperson in the Salesperson table. You do this so that you don't have to include all the salesperson data with every customer record. You use these same key fields in the `SELECT` statement to set the table relationships so that you can display and manipulate the related data. That is, when you view customer information, you want to see the salesperson's name, not his or her ID.

You can use two clauses to specify the relationships between tables:

- `JOIN`—This combines two tables, based on the contents of specified fields in each table and the type of `JOIN`.
- `WHERE`—This usually is used to filter the records returned by a query, but it can be used to emulate an `INNER JOIN`. You will take a look at the `INNER JOIN` in the following section.

NOTE Using the `WHERE` clause to join tables creates a read-only recordset. To create a modifiable recordset, you must use the `JOIN` clause.

Using a *JOIN* Clause

The basic format of the `JOIN` clause is as follows:

```
table1 {INNER¦LEFT¦RIGHT} JOIN table2 ON table1.key1 = table2.key2
```

The Query engine used by Visual Basic (also used by Access, Excel, and other Microsoft products) supports three `JOIN` clauses: `INNER`, `LEFT`, and `RIGHT`. Each of these clauses returns records that meet the `JOIN` condition, but each behaves differently in returning records that do not meet that condition. Table C.2 shows the records returned from each table for the three `JOIN` conditions. For this discussion, *`table1`* is the left table and *`table2`* is the right table. In general, the left table is the first one specified (on the left side of the `JOIN` keyword) and the right table is the second table specified (on the right side of the `JOIN` keyword).

NOTE You can use any comparison operator (<, <=, =, >=, >, or <>) in the `JOIN` clause to relate the two tables.

Table C.2 Records Returned Based on the Type of *JOIN* Used

JOIN Type Table	Records from Left Table	Records from Right Table
`INNER`	Only records with corresponding record in right table	Only records with corresponding record in left table
`LEFT`	All records	Only records with corresponding record in left table
`RIGHT`	Only records with corresponding record in right table	All records

To further understand these concepts, consider the sample database with its Customers and Salesperson tables. In that database, you created a small information set in the tables consisting of ten customers and four salespeople. Two of the customers have no salesperson listed, and one of the salespeople has no customers (he's a new guy!). You select the same fields with each `JOIN` but specify an `INNER JOIN`, `LEFT JOIN`, and `RIGHT JOIN` (see Listing C.7). Figure C.4 shows the two base-data tables from which this listing is working. Figure C.5 shows the resulting recordsets for each of the `JOIN` operations.

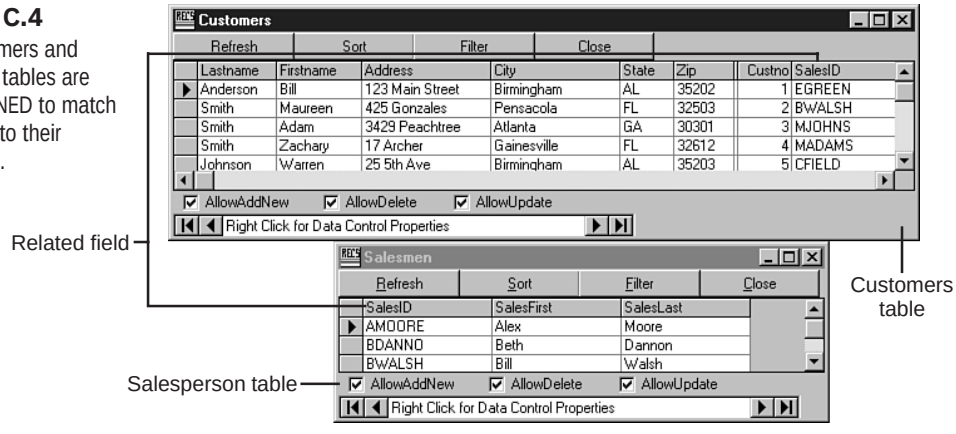


FIGURE C.4
The Customers and Salesmen tables are RIGHT JOINED to match salesmen to their customers.

Listing C.7 JOIN.TXT—Examples of the Three *JOIN* Types

```
'*************************
'Select using an INNER JOIN
'*************************
SELECT CS.Lastname, CS.Firstname, SL.Saleslast, SL.Salesfirst  _
    FROM Customers AS CS, Salesmen AS SL,  _
```

```
    CS INNER JOIN SL ON CS.SalesID=SL.SalesID
'**************************
'Select using an LEFT JOIN
'**************************
SELECT CS.Lastname, CS.Firstname, SL.Saleslast, SL.Salesfirst  _
    FROM Customers AS CS, Salesmen AS SL,  _
    CS LEFT JOIN SL ON CS.SalesID=SL.SalesID
'**************************
'Select using an RIGHT JOIN
'**************************
SELECT CS.Lastname, CS.Firstname, SL.Saleslast, SL.Salesfirst  _
    FROM Customers AS CS, Salesmen AS SL,  _
    CS RIGHT JOIN SL ON CS.SalesID=SL.SalesID
```

FIGURE C.5
Different records are returned with the different `JOIN` types.

INNER JOIN

INNERJOIN2

LASTNAME	FIRSTNAME	SALESLAST	SALESFIRST
Evans	Wanda	Burns	John
Hawthorne	Wanda	Burns	John
Moore	Paula	Burns	John
Hawthorne	Lisa	Green	Elizabeth
Thompson	Frank	Green	Elizabeth
Walters	Lisa	Green	Elizabeth
Evans	Lisa	Green	Elizabeth
Hawthorne	Michele	Green	Elizabeth

LEFT JOIN

leftjoin

LASTNAME	FIRSTNAME	SALESLAST	SALESFIRST
Anderson	Bill		
Smith	Maureen	Walsh	Bill
Smith	Adam	Johnson	Mary
Smith	Zachary	Adams	Max
Johnson	Warren	Fields	Carol
Williams	Stephanie	Moore	Alex
Taylor	Lisa	Dannon	Beth
Davis	David	Smith	Robyn
Miller	Catherine		
Roberts	Judy	Evans	Lisa

RIGHT JOIN

rightjoin

LASTNAME	FIRSTNAME	SALESLAST	SALESFIRST
Smith	Zachary	Adams	Max
Johnson	Warren	Fields	Carol
Williams	Stephanie	Moore	Alex
Taylor	Lisa	Dannon	Beth
Davis	David	Smith	Robyn
		Thomas	Jim
Roberts	Judy	Evans	Lisa
		Reid	Sam

Note that, in addition to returning the salesperson with no customers, the `RIGHT JOIN` returned all customer records for each of the other salespeople, not just a single record. This is because a `RIGHT JOIN` is designed to return all the records from the right table, even if they have no corresponding record in the left table.

Using the *WHERE* Clause You can use the `WHERE` clause to relate two tables. The `WHERE` clause has the same effect as an `INNER JOIN`. Listing C.8 shows the same `INNER JOIN` as Listing C.7, this time using the `WHERE` clause instead of the `INNER JOIN`.

Listing C.8 WHERE.TXT—A *WHERE* Clause Performing the Same Function as an *INNER JOIN*

```
'****************************************
'Select using WHERE to relate two tables
'****************************************
SELECT CS.Lastname, CS.Firstname, SL.Saleslast, SL.Salesfirst  _
    FROM Customers AS CS, Salesmen AS SL,  _
    WHERE CS.SalesID=SL.SalesID
```

Setting the Filter Criteria

One of the most powerful features of SQL commands is that you can control the range of records to be processed by specifying a filter condition. You can use many types of filters, such as `Lastname = "Smith"`, `Price < 1`, or `birthday between 5/1/94 and 5/31/94`. Although the current discussion is specific to the use of filters in the `SELECT` command, the principles shown here also work with other SQL commands, such as `DELETE` and `UPDATE`.

Filter conditions in a SQL command are specified using the `WHERE` clause. The general format of the `WHERE` clause is as follows:

`WHERE` *`logical-expression`*

There are four types of *predicates* (logical statements that define the condition) that you can use with the `WHERE` clause. These are shown in the following table:

Predicate	Action
Comparison	Compares a field to a given value
`LIKE`	Compares a field to a pattern (for example, `A*`)
`IN`	Compares a field to a list of acceptable values
`BETWEEN`	Compares a field to a range of values

Using the Comparison Predicate As its name suggests, the *comparison predicate* is used to compare the values of two expressions. There are six comparison operators (the symbols that describe the comparison type) that you can use; the operators and their definitions are summarized in Table C.3.

Table C.3 Comparison Operators Used in the *WHERE* Clause

Operator	Definition
<	Less than
<=	Less than or equal to
=	Equal to
>=	Greater than or equal to
>	Greater than
<>	Not equal to

Here is the generic format of the comparison predicate:

```
expression1 comparison-operator expression2
```

For all comparisons, both expressions must be of the same type (for example, both must be numbers or both must be text strings). Several comparisons of different types are shown in Listing C.9. The comparison values for strings and dates require special formatting. Any strings used in a comparison must be enclosed in single quotes (for example, `'Smith'` or `'AL'`). Likewise, dates must be enclosed between pound signs (for example, `#5/15/94#`). The quotes and the pound signs tell the Query engine the type of data that is being passed. Note that numbers do not need to be enclosed within special characters.

Listing C.9 COMPARE.TXT—Comparison Operators Used with Many Types of Data

```
'*******************************************************
'Comparison of text data using customer table as source
'*******************************************************
SELECT * FROM Customers WHERE Lastname='Smith'
'****************************************************
'Comparison of numeric data using Retail Items table
'****************************************************
SELECT * FROM [Retail Items] WHERE Retail<2
'****************************************
'Comparison of date data using Sales table
'****************************************
SELECT * FROM Sales WHERE Date>#8/15/94#
```

Using the *LIKE* Predicate With the `LIKE` predicate, you can compare an *expression* (that is, a field value) to a pattern. The `LIKE` predicate lets you make comparisons such as last names starts with *S*, titles containing *SQL*, or five-letter words starting with *M* and ending with *H*. You use the wild cards * and ? to create the patterns. The actual predicates for these comparisons would be `Lastname LIKE 'S*'`, `Titles LIKE '*SQL*'`, and `Word LIKE 'M???H'`, respectively.

The `LIKE` predicate is used exclusively for string comparisons. The format of the `LIKE` predicate is as follows:

`expression` `LIKE` *`pattern`*

The patterns defined for the `LIKE` predicate make use of wild-card matching and character-range lists. When you create a pattern, you can combine some of the wild cards and character lists to allow greater flexibility in the pattern definition. When used, character lists must meet three criteria:

- The list must be enclosed within square brackets.
- The first and last characters must be separated by a hyphen.
- The range of the characters must be defined in ascending order (for example, a z, and not z a).

In addition to using a character list to match a character in the list, you can precede the list with an exclamation point to indicate that you want to exclude the characters in the list. Table C.4 shows the type of pattern matching you can perform with the `LIKE` predicate. Listing C.10 shows the use of the `LIKE` predicate in several `SELECT` statements.

Table C.4 The *LIKE* Predicate Using a Variety of Pattern Matching

Wild Card	Used to Match	Example Pattern	Example Results
*	Multiple characters	S*	Smith, Sims, sheep
?	Single character	an?	and, ant, any
#	Single digit	3524#	35242, 35243
[list]	Single character in list	[c-f]	d, e, f
[!list]	Single character not in list	[!c-f]	a, b, g, h
combination	Specific to pattern	a?t*	art, antique, artist

Listing C.10 LIKE.TXT—Use the *LIKE* Predicate for Pattern-Matching

```
'****************************
'Multiple character wild card
'****************************
SELECT * FROM Customers WHERE Lastname LIKE 'S*'
'*************************
'Single character wild card
'*************************
SELECT * FROM Customers WHERE State LIKE '?L'
'***********************
```

```
'Character list matching
'************************
SELECT * FROM Customers WHERE MID$(Lastname,1,1) LIKE '[a-f]'
```

Using the *IN* Predicate The `IN` predicate lets you determine whether the expression is one of several values. Using the `IN` predicate, you can check state codes for customers to determine whether the customer's state matches a sales region. This example is shown in the following sample code:

```
SELECT * FROM Customers WHERE State IN ('AL', 'FL', 'GA')
```

Using the *BETWEEN* Predicate The `BETWEEN` predicate lets you search for expressions with values within a range of values. You can use the `BETWEEN` predicate for string, numeric, or date expressions. The `BETWEEN` predicate performs an *inclusive search*, meaning that if the value is equal to one of the endpoints of the range, the record is included. You can also use the `NOT` operator to return records outside the range. The form of the `BETWEEN` predicate is as follows:

```
expression [NOT] BETWEEN value1 AND value2
```

Listing C.11 shows the use of the `BETWEEN` predicate in several scenarios.

Listing C.11 BETWEEN.TXT—Using the *BETWEEN* Predicate to Check an Expression Against a Range of Values

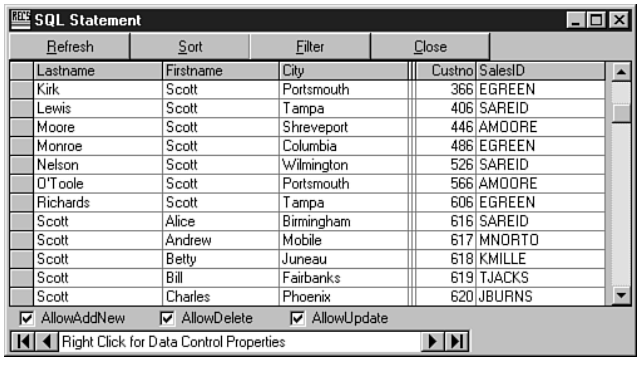
```
'*****************
'String comparison
'*****************
SELECT * FROM Customers WHERE Lastname BETWEEN 'M' AND 'W'
'******************
'Numeric comparison
'******************
SELECT * FROM [Retail Items] WHERE Retail BETWEEN 1 AND 2.5
'***************
'Date comparison
'***************
SELECT * FROM Sales WHERE Date BETWEEN #8/01/94# AND #8/10/94#
'************************
'Use of the NOT operator
'************************
SELECT * FROM Customers WHERE Lastname NOT BETWEEN 'M' AND 'W'
```

Combining Multiple Conditions The `WHERE` clause can also accept multiple conditions so that you can specify filtering criteria on more than one field. Each individual condition of the multiple conditions is in the form of the conditions described in the preceding sections on using predicates. These individual conditions are then combined using the logical operators `AND` and `OR`. By using multiple-condition statements, you can find all the Smiths in the Southeast, or you can find anyone whose first or last name is Scott. Listing C.12 shows the statements for these examples. Figure C.6 shows the recordset resulting from a query search for Scott.

Listing C.12—ANDOR.TXT—Combining Multiple *WHERE* Conditions with *AND* or *OR*

```
'********************************
'Find all Smiths in the Southeast
'********************************
SELECT * FROM Customers WHERE Lastname = 'Smith' AND   _
    State IN ('AL', 'FL', 'GA')
'**************************************************
'Find all occurrences of Scott in first or last name
'**************************************************
SELECT * FROM Customers WHERE Lastname = 'Scott' _
     OR Firstname = 'Scott'
```

FIGURE C.6
You can use multiple conditions to enhance a `WHERE` clause.



Lastname	Firstname	City	Custno	SalesID
Kirk	Scott	Portsmouth	366	EGREEN
Lewis	Scott	Tampa	406	SAREID
Moore	Scott	Shreveport	446	AMOORE
Monroe	Scott	Columbia	486	EGREEN
Nelson	Scott	Wilmington	526	SAREID
O'Toole	Scott	Portsmouth	566	AMOORE
Richards	Scott	Tampa	606	EGREEN
Scott	Alice	Birmingham	616	SAREID
Scott	Andrew	Mobile	617	MNORTO
Scott	Betty	Juneau	618	KMILLE
Scott	Bill	Fairbanks	619	TJACKS
Scott	Charles	Phoenix	620	JBURNS

Setting the Sort Conditions

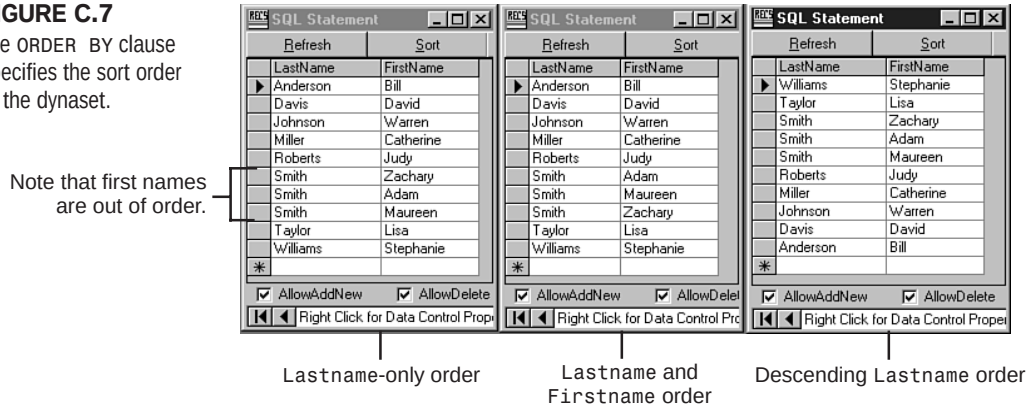
In addition to specifying the range of records to process, you can also use the `SELECT` statement to specify the order in which you want the records to appear in the output dynaset. The `SELECT` statement controls the order in which the records are processed or viewed. Sorting the records is done by using the `ORDER BY` clause of the `SELECT` statement.

You can specify the sort order with a single field or with multiple fields. If you use multiple fields, the individual fields must be separated by commas.

The default sort order for all fields is ascending (that is, A-Z, 0-9). You can change the sort order for any individual field by specifying the `DESC` keyword after the field name (the `DESC` keyword affects only the one field, not any other fields in the `ORDER BY` clause). Listing C.13 shows several uses of the `ORDER BY` clause. Figure C.7 shows the results of these `SELECT` statements.

NOTE When you're sorting records, the presence of an index for the sort field can significantly speed up the SQL query.

FIGURE C.7
The `ORDER BY` clause specifies the sort order of the dynaset.



Listing C.13 SORT.TXT—Specifying the Sort Order of the Output Dynaset

```
'*****************
'Single field sort
'*****************
SELECT * FROM Customers ORDER BY Lastname
'******************
'Multiple field sort
'******************
SELECT * FROM Customers ORDER BY Lastname, Firstname
'*********************
'Descending order sort
'*********************
SELECT * FROM Customers ORDER BY Lastname DESC, Firstname
```

Using Aggregate Functions

You can use the `SELECT` statement to perform calculations on the information in your tables by using the SQL *aggregate functions.* To perform the calculations, define them as a field in your `SELECT` statement, using the following syntax:

`function(expression)`

The expression can be a single field or a calculation based on one or more fields, such as `Quantity * Price` or `SQR(Datapoint)`. The `Count` function can also use the wild card * as the expression, because `Count` returns only the number of records. Table C.5 shows the 11 aggregate functions available in Microsoft SQL.

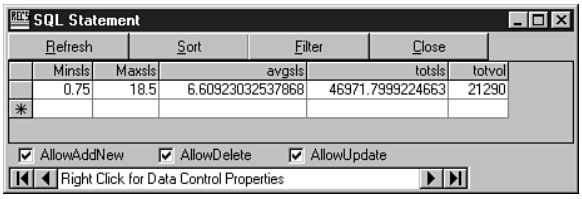
Table C.5 Aggregate Functions Provide Summary Information About Data in the Database

Function	Returns
`Avg`	The arithmetic average of the field for the records that meet the `WHERE` clause
`Count`	The number of records that meet the `WHERE` clause
`Min`	The minimum value of the field for the records that meet the `WHERE` clause
`Max`	The maximum value of the field for the records that meet the `WHERE` clause
`Sum`	The total value of the field for the records that meet the `WHERE` clause
`First`	The value of the field for the first record in the recordset
`Last`	The value of the field for the last record in the recordset
`StDev`	The standard deviation of the values of the field for the records that meet the `WHERE` clause
`StDevP`	The standard deviation of the values of the field for the records that meet the `WHERE` clause
`Var`	The variance of the values of the field for the records that meet the `WHERE` clause
`VarP`	The variance of the values of the field for the records that meet the `WHERE` clause

NOTE In Table C.5, `StDev` and `StDevP` seem to perform the same function. The same is true of `Var` and `VarP`. The difference between the functions is that the `StDevP` and `VarP` evaluate populations where `StDev` and `Var` evaluate samples of populations.

As with other SQL functions, these aggregate functions operate only on the records that meet the filter criteria specified in the `WHERE` clause. Aggregate functions are unaffected by sort order. Aggregate functions return a single value for the entire recordset unless the `GROUP BY` clause (described in the following section) is used. If `GROUP BY` is used, a value is returned for each record group. Listing C.14 shows the `SELECT` statement used to calculate the minimum, maximum, average, and total sales amounts, as well as the total item volume from the Sales table in the sample case. Figure C.8 shows the output from this query.

FIGURE C.8
The table shows the summary information from aggregate functions.



Minsls	Maxsls	avgsls	totsls	totvol
0.75	18.5	6.60923032537868	46971.7999224663	21290

Listing C.14 SUMMARY.TXT—Using Aggregate Functions to Provide Summary Information

```
SELECT Min(SL.Quantity * RT.Retail) AS Minsls,  _
     Max(SL.Quantity * RT.Retail) AS Maxsls,  _
     Avg(SL.Quantity * RT.Retail) AS Avgsls,  _
     Sum(SL.Quantity * RT.Retail) AS Totsls,  _
     Sum(SL.Quantity) AS Totvol  _
     FROM Sales AS SL, [Retail Items] AS RT  _
     WHERE SL.[Item Code]=RT.[Item Code]
```


Creating Record Groups

Creating record groups lets you create a recordset that has only one record for each occurrence of the specified field. For example, if your group the Customers table by state, you have one output record for each state. This arrangement is especially useful when combined with the calculation functions described in the preceding sections. When groups are used in conjunction with aggregate functions, you can easily obtain summary data by state, salesperson, item code, or any other desired field.

Most of the time, you want to create groups based on a single field. You can, however, specify multiple fields in the `GROUP BY` clause. If you do, a record is returned for each unique combination of field values. You can use this technique to get sales data by salesperson and item code. Separate multiple fields in a `GROUP BY` clause with commas. Listing C.15 shows an update of Listing C.14, adding groups based on the salesperson ID. Figure C.9 shows the results of the query.

Listing C.15 GROUP.TXT—Using the *GROUP BY* Clause to Obtain Summary Information for Record Groups

```
SELECT SL.SalesID, Min(SL.Quantity * RT.Retail) AS Minsls,  _
     Max(SL.Quantity * RT.Retail) AS Maxsls,  _
     Avg(SL.Quantity * RT.Retail) AS Avgsls,  _
     Sum(SL.Quantity * RT.Retail) AS Totsls,  _
     Sum(SL.Quantity) AS Totvol  _
     FROM Sales AS SL, [Retail Items] AS RT  _
     WHERE SL.[Item Code]=RT.[Item Code]  _
     GROUP BY SL.SalesID
```

FIGURE C.9
Using `GROUP BY` creates a summary record for each defined group.

SQL Statement

Refresh | Sort | Filter | Close

salesid	Minsls	Maxsls	avgsls	totsls	totvol
AMOORE	0.75	18.5	6.45120879097299	2935.29999989271	1329
BDANNO	0.75	18.5	6.52875492318346	3303.54999113083	1585
BWALSH	0.75	18.5	6.65022123308308	3005.89999735355	1364
CFIELD	0.75	18.5	6.59663043488627	3034.45000004768	1386
EGREEN	0.75	18.5	6.38790786060399	3328.09999537468	1556
JBURNS	0.75	18.5	6.64333957679724	3540.89999443293	1612
JTHOMA	0.75	18.5	6.70352821484689	3324.94999456406	1453
KMILLE	0.80000	18.5	6.59501132267673	2908.39999330044	1324
LEVANS	0.80000	18.5	6.60346151521573	3433.79998791218	1560
MADAMS	0.75	18.5	6.86575178471272	2876.74999779463	1262
MJOHNS	0.75	18.5	6.76488886766964	3044.19999045134	1349
MNORTO	0.75	18.5	6.85203159999094	3035.44999879599	1324
RSMITH	0.75	18.5	6.32583147234504	2852.94999402761	1331

☑ AllowAddNew ☑ AllowDelete ☑ AllowUpdate

Right Click for Data Control Properties

The `GROUP BY` clause can also include an optional `HAVING` clause. The `HAVING` clause works similarly to a `WHERE` clause but examines only the field values of the returned records. The `HAVING` clause determines which of the selected records to display; the `WHERE` clause determines which records to select from the base tables. You can use the `HAVING` clause to display only those salespeople with total sales exceeding $3,000 for the month. Listing C.16 shows this example; Figure C.10 shows the output from this listing.

Listing C.16 HAVING.TXT—The *HAVING* Clause Filters the Display of the Selected Group Records

```
SELECT SL.SalesID, Min(SL.Quantity * RT.Retail) AS Minsls,  _
     Max(SL.Quantity * RT.Retail) AS Maxsls,  _
     Avg(SL.Quantity * RT.Retail) AS Avgsls,  _
     Sum(SL.Quantity * RT.Retail) AS Totsls,  _
     Sum(SL.Quantity) AS Totvol  _
     FROM Sales AS SL, [Retail Items] AS RT  _
     SL INNER JOIN RT ON SL.[Item Code]=RT.[Item Code]  _
     GROUP BY SL.SalesID  _
     HAVING Sum(SL.Quantity * RT.Retail) > 3000
```

FIGURE C.10
The `HAVING` clause limits the display of group records.

SQL Statement

Refresh | Sort | Filter | Close

salesid	Minsls	Maxsls	avgsls	totsls	totvol
BDANNO	0.75	18.5	6.52875492318346	3303.54999113083	1585
BWALSH	0.75	18.5	6.65022123308308	3005.89999735355	1364
CFIELD	0.75	18.5	6.59663043488627	3034.45000004768	1386
EGREEN	0.75	18.5	6.38790786060399	3328.09999537468	1556
JBURNS	0.75	18.5	6.64333957679724	3540.89999443293	1612
JTHOMA	0.75	18.5	6.70352821484689	3324.94999456406	1453
LEVANS	0.80000	18.5	6.60346151521573	3433.79998791218	1560
MJOHNS	0.75	18.5	6.76488886766964	3044.19999045134	1349
MNORTO	0.75	18.5	6.85203159999094	3035.44999879599	1324
TJACKS	0.75	18.5	6.71896550881452	3507.29999560118	1566

☑ AllowAddNew ☑ AllowDelete ☑ AllowUpdate

Right Click for Data Control Properties

Creating a Table

In all the examples of the `SELECT` statement used earlier in this chapter, the results of the query were output to a dynaset or a snapshot. Because these recordsets are only temporary, their contents exist only as long as the recordset is open. After a close method is used or the application is terminated, the recordset disappears (although any changes made to the underlying tables are permanent).

Sometimes, however, you might want to permanently store the information in the recordset for later use. Do so with the `INTO` clause of the `SELECT` statement. With the `INTO` clause, you specify the name of an output table (and, optionally, the database for the table) in which to store the results. You might want to do this to generate a mailing-list table from your customer list. This mailing-list table can then be accessed by your word processor to perform a mail-merge function or to print mailing labels. Listing C.4, earlier in this chapter, generated such a list in a dynaset. Listing C.17 shows the same basic `SELECT` statement as was used in Listing C.4, but the new listing uses the `INTO` clause to store the information in a table.

Listing C.17—INTO.TXT—Using the *INTO* Clause to Save Information to a New Table

```
SELECT CS.Firstname & ' ' & CS.Lastname, CS.Address, ZP.City, _
    ZP.State, CS.ZIP INTO Mailings FROM Customers AS CS, _
    Zipcode IN USZIPS AS ZP WHERE CS.Zip = ZP.Zip
```

CAUTION

The table name you specify should be that of a new table. If you specify the name of a table that already exists, that table is overwritten with the output of the `SELECT` statement.

Using Parameters

So far in all of the clauses, you have seen specific values specified. For example, you specified 'AL' for a state of 1.25 for a price. But what if you don't know in advance what value you want to use in comparison? Well, this is precisely what parameters are used for in a SQL statement. The parameter is to the SQL statement what a variable is to a program statement. The parameter is a placeholder whose value is assigned by your program before the SQL statement is executed.

To use a parameter in your SQL statement, you first have to specify the parameter in the `PARAMETERS` declaration part of the statement. The `PARAMETERS` declaration comes before the `SELECT` or other manipulative clause in the SQL statement. The declaration specifies both the name of the parameter and its data type. The `PARAMETERS` clause is separated from the rest of the SQL statement by a semicolon.

After you have declared the parameters, you simply place them in the manipulative part of the statement where you want to be able to substitute a value. The following code line shows how a parameter would be used in place of a state ID in a SQL statement:

```
PARAMETERS StateName String; SELECT * FROM Customers
    WHERE State = StateName
```

When you go to run the SQL statement in your program, each parameter is treated like a property of the `QueryDef`. Therefore, you need to assign a value to each parameter before you use the `Execute` method. The following code shows you how to set the property value for the preceding SQL statement and open a recordset:

```
Dim OldDb As Database, Qry As QueryDef, Rset As Recordset
Set OldDb = DBEngine.Workspaces(0).OpenDatabase("C:\Triton.Mdb")
Set Qry = OldDb.QueryDefs("StateSelect")
Qry!StateName = "AL"
Set Rset = Qry.OpenRecordset()
```

As you can see, using parameters makes it easy to store your queries in the database and still maintain the flexibility of being able to specify comparison values at runtime.

SQL Action Statements

In the previous section, you saw how the `SELECT` statement can be used to retrieve records and place the information in a dynaset or table for further processing by a program. This was just one of the four manipulative statements that you defined earlier in this chapter. The three remaining statements are as follows:

- `DELETE FROM`—An action query that removes records from a table
- `INSERT INTO`—An action query that adds a group of records to a table
- `UPDATE`—An action query that sets the values of fields in a table

In the following sections, you take a look at how to use these statements to further refine that data that you are manipulating in a database via a SQL function.

Using the *DELETE* Statement

The `DELETE` statement is used to create an *action query*. The `DELETE` statement's purpose is to delete specific records from a table. An action query does not return a group of records into a dynaset as `SELECT` queries do. Instead, action queries work like program *subroutines*. That is, an action query performs its functions and returns to the next statement in the calling program.

The syntax of the `DELETE` statement is as follows:

```
DELETE FROM tablename [WHERE clause]
```

The `WHERE` clause is an optional parameter. If it is omitted, all the records in the target table are deleted. You can use the `WHERE` clause to limit the deletions to only those records that meet

specified criteria. In the WHERE clause, you can use any of the comparison predicates defined in the earlier section "Using the Comparison Predicate." Following is an example of the DELETE statement used to eliminate all customers who live in Florida:

```
DELETE FROM Customers WHERE State='FL'
```

CAUTION

After the DELETE statement is executed, the records are gone and can't be recovered. The only exception is if transaction processing is used. If you're using transaction processing, you can use a ROLLBACK statement to recover any deletions made since the last BEGINTRANS statement was issued.

Using the *INSERT* Statement

Like the DELETE statement, the INSERT statement is another action query. The INSERT statement is used in conjunction with the SELECT statement to add a group of records to a table. The syntax of the statement is as follows:

```
INSERT INTO tablename SELECT rest-of-select-statement
```

You build the SELECT portion of the statement exactly as explained in the first part of this chapter in the section "Using *SELECT* Statements." The purpose of the SELECT portion of the statement is to define the records to be added to the table. The INSERT statement defines the action of adding the records and specifies the table that is to receive the records.

One use of the INSERT statement is to update tables created with the SELECT INTO statement. Suppose that you're keeping a church directory. When you first create the directory, you create a mailing list for the current member list. Each month, as new members are added, you either can rerun the SELECT INTO query and re-create the table, or you can run the INSERT INTO query and add only the new members to the existing mailing list. Listing C.18 shows the creation of the original mailing list and the use of the INSERT INTO query to update the list.

Listing C.18 INSERT.TXT—Using the *INSERT INTO* Statement to Add a Group of Records to a Table

```
'*******************************
'Create a new mailing list table
'*******************************
SELECT CS.Firstname & ' ' & CS.Lastname, CS.Address, ZP.City, _
    ZP.State, CS.ZIP INTO Mailings FROM Members AS CS, _
    Zipcode IN USZIPS AS ZP WHERE CS.Zip = ZP.Zip
'***********************************
'Update the mailing list each month
'***********************************
INSERT INTO Mailings SELECT CS.Firstname & ' ' & CS.Lastname,  _
     CS.Address, ZP.City, ZP.State, CS.ZIP  _
     FROM Customers AS CS, Zipcode IN USZIPS AS ZP   _
     WHERE CS.Zip = ZP.Zip AND CS.Memdate>Lastmonth
```

Using the *UPDATE* Statement

The UPDATE statement is another action query. It is used to change the values of specific fields in a table. The syntax of the UPDATE statement is as follows:

```
UPDATE tablename SET field = newvalue [WHERE clause]
```

You can update multiple fields in a table at one time by listing multiple *field = newvalue* clauses, separated by commas. The inclusion of the WHERE clause is optional. If it is excluded, all records in the table are changed.

Listing C.19 shows two examples of the UPDATE statement. The first example changes the salesperson ID for a group of customers, as happens when a salesperson leaves the company and his or her accounts are transferred to someone else. The second example changes the retail price of all retail sales items, as can be necessary to cover increased operating costs.

Listing C.19 UPDATE.TXT—Using the *UPDATE* Statement to Change Field Values for Many Records at Once

```
'*******************************************
'Change the SalesID for a group of customers
'*******************************************
UPDATE Customers SET SalesID = 'EGREEN' WHERE SalesID='JBURNS'
'*******************************************************
'Increase the retail price of all items by five percent
'*******************************************************
UPDATE [Retail Items] SET Retail = Retail * 1.05
```

Using Data-Definition-Language Statements

Data-definition-language statements (DDLs) let you create, modify, and delete tables and indexes in a database with a single statement. For many situations, these statements take the place of the data-access-object methods described in Chapter 24, "Database Design and Normalization." However, there are some limitations to using the DDL statements. The main limitation is that these statements are supported only for Jet databases (remember that data-access objects can be used for any database accessed with the Jet engine). The other limitation of DDL statements is that they support only a small subset of the properties of the table, field, and index objects. If you need to specify properties outside of this subset, you must use the methods described in Chapter 24.

Defining Tables with DDL Statements

Three DDL statements are used to define tables in a database:

- CREATE TABLE—Defines a new table in a database
- ALTER TABLE—Changes a table's structure
- DROP TABLE—Deletes a table from the database

Creating a Table with DDL Statements To create a table with the DDL statements, you create a SQL statement containing the name of the table and the names, types, and sizes of each field in the table. The following code shows how to create the Orders table of the sample case:

```
CREATE TABLE Orders (Orderno LONG, Custno LONG, SalesID TEXT (6), _
    OrderDate DATE, Totcost SINGLE)
```

Notice that when you specify the table name and field names, you do not have to enclose the names in quotation marks. However, if you want to specify a name with a space in it, you must enclose the name in square brackets (for example, `[Last name]`).

When you create a table, you can specify only the field names, types, and sizes. You can't specify optional parameters such as default values, validation rules, or validation error messages. Even with this limitation, the DDL `CREATE TABLE` statement is a powerful tool that you can use to create many of the tables in a database.

Modifying a Table By using the `ALTER TABLE` statement, you can add a field to an existing table or delete a field from the table. When adding a field, you must specify the name, type, and (when applicable) the size of the field. You add a field using the `ADD COLUMN` clause of the `ALTER TABLE` statement. To delete a field, you only need to specify the field name and use the `DROP COLUMN` clause of the statement. As with other database-modification methods, you can't delete a field used in an index or a relation. Listing C.20 shows how to add and then delete a field from the Orders table created in the preceding section.

Listing C.20 ALTERTAB.TXT—Using the *ALTER TABLE* Statement to Add or Delete a Field from a Table

```
'**************************************************
'Add a shipping charges field to the "Orders" table
'**************************************************
ALTER TABLE Orders ADD COLUMN Shipping SINGLE
'*********************************
'Delete the shipping charges field
'*********************************
ALTER TABLE Orders DROP COLUMN Shipping
```

Deleting a Table You can delete a table from a database using the `DROP TABLE` statement. The following simple piece of code shows how to get rid of the Orders table. Use caution when deleting a table; the table and all its data are gone forever after the command has been executed.

```
DROP TABLE Orders
```

Defining Indexes with DDL Statements

Two DDL statements are designed especially for use with indexes:

- `CREATE INDEX`—Defines a new index for a table
- `DROP INDEX`—Deletes an index from a table

Creating an Index You can create a single-field or multi-field index with the `CREATE INDEX` statement. To create the index, you must give the name of the index, the name of the table for the index, and at least one field to be included in the index. You can specify ascending or descending order for each field. You can also specify that the index is a primary index for the table. Listing C.21 shows how to create a primary index on customer number and a two-field index with the sort orders specified. These indexes are set up for the Customers table of the sample case.

Listing C.21 CREATEIND.TXT—Create Several Types of Indexes with the *CREATE INDEX* Statement

```
'****************************************
'Create a primary index on customer number
'****************************************
CREATE INDEX Custno ON Customers (Custno) WITH PRIMARY
'*************************************************************
'Create a two field index with ascending order on Lastname and
'   descending order on Firstname.
'*************************************************************
CREATE INDEX Name2 ON Customers (Lastname ASC, Firstname DESC)
```

Deleting an Index Getting rid of an index is just as easy as creating one. To delete an index from a table, use the `DROP INDEX` statement as shown in the following example. These statements delete the two indexes created in Listing C.21. Notice that you must specify the table name for the index that you want to delete:

```
DROP INDEX Custno ON Customers
DROP INDEX Name2 ON Customers
```

Using SQL

As stated at the beginning of the chapter, you can't place a SQL statement by itself in a program. It must be part of another function. This part of the chapter describes the various methods used to implement the SQL statements.

Executing an Action Query

The Jet engine provides an execute method as part of the database object. The execute method tells the engine to process the SQL query against the database. An action query can be executed by specifying the SQL statement as part of the execute method for a database. An action query can also be used to create a `QueryDef`. Then the query can be executed on its own. Listing C.22 shows how both of these methods are used to execute the same SQL statement.

Listing C.22 EXECUTE.TXT—Run SQL Statements with the *DatabaseExecute* or *QueryExecute* Method

```
Dim OldDb AS Database, NewQry AS QueryDef
'*****************************************************
'Define the SQL statement and assign it to a variable
'*****************************************************
SQLstate = "UPDATE Customers SET SalesID = 'EGREEN'"
SQLstate = SQLstate + " WHERE SalesID='JBURNS'"
'****************************************
'Use the database execute to run the query
'****************************************
OldDb.Execute SQLstate
'***************************************
'Create a QueryDef from the SQL statement
'***************************************
Set NewQry = OldDb.CreateQueryDef("Change Sales", SQLstate)
'**************************************
'Use the query execute to run the query
'**************************************
NewQry.Execute
'*****************************************************
'Run the named query with the database execute method
'*****************************************************
OldDb.Execute "Change Sales"
```

Creating a *QueryDef*

Creating a `QueryDef` lets you name your query and store it in the database with your tables. You can create either an action query or a *retrieval query* (one that uses the `SELECT` statement). After the query is created, you can call it by name for execution (shown in a listing in the previous section "Executing an Action Query") or for creation of a dynaset (as described in the following section). Listing C.22 showed how to create a `QueryDef` called `Change Sales` that is used to update the salesperson ID for a group of customers.

Creating Dynasets and Snapshots

To use the `SELECT` statement to retrieve records and store them in a dynaset or snapshot, you must use the `SELECT` statement in conjunction with the `OpenRecordset` method. Using the `OpenRecordset` method, you specify the type of recordset with the options parameter. With this method, you either can use the `SELECT` statement directly or use the name of a retrieval query that you have previously defined. Listing C.23 shows these two methods of retrieving records.

Listing C.23 CREATEMETH.TXT—Using the Create Methods to Retrieve the Records Defined by a *SELECT* Statement

```
Dim OldDb As Database, NewQry As QueryDef, NewDyn As Recordset
Dim NewSnap As Recordset
'*******************************************************
'Define the SELECT statement and store it to a variable
'*******************************************************
SQLstate = "SELECT RI.[Item Description], SL.Quantity,"
SQLstate = SQLstate & " RI.Retail, _
     SL.Quantity * RI.Retail AS Subtot"
SQLstate = SQLstate & "FROM [Retail Items] AS RI, Sales AS SL"
SQLstate = SQLstate & "WHERE SL.[Item Code]=RI.[Item Code]"
'************************
'Create dynaset directly
'************************
Set NewDyn = OldDb.OpenRecordset(SQLstate, dbOpenDynaset)
'***************
'Create QueryDef
'***************
Set NewQry = OldDb.CreateQueryDef("Get Subtotals", SQLstate)
NewQry.Close
'******************************
'Create snapshot from querydef
'******************************
Set NewSnap = OldDb.OpenRecordset("Get Subtotals", dbOpenSnapshot)
```

You have seen how `SELECT` statements are used to create dynasets and snapshots. But, the comparison part of a `WHERE` clause and the sort list of an `ORDER BY` clause can also be used to set dynaset properties. The filter property of a dynaset is a `WHERE` statement without the `WHERE` keyword. When setting the filter property, you can use all the predicates described in the section "Using the *WHERE* Clause," earlier in this chapter. In a like manner, the sort property of a dynaset is an `ORDER BY` clause without the `ORDER BY` keywords.

Using SQL Statements with the Data Control

The data control uses the `RecordSource` property to create a recordset when the control is loaded. The `RecordSource` can be a table, a `SELECT` statement, or a predefined query. Therefore, the entire discussion on the `SELECT` statement (in the section "Using *SELECT* statements") applies to the creation of the recordset used with a data control.

NOTE When you specify a table name for the `RecordSource` property, Visual Basic uses the name to create a `SELECT` statement such as this:

```
SELECT * FROM table
```

Creating SQL Statements

When you create and test your SQL statements, you can program them directly into your code and run the code to see whether they work. This process can be very time-consuming and frustrating, especially for complex statements. There are, however, three easier ways of developing SQL statements that might be available to you:

- The Visual Data Manager Add-in that comes with Visual Basic
- Microsoft Access (if you have a copy)
- Microsoft Query

NOTE Users of Microsoft Excel or Microsoft Office also have access to Microsoft Query, the tool in Access.

The Visual Data Manager and Access both have query builders that can help you create SQL queries. They provide dialog boxes for selecting the fields to include, and they help you with the various clauses. When you have finished testing a query with either application, you can store the query as a `QueryDef` in the database. This query can then be executed by name from your program. As an alternative, you can copy the code from the query builder into your program, using standard cut-and-paste operations.

Using the Visual Data Manager

The Visual Data Manager is a Visual Basic add-in that allows you to create and modify databases for your Visual Basic programs. The Visual Data Manager also has a window that allows you to enter and debug SQL queries. And if you don't want to try to create the query yourself, VDM has a query builder that makes it easy for you to create queries by making choices in the builder.

NOTE If you want to learn about the inner workings of the Visual Data Manager, it is one of the sample projects installed with Visual Basic. The project file is VISDATA.VBP and is found in the VISDATA folder of the Samples folder.

To start the Visual Data Manager, simply select the Visual Data Manager item from the Add-Ins menu of Visual Basic. After starting the program, open the File menu and select the Open Database item; then select the type of database to open from the submenu. You are presented with a dialog box that allows you to open a database. After the database is opened, a list of the tables and queries in the database appears in the left window of the application. The Visual Data Manager with the Triton.Mdb database open is shown in Figure C.11.

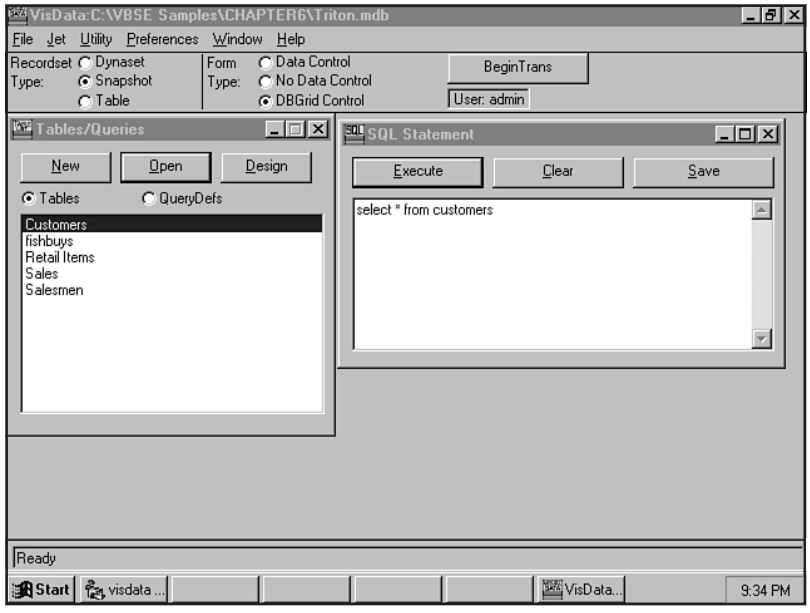


FIGURE C.11
You can use the Visual Data Manager Add-In to develop SQL queries.

To develop and test SQL statements, first enter the statement in the text box of the SQL dialog box (the one on the right in Figure C.11). When you're ready to test the statement, click the Execute SQL button. If you're developing a retrieval query, a dynaset is created and the results are displayed in a data entry form (or a grid) if the statement has no errors. If you're developing an action query, a message box appears, telling you that the execution of the query is complete (again, assuming that the statement is correct). If you have an error in your statement, a message box appears informing you of the error.

The Visual Data Manager Add-In also includes a Query Builder. You can access the Query Builder (shown in Figure C.12) by choosing Query Builder from the Utilities menu of the Visual Data Manager. To create a query with the Query Builder, follow these steps:

1. Select the tables to include from the Tables list.
2. Select the fields to include from the Fields to Show list.
3. Set the `WHERE` clause (if any) using the Field Name, Operator, and Value drop-down lists at the top of the dialog box.
4. Set the table `JOIN` conditions (if any) by clicking the Set Table Joins command button.
5. Set a single-field `ORDER BY` clause (if any) by selecting the field from the Order By Field drop-down box and selecting either the Asc or Desc option.
6. Set a single `GROUP BY` field (if any) by selecting the field from the Group By Field drop-down box.

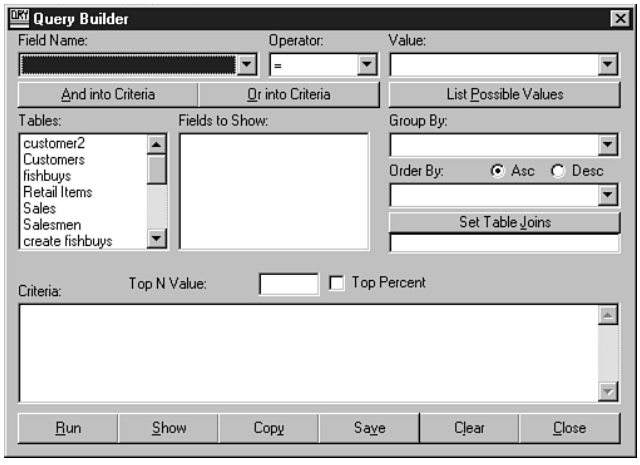


FIGURE C.12
The Query Builder makes it easy to build SQL statements.

After you have set the Query Builder parameters, you can run the query, display the SQL statement, or copy the query to the SQL statement window. The Query Builder provides an easy way to become familiar with constructing `SELECT` queries.

When you have developed the query to your satisfaction (either with the Query Builder or by typing the statement directly), you can save the query as a `QueryDef` in your database. In your Visual Basic code, you can then reference the name of the query you created. Alternatively, you can copy the query from Visual Data Manager and paste it into your application code.

Using Microsoft Access

If you have a copy of Microsoft Access, you can use its query builder to graphically construct queries. You can then save the query as a `QueryDef` in the database and reference the query name in your Visual Basic code.

One of more creative uses for Access is to reverse-engineer a `QueryDef`. Microsoft Access allows you to build a graphical representation of the tables and databases for a particular `QueryDef` entered in SQL format. This reverse-engineering process gives you a unique way to debug or make modifications graphically to an existing query.

Optimizing SQL Performance

Developers always want to get the best possible performance from every aspect of their applications. Wanting high performance out of SQL queries is no exception. Fortunately, there are several methods you can use to optimize the performance of your SQL queries.

Using Indexes

The Microsoft Jet database engine uses an optimization technology called Rushmore. Under certain conditions, Rushmore uses available indexes to try to speed up queries. To take maximum advantage of this arrangement, you can create an index on each of the fields you typically use in a `WHERE` clause or a `JOIN` condition. This is particularly true of key fields used to relate tables (for example, the `Custno` and `SalesID` fields in the sample database). An index also works better with comparison operators than with the other types of `WHERE` conditions, such as `LIKE` or `IN`.

NOTE Only certain types of queries are optimizable by Rushmore. For a query to use Rushmore optimization, the `WHERE` condition must use an indexed field. In addition, if you use the `LIKE` operator, the expression should begin with a character, not a wild card. Rushmore works with Jet databases and FoxPro and dBase tables. Rushmore does not work with ODBC databases.

Compiling Queries

Compiling a query refers to creating a `QueryDef` and storing it in the database. If the query already exists in the database, the command parser does not have to generate the query each time it is run, and this increases execution speed. If you have a query that is frequently used, create a `QueryDef` for it.

Keeping Queries Simple

When you're working with a lot of data from a large number of tables, the SQL statements can become quite complex. Complex statements are much slower to execute than simple ones. Also, if you have a number of conditions in `WHERE` clauses, this increases complexity and slows execution time.

Keep statements as simple as possible. If you have a complex statement, consider breaking it into multiple smaller operations. For example, if you have a complex `JOIN` of three tables, you might be able to use the `SELECT INTO` statement to create a temporary table from two of the three and then use a second `SELECT` statement to perform the final `JOIN`. There are no hard-and-fast rules for how many tables are too many or how many conditions make a statement too complex. If you're having performance problems, try some different ideas and find the one that works best.

Another way to keep things simple is to try to avoid pattern-matching in a `WHERE` clause. Because pattern-matching does not deal with discrete values, pattern-matching is hard to optimize. In addition, patterns that use wild cards for the first character are much slower than those that specifically define that character. For example, if you're looking for books about SQL, finding ones with *SQL* anywhere in the title (`pattern = "*SQL*"`) requires looking at every title in the table. On the other hand, looking for titles that start with *SQL* (`pattern = "SQL*"`) lets you skip over most records. If you had a Title index, the search would go directly to the first book on SQL.

Passing SQL Statements to Other Database Engines

Visual Basic has the capability of passing a SQL statement through to an ODBC database server such as SQL Server. When you pass a statement through, the Jet engine does not try to do any processing of the query, but it sends the query to the server to be processed. Remember, however, that the SQL statement must conform to the SQL syntax of the host database.

To use the pass-through capability, set the options parameter in the `OpenRecordset` or the execute methods to the value of the `dbSQLPassThrough` constant.

The project file, SQLDEMO.VBP, available from the Que Web site, contains many of the listings used in this chapter. Each listing is assigned to a command button. Choosing the command button creates a dynaset by using the SQL statement in the listing; the results are displayed in a data-bound grid. The form containing the grid also has a text box that shows the SQL statement. Download the file from `www.mcp.com/info`.

From Here...

This chapter has taught you the basics of using SQL in your database program. You have seen how to select records and how to limit the selection using the `WHERE` clause. You have also seen how SQL statements can be used to modify the structure of a database and how to use aggregate functions to obtain summary information.

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