Microsoft

MCTS

Exam 70-528

Evaluation software inside!
Microsoft Visual Studio® 2005

15%
EXAM DISCOUNT!
Limited time offer. Details inside.

Microsoft® .NET FRAMEWORK 2.0 Web-Based Client Development

Glenn Johnson and Tony Northrup

Self-Paced

Training Kit

PUBLISHED BY

Microsoft Press
A Division of Microsoft Corporation
One Microsoft Way
Redmond, Washington 98052-6399

Library of Congress Control Number 2006932076

ISBN-13: 978-0-7356-2334-7
ISBN-10: 0-7356-2334-1

Printed and bound in the United States of America.

1 2 3 4 5 6 7 8 9 QWT 1 0 9 8 7 6

Distributed in Canada by H.B. Fenn and Company Ltd.

A CIP catalogue record for this book is available from the British Library.

Microsoft Press books are available through booksellers and distributors worldwide. For further information about international editions, contact your local Microsoft Corporation office or contact Microsoft Press International directly at fax (425) 936-7329. Visit our Web site at www.microsoft.com/mspress. Send comments to tkinput@microsoft.com.

Acquisitions Editor: Ken Jones
Project Editor: Jenny Moss Benson
Editorial Production: nSight, Inc.
Copy Editor: Evan Gelder
Technical Reviewer: Thomas Keegan
Indexer: Nancy Guenther

Body Part No. X12-48741

About the Authors

Glenn Johnson

Glenn Johnson is a professional trainer, consultant, and developer whose experience spans the past 20 years. As a consultant and developer, he has worked on several large projects, the latest being a successful conversion of a SmallTalk/GemStone system to C#/Microsoft SQL Server for a very large customer. This is Glenn's third .NET-related book, and he has also developed courseware for and taught classes in many countries on Microsoft ASP.NET, Visual Basic .NET, C#, and the .NET Framework.

Glenn holds the following Microsoft Certifications: MCT, MCPD, MCTS, MCAD, MCSD, MCDBA, MCP + Site Building, MCSE + Internet, MCP + Internet, and MCSE. You can find Glenn's Web site at *http://GJTT.com*.

Tony Northrup

Tony Northrup, MCTS, MCSE, CISSP, and Microsoft MVP, is a consultant and author. He has written more than a dozen books covering Windows networking, security, and develop ment. Among other titles, Tony is coauthor of the MCSA/MCSE Self-Paced Training Kits for Exams 70-536 and 70-330/340.

When he's not consulting or writing, Tony enjoys cycling, hik ing, and nature photography. Tony lives in Phillipston, Massa chusetts, with his wife, Erica, his cat, Sam, and his dog, Sandi. You can learn more about Tony by visiting his Web site at *http://www.northrup.org*.

Chapter 1

Introducing the ASP.NET 2.0 Web Site

Microsoft Visual Studio 2005 and ASP.NET 2.0 represent a major release for Microsoft. If you have previous experience with Visual Studio products, you will see the differences immediately when you attempt to create your first Web site. Even if you are new to Visual Studio 2005 and ASP.NET 2.0, you will be able to immediately take advantage of the productivity enhancements.

This chapter starts by introducing the Web site players (Web server, Web browser, and Hypertext Transfer Protocol [HTTP]). It explores the architecture of an ASP.NET Web site and then shows the various ways that you can create a Web site. After that, you will learn about some of the Web site configuration options in Visual Studio 2005.

Exam objectives in this chapter:

- Program a Web application.
  - Avoid performing unnecessary processing on a round trip by using a page's *IsPostBack* property.
- Create and configure a Web application.
  - Create a new Web application.
  - Add Web Forms pages to a Web application.
- Configure settings for a Web application.
  - Configure system-wide settings in the Machine.config file.
  - Configure settings for a Web application in the application's Web.config file.
  - Manage a Web application's configuration by using the Web Site Adminis tration Tool.
- Optimize and troubleshoot a Web application.
  - Troubleshoot a Web application by using ASP.NET Trace.

Lessons in this chapter:

Before You Begin

To complete this chapter, you must:

- Be familiar with Microsoft Visual Basic or C#.
- Have Microsoft Windows XP, Internet Information Services (IIS) 5.1, and Visual Studio 2005 installed with Microsoft SQL Server 2005 Express Edition.
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Understand how to make assemblies available to other applications.
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.

Real World

Glenn Johnson

It's easier to learn how to develop Web clients once you understand who the players are. I have seen many people attempt to learn Web development without learning the roles of the Web browser, HTTP, and the Web server. It's not a pretty sight.

Lesson 1: Understanding the Players

It's important to get an understanding of the roles of the Web server, Web browser, and HTTP before starting your Web development. The typical communication pro cess can be generalized into the following steps:

1. The Web browser initiates a request for a Web server resource.
2. HTTP is used to send the GET request to the Web server.
3. The Web server processes the request.
4. The Web server sends a response to the Web browser. HTTP protocol is used to send the HTTP response to the Web browser.
5. The Web browser processes the response, displaying the Web page.
6. The user enters data and performs an action, such as clicking a Submit button that causes the data to be sent back to the Web server.
7. HTTP is used to POST the data back to the server.
8. The Web server processes the data.
9. The Web server sends the response back to the Web browser.
10. HTTP is used to send the HTTP response to the Web browser.
11. The Web browser processes the response, displaying the Web page.

This section gives a brief description of how the Web browser exchanges communica tions with the Web server via HTTP. It also describes the responsibilities of both the Web browser and Web server.

After this lesson, you will be able to:

- Describe the Web server's role in responding to requests for resources.
- Describe the Web browser's role in collecting and presenting data to the user.
- Describe HTTP's role in communicating to the Web server.
- Describe how HTTP verbs are used to request resources from the Web server.
- Describe the status-code groups that are implemented in HTTP.
- Describe Distribute Authoring and Versioning.
- Describe *PostBack*, the common method of sending data to the Web server.
- Describe some methods for troubleshooting HTTP.

Estimated lesson time: 30 minutes

The Web Server's Role

Let's start with the *Web server*. The original Web servers were responsible for receiving and handling *requests* from the browsers via HTTP. Each Web server handled the request and sent a *response* back to the Web browser. After that, the Web server closed the connection and released all resources that were involved in the request. All resources were released because the Web server needed to be able to handle thou sands of requests per minute, and the original Web pages were simple, static HTML pages. The Web environment was considered to be "stateless" because no data was held at the Web server between Web browser requests, and because the connection was closed after the response was sent (see Figure 1-1).

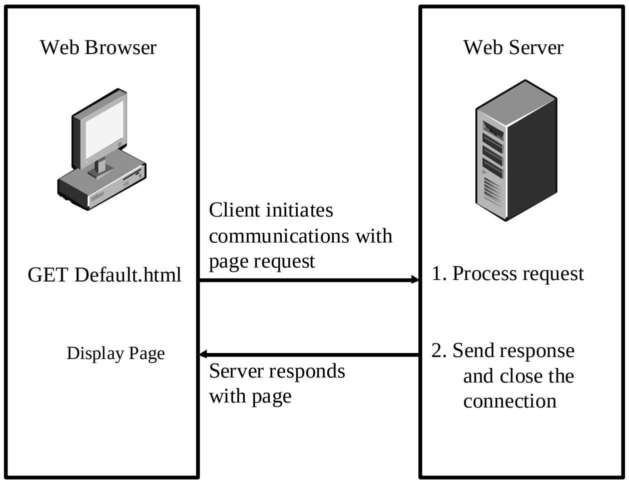

Web Browser
Web Server
Client initiates communications with page request
GET Default.html
1. Process request
Display Page
2. Send response and close the connection
Server responds with page

Figure 1-1 A simple request/response between Web browser and Web server in a stateless environment.

Today's Web servers deliver services that go far beyond the original Web servers. In addition to serving static HTML files, the Web servers can also handle requests for pages that contain code that will execute at the server; the Web servers will respond with the results of code execution, as shown in Figure 1-2. Web servers also have the ability to store data across Web page requests, which means that Web pages can be connected to form Web applications. Because many Web sites are set up as Web appli cations containing many Web pages, the idea of a Web server delivering a single page to the Web browser and closing the connection is rather outdated. Web servers now implement "keep alive" features for connections that make the Web servers keep the connections to the Web browsers open for a period of time with anticipation of addi tional page requests from a Web browser.

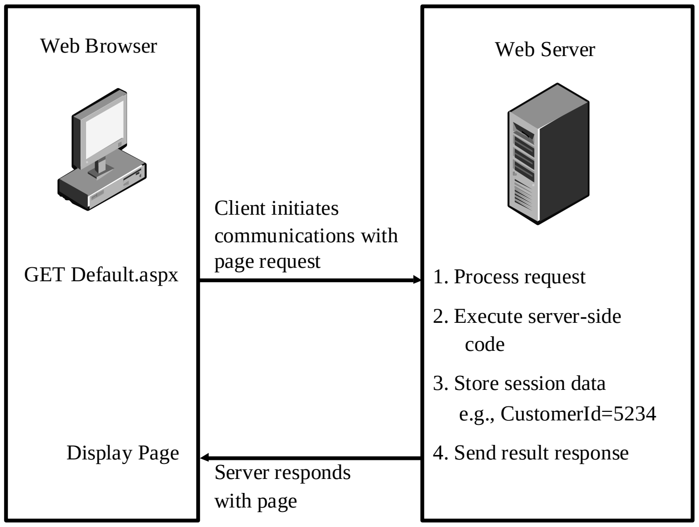

Web Browser
Web Server
Client initiates communications with page request
GET Default.aspx
1. Process request
2. Execute server-side code
3. Store session data e.g., CustomerId=5234
Display Page
4. Send result response
Server responds with page

Figure 1-2 Web servers now store state between page requests to enable the creation of Web applications.

The Web Browser's Role

The *Web browser* provides a platform-independent means of displaying Web pages that were written with HTML. Platform-independent means that HTML was designed to be able to render within any operating system while placing no constraint on the window size. HTML was designed to "flow," wrapping text as necessary to fit into the browser window. The Web browser also needs to display images and respond to hyperlinks. Each Web page request to the Web server results in the Web browser clearing the browser screen and displaying the new Web page.

Although the Web browser's role is simply to present data and collect data, many new client-side technologies enable today's Web browsers to execute code such as Java-Script and to support plug-ins which improve the user's experience. Technologies such as Asynchronous JavaScript and XML (AJAX) allow the Web browsers to talk to the Web servers without clearing the existing Web pages from the browser window. These technologies make the user experience much better and more robust than the user experience provided by the original Web browsers.

Understanding Hypertext Transfer Protocol's Role

HTTP is a text-based communication protocol that is used to request Web pages from the Web server and send responses back to the Web browser. HTTP messages are typically sent between the Web server and Web browser using port 80, or, when using secure HTTP (HTTPS), port 443.

MORE INFO HTTP/1.1 Specification

For more information on HTTP/1.1, see the HTTP/1.1 specification at *http://www.w3.org/Protocols/rfc2616/rfc2616.html*.

When a Web page is requested, a textual command like the following is sent to the Web server:

```
GET /default.aspx HTTP/1.1
Host: www.northwindtraders.com
```

Notice that the first line contains the *method*, also known as a verb or a command, called *GET*, and is followed by the Uniform Resource Locator (URL) of the Web page to be retrieved, which is followed by an indicator of the HTTP version to be used. The method indicates what action is to be performed by the Web server using the URL that follows the method. Table 1-1 contains a list of some of the common HTTP meth ods with a description of their uses. Note that, if *Distributed Authoring and Versioning (DAV)* is enabled on the Web site, many more verbs will be available, such as *LOCK* and *UNLOCK*.

The second line identifies the name of the host that may be used by the Web server if the Web server is hosting more than one Web site. This process is known as using host headers to identify the Web site that will handle the request(s).

Table 1-1 Common HTTP/1.1 Methods

HTTP Method	Description
OPTIONS	Used by client applications to request a lists of all supported verbs. Checks to see if a server allows a particular verb before wasting net work bandwidth trying to send an unsupported request.
GET	Gets a URL from the server. A *GET* request for a specific URL, say, /test.htm, retrieves the test.htm file. Data retrieved using this verb is typically cached by the browser. *GET* also works with collections, such as those in directories that contain collections of files. If you request a directory, the server can be configured to return a default file, such as index.html, that may be representative of the directory.

Table 1-1 Common HTTP/1.1 Methods

HTTP Method	Description
HEAD	Retrieves the meta information for a resource. This information is typ ically identical to the meta information sent in response to a *GET* request, but the *HEAD* verb never returns the actual resource. The meta information is cacheable.
POST	Used to create a new, dynamically named resource. Data retrieved using this verb is typically not cached.
PUT	Allows a client to directly create a resource at the indicated URL on the server. The server takes the body of the request, creates the file specified in the URL, and copies the received data to the newly cre ated file. If the file exists and is not locked, the content of the file will be overwritten.
DELETE	Used to delete a resource at the Web server. Requires write permis sions on the directory.
TRACE	Used for testing or diagnostics; allows the client to see what is being received at the other end of the request chain. Responses to this method are never cached.
CONNECT	Reserved for use with a proxy that can dynamically switch to being a tunnel, such as Secure Socket Layer (SSL) protocol.
DEBUG	Is not defined in the HTTP/1.1 specification, but is used to start ASP.NET debugging. Informs Visual Studio 2005 of the process that the debugger will attach to.

Notice that Web-browser-to-Web-server communication is referred to as a *request*. In ASP.NET, the *Request* object represents the Web browser's communications to the Web server asking for a resource.

What Is Distributed Authoring and Versioning?

Distributed Authoring and Versioning (DAV) is a set of extensions to HTTP/1.1 that simplifies Web site development when working in a team scenario. DAV is an open standard and is available on numerous platforms. DAV provides the ability to lock and unlock files plus the ability to designate versions.

DAV is built directly on HTTP/1.1, so no other protocols, such as File Transfer Pro tocol (FTP) or Server Message Block (SMB), are required. DAV also provides the ability to query the Web server for various resource properties such as file names, time stamps, and sizes. DAV also gives the developers the ability to perform server-side file copying and moving. For example, you can use the HTTP *GET* and *PUT* verbs to retrieve files from the Web servers and save them to different loca tions, or you can use the DAV's *COPY* verb to simply tell a server to copy the file.

The communication from the Web server back to the Web browser is commonly referred to as the *response*. In ASP.NET this is represented as the *Response* object. When the Web server responds to a request, the communication is typically in the fol lowing text-based format:

```
HTTP/1.1 200 OK
Server: Microsoft-IIS/6.0
Content-Type: text/html
Content-Length: 38
<html><body>Hello, world.</body><html>
```

The first line contains the protocol and version information, plus a status-code and reason. The three-digit status codes are grouped as shown in Table 1-2.

Exam Tip Even if you don't memorize every status code, it's helpful to know the five status-code groupings in Table 1-2.

Table 1-2 Status-Code Groups

Status-Code Group	Description
1xx	Informational: Request received, continuing to process.
2xx	Success: The action was successfully received, understood, and accepted.
3xx	Redirect Command: Further action must be taken in order to com plete the request.
4xx	Client Error: The request has a syntax error or the server does not know how to fulfill the request.
5xx	Server Error: The server failed to fulfill a request that appears to be valid.

In addition to the status-code groups, HTTP/1.1 defines unique status-codes and rea sons. (A reason is nothing more than a very brief description of the status-code.) Table 1-3 shows a list of the common status-codes and reasons. Reason text can be modified without breaking the protocol.

Table 1-3 Common Status-Codes and Reasons

Status-Code	Reason
100	Continue
200	OK
201	Created
300	Multiple Choices
301	Moved Permanently
302	Found
400	Bad Request
401	Unauthorized
403	Forbidden
404	Not Found
407	Proxy Authentication Required
408	Request Time-out
413	Request Entity Too Large
500	Internal Server Error
501	Not Implemented

The second line of the response indicates the type of Web server. The third line (Con tent-Type) indicates the type of resource that is being sent to the Web browser. This indicator is in the form of a *Multipurpose Internet Mail Extensions* (MIME) type. In this case, the file is a static HTML text file. The MIME type is a two-part designator "type/ subtype," in which the first part is the resource type and the second part is the resource subtype. Some common types are shown in Table 1-4.

Table 1-4 Common MIME Types

MIME Type	Description
text	Textual information. No special software is required to get the full meaning of the text, aside from support for the indicated character set. One subtype is *plain*, which means that the text can be read without requiring additional software. Other subtypes are *html* and *xml*, which indicate the appropriate file type(s).
image	Image data. Requires a display device (such as a graphical display or a graphics printer) to view the information. Subtypes are defined for two widely used image formats, *jpeg* and *gif*.
audio	Audio data. Requires an audio output device (such as a speaker or headphones) to "hear" the contents. An initial subtype called *basic* is defined for this type.
video	Video data. Requires the capability to display moving images, typi cally including specialized hardware and software. An initial sub type called *mpeg* is defined for this type.
application	Other kinds of data, typically either uninterpreted binary data or information to be processed by an application. The subtype, called *octet-stream,* is to be used in the case of uninterpreted binary data, in which the simplest recommended action is to offer to write the information into a file for the user. The *PostScript* subtype is also defined for the transport of PostScript material.

MORE INFO MIME Types

The registry contains a list of MIME types/subtypes at the following location:

HKEY_CLASSES_ROOT\MIME\Database\Content Type.

After the content-length line, the response message is returned. This message is based on the MIME type. The browser attempts to handle the message based on its MIME type.

Submitting Form Data to the Web Server

The HTML <form> tag can be used to create a Web form that collects data and sends the data to the Web server. A typical use of <form> tag is as follows.

```
<form method="POST" action = "getCustomer.aspx" >
    Enter Customer ID:
    <input type="text" name="Id">
    <input type="submit" value="Get Customer">
</form>
```

This form prompts for a Customer ID, displays a text box that collects the desired cus tomer ID, and also displays a submit button that initiates the sending of data to the Web server. The method of the form indicates the HTTP verb to use when sending the data to the server. The action is the relative URL of the resource that the data will be sent to.

There are two HTTP methods that can be used to submit the form data back to the Web server: *GET* and *POST*. When the *GET* verb is used, the *QueryString* containing the data is appended to the URL. The QueryString is a collection of key=value state ments, separated by ampersand (&) characters that can be passed to the Web server by concatenating a question mark (?) to the end of the URL, and then concatenating the QueryString as follows:

```
GET /getCustomer.aspx?Id=123&color=blue HTTP/1.1
Host: www.northwindtraders.com
```

In this example, a *GET* request is made to the Web server for a Web page called get-Customer.aspx on the root of the Web site, and the QueryString contains the data that follows the question mark (?). An advantage to using the *GET* verb is that the com plete URL and QueryString can be seen and modified in the address bar of the Web browser as needed. Keep in mind that, depending on the scenario, this could also be a disadvantage. The complete URL and QueryString are easy to save as a unit. For example, you can bookmark a Web page that has data that is included in the Query-String. One disadvantage is that the QueryString is limited in size by the Web browser and Web server being used. For example, when using Microsoft Internet Explorer and IIS, the limit is 1024 characters. Another consideration is that you may not want to allow a user to type the URL and QueryString directly into the address bar without navigating through other Web pages first.

When the *POST* verb is used to submit data back to the Web server, the data is placed into the message body as follows:

```
POST /getCustomer.aspx HTTP/1.1
Host: www.northwindtraders.com

Id=123&color=blue
```

Using the *POST* verb removes the size constraint on the data. We posted more than 10 megabytes of data to see if the Web server would accept the data. It worked, but send ing that much data across the Internet can cause other problems, primarily band width-related, such as timeout errors and performance problems. The *POST* verb does not allow the user to simply type the data, because this data is hidden in the message body. In most scenarios, using the *POST* verb is the more desirable way to send data to the Web server.

Sending data back to the server is often referred to as a *PostBack* to the server. Although its name comes from the *POST* verb, it is possible to perform a PostBack using the *GET* method described above. An ASP.NET Web page contains a property called *IsPostBack* that is used to determine if data is being sent back to the Web server or if the Web page is simply being requested.

HTTP Troubleshooting

You can easily view the exchange of HTTP messages by using a network sniffer. The sniffer captures all packets between the Web browser and the Web server, and you can simply view the packet data to read messages such as the requests and responses described in this section.

Real World

Glenn Johnson

I always keep Microsoft Network Monitor, which is a network packet sniffer that is included with Microsoft Server Opererating Systems and Microsoft Systems Management Server (SMS), installed on my computer so I can readily run this application to see the packet-by-packet conversation between my computer and other computers on the network. This is probably the best way to understand what’s happening because you see the raw data packets that were exchanged.

Another tool that you can use for HTTP diagnostics is Telnet. Telnet is nothing more than a terminal emulator that sends and receives textual data on port 23, but you can specify port 80 to communicate to the Web server. With Telnet, you can type the HTTP commands and view the results.

There are also many applications you can download from the Internet to troubleshoot and analyze HTTP. Simply type **HTTP** as the keyword in a search on the site *http://www.download.com* to get a list of such applications.

Quick Check

1. What protocol is used to communicate between the Web browser and the Web server?
2. In ASP.NET, what does the *Request* object represent?
3. In ASP.NET, what does the *Response* object represent?

Quick Check Answers

1. HTTP
2. The *Request* object represents the communication from the Web browser to the Web server.
3. The *Response* object represents the communication from the Web server to the Web browser.

Lab: Exploring HTTP

In this lab, you explore the HTTP by using Telnet, which is the terminal emulation application that is built into Windows XP.

� **Exercise 1: Starting and Configuring Telnet**

In this exercise, you start Telnet and configure it to work with HTTP.

1. Open a command prompt. Do so by selecting Start | All Programs | Accessories | Command Prompt.
2. Clear the screen. Type the following command to clear the screen:

```
CLS
```

3. Start Telnet. In the command prompt window, type the following command to start the Telnet client:

```
Telnet.exe
```

4. **Configure Telnet to echo type characters.** Type the following command into the Telnet window, which will cause locally typed characters to be displayed while you type them:

```
set localecho
```

Telnet will respond with the following:

```
Local echo on
```

5. **Set carriage return and line feed to On.** Type the following command to instruct Telnet that it should treat the Enter key as a combination of carriage return and line feed.

```
set crlf
```

Telnet will respond with the following:

```
New line mode - Causes return key to send CR & LF
```

� **Exercise 2: Communicating with a Web Site**

In this exercise, you connect to a Web site, request the default page, and observe the result.

NOTE Take your time

In this section, if you mistype a command, you will need to start over, so take your time entering each command.

1. In this exercise, you will open a connection to a Web site. Type the following command into the Telnet command window to open a connection to GJTT.com on port 80:

```
o GJTT.com 80
```

The Web server responds with the following:

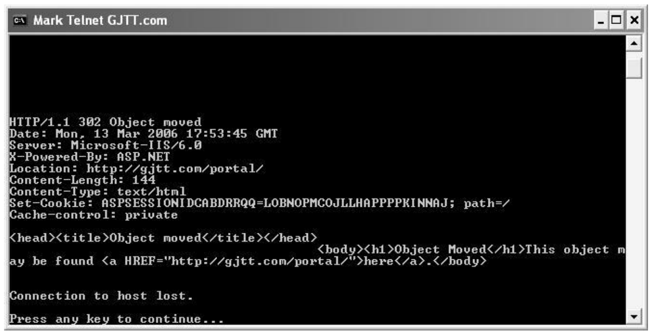
```
Connecting To GJTT.com...
```

Note that this Telnet will not indicate that you are indeed connected.

2. Press the Enter key until the cursor is positioned on the next line.
3. Attempt to *GET* the default page. Type the following lines. After typing the sec ond line, press the Enter key two times; this indicates the end of message to the Web server.

```
GET / HTTP/1.1
Host: GJTT.com
```

After pressing the Enter key two times, you will see the result shown in Figure 1 3. Notice that the status-code is 302 with a reason of Object Moved. The message body contains HTML with a hyperlink to the new location.



```
HTTP/1.1 302 Object moved
Date: Mon, 13 Mar 2006 17:53:45 GMT
Server: Microsoft-IIS/6.0
X-Powered-By: ASP.NET
Location: http://gjtt.com/portal/
Content-Length: 144
Content-Type: text/html
Set-Cookie: ASPSESSIONIDCABDRRQQ=LOBNOPMCOJLLHAPPPPKINNAJ; path=/
Cache-control: private

<head><title>Object moved</title></head>
                                        <body><h1>Object Moved</h1>This object m
ay be found <a HREF="http://gjtt.com/portal/">here</a>.</body>


Connection to host lost.

Press any key to continue...
```

Figure 1-3 The response is a result code that indicates a redirect.

4. Try other sites. After pressing the Enter key, you will be back at the Telnet com mand prompt. Repeat the steps in this exercise to connect to other Web sites.

Lesson Summary

- The Web server is responsible for accepting a request for a resource and sending a response.
- The Web browser is responsible for displaying data to the user, collecting data from the user, and sending data to the Web server.
- HTTP is a text-based communication protocol that is used to communicate between Web browsers and Web servers, using port 80.
- Secure HTTP (HTTPS) uses port 443.
- Each HTTP command contains a method that indicates the desired action. Com mon methods are *GET* and *POST*.
- Sending data to the Web server is commonly referred to as a PostBack.
- You can troubleshoot HTTP by using the Telnet application or a packet sniffer.

Lesson 2: Creating a Web Site and Adding New Web Pages

This lesson presents methods that will help you create a new Web site using Visual Studio 2005. When you create a new Web site, you will be presented with options that are important for you to understand. You will learn how Visual Studio 2005 makes it easy to create the new Web site and add new Web pages.

After this lesson, you will be able to:

- Create a new Web site within Visual Studio 2005.
- Add new Web pages, which are also known as Web Forms, to a Web site.

Estimated lesson time: 60 minutes

Understanding the Visual Studio 2005 Web Site Types

Before creating your first Web site in Visual Studio 2005, let's look at the general archi tecture of a Web site. In Visual Studio 2005, the project structure has been changed to more accurately reflect the way Web Applications are typically constructed. Web projects are now called "Web Sites." You now have several options for running and testing your Web site, based on the type of Web site that you have. A new Web site can be file-based, FTP-based, local HTTP-based, or remote HTTP-based. These options simplify the system requirements on the developer's machine. Listed below is a description of each of the options.

NOTE .NET 2.0

The Web site types are new in .NET 2.0.

- **File** The file-based Web site consists of a folder, or folder structure, that con tains all of the files for the Web site. This Web site uses the lightweight ASP.NET development server that is included in Visual Studio 2005, and does not use or require IIS on the local machine.
- **FTP** The FTP-based Web site is used when you want to use FTP to manage the files on a local or remote Web site. This option is more frequently used when your Web site is hosted on a remote computer and your access to the files and folders on your Web site is via FTP instead of through Front Page Server Extensions.

- **Local HTTP** The local HTTP-based Web site is used when you are working with IIS on your local machine. This Web site may be configured at the root of the IIS Web Server, or in a virtual directory that is configured as an application.
- **Remote HTTP** The remote HTTP-based Web site is used when you have a remote site that is hosted on a remote server and gives you access to your Web files via Front Page Server Extensions.

The Visual Studio 2005 Solution Files

When a Web site is created, a solution file (.sln) and a hidden solution user options file (.suo) are created. By default, these files are created in the My Documents\Visual Studio 2005\Projects folder. The solution file is a text file that contains information such as the following:

- A list of the projects that are to be loaded into Visual Studio 2005
- A list of project dependencies
- Microsoft Visual SourceSafe information
- A list of add-ins that are available

The solution user options file is a binary file that contains various user settings related to the Integrated Development Environment (IDE), such as the following:

- The task list
- Debugger break points and watch window settings
- Visual Studio window locations

Note that the solution files are not located in your Web site's folder because they are Visual Studio 2005–specific and are not required in the deployed Web site. Also, a solu tion may contain many Web sites and Visual Studio projects, so it's best to keep the solu tion files in an independent folder. Solution files also can be developer-specific, meaning that developers may want to configure solution files based on their preferences.

Looking at the ASP.NET Page Structure

When an ASP.NET Web page is created, it must have an *.aspx* extension. The typical Web page is composed of three sections: page directives, code, and page layout. These sections are defined as follows:

- **Page Directives** This section is used to set up the environment, specifying how the page should be processed. For example, this is where you can import namespaces and load assemblies.
- **Code** This section contains code to handle events from the page or its controls. Code can be placed in a <script> tag. By default, script blocks contain client-side code but they may be designated as being server-side code by including the *runat="server"* attribute in the <script> tag. As a side note, code can also be con tained in attached files, called code-behind files. All page code is compiled prior to execution. In addition, all pages can be precompiled to an assembly if the assembly is the only file that needs to be deployed.
- **Page Layout** The page layout is the HTML of the page, which includes the HTML body and its markup. The body can contain client and server controls as well as simple text.

A simple Web page may look like the following.

```
<!—page directives-->
<%@ Page Language="VB" %>
 <!--script-->
<script runat="server">
    Private Sub SayHi(ByVal sender As Object, ByVal args As EventArgs)
        Response.Write("Hello " + txtName.Value)
    End Sub
</script>

<!--layout-->
<html>
<head>
    <title>Say Hi Page</title>
</head>
<body>
    <form id="form1" runat="server">
     <input runat="server" id="txtName" type="text" />
     <input runat="server" id="btnSayHi" type="button"
        value="Say Hi" onserverclick="SayHi" />
    </form>
</body>
</html>
```

Notice the *runat="server"* attribute that is used. For the script block, this indicates that the code will run at the server. For the form and its controls, this indicates that ASP.NET will create server-side objects to match these HTML tags. A server-side object is capable of running server-side code and raising server-side events.

In-Line versus Code-Behind Programming Model

The previous Web page contains all the code and markup in a single file. This is called in-line programming. Although this model is simple, and might be a logical model to choose when you are converting an ASP application (that also has all of its code in a single file) to ASP.NET, new applications should always be implemented with the code-behind programming model. The code-behind programming model is always the preferred model because it provides clean separation between the client-side code and the server-side code.

The code-behind programming model adds another file to the Web page that is called the code-behind page. The code-behind page contains the server-side code, thus sep arating server-side code from the client-side code and markup.

NOTE .NET 2.0

Partial classes are new to ASP.NET version 2.0. The implementation of partial classes allowed the dynamic compilation to change in ASP.NET 2.0.

The code-behind files in ASP.NET 2.0 use a new language feature called partial classes, which allow code-behind files to be dynamically compiled with their associated ASPX pages into a single class type. This means you no longer need to declare member vari ables in the code-behind page for each control. This greatly simplifies maintenance of sites that use this code-separation technique.

Dynamic Web Site Compilation

ASP.NET 2.0 implements a new dynamic Web site compilation model. In ASP.NET 2.0, the code is not compiled until it is required by a user accessing your site. With dynamic compilation, the Web site doesn't produce a deployable executable assem bly as its output when it is built in Visual Studio 2005. Instead, each page is compiled when it is requested. The compiled page has a dependency on the source file's time stamp. If the source code is changed, the page is recompiled the next time it is requested. Dynamic compilation offers the following advantages:

- The entire application does not need to be recompiled every time a change is made to a single page or component, which is especially great news to develop ers of large Web sites. Remember that each page is recompiled as needed based on the timestamp of the source code files.

- Pages that contain compile errors do not prevent other pages in the Web site from running. This means that you can test Web sites that contain pages still in development.

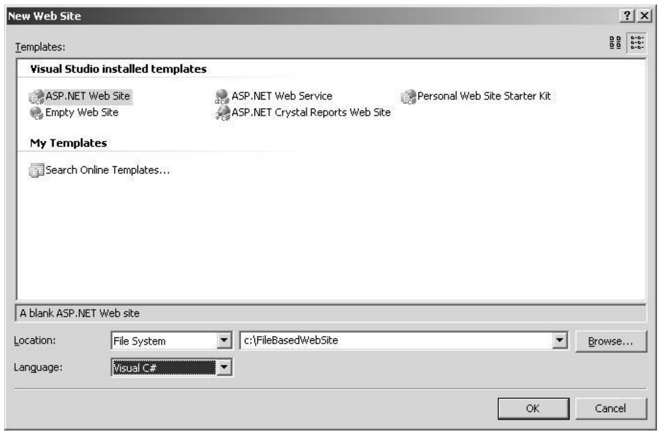
In Visual Studio 2005, when you compile a Web site, the Web site still gets built, but there is now verification that all the pages and their dependencies can be compiled. No assembly is created for running the Web site. Compiling in Visual Studio 2005 is more rigorous than in earlier versions of Visual Studio .NET because Visual Studio now verifies that the code can be compiled and finds errors in the markup syntax and Web.config file.

Creating a Web Site

We mentioned that there are four ways to create a Web site. This section demonstrates the creation of each of the Web site types: file, FTP, local HTTP, and remote HTTP. The basic steps for creating a new Web site in Visual Studio 2005 are as follows:

1. In Visual Studio 2005, use the menus to request the creation of a new Web site.
2. Select the Web site type, the default programming language, and the location.
3. Click OK. Enter additional information if prompted.

You can create a Web Site application by opening Visual Studio 2005 and selecting File | New | Web Site. The New Web Site dialog box appears, as shown in Figure 1-4.


New Web Site
Templates:
Visual Studio installed templates
ASP.NET Web Site
ASP.NET Web Service
Personal Web Site Starter Kit
Empty Web Site
ASP.NET Crystal Reports Web Site
My Templates
Search Online Templates...
Browse...
OK
Cancel

A blank ASP.NET Web site

Location: File System c:\FileBasedWebSite

Language: Visual C#

Figure 1-4 The New Web Site dialog box contains properties for setting the Web site type, location, and default language.

Creating a File-Based Web Site

In the New Web Site dialog box, change the Location drop-down list to File System, and type a valid location on a local drive. After that, select the default language for the Web site and click OK.

Visual Studio 2005 creates the folder for your site and a new page named Default.aspx. When the new page is created, Visual Studio 2005 displays the page in HTML Source view, where you can see the page's HTML elements.

Creating an FTP-Based Web Site

In the New Web Site dialog box, select FTP from the Location drop-down list, and type a valid local or remote location that uses FTP to manage the files. After that, select the default language for the Web site and click OK. You will be prompted for FTP parameters, as shown in Figure 1-5.

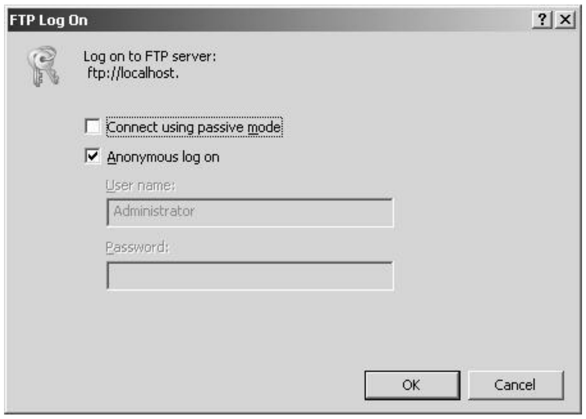


Figure 1-5 Configure the FTP parameters for Web site access.

Active Mode versus Passive Mode

FTP is TCP-based (has a connection) and has no UDP (connectionless) compo nent. FTP requires two ports for communication: a command port and a data port. Port 21 is typically the command port at the server; port 20 is the typical data port when using active mode FTP.

Active mode FTP communications is the default and starts with the client selec tion of two ports: n and n+1. The client will use port n to initiate communica tions to port 21 of the server. When the server responds, the client sends a *port* command, which instructs the server of the port to use for data communica tions, as shown in Figure 1-6. It's the server that initiates data communications, from port 20 to the client's data port (n+1). If the client has a firewall installed, the server may be blocked from initiating communications to the client on the data port.

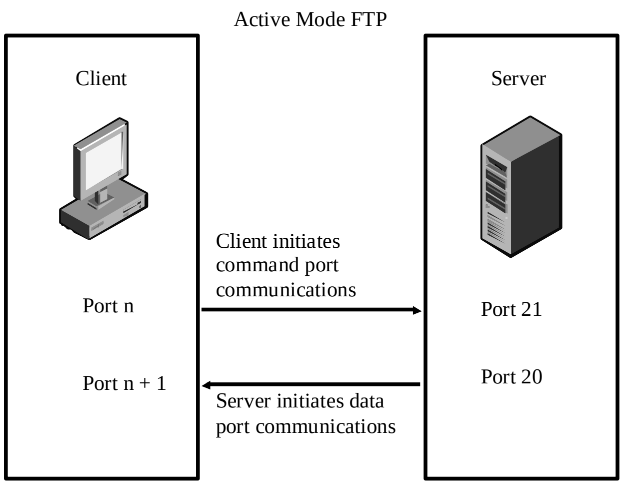

Active Mode FTP
Client
Server
Client initiates command port communications
Port n
Port 21
Port n + 1
Port 20
Server initiates data port communications

Figure 1-6 Active mode requires that the server initiate the connection on the data port.

Passive-mode FTP communications can be used to correct the problem with active-mode communications. Passive mode starts with the client selection of two ports: n and n+1. The client will use port n to initiate communications to port 21 of the server. When the server responds, the client sends a *pasv* com mand to the server. The server selects a random port p to use for data commu nications and sends the port number to the client. The client then initiates communications on the data port (n+1) to the server's data port (p), as shown in Figure 1-7.

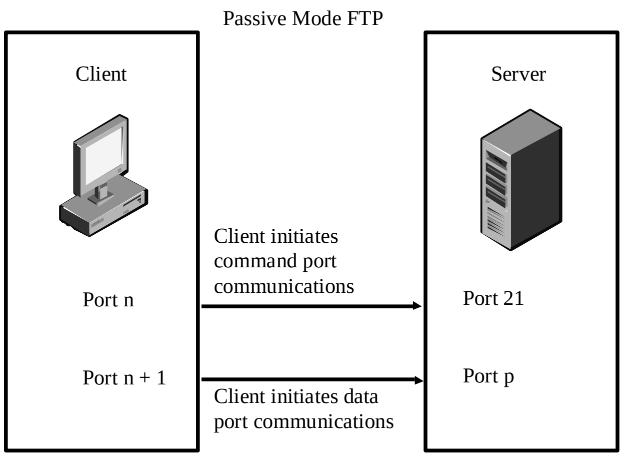

Passive Mode FTP
Client
Server
Client initiates command port communications
Port n
Port 21
Port n + 1
Port p
Client initiates data port communications

Figure 1-7 When using passive mode, the client initiates communications on the command and data ports.

Notice that when using passive mode, the client initiates communications of the command port and the data ports. This fixes the problem of the client having a firewall installed that blocks the server's request to initiate communications on the data port.

Creating a Local or Remote HTTP-Based Web Site

In the New Web Site dialog box, change the Location drop-down list selection to HTTP and type a valid HTTP location, either localhost or a fully qualified remote location. If you enter a remote location, the remote server must have Front Page Server Extensions installed. After that, select the default language for the Web site and click OK.

Quick Check

1. Where are solution files created by default?
2. For new applications created with ASP.NET 2.0, what is the recommended programming model?

Quick Check Answers

1. In the My Documents\Visual Studio 2005\Projects folder.
2. The code-behind programming model.

What's in the Newly Created Web Site?

When you create a new Web site, Visual Studio 2005 creates a new page named Default.aspx. When the new page is created, Visual Studio 2005 displays the page in HTML Source view, where you can see the page's HTML elements.

The Default.aspx page that is created also has a code-behind page called Default.aspx.vb or Default.aspx.cs, depending on the programming language that you choose. Code-behind pages are optional files that contain server-side code. The pro gramming language you choose is the default language for your Web site, but you can use multiple programming languages in the same Web application.

The new Web site also contains a special folder called App_Data. This folder is reserved for databases such as SQL Server 2005 Express Edition .mdf files. Table 1-5 contains a list of special folders that you can add to your Web site. A primary benefit of adhering to the suggested folder structure is that a user who attempts to browse to any of these folders (except App_Themes) will receive an HTTP 403 Forbidden error.

Table 1-5 ASP.NET 2.0 Special Folders

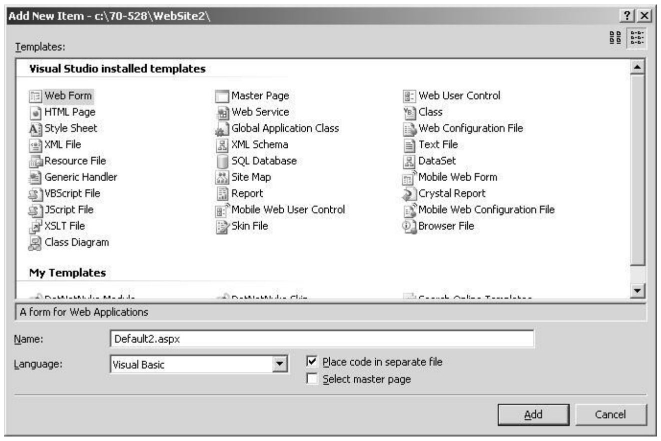
Folder Name	Description
App_Browsers	Contains browser definitions files (.browser) that ASP.NET uses to identify browsers and determine their capabilities.
App_Code	Contains source code for classes and business objects (.cs, .vb, and .jsl files) that you want to compile as part of your application.
App_Data	Contains application data files (.mdf and .xml files).
App_GlobalResources	Contains resources (.resx and .resources files) that are compiled into assemblies and have a global scope.
App_LocalResources	Contains resources (.resx and .resources files) that are scoped to a specific page, user control, or master page in an application.
App_Themes	Contains files (.skin and .css files, as well as image files and generic resources) that define the appearance of Web pages and controls.
App_WebReferences	Contains Web reference files (.wsdl, .xsd, .disco, and .dis comap files) that define Web references.
Bin	Contains compiled assemblies (.dll files) for code that you want to reference in your application. Assemblies in the Bin folder are automatically referenced in your application.

Adding New Web Pages to the Web Site

After the Web site has been created, you can add as many Web pages as you need to create your Web site application. A Web page is also known as a *Web Form* and may be composed of a single file when using the in-line programming model or a pair of files when using the code-behind programming model. The steps for adding a new Web page to a Web site are as follows:

1. Using Visual Studio 2005 menus, request a new Web Form.
2. Assign a name to the Web Form.
3. Select the programming language for this Web Form.
4. Change other settings as necessary and click OK.

You can easily add new Web pages to the Web site by simply selecting Website | Add New Item. Select the Web Form, assign a name, and select the programming lan guage, as shown in Figure 1-8. Notice that the option Place Code In Separate File allows you to indicate whether you want a code-behind file. Note that you can also assign a master page, which allows you to create a consistent look and feel for your Web site. We will cover master pages in more detail in Chapter 9, "Customizing and Personalizing a Web Application."



A form for Web Applications

Name: Default2.aspx

Language: Visual Basic

[✓] Place code in separate file

[ ] Select master page

Figure 1-8 Adding a new Web Form to the Web site.

Lab: Create a New Web Site

In this lab, you will create a new Web site and explore its contents using Visual Studio 2005. After that, you will add a new Web page to the Web site.

� Exercise 1: Creating a New Web Site

1. Start Visual Studio 2005. Select Start | All Programs | Microsoft Visual Studio 2005 | Microsoft Visual Studio 2005.
2. Create a file-based Web site. Select File | New | Web Site. The New Web Site dia log box appears.

3. In the New Web Site dialog box, change the Location drop-down list to File Sys tem and type **C:\70-528\MyFirstSite** as the location on a local drive. Then select your preferred programming language for the Web site and click OK. This creates a new directory and subdirectory for the new Web site.
4. Explore the new Web site. In the Solution Explorer window, notice the special folder called App_Data and the Web page called Default.aspx. Click the plus (+) sign beside the Default.aspx file to reveal the code-behind page.
5. Explore the temporary files. Open the following folder with Windows Explorer:

   %WinDir%\Microsoft.NET\Framework\v2.0.50727\Temporary ASP.NET Files

   Notice that this folder contains a subdirectory called myfirstsite. This folder was dynamically created and contains files related to your new Web site. The first file is the Code Compile Unit (.ccu) file, which contains a serialized collection of source code objects that can be compiled. Next is the compiler (.compiled) file, which is an .xml file containing compiler information. This file indicates that the Code Compile Unit file is created from the Web page and its corresponding code-behind page. The last one is the Hash.web file, which contains a hash of the Web site.
6. While the temporary files folder is open and in view, build the Web site. In Visual Studio 2005, select Build | Build Web Site. Notice that the code files are being created, and then the newly created files are deleted and replaced with assemblies. After the build is completed, note the files that exist in the tempo rary files folder. A dynamic-link library (DLL) was created that contains the com piled Web page and its code-behind page. Also, a new compiled file has been created, containing the compiler settings that were used to create the DLL.
7. Browse the default.aspx page. In Visual Studio 2005, select Debug | Start With out Debugging. After a moment you should see your blank Web page. Notice that there are no new files in the temporary files folder because this page was already compiled and has not been changed. Leave these windows open if you are going to proceed to the next exercise.

� **Exercise 2: Adding a New Web Page**

In this exercise, you add a new Web page to the Web site that you just created.

1. Add a new Web page. In Visual Studio 2005, select Website | Add New Item. In the Add New Item dialog box, select Web Form, assign Page2.aspx as the name, select your preferred programming language, and click Add.

2. Observe the result in Visual Studio 2005. In the Solution Explorer window, a new file has been added called Page2.aspx. Click the plus (+) sign next to Page2.aspx to reveal the code-behind page.
3. Observe the result in the temporary files folder. Open the temporary files folder and notice that a new code compile unit file has been created. Also, a compiler file was created that contains the compiler settings that are required to create the code compiler unit file.
4. Browse the Default.aspx page. In Visual Studio 2005, select Debug | Start Without Debugging. After a moment, you should see your blank Web page. Notice that there are two new files in the temporary files folder. The .dll file is an assembly that contains the compiled Page2.aspx file and its code-behind file.

Lesson 3: Working with Web Configuration Files

Web sites are configured based on a hierarchy of XML configuration files, as shown in Figure 1-9. The first configuration file is the Machine.config file. This file is located in the configuration folder for the version of the .NET Framework installed on the com puter, and is usually found at the following location:

%WINDIR%\Microsoft.NET\Framework\version\Config\machine.config

The Machine.config file contains settings for all .NET application types, such as Windows, Console, ClassLibrary, and Web applications. These settings are global to the machine. Some of the settings in the Machine.config file can be overridden by set tings in Web.config files that are in the hierarchy, while other settings are more global in nature. The global ones complete the .NET Framework, so they are protected and cannot be overridden by the Web.config files.

After this lesson, you will be able to:

- Understand the configuration file hierarchy.
- Use the GUI configuration tool to make changes to the configuration files.

Estimated lesson time: 20 minutes

The next file in the hierarchy is the Root Web.config file, which is located in the same directory as the Machine.config file. This file contains default Web server settings, some of which can override settings in the Machine.config file.

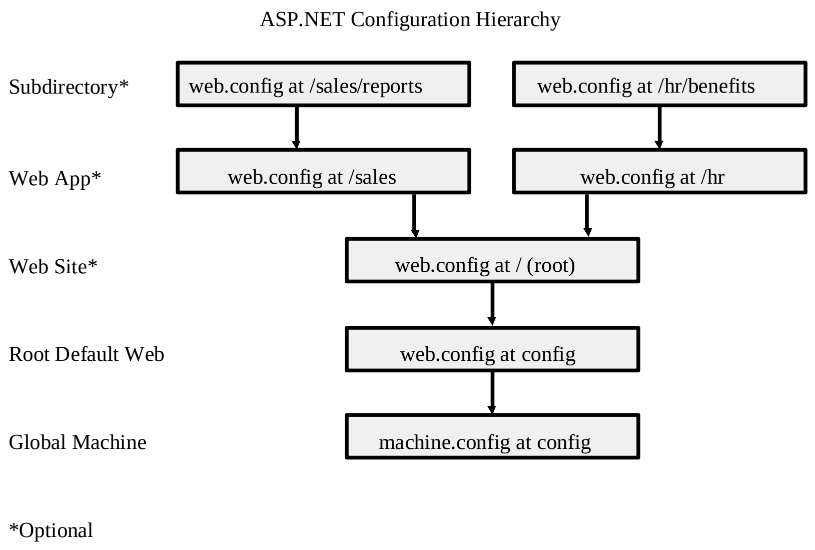


Figure 1-9 The configuration file hierarchy.

At the root directory of each Web site, you have the ability to add a Web.config file. This file is optional and can contain additional settings for the Web site as well as set ting overrides. In each Web application, you can optionally have a Web.config file to provide more settings and override settings. Finally, each subdirectory in a Web appli cation can optionally have a Web.config file where only a subset of the settings is valid.

Processing the Configuration Files

When you initially run your Web application, the runtime builds a cache of the effec tive settings for your Web application by flattening the layers of configuration files as follows:

1. The Machine.config file settings are retrieved.
2. The settings from the root Web.config file are added to the caches, overwriting any conflicting settings that were created earlier while reading the Machine.con fig file.
3. If there is a Web.config file at the root of the Web site, this file is read into the cache, overwriting existing entries.
4. If there is a Web.config file at the Web application, it is read into the caches, also overwriting any existing settings. The resulting cache contains the settings for this Web site.
5. If you have subdirectories in your Web application, the subdirectories can have a Web.conifg file that includes settings that are specific to the files and folders that are contained within this folder. To calculate the effective settings for the folder, the Web site settings are read (steps 1-4), and then this Web.config is read into the cache for this folder, overwriting (thereby overriding) any existing settings.

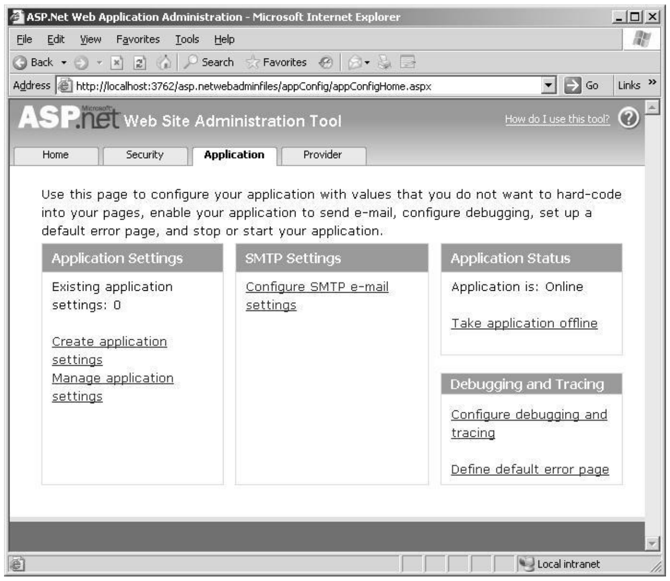
Modifying the Configuration Files

Because they are XML files, the configuration files can be opened and modified with any text editor or XML editor. You can also use the .NET Framework 2.0 Configura tion snap-in with the Microsoft Management Console (MMC), which provides a graphical user interface (GUI) for modifying some of the configuration file settings that an administrator may want to change.

Visual Studio 2005 also provides the Web Site Administration Tool, which can be used to modify many of the configuration file settings. You can access this tool by selecting Website | ASP.NET Configuration.

The Web Site Administration Tool allows you to edit the following categories of the configuration files:

- **Security** This setting allows you to set up security for your Web site. In this cat
egory, you can add users, roles, and permissions for your Web site.
- **Application Configuration** This category is used to modify the application set
tings. Figure 1-10 shows the Web Site Administration Tool, which displays the Application tab.
- **Provider Configuration** This configuration file contains settings that allow you to specify the database provider to use for maintaining membership and roles.


ASP.Net Web Application Administration - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3762/asp.netwebadminfiles/appConfig/appConfigHome.aspx Go Links
ASP.net Web Site Administration Tool
How do I use this tool?
Home Security Application Provider
Local intranet

Use this page to configure your application with values that you do not want to hard-code into your pages, enable your application to send e-mail, configure debugging, set up a default error page, and stop or start your application.

Application Settings
Existing application settings: 0
Create application settings
Manage application settings

SMTP Settings
Configure SMTP e-mail settings

Application Status
Application is: Online
Take application offline

Debugging and Tracing
Configure debugging and tracing
Define default error page

Figure 1-10 The Web Site Administration Tool showing the Application tab.

The Web Site Administration Tool lets you create and modify Web site settings that are not inherited. If a setting is inherited and cannot be overridden, it will appear, but it will be dimmed when the setting is disabled.

Quick Check

1. Is the format of a configuration file CSV, INI, XML, or DOC?
2. If a setting exists in the root Web.config file and also in the Web.config file at the Web application but with a different value, which Web.config file takes precedence?

Quick Check Answers

1. The configuration file is formatted with XML.
2. The Web.config file at the Web application takes precedence.

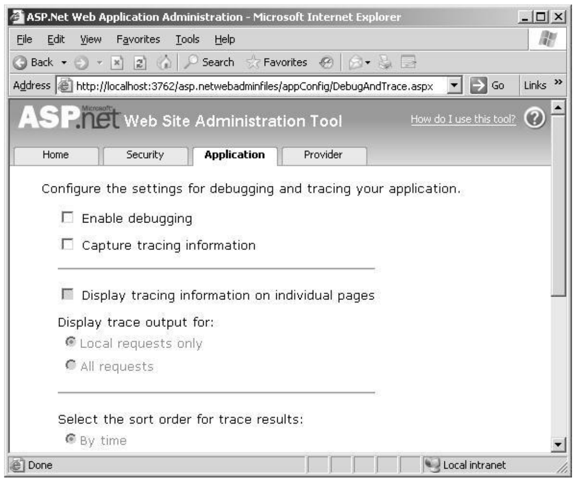
Lab: Modifying Your Web Site Configuration

In this lab, you use the Web Site Administration Tool to modify the Web site configu ration by enabling debugging on the Web site. After that, you view the changes in the Web.config file.

� **Exercise 1: Creating the New Web.Config File**

In this exercise, you start Visual Studio 2005 and open the Web site from the previous lab.

1. Open the MyFirstSite from the previous lab. Alternatively, you can open the completed Lesson 2 lab project from the CD.
2. Note that this project does not contain a Web.config file yet. If the project does contain a Web.config file, delete it.
3. Open the Web Site Administration Tool by selecting Website | ASP.NET Configuration.
4. Click the Application tab to display the application settings.
5. Click the link to display the Configure debugging and tracing page, as shown in Figure 1-11.


ASP.Net Web Application Administration - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3762/asp.netwebadminfiles/appConfig/DebugAndTrace.aspx
Go Links
ASP.net Web Site Administration Tool
How do I use this tool?
Home Security Application Provider
Done
Local intranet

Configure the settings for debugging and tracing your application.

- [ ] Enable debugging
- [ ] Capture tracing information

- [ ] Display tracing information on individual pages

Display trace output for:
- ● Local requests only
- ○ All requests

Select the sort order for trace results:
- ● By time

Figure 1-11 The Configure debugging and trace page.

6. Select the Enable Debugging check box. This will enable debugging for the cur rent Web site. Notice that selecting this check box performs a PostBack to the Web server.

7. Close the Web Site Administration Tool.

8. A new Web.config file was created. Click the Refresh button at the top of the Solution Explorer window and the Web.config file will appear.

9. Open the Web.config file. The new Web.config file will contain the following:

```
<?xml version="1.0" encoding="utf-8"?>
<configuration
xmlns="http://schemas.microsoft.com/.NetConfiguration/v2.0">
 <system.web>
<compilation debug="true" />
 </system.web>
</configuration>
```

Notice that the file contains the setting to set debug to true.

Lesson 4: Using ASP.NET Trace to Explore Web Pages

The trace facility that is included in ASP.NET can be used to troubleshoot and diag nose problems with your Web site. You can also use the trace facility to explore resource usage on each Web page. This lesson covers the enabling and configuring of the trace facility and then explores the data that is made available by the trace facility.

After this lesson, you will be able to:

- Enable and configure the ASP.NET trace facility.
- Understand the data that is available in the ASP.NET trace facility.

Estimated lesson time: 20 minutes

Enabling and Configuring the ASP.NET Trace Facility

The trace facility can be enabled in the Web.config file, but you can use the Web Site Administration Tool to provide a user-friendly GUI to enable and configure this option. This section demonstrates the enabling and setting of the ASP.NET trace facil ity options.

Enabling the Trace Facility Using the Web Site Administration Tool

The following steps identify how to enable and configure the trace facility using the Web Site Administration Tool:

1. Open the Web Site Administration Tool by selecting Website | ASP.NET Configuration.
2. Click the Application tab and click the Configure debugging and tracing link to view and modify the trace settings.
3. Click Capture Tracing Information. This enables the trace facility.
4. Change the settings as necessary. Table 1-6 describes each of the settings.

Table 1-6 ASP.NET Trace Settings

Web Site Administration Tool Setting	Web.Config Setting	Description
Capture tracing information	Enabled	Enables the trace facility. When this option is enabled, the other trace options are also enabled.
Display tracing information on individual pages	pageOutput	Displays the trace information directly on the Web page that is being traced. Depending on the page content, the trace information displays either at the bottom of the Web page or behind the regular Web page content.
Display trace output for	localOnly	Designates either Local requests only or All requests. When set to Local Requests Only, the trace facility only operates with requests and PostBacks from the computer that the Web server is running on. The All requests setting enables the trace facility to respond for all requests and PostBacks from any computer to the Web site.
Select the sort order for trace results	traceMode	Enables sorting of the trace output either by time or by category.
Number of trace requests to cache	requestLimit	Sets the quantity of items to hold in the cache.
Select which trace results to cache	mostRecent	Designates the Most Recent Trace Results or the Oldest Trace Results. When set to Most Recent Trace Results, the cache con tinues to update, holding the latest results. When set to Oldest Trace Results, as soon as the number of requests has been met, the cache no longer updates until after the Web application is restarted.

5. Run the Web application.
6. Navigate to the trace.axd page on the Web application (*http://server/applica tion/trace.axd*). This is not a physical Web page. Instead, trace.axd is a virtual page that is constructed dynamically based on the Web pages you visited, and displays the trace data that is available.

Enabling the Trace Facility in the Web.Config File

The ASP.NET trace facility can also be enabled in the Web application's Web.config file. You do so using the following steps:

1. Open the Web.Config file for your site. This is an XML file that contains settings for the Web site.
2. Locate the trace element, which looks something like this.

```
<trace
    enabled="false"
    requestLimit="10"
    pageOutput="false"
    traceMode="SortByTime"
    localOnly="true"
    mostRecent="true"
/>
```

3. Change the settings as necessary. Table 1-6 describes each of the settings.
4. Run the Web application.
5. Navigate to the trace.axd page on the Web application (*http://server/applica tion/trace.axd*) to display the trace data that is available.

Viewing the Trace Data

After turning on the ASP.NET trace facility, you can either view the trace output on each Web page (pageOutput="true"), or view the trace output by navigating to the trace.axd (*http://server/application/trace.axd*) page on the current Web application. When navigating to the trace.axd page, a summary page displays, which contains the list of results that are in the cache. Click on one of the cached results to view the result of a single page request, which is similar to the resultant information that is shown on each Web page when the page output is set to True.

Security Alert If you opt for displaying the trace information on individual pages, the trace information can be displayed on any browser that makes a request. This is a potential security threat because sensitive information such as server variables will display. Be sure to disable page tracing on production Web servers.

The trace result page is broken into sections, as described in Table 1-7. This informa tion can be very useful when you are trying to identify performance issues and resource usage.

Table 1-7 Trace Result Sections

Trace Result Section	Description
Request Details	Provides general details about the page request.
Trace Information	Displays performance information related to the Web page's life-cycle events. The From First(s) column displays the running time from when the page request started. The From Last(s) column shows the elapsed time since the pre vious event.
Control Tree	Displays information about each control on the Web page, such as the size of the rendered controls.
Session State	Displays all Session variables and their values.
Application State	Displays all Application variables and their states.
Request Cookies Collection	Displays the list of cookies that are passed to the server as part of the request.
Response Cookies Collection	Displays the list of cookies that are passed to the browser as part of the response.
Headers Collection	Displays the list of HTTP headers that are sent to the Web server as part of the request.
Form Collection	Displays the list of values that are posted back to the Web server.
QueryString Collection	Displays the list of values that are included in the query string.
Server Variables	Displays all server variables.

Quick Check

1. How can you make the trace data display on your Web page?
2. What is the name of the virtual page that you can request to view trace data when the trace data is not displayed on its corresponding Web page?

Quick Check Answers

1. Set pageOutput="true".
2. The virtual page is called Trace.axd.

Lab: Using the ASP.NET Trace Facility

In the following lab, you use the Web Site Administration Tool to modify the Web site configuration by enabling the ASP.NET trace facility on the Web site. After that, you browse your Web site and view the trace results.

� **Exercise 1: Enable the ASP.NET Trace Facility**

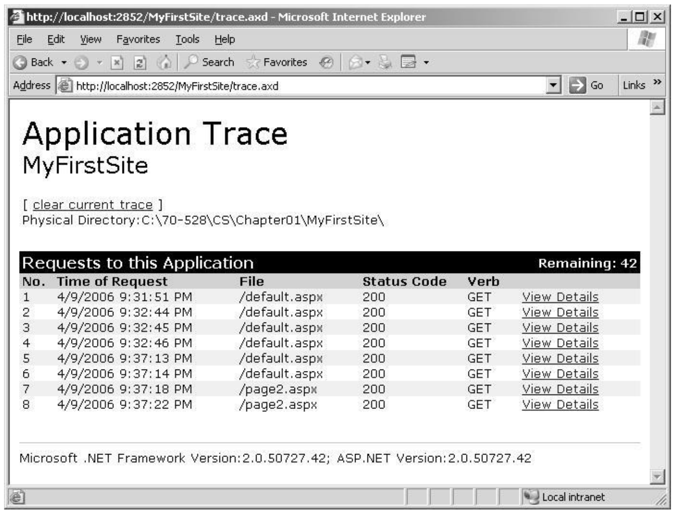
In this exercise, you start Visual Studio 2005 and open the Web site from the previous lab.

1. Open the MyFirstSite from the previous lab. Alternatively, you can open the completed Lesson 3 lab project from the CD.
2. Open the Web Site Administration Tool by selecting Website | ASP.NET Configuration.
3. Click the Application tab to display the application settings.
4. Click the link to display the Configure debugging and tracing page.
5. Click Capture tracing information. This enables the trace facility.
6. Make the following changes to cache the latest 50 local request results without displaying on the Web page:
   - Select the Capture Tracing Information check box.
   - Ensure the Display Tracing Information On Individual Pages check box is unchecked.
   - Set the Display Trace Output For option to Local Requests Only.
   - Set the Select The Sort Order For Trace Results option to By Time.
   - Set the Number Of Trace Requests To Cache drop-down list to 50.
   - Set the Select Which Trace Results To Cache option to Most Recent Trace Results.
7. Close the Web Site Administration Tool.
8. Open the Web.config file. The new Web.config file will contain the following:

```
<?xml version="1.0" encoding="utf-8"?>
<configuration
    xmlns="http://schemas.microsoft.com/.NetConfiguration/v2.0">
    <system.web>
      <trace
            enabled="true"
            mostRecent="true"
            requestLimit="50" />
      <compilation debug="true" />
    </system.web>
</configuration>
```

Notice that the file contains the trace element and attributes to enable tracing as described.

9. Press F5 to run the Web application. Although the default.aspx page is blank because it has no controls on it, the trace facility is still logging results. Press F5 a couple times to refresh the Web page.
10. In the Address bar, change the URL to point to the Page2.aspx file. Press F5 a couple times to refresh the Web page.
11. In the Address bar, change the URL to request the trace.axd page. You should see the trace summary page shown in Figure 1-12.


http://localhost:2852/MyFirstSite/trace.axd - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2852/MyFirstSite/trace.axd
Go Links
Local intranet

Application Trace
MyFirstSite

[clear current trace]
Physical Directory:C:\70-528\CS\Chapter01\MyFirstSite\

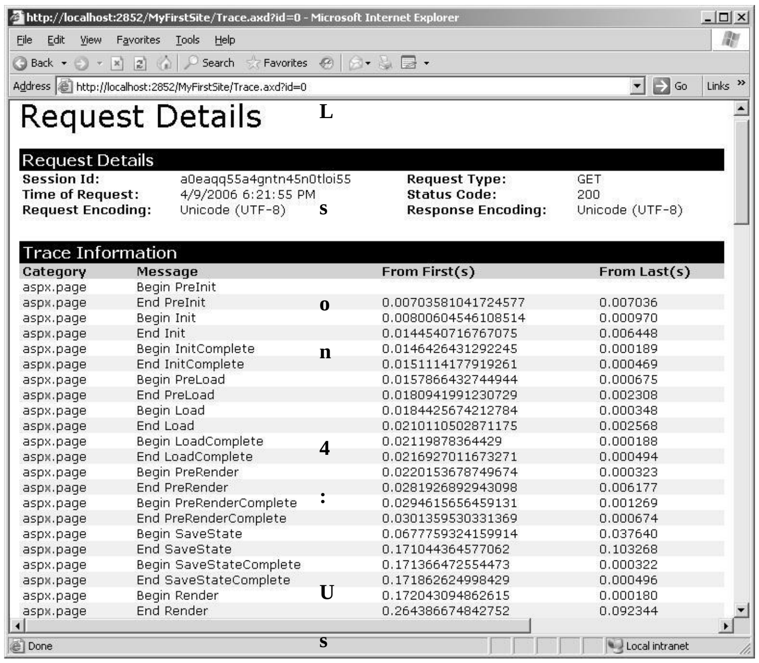
Requests to this Application — Remaining: 42

No.	Time of Request	File	Status Code	Verb	
1	4/9/2006 9:31:51 PM	/default.aspx	200	GET	View Details
2	4/9/2006 9:32:44 PM	/default.aspx	200	GET	View Details
3	4/9/2006 9:32:45 PM	/default.aspx	200	GET	View Details
4	4/9/2006 9:32:46 PM	/default.aspx	200	GET	View Details
5	4/9/2006 9:37:13 PM	/default.aspx	200	GET	View Details
6	4/9/2006 9:37:14 PM	/default.aspx	200	GET	View Details
7	4/9/2006 9:37:18 PM	/page2.aspx	200	GET	View Details
8	4/9/2006 9:37:22 PM	/page2.aspx	200	GET	View Details

Microsoft .NET Framework Version:2.0.50727.42; ASP.NET Version:2.0.50727.42

Figure 1-12 The trace.axd summary screen.

12. Click one of the links to open one of the trace result pages. Notice that Trace Information contains the timings for the events in the Web page life cycle as shown in Figure 1-13.



http://localhost:2852/MyFirstSite/Trace.axd?id=0 - Microsoft Internet Explorer

Address http://localhost:2852/MyFirstSite/Trace.axd?id=0

Request Details

Request Details

Session Id:	a0eaqq55a4gntn45n0tloi55	**Request Type:**	GET
Time of Request:	4/9/2006 6:21:55 PM	**Status Code:**	200
Request Encoding:	Unicode (UTF-8)	**Response Encoding:**	Unicode (UTF-8)

Trace Information

Category	Message	From First(s)	From Last(s)
aspx.page	Begin PreInit		
aspx.page	End PreInit	0.00703581041724577	0.007036
aspx.page	Begin Init	0.00800604546108514	0.000970
aspx.page	End Init	0.0144540716767075	0.006448
aspx.page	Begin InitComplete	0.0146426431292245	0.000189
aspx.page	End InitComplete	0.0151114177919261	0.000469
aspx.page	Begin PreLoad	0.0157866432744944	0.000675
aspx.page	End PreLoad	0.0180941991230729	0.002308
aspx.page	Begin Load	0.0184425674212784	0.000348
aspx.page	End Load	0.0210110502871175	0.002568
aspx.page	Begin LoadComplete	0.02119878364429	0.000188
aspx.page	End LoadComplete	0.0216927011673271	0.000494
aspx.page	Begin PreRender	0.0220153678749674	0.000323
aspx.page	End PreRender	0.0281926892943098	0.006177
aspx.page	Begin PreRenderComplete	0.0294615656459131	0.001269
aspx.page	End PreRenderComplete	0.0301359530331369	0.000674
aspx.page	Begin SaveState	0.0677759324159914	0.037640
aspx.page	End SaveState	0.171044364577062	0.103268
aspx.page	Begin SaveStateComplete	0.171366472554473	0.000322
aspx.page	End SaveStateComplete	0.171862624998429	0.000496
aspx.page	Begin Render	0.172043094862615	0.000180
aspx.page	End Render	0.264386674842752	0.092344

Figure 1-13 The detailed trace information.

Chapter 2

Adding and Configuring Server Controls

Web site development provides many challenges that other application development projects don't have. One such challenge is for the developer to create a Web site appli cation that provides seamless communication between the Web browser and the Web server. By seamless, we mean being able to move data back and forth in a way that gives the user the impression that the Web browser and server are one. ASP.NET helps the developer with this challenge by supplying server controls that provide automatic communication to the Web server when an event takes place.

This chapter starts with a description of the two primary types of server controls that are available in ASP.NET: Hypertext Markup Language (HTML) and Web. After that, this chapter dives deeply into the Web page and server control life cycle to help you understand the operation of a server control. Lastly, this chapter covers some of the controls that are available in ASP.NET 2.0.

Exam objectives in this chapter:

- Add and configure Web server controls.
    - Create HTML server controls in the designer.
    - Set HTML server control properties programmatically.
    - Use HTML server controls to programmatically access HTML tags.
    - Create HTML controls as elements in an HTML document.
    - Add Web server controls to a Web Form.
    - Configure the properties of Web server controls programmatically.
    - Configure Web server control properties by using the Microsoft Visual Stu dio Property Editor.
    - Specify whether events of a control cause a Web Form to post to the server.
    - Configure a control to receive postback events.
    - Access controls in Web Forms pages when working with naming contain ers and child controls.

- ❑ Use the Label Web server control to display customized text on a Web page.
- ❑ Enable users to type information into a Web Form by using the TextBox Web server control.
- ❑ Use the Button Web server control to send a command to the server when a button is clicked.
- ❑ Implement the CheckBox Web server control.
- ❑ Create a mutually exclusive set of choices by using the RadioButton Web server control.
- ❑ Dynamically add Web server controls to a Web Forms page programmatically.

- Create event handlers for pages and controls.
    - ❑ Create event handlers for a page or control at design time.
    - ❑ Program a Web application.
    - ❑ Convert HTML server controls to HTML elements.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic or C# and:

- Have a basic understanding of HTML and client-side scripting.
- Know how to create a new Web site.

Real World

Glenn Johnson

On many occasions, I've seen developers select the wrong server control for the functionality that needed to be implemented. The problem was that these devel opers tended to use only a select few controls for most tasks. The end result is that they spent excessive amounts of time developing something that already existed in a different control.

Lesson 1: Using a Server Control

A *server control* is a control that is programmable by writing server-side code to respond to events from the control. Server controls automatically maintain their state between calls to the server and are easily identified by their *runat="server"* attribute. A server control must have an ID attribute for you to reference it in code. ASP.NET pro vides two primary types of server controls: HTML and Web. All server controls, including the Web page class itself, inherit from the *System.Web.UI.Control* class. Fig ure 2-1 shows the class hierarchy of the *Control* class with its primary child classes.

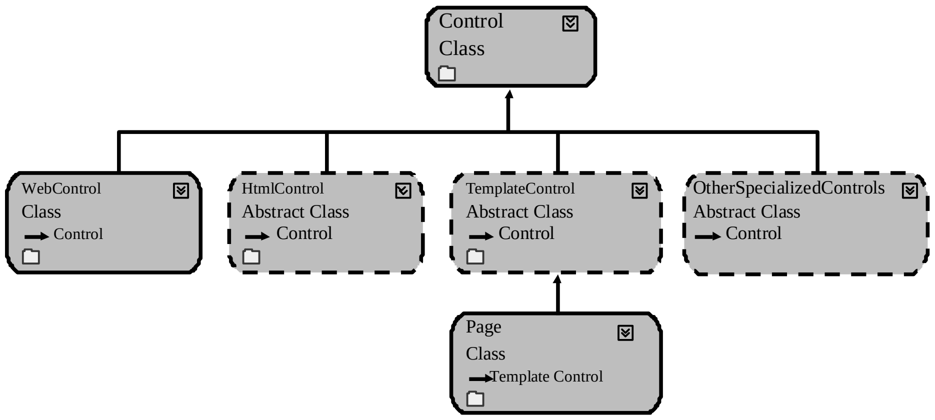


Figure 2-1 The *Control* class with its primary child classes. Note that *OtherSpecializedControls* is not a class; it's simply an indicator that there are other specialized controls that inherit from the *Control* class.

This section covers the life cycle of the Web page and its controls. After that, HTML and Web server controls are covered.

After this lesson, you will be able to:

- Describe the life cycle of the Web page and its controls.
- Describe *ViewState*.
- Explain the order and purpose of the primary events that take place when a page is requested.

Estimated lesson time: 30 minutes

Understanding the Life Cycle of the Web Page and Its Controls

To thoroughly understand how server controls operate, it's important to have a good understanding of the life cycle of a Web page and its controls. The life cycle starts when the browser requests a Web page from a Web site. The Web server constructs the Web page object and all of its child control objects and uses these objects to ren der the Web page to the browser. After that, the objects are destroyed. The Web page object and its child control objects are destroyed to free up resources. This allows the Web server to scale nicely but poses problems when you're trying to hold onto object data, or *state*, between calls to the server. This is where *ViewState* comes to the rescue.

What Is *ViewState*?

ViewState is the mechanism by which Web page object and child control object data can be maintained between page requests. Any object data that cannot be represented as HTML in the Web page is eligible to be placed into *ViewState*. For example, when a user clicks the Submit button on a Web page, a Postback occurs, sending all form data back to the Web server. *ViewState* is implemented by using a hidden form field called "__ViewState" to store the data. At the server, *ViewState* is used to reconstruct the Web page and its server controls.

Using *EnableViewState* to Minimize *ViewState* Size

Adding lots of data to *ViewState* can cause performance problems because the data is sent to the browser when a page is requested and back to the server when the data is posted back. To minimize the data that is in *ViewState*, you can set the *EnableViewState* property, which your server controls to *false*. Be careful, however, because setting this property to *false* means that you need to write code to repopulate the control yourself between page calls.

Control and Data State Separation

In ASP.NET 2.0, controls have the ability to separate data state and control state. Pre vious versions of ASP.NET stored data and control state together, and when a con trol's *EnableViewState* property was set to *false*, the control lost its appearance along with the data. What this means is that, in ASP.NET 2.0 you can set a control's *Enable-ViewState* to *false* and you lose the data but not the control's appearance. This also means that a control may still be contributing to the size of the __*ViewState* input even when the *EnableViewState* property is set to *false*.

NOTE .NET 2.0

Control state and data state separation is new in ASP.NET version 2.0.

Identifying *ViewState* Contributors

One problem that plagues many Web pages is that *ViewState* becomes bloated, which causes performance problems when receiving and posting pages. You can use the ASP.NET trace facility to examine the controls that contribute to *ViewState*. The trace facility also displays the *ViewState* size for each control, which means that you can eas ily identify the source of the bloat.

To use the ASP.NET trace facility to identify *ViewState* contributors, follow these steps:

1. Enable the trace facility as described in Chapter 1, "Introducing the ASP.NET 2.0 Web Site."
2. Browse the Web site, visiting the Web pages that you are interested in obtaining *ViewState* information for.
3. View the trace information; the Control Tree section indicates the *ViewState* size and the *ControlState* size for each control on the Web page.

Web Page and Server Control Events

All server controls have methods and events that execute during their life cycles, as their pages are being created and destroyed. Because the Web page derives from the *Control* class, it also has methods and events that execute as it is being created and destroyed. Table 2-1 contains an ordered list of the methods that execute and the events that take place when a page is requested. This table also contains the method names that correspond to the event. This list is specifically focused on *ViewState* and its availability during the control's life cycle.

Table 2-1 Web Page/Server Control Life Cycle Methods and Events

Method (Event)	Description
1. *OnInit (Init)*	Initializes each child control of the current control.

Table 2-1 Web Page/Server Control Life Cycle Methods and Events

Method (Event)	Description
2. *LoadControlState*	Loads the *ControlState* of the control. To use this method, the control must call the *Page.RegisterRequiresControlState* method in the *OnInit* method of the control.
3. *LoadViewState*	Loads the *ViewState* of the control.
4. *LoadPostData*	Is defined on interface *IPostBackDataHandler*. Controls that implement this interface use this method to retrieve the incoming form data and update the control's properties accordingly.
5. *Load (OnLoad)*	Allows actions that are common to every request to be placed here. Note that the con trol is stable at this time; it has been initialized and its state has been reconstructed.
6. *RaisePostDataChangedEvent*	Is defined on the interface *IPostBackData-Handler*. Controls that implement this inter face use this event to raise change events in response to the Postback data changing between the current Postback and the previ ous Postback. For example, if a TextBox has a *TextChanged* event and AutoPostback is turned off, clicking a button causes the *Text-Changed* event to execute in this stage before handling the click event of the button, which is raised in the next stage.
7. *RaisePostbackEvent*	Handles the client-side event that caused the Postback to occur.

Table 2-1 **Web Page/Server Control Life Cycle Methods and Events**

Method (Event)	Description
8. *PreRender (OnPreRender)*	Allows last-minute changes to the control. This event takes place after all regular Post-back events have taken place. This event takes place before saving *ViewState*, so any changes made here are saved.
9. *SaveControlState*	Saves the current control state to *ViewState*. After this stage, any changes to the control state are lost. To use this method, the control must call the *Page.RegisterRequiresControlState* method in the *OnInit* method of the control.
10. *SaveViewState*	Saves the current data state of the control to *ViewState*. After this stage, any changes to the control data are lost.
11. *Render*	Generates the client-side HTML, Dynamic Hypertext Markup Language (DHTML), and script that are necessary to properly display this control at the browser. In this stage, any changes to the control are not persisted into *ViewState*.
12. *Dispose*	Accepts cleanup code. Releases any unman-aged resources in this stage. Unmanaged resources are resources that are not handled by the .NET common language runtime, such as file handles and database connections.
13. *UnLoad*	Accepts cleanup code. Releases any managed resources in this stage. Managed resources are resources that are handled by the runtime, such as instances of classes created by the .NET common language runtime.

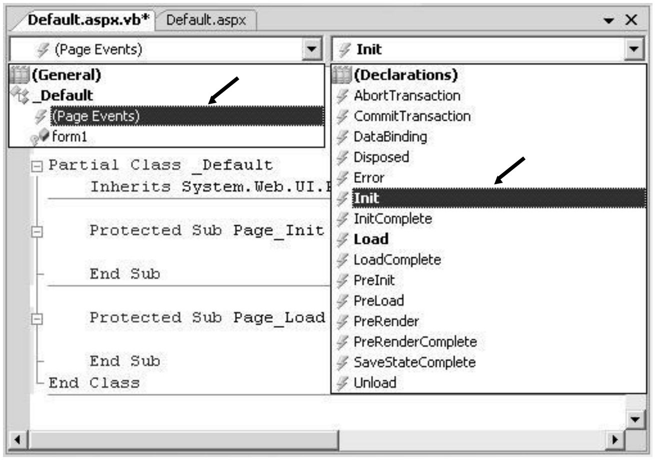
Creating Event Handlers

The Web page and its server controls have a default event. For example, the Web page's default event is *Load* event, and the button's default event is the *Click* event. In the Microsoft Visual Studio 2005 design time environment, you can add an event han dler method for the default event by simply double-clicking the design surface of the object. An event handler is created in the code-behind file. For example, if you double-click on the Web page (don't double-click a server control), a *Page_Load* event handler method is created in the code-behind page, and you can simply add your custom code into this method.

The VB.NET and C# Web page designers differ when it comes to creating event han dlers for other events, including *PostBack* events.

Adding the VB.NET Event Handler For VB.NET, use the following steps to create an event handler for the Init event, assuming that you are currently looking at the Web page:

1. Right-click the Web page and click View Code. This opens the code-behind page without inserting any code.
2. In the code-behind file, click the object drop-down list and click Page Events, as shown in Figure 2-2.



```
Partial Class _Default
    Inherits System.Web.UI.P

    Protected Sub Page_Init

    End Sub

    Protected Sub Page_Load

    End Sub
End Class
```

Figure 2-2 Add the *Init* event handler to a VB.NET Web page.

3. Click the event drop-down list and click the *Init* event that adds the following event handler code:

```
Protected Sub Page_Init(ByVal sender As Object, ByVal e As System.EventArgs) _
    Handles Me.Init

End Sub
```

Adding the C# Event Handler In C#, the event handler drop-down list only contains existing events, not all events. This means that you need to explicitly type the event handler methods for Page events, but there is a way to use the Graphical User Interface (GUI) to add event handlers for the server controls that are on the Web page. To add the *Init* event handler to a C# Web page, follow these steps:

1. Type the following code into the code-behind page. The Web page has its *AutoEventWireup* property set to *true* in the *@Page* directive at the top of the Source view, which means that the runtime automatically connects to the event handler that you create as long as the method name is in the form *Page_Event*.

```
private void Page_Init(object sender, EventArgs e)
{

}
```

2. To add an event handler for a server control that's on the Web page, in Design view, click the server control to select it.
3. In the Properties windows, click the Events icon, which is the button that has the yellow lightning bolt. This changes the Properties window to the events view.
4. Locate the Init event. Double-click anywhere on the line that contains the Init event, which opens the code-behind page and inserts the following event handler code as shown in Figure 2-3.

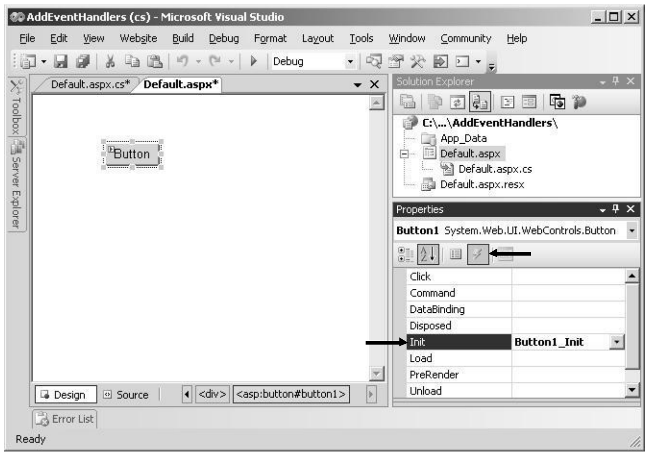

AddEventHandlers (cs) - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window Community Help
Debug
Default.aspx.cs* Default.aspx*
Toolbox Server Explorer
Button
Design Source <div> <asp:button#button1>
Error List
Ready
Solution Explorer
C:\...\AddEventHandlers\
App_Data
Default.aspx
Default.aspx.cs
Default.aspx.resx
Properties
Button1 System.Web.UI.WebControls.Button
Click
Command
DataBinding
Disposed
Init Button1_Init
Load
PreRender
Unload

Figure 2-3 Add the *Init* event handler to a C# server control.

Making the Decision: HTML or Web Server Controls?

The following sections cover HTML and Web server controls. Frequently, the ques tion arises: which one should I use? Here is some guidance that can help you choose the proper control type.

Consider using the HTML server controls when any of the following conditions exist:

- You are migrating existing ASP pages to ASP.NET.
- The control needs to have custom client-side JavaScript attached to the control's events.
- The Web page has lots of client-side JavaScript and that is referencing the control.

In all other cases, you should consider using the more powerful Web server controls.

MORE INFO HTML and Web server controls

For more information about the differences between HTML server controls and Web server con trols, visit *http://msdn2.microsoft.com/en-us/zsyt68f1.aspx.*

HTML Server Controls

An *HTML server control* looks like its matching HTML tag, but it also contains the *runat="server"* attribute. HTML server controls provide server-side objects that you can programmatically access. In the Web browser, they typically render as single HTML tags. The primary reason to use HTML server controls is to provide an easy conver sion of older Web sites to ASP.NET. Figure 2-4 shows the class hierarchy of the com mon HTML server controls.

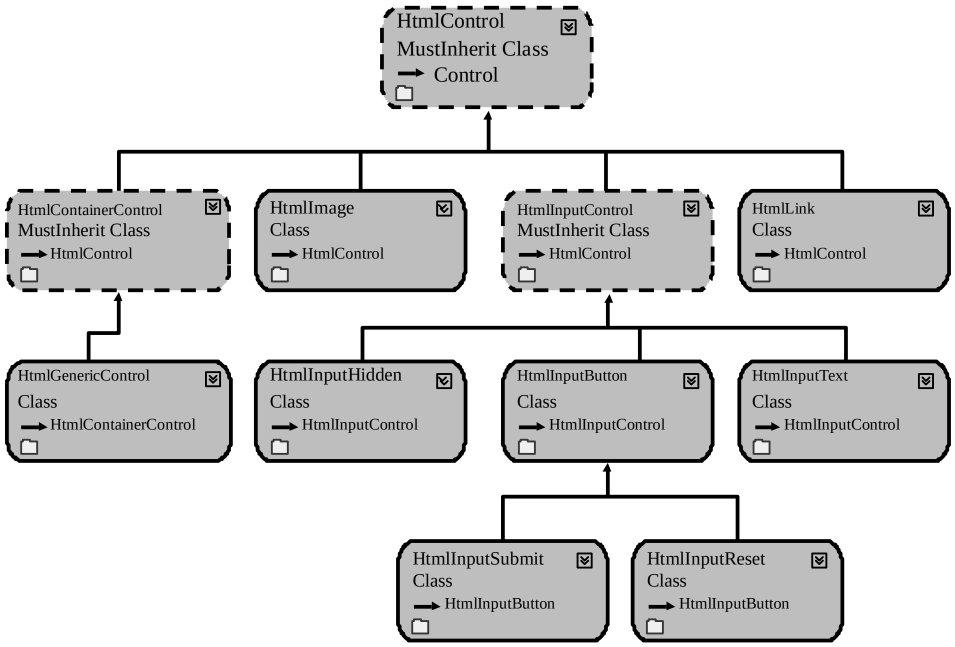


Figure 2-4 The class hierarchy of the common HTML server controls.

Creating HTML Control Elements in an HTML Document

You can easily create HTML controls as elements in an HTML document. Consider the following Web page on an existing ASP Web site.

Old ASP Web Page

```
<html>
    <head><title>Customer Page</title></head>
    <body>
      <form name="Form1" method="post" action="update.asp" id="Form1" >
            <input type="text" name="CustomerName"
                  id="CustomerName" >
            <input type="submit" name="SubmitButton"
                  value="Submit" id="SubmitButton" >
      </form>
    </body>
</html>
```

This is a form that has a text box and a submit button. The user can type a customer name and click the submit button to POST the data back to the update.asp page at the Web server.

Using HTML controls, you can easily convert the Web page to ASP.NET 2.0, resulting in the following.

Converted ASP.NET 2.0 Web Page

```
<html>
   <head><title>Customer Page</title></head>
   <body>
     <form name="Form1" method="post" id="Form1" runat="server">
            <input type="text" name="CustomerName"
                  id="CustomerName" runat="server" >
            <input type="submit" name="SubmitButton"
                  value="Submit" id="SubmitButton" runat="server">
     </form>
   </body>
</html>
```

Notice that there is a one-to-one conversion from the HTML tag to the HTML server control, but the *runat="server"* attribute was added. In essence, HTML controls were created by simply modifying the elements of the HTML document. Also, notice that the action attribute was removed from the form tag, because it's customary to send the data back to the same page.

Creating HTML Server Controls in the Designer

To create an HTML server control using the Visual Studio 2005 designer, perform the following steps:

1. Click the HTML tab in the Toolbox.
2. Drag an HTML element to either the Design or Source view of the Web page.
3. Convert the element to an HTML server control. In Source view, add the *runat="server"* attribute. In Design view, right-click the HTML element and click Run As Server Control. A glyph appears on the upper-left corner of the control in Design view to indicate that it is a server control.

NOTE Location of HTML Server Controls

An HTML server control must be located inside a form element that has the *runat="server"* attribute to operate properly.

If you decide that you no longer need to program an HTML server control in server code, you should convert it back to a plain HTML element. Each HTML server control in a page uses resources, so it is a good practice to minimize the number of controls that the ASP.NET page has to work with. In Design view, right-click the control and clear the check mark next to Run As Server Control. In Source view, remove the *runat="server"* attribute from the control's tag. If the HTML element is referenced by client script, you should not remove the *ID* attribute.

Setting the HTML Server Control Properties

By default, HTML elements within an ASP.NET file are treated as literal text. You can not reference them in server-side code until you convert the HTML element into an HTML server control. You should also set the element's *ID* attribute to give you a way to programmatically reference the control. Table 2-2 contains a list of the properties that all HTML server controls have in common. You can set the properties of the HTML server control by setting the attributes in the Source view, by setting the prop erties in the Design view, or by setting the properties programmatically in code. This section examines all three methods.

Table 2-2 Common HTML Server Control Properties

Property	Description
Attributes	A list of all attribute name/value pairs expressed on a server control tag within a selected ASP.NET page. This is accessible via code.
Disabled	A value that indicates whether the disabled attribute is included when an HTML control is rendered on the browser, which makes the control read-only when true.
Id	The programmatic identification of the control.
Style	A list of all cascading style sheet (CSS) properties that are applied to the specified HTML server control.
TagName	The element name of a tag that contains a *runat="server"* attribute.
Visible	A value that indicates whether the HTML server control is dis played on the page. If this value is set to *false*, the control does not render any HTML to the browser.

Setting Properties in Source View In Source view, you set the properties of an HTML control by adding the appropriate HTML attribute to the HTML server control's ele ment. Consider the following HTML server control button.

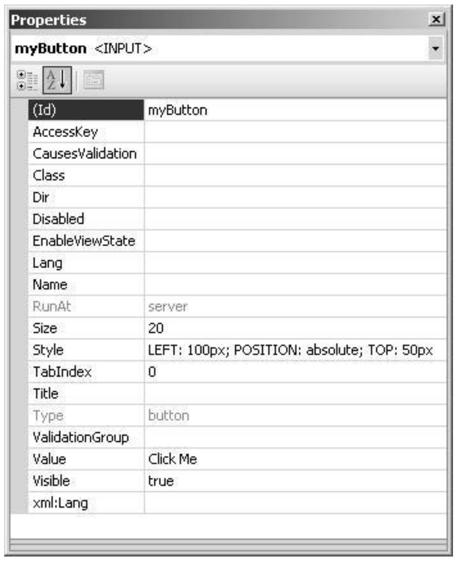
```
<input type="button"
    id="myButton"
    runat="server"
    style="position: absolute; top: 50px; left: 100px;"
    value="Click Me"
    visible="true" />
```

Notice that this server control has many of the same attributes that an HTML input button element has, except it has the *runat="server"* attribute and the *visible* attribute. The ID sets the programmatic identification to myButton, the *style* attribute sets the location of the control, the value of Click Me displays on the button face, and the but ton is visible. The rendered HTML looks like the following:

```
<input
    id="myButton"
    name="myButton"
    type="button"
    style="position: absolute; top: 50px; left: 100px;"
    value="Click Me" />
```

Notice that the *visible* attribute is missing. The fact that the input element was in the rendered HTML is an indicator that the *visible* attribute was set to *true*. If the *visible* attribute was set to *false*, the input element would be missing from the rendered HTML at the browser. Also, if the *name* attribute is not explicitly set, the *name* attribute is set to the *ID* attribute's value.

Setting Properties in Design View In Design view, the properties of an HTML control are set by clicking the server control and modifying the desired properties in the Prop erties window. Figure 2-5 shows the same button configured using the Properties window. Changes that are made in the Properties window are reflected in the Source view, and changes in the Source view are reflected in the Properties window in Design view.



(Id)	myButton
AccessKey	
CausesValidation	
Class	
Dir	
Disabled	
EnableViewState	
Lang	
Name	
RunAt	server
Size	20
Style	LEFT: 100px; POSITION: absolute; TOP: 50px
TabIndex	0
Title	
Type	button
ValidationGroup	
Value	Click Me
Visible	true
xml:Lang	

Figure 2-5 Setting the HTML input button properties using the Properties window.

Setting Properties Programmatically in Code To set the properties of an HTML server control programmatically, use the dot notation to refer to the HTML server con trol by its *ID* property, and specify the property that you wish to change. All properties are essentially strings, integers, or boolean except the *style* property, which is a collec tion of keys as strings and values as strings. The following code was added to the *Page_Load* event handler; it sets the *visible* and *style* properties of the button that has the ID myButton:

```
'VB
myButton.Visible = True
myButton.Style.Add("position", "absolute")
myButton.Style.Add("left", "75px")
myButton.Style.Add("top", "150px")

//C#
myButton.Visible = true;
myButton.Style.Add("position", "absolute");
myButton.Style.Add("left", "75px");
myButton.Style.Add("top", "150px");
```

Using HTML Server Controls to Programmatically Access HTML Tags If you need to access the properties of an HTML tag from a server control, the HTML tag must be converted to an HTML server control by adding the *runat="server"* attribute. The fol lowing steps demonstrate how clicking the HTML Button Input reads the value from an HTML Text Input and sets the *innerText* of an HTML Div:

1. Add an HTML Text Input and an HTML Div from the Toolbox.
2. Position these HTML elements as shown in Figure 2-6.

NOTE Setting the Layout to Absolute Positioning

If you want to enable absolute positioning of controls on your Web pages, you can change the default positioning by selecting Layout | Positioning | Auto-position Options to display the Options window. Locate the HTML Designer | CSS Positioning options and set the posi tioning options to Absolutely positioned for controls added using the Toolbox, paste, or drag-and-drop options.

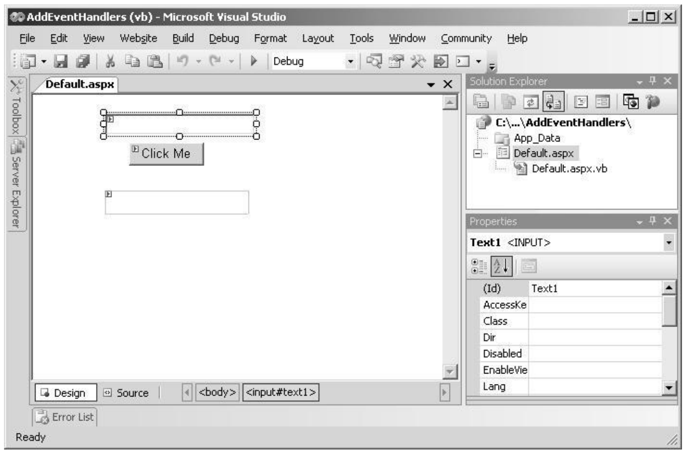


Figure 2-6 Add HTML elements to the page and convert to HTML server controls.

3. Right-click the HTML Text Input and HTML Div and click Run As Server Control.
4. Double-click myButton to add the Click event handler and add code to read from the HTML Text Input and place its value into the HTML Div's *innerText* property.

```
'VB
Protected Sub myButton_ServerClick(ByVal sender As Object, _
        ByVal e As System.EventArgs) _
        Handles myButton.ServerClick
    DIV1.InnerText = Text1.Value
End Sub
```

```
//C#
protected void myButton_ServerClick(object sender,
       System.EventArgs e)
{
     DIV1.InnerText = Text1.Value;
}
```

Best Practices for Using HTML Server Controls

HTML server controls are also useful when your control needs to have client-side Java-Script events attached.

There are a couple of disadvantages to using HTML server controls. One disadvantage is that HTML controls don't have a programming model that is consistent with Win-Form programming. For example, in WinForm programming, the data that is typed in the text box is available via the *Text* property, whereas the HTML server control's text box data is available via the *Value* property.

Another disadvantage to HTML server controls is that an HTML server control directly maps to a single HTML tag. Wouldn't it be great if you could add a single server control to a Web page and it would be rendered as many HTML tags? Web server controls are the answer.

Web Server Controls

Web server controls offer more functionality and a more consistent programming model than HTML server controls. Web server controls may also render as many HTML tags and may also include client-side JavaScript code. This means that it is pos sible to create very elaborate Web server controls, such as a calendar control or a data grid control.

Most, but not all, Web server controls inherit from the *WebControl* class. Figure 2-7 shows the class hierarchy of some of the more common Web server controls.

Web server controls have the ability to detect the Web browser's capabilities and ren der appropriately based on those capabilities. This means that the Web server con trols can use the Web browser to its fullest potential.

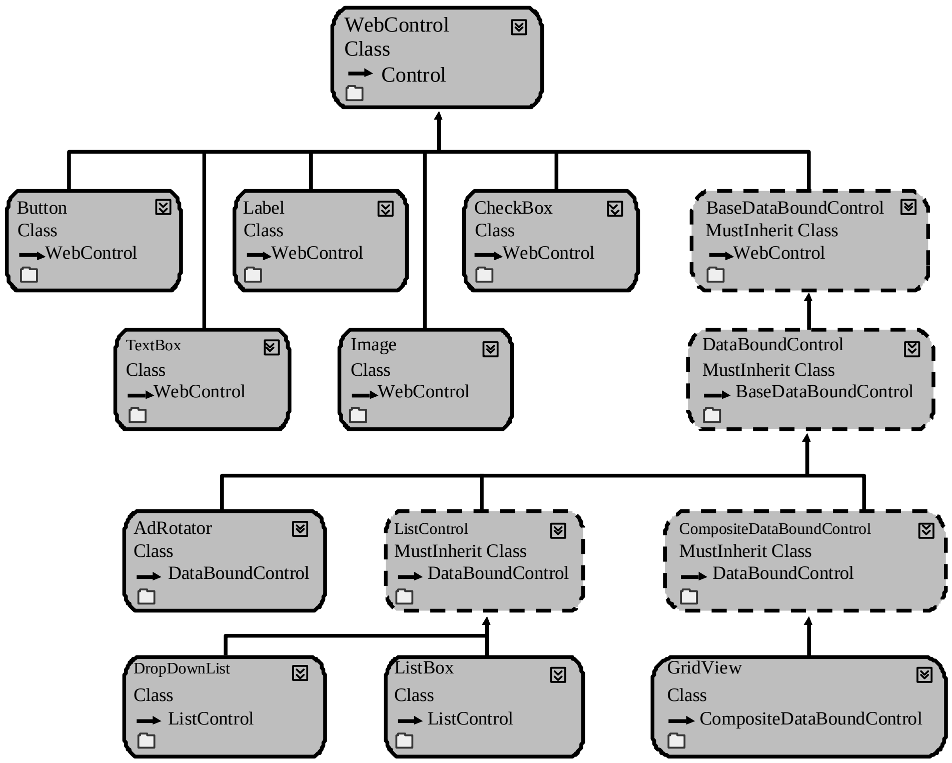


Figure 2-7 The class hierarchy of some of the common Web server controls.

In the design environment, a typical Web server control's source markup might look like the following.

```
<asp:textbox        attributes runat="server" />
```

The attributes of the Web server control are used to control the look and behavior of the Web server control. These attributes may not render as attributes in the HTML that is rendered to the Web browser.

Adding Web Server Controls to the Web Page

A Web server control can be added to a Web page using Visual Studio 2005 Design view or Source view, or the Web server controls can be added dynamically via code. This section covers each of these methods.

Adding Web Server Controls Using Design View

Use these steps to add a Web server control to a Web page using the Design view:

1. Open the Web page in Visual Studio 2005.
2. Click the Design tab on the bottom of the Web page.
3. Open the Toolbox and click the tab called Standard.
4. Drag and drop a Web server control on the Web page.

Adding Web Server Controls Using Source View

Use these steps to add a Web server control to a Web page using the Source view:

1. Open the Web page in Visual Studio 2005.
2. Click the Source view tab on the bottom of the Web page.
3. Perform either step 4 or steps 5 and 6.
4. In the Source View of the Web page, type the Web server control element and its attributes.
5. Open the Toolbox and click the Standard tab.
6. In the Source View of the Web page, drag and drop a Web server control.

Like the HTML server control, the Web server control must be located within a form element that has the *runat="server"* attribute.

Adding Web Server Controls Dynamically Via Code

In addition to adding Web server controls using Visual Studio 2005, you can also pro grammatically add Web server controls to the Web page dynamically. It is important to understand the Web page and server control life cycle described in Table 2-1 to assure that the control operates properly. Notice that the *OnInit(Init)* method and event are typically used to initiate child controls. The following steps demonstrate the implementation of dynamically generated Web controls:

1. Open the Web page's code-behind page in Visual Studio 2005.
2. Click the Source view tab on the bottom of the Web page.
3. In the *Page_Init* method, add code to create a new instance of the Web server control.
4. After creating the instance, add code to make the control visible.

5. Add the control to the *Controls* collection of form1. Your code should look like the following.

```
'VB
Protected Sub Page_Init(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Me.Init
    Dim c As New TextBox()
    c.ID = "txtUserName"
    c.Visible = True
    form1.Controls.Add(c))
End Sub

//C#
protected void Page_Init(object sender,
        System.EventArgs e)
{
    TextBox c = new TextBox();
    c.ID = "txtUserName";
    c.Visible = true;
    form1.Controls.Add(c));
}
```

Setting the Web Server Control Properties

Most, but not all Web Server controls inherit from the *WebControl* class. All Web server controls must contain a valid ID to give you a way to programmatically refer ence the control. Table 2-3 contains a list of the properties that all Web server controls have in common. You can set the properties of the Web server control by setting the attributes in the Source view, by setting the properties in the Design view, or by setting the properties programmatically in code. This section examines all three methods.

Table 2-3 Common Web Server Control Properties

Property	Description
AccessKey	The keyboard shortcut key. It can specify a single letter or number that the user can press while holding down Alt. For example, specify "Q" if you want the user to press Alt+Q to access the control. The property is supported only in Microsoft Internet Explorer 4.0 and later.

Table 2-3 Common Web Server Control Properties

Property	Description
Attributes	A collection of additional attributes on the control that is not defined by a public property, but that should be ren dered in the primary HTML element of this control. This allows you to use an HTML attribute that is not directly supported by the control. This property is accessible pro grammatically; it cannot be set in the designer.
BackColor	The background color of the control, which can be set using standard HTML color identifiers, such as "red" or "blue," or RGB values expressed in hex format ("#ffffff").
BorderColor	The border color of the control, which can be set using standard HTML color identifiers, such as "black" or "red," or RGB values expressed in hex format ("#ffffff").
BorderWidth	The width of the control's border in pixels. Not fully sup ported for all controls in browsers earlier than Internet Explorer 4.0.
BorderStyle	The border style, if there is any. Possible values are: Not-Set, None, Dotted, Dashed, Solid, Double, Groove, Ridge, Inset, and Outset.
CssClass	The cascading style sheet (CSS) class to assign to the control.
Style	A list of all cascading style sheet (CSS) properties that are applied to the specified HTML server control.
Enabled	An attribute that disables the control when set to false. This dims the control and makes it inactive. It doesn't hide the control.
EnableTheming	The default of true, which enables themes for this control.
EnableViewState	The default of true, which enables view state persistence for the control.

Table 2-3 Common Web Server Control Properties

Property	Description
Font	An attribute that contains subproperties that you can declare using the property-subproperty syntax in the opening tag of a Web server control element. For exam ple, you can make a Web server control's text italic by including the *Font-Italic* attribute in its opening tag.
ForeColor	The foreground color of the control. It is not fully sup ported for all controls in browsers earlier than Internet Explorer 4.0.
Height	The control's height. It is not fully supported for all con trols in browsers earlier than Internet Explorer 4.0.
SkinID	The skin to apply to the control.
TabIndex	The control's position in the tab order. If this property is not set, the control's position index is 0. Controls with the same tab index can be tabbed according to the order in which they are declared in the Web page. This works only in Internet Explorer 4.0 and later.
ToolTip	The text that appears when the user hovers the mouse pointer over a control. The *ToolTip* property does not work in all browsers.
Width	The width of the control. The possible units are: Pixel, Point, Pica, Inch, Mm, Cm, Percentage, Em, and Ex. The default unit is pixels.

Setting Properties in Source View In Source view, the properties of a Web server con trol are set by adding the appropriate attributes to the Web server control's element. Consider the following Web server control button:

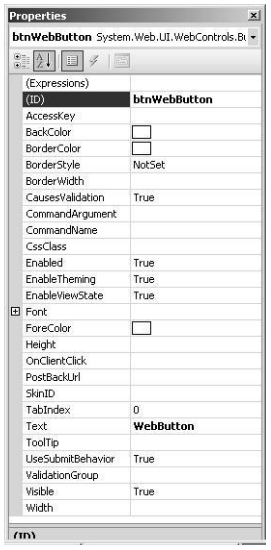
```
<asp:Button ID="btnWebButton"
    runat="server"
    Style=" position: absolute; top: 50px; left: 300px;"
    Text="WebButton" />
```

Notice that this server control has different attributes from its HTML counterpart. For example, the *Text* property on the Web server control coincides with the value prop erty on the HTML server control. The difference is an attempt to provide a consistent programming model among Web server controls and Windows Forms controls. As with HTML server controls, the *ID* property sets the programmatic identification. The *style* attribute sets the location of the control, and the *Text* of WebButton displays on the button face. The rendered HTML looks like the following:

```
<input id="btnWebButton"
    type="submit"
    name="btnWebButton"
    value="WebButton"
    style=" position: absolute; top: 50px; left: 300px;" />
```

Notice that the rendered HTML creates an HTML input element that is configured as a submit button, and the *value* attribute becomes the *Text* property on the Web server control. Also, if the *name* attribute is not explicitly set, the *name* attribute is automati cally set to the ID.

Setting Properties in Design View In Design view, the properties of a Web control are set by clicking the server control and modifying the desired properties in the Proper ties window. Figure 2-8 shows the same button configured using the Properties win dow. It's rather interesting to note that the *Style* property is not available in the Properties window. Changes that are made in the Properties window are reflected in the Source view; changes in the Source view are reflected in the Properties window in Design view.


Properties

btnWebButton System.Web.UI.WebControls.Bu

(Expressions)	
(ID)	**btnWebButton**
AccessKey	
BackColor	☐
BorderColor	☐
BorderStyle	NotSet
BorderWidth	
CausesValidation	True
CommandArgument	
CommandName	
CssClass	
Enabled	True
EnableTheming	True
EnableViewState	True
⊞ Font	
ForeColor	☐
Height	
OnClientClick	
PostBackUrl	
SkinID	
TabIndex	0
Text	**WebButton**
ToolTip	
UseSubmitBehavior	True
ValidationGroup	
Visible	True
Width	

(ID)

Figure 2-8 Setting the Web server *Button* control properties using the Properties window.

Setting Properties Programmatically in Code To set the properties of a Web server control programmatically, use the dot notation to refer to the Web server control by its *ID* property and specify the property that you wish to change. The following code was added to the *Page_Load* event handler; it sets the *visible* and *style* properties of the but ton that has the ID of *btnWebButton*.

```
'VB
btnWebButton.Visible = True
btnWebButton.Style.Add("position", "absolute")
btnWebButton.Style.Add("top", "200px")
btnWebButton.Style.Add("left", "350px")

//C#
btnWebButton.Visible = true
btnWebButton.Style.Add("position", "absolute");
btnWebButton.Style.Add("top", "200px");
btnWebButton.Style.Add("left", "350px");
```

Notice that the Style property is available for programmatic access and that changing the top and left values causes the control to be relocated.

Controlling Automatic PostBack

Some server controls always cause a PostBack when a specific event occurs. For exam ple, the *Button* control's *Click* event always causes a PostBack. Other controls, such as the *TextBox*, have events that do not cause an automatic PostBack, but they are config urable to do so as required. For example, the *TextBox* contains a default event called *TextChanged*. By default, the *TextChanged* event does not cause an automatic PostBack, but the event is not lost. Instead, the event is raised when a different control, such as a *Button*, causes a PostBack.

When working with events that do not cause automatic PostBacks, it's important to understand when these events are raised with regard to the Web page life cycle that was defined in Table 2-1. Any postponed events, that is, events that do not cause auto matic PostBacks, execute before the events that caused the PostBacks. For example, if the text is changed in a *TextBox* and a Button is clicked, the Button causes a PostBack, but the *TextChanged* event of the *TextBox* executes and then the *Click* event of the But ton executes.

If you want to change a postponed event to an immediate event, set the *AutoPostBack* property of the control to *true*. You can do so in the Properties window, via code, or by adding the *AutoPostBack="True"* attribute to the Web server control element in Source view.

Working with Naming Containers and Child Controls

A Web page is made up of a hierarchy of controls. The *System.Web.UI.Control* class, which is the class that the Web page and its controls inherit from, has a *Controls* col lection property. This means that the Web page has a *Controls* collection, each of the controls in that collection has its own *Controls* collection, and so on.

The Web page is a *naming container* for the controls that are added to it. A naming con tainer defines a unique namespace for control names. Within a naming container, every control must be uniquely identifiable. Typically, this is accomplished by assign ing a unique value to the server control's *ID* property. The *ID* is the programmatic name of the control instance. For example, if you set the *ID* property of a *Label* control to *lblMessage*, you can reference the control in code as *lblMessage* and there cannot be another control in this naming container that has the *ID* of *lblMessage*.

Many data-bound controls, such as the *GridView* control, are containers for child con trols. For example, when the *GridView* control is instantiated, it generates multiple instances of child controls to represent the row and column data. How can multiple *GridView* controls be added to a Web page, and then, when their child controls are cre ated, each has its own unique *ID* property? This is because the *GridView* control is a naming container.

The naming container for a given child control is a control above it (parent or higher) in the hierarchy that implements the *INamingContainer* interface. A server control implements this interface to create a unique namespace for populating the *UniqueID* property values of its child server controls. The *UniqueID* property contains the fully qualified name of the control. The difference between this property and the *ID* prop erty is that the *UniqueID* property is generated automatically by the *NamingContainer* and contains the *NamingContainer* information.

Searching for Controls If you want to locate a child control within a given *Naming-Container*, use the *FindControl* method of the *NamingContainer*. The *FindControl* method recursively searches the underlying child controls, but the searches do not enter the *Controls* collection of any child control that is a *NamingContainer*. The fol lowing code snippet shows how to find a control named *lblMessage* on the Web page.

```
'VB
Dim c As Control = FindControl("lblMessage")

//C#
Control c = FindControl("lblMessage");
```

This code snippet may not have much value because you can simply access lblMes sage directly by its *ID*. The *FindControl* method is most valuable when you need to locate a control that has been dynamically created. If a control is created dynamically, you are not able to directly reference it by its *ID* property. Instead, you need to find the control, based on its *ID* property, and assign the returned value to a control variable that you can use to access the control. For example, the *GridView* dynamically creates its child controls using the format "ctl" plus *n*, where *n* is a numeric index for each control. To access a child control called *ctl08*, use the following code.

```
'VB
Dim c As Control = GridView1.FindControl("ctl08")

//C#
Control c = GridView1.FindControl("ctl08");
```

Quick Check

1. What property do you modify on a server control to minimize the size of the *ViewState* data?
2. What happens in the *OnInit* method of a control?
3. If you are migrating ASP pages to ASP.NET, what type of server controls would you use?

Quick Check Answers

1. Set *EnableViewState* to *false*.
2. Each child control of the current control is initialized.
3. Use HTML server control.

Lab: Exploring Web Page and Server Control Life Cycle Events

In this lab, you explore the Web page and server control life cycle events to gain an understanding of these events.

� **Exercise 1: Configuring Web page event handlers**

In this exercise, you configure some of the Web page and server control events by add ing event handlers for some of the primary events and running the Web page to dis play the order of the events.

1. Open Visual Studio 2005 and create a new Web site called LifeCycleEvents using your preferred programming language. The new Web site is created and a Web page called Default.aspx is displayed.
2. Double-click the Default.aspx Web page to create a *Page_Load* event handler.
3. In the *Page_Load* event handler, add the following code.

```
'VB
Protected Sub Page_Load(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Me.Load
     System.Diagnostics.Debug.Write("Page_Load<br>")
End Sub

//C#
protected void Page_Load(object sender, EventArgs e)
{
     System.Diagnostics.Debug.Write("Page_Load<br>");
}
```

4. Use the following procedure to add event handlers for the *PreInit*, *Init*, *PreRender*, and *Unload* events, placing Debug.Write code in each event handler that writes the name of the event handler to the Debug window.

VB.NET

   a. In the code-behind file, click the object drop-down list and click Page Events, as shown in Figure 2-2.
   b. Click the event drop-down list and click the desired event, which adds the event handler code.
   c. Add the following event handler code, taking care to replace the event han dler name string with the actual name of the event handler.

```
     System.Diagnostics.Debug.Write("HandlerName")
```

   d. Your code should look like the following:

```
Partial Class _Default
     Inherits System.Web.UI.Page

     Protected Sub Page_Init(ByVal sender As Object, _
             ByVal e As System.EventArgs) Handles Me.Init
       System.Diagnostics.Debug.WriteLine("Page_Init")
     End Sub

     Protected Sub Page_Load(ByVal sender As Object, _
             ByVal e As System.EventArgs) Handles Me.Load
```

```
            System.Diagnostics.Debug.WriteLine("Page_Load")
        End Sub

        Protected Sub Page_PreInit(ByVal sender As Object, _
                ByVal e As System.EventArgs) Handles Me.PreInit
            System.Diagnostics.Debug.WriteLine("Page_PreInit")
        End Sub

        Protected Sub Page_PreRender(ByVal sender As Object, _
                ByVal e As System.EventArgs) Handles Me.PreRender
            System.Diagnostics.Debug.WriteLine("Page_PreRender")
        End Sub

        Protected Sub Page_Unload(ByVal sender As Object, _
                ByVal e As System.EventArgs) Handles Me.Unload
            System.Diagnostics.Debug.WriteLine("Page_Unload")
        End Sub
    End Class
```

C#

a. Type the code for each of the events. The code is in the following format, but be sure to replace Event with the name of the event name:

```
        protected void Page_Event(object sender, EventArgs e)
        {
        }
```

b. Add the following event handler code, taking care to place the event han dler name in string:

```
            System.Diagnostics.Debug.Write("HandlerName");
```

c. Your code should look like the following:

```
    using System;
    using System.Data;
    using System.Configuration;
    using System.Web;
    using System.Web.Security;
    using System.Web.UI;
    using System.Web.UI.WebControls;
    using System.Web.UI.WebControls.WebParts;
    using System.Web.UI.HtmlControls;

    public partial class _Default : System.Web.UI.Page
    {
        protected void Page_Load(object sender, EventArgs e)
        {
            System.Diagnostics.Debug.WriteLine("Page_Load");
            }

        protected void Page_Init(object sender, EventArgs e)
        {
            System.Diagnostics.Debug.WriteLine("Page_Init");
        }

        protected void Page_PreRender(object sender, EventArgs e)
        {
            System.Diagnostics.Debug.WriteLine("Page_PreRender");
        }

        protected void Page_PreInit(object sender, EventArgs e)
        {
            System.Diagnostics.Debug.WriteLine("Page_PreInit");
        }

        protected void Page_Unload(object sender, EventArgs e)
        {
            System.Diagnostics.Debug.WriteLine("Page_Unload");
        }
    }
```

5. Press F5 to run the Web application. You then receive a prompt stating that the Web site cannot be debugged without adding a Web.config file with debugging enabled. Click OK. The Web page is displayed, although it is blank because no controls were added.
6. Locate the Output window in Visual Studio 2005. In the Output window, you should see the following list of events. Notice the order of the events.

```
Page_PreInit
Page_Init
Page_Load
Page_PreRender
Page_Unload
```

Lesson 2: Exploring Common Web Server Controls

ASP.NET 2.0 provides many Web server controls that can be used to increase produc tivity. This lesson briefly covers some of the more common Web server controls.

After this lesson, you will be able to:

- Use the Following Web server controls:
  - *Label*
  - *TextBox*
  - *Button*
  - *CheckBox*
  - *RadioButton*

Estimated lesson time: 60 minutes

Real World

Glenn Johnson

A friend of mine asked me to review his Web site, so I navigated to his site and did some exploring to get acquainted with it. It didn't take long for me to see that I was able to enter <script> tags into some of the *TextBoxes* on the site; and that the script was stored in the database. When someone else visited the site, the script was loaded from the database and executed. This Web site contained numerous Cross Site Scripting (XSS) vulnerabilities that could be exploited to allow hackers to steal users' identity information.

Fortunately, the site wasn't in production, so he was able to correct the problems and avoid the embarrassment that this could have caused him and his company.

The *Label* Control

The *Label* control displays text at a specific location on the Web page using the prop erties that the control has been assigned. Use the *Label* control when server code changes the text or the properties. If you only need to display static text, use HTML or the *Literal* control instead of using a *Label* control. The *Literal* control also displays text and the text can be changed by server code, but the *Literal* control does not sup port styles, themes, and skins.

Labels can be used as the caption of the *TextBox* or other controls in a situation where using the access key for the *Label* moves the focus to the control to the right of the *Label*.

Security Alert Populating the *Label* control with data from an untrusted source can create Cross Site Scripting (XSS) vulnerabilities. Use the *HttpUtility.HtmlEncode* or the *Server.HtmlEncode* method to encode the untrusted data that is placed in the *Text* property.

To add a *Label* Web server control to a Web page, perform the following steps:

1. If you are in the Source view of the Web page, type an <*asp:Label*> element. If you are in the Design view of the Web page, drag the *Label* control from the Standard tab of the ToolBox to the Web page.
2. Set the control's *Text* property. You can include HTML formatting in the prop erty. For example, you can underline portions of the text by placing the <*u*> element around the text.

The *TextBox* Control

The *TextBox* control collects text from the user. The *Text* property gets or sets the con tents of the *TextBox* control.

The *TextBox* contains a *TextMode* property that you can set to SingleLine (default), MultiLine, or Password. SingleLine allows the user to enter a single line of text, Multi-Line allows the user to enter many lines of text, and Password creates a single-line text box that masks the value entered by the user.

The *Columns* property sets the maximum width of the *TextBox*; the *Rows* property sets the maximum height of a multiline TextBox.

The *MaxLength* property limits the number of characters that can be entered; the *Wrap* property automatically continues the text on the next line when the end of the text box is reached.

The *Button* Control

The *Button* control displays a push button on the Web page that the user can click to trigger a PostBack to the Web server. A *Button* can be either a submit (default) button or a command button.

A submit button does not have its *CommandName* property set and simply performs a PostBack to the server. You provide an event handler for the *Click* event to control the actions performed when the user clicks the submit button.

You can use a *Button* as a command button by assigning a command name, such as *ChangeChannel* or *FastFoward*, to the *CommandName* property. Using the *Command-Name* property allows you to create multiple *Button* controls on a Web page; you can programmatically determine which *button* is clicked in the event handler for the *Com mand* event. You can also use the *CommandArgument* property to provide additional information about the command to perform, such as *ChannelUp*, *ChannelDown*, *x2* (FastForward x 2), or *x3* (FastForward x 3). Simply provide an event handler for the *Command* event to control the actions performed when a command button is clicked.

The *Button* control also contains a *CausesValidation* property that is set to true by default, which causes page validation to be performed when a *Button* control is clicked. Set the *CausesValidation* property to *false* when you want a *button* to bypass validation. Reset and help buttons are examples of buttons that typically bypass validation.

The *CheckBox* Control

The *CheckBox* control gives the user the ability to select between true and false. The *CheckBox* control's *Text* property specifies its caption. Use the *TextAlign* property to specify on which side that the caption appears. The *Checked* property is used to set and get the status of the *CheckBox* control.

Security Alert Populating the *CheckBox* control's *Text* property with data from an untrusted source can create Cross Site Scripting (XSS) vulnerabilities. Use the *HttpUtility.HtmlEncode* or *Server.HtmlEncode* method to encode the untrusted data that is placed in the *Text* property.

The *CheckedChanged* event is raised when the state of the *CheckBox* control changes, but by default, the *AutoPostBack* property of the *CheckBox* control is set to *false*. This means that changing the checked state does not cause a PostBack, but the *Check-Changed* event is raised when another control performs a PostBack.

Exam Tip If you need to create groups of *CheckBox* controls, consider using the *CheckBoxList* control. The *CheckBox* provides better layout control, but the *CheckBoxList* control is easier to use when binding with data.

The *RadioButton* Control

The *RadioButton* control gives the user the ability to select between mutually exclusive *RadioButton* controls in a group. To group multiple *RadioButton* controls together, specify the same *GroupName* for each *RadioButton* control. Grouping radio buttons together only allows a mutually exclusive selection from the group.

Security Alert Populating the *RadioButton* control's *Text* property with data from an untrusted source can create Cross Site Scripting (XSS) vulnerabilities. Use the *HttpUtility.HtmlEncode* or *Server.HtmlEncode* method to encode the untrusted data that is placed in the *Text* property.

The *RadioButton* control's *Text* property specifies its caption. Use the *TextAlign* prop erty to specify the side that the caption appears on. The *Checked* property is used to set and get the status of the *RadioButton* control.

Exam Tip Be sure to also consider using the *RadioButtonList*. The *RadioButton* provides better lay out control, but the *RadioButtonList* control is easier to use when binding with data.

Quick Check

1. What are the two types of Web server buttons that can be created?
2. How do you create a *TextBox* that retrieves a password from the user?
3. How do you make a *CheckBox* cause immediate PostBack?

Quick Check Answers

1. The two types of buttons are Submit and Command.
2. Set *TextMode* to *Password*.
3. Set its *AutoPostBack* property to *true*.

Lab: Working With Web Server Controls

In this lab, you work with the Web server controls that are defined in this chapter.

� Exercise 1: Adding Controls to the Web Page

In this exercise, you add Web page controls to the Web page that was created in the previous lab.

1. Open Visual Studio 2005 and open the Web site called LifeCycleEvents that you created in the previous lab. Alternatively, you can open the completed Lesson 1, Exercise 1 project from the CD.
2. Open the Default.aspx Web page in Design view.
3. Drag a *Label*, *TextBox, Button, CheckBox,* and three *RadioButtons* onto the Web page. Change the *Text* properties of these controls to match Figure 2-9, which shows how the Web page should look.

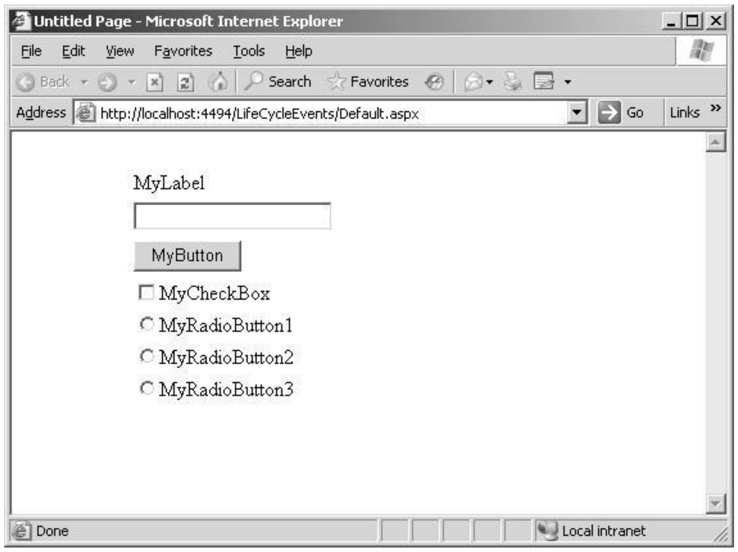

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4494/LifeCycleEvents/Default.aspx
Go Links
MyLabel
MyButton
MyCheckBox
MyRadioButton1
MyRadioButton2
MyRadioButton3
Done
Local intranet

Figure 2-9 Drag Web server controls onto the Web page as shown.

4. Right-click the Web page and click View Code to open the code-behind page. Notice that no additional code was added to the code-behind page.
5. Press F5 to run the Web application.
6. Try clicking the *Button*, *CheckBox*, and *RadioButton* controls. Observe the behav ior of these controls. Notice that the *Button* is the only control that performs a PostBack to the Web server. Also notice that the *RadioButton* controls are not mutually exclusive.

7. Double-click the *Button* control to add the Button's *Click* event handler. Add the following code to populate the *Label* with any text that has been typed into the *TextBox*. Be sure to take the security warnings seriously and use the *HtmlEncode* method. The code should look like the following.

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button1.Click
    Label1.Text = Server.HtmlEncode(TextBox1.Text)
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    Label1.Text = Server.HtmlEncode(TextBox1.Text);
}
```

8. Double-click the *CheckBox* control to add the *CheckedChanged* event handler. Add code to replace its *Text* property with the current date and time if the *CheckBox* is selected. Your code should look like the following.

```
'VB
Protected Sub CheckBox1_CheckedChanged(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles CheckBox1.CheckedChanged
    If (CheckBox1.Checked) Then
      CheckBox1.Text = DateTime.Now.ToString()
    End If
End Sub

//C#
protected void CheckBox1_CheckedChanged(object sender, EventArgs e)
{
    if (CheckBox1.Checked)
    {
      CheckBox1.Text = DateTime.Now.ToString();
    }
}
```

9. To make the *RadioButton* controls mutually exclusive, these controls must have the same *GroupName* property setting, as long as the setting is not empty. Assign "MyGroup" to the *GroupName* property of all three *RadioButton* controls.

10. Add a single event handler for the *CheckedChanged* event of the three *RadioButtons*. You can do so by selecting all three *RadioButton* controls, and then clicking the lightning bolt icon in the Properties window to see the events that are available. In the *CheckedChanged* event, type **RadioChanged** and press Enter. This adds an

event hander to the code-behind page. In the event handler, add code to copy the text of the selected *RadioButton* into the *TextBox* control. The event handler should look like the following.

```
'VB
Protected Sub RadioChanged(ByVal sender As Object, _
       ByVal e As System.EventArgs) _
       Handles RadioButton1.CheckedChanged, _
              RadioButton2.CheckedChanged, _
              RadioButton3.CheckedChanged
     Dim r As RadioButton = CType(sender, RadioButton)
     TextBox1.Text = r.Text
End Sub

//C#
protected void RadioChanged(object sender, EventArgs e)
{
     RadioButton r = (RadioButton)sender;
     TextBox1.Text = r.Text;
}
```

11. Press F5 to run the Web application. The Web page is displayed.
12. Type something into the *TextBox* control and click the *Button* control. You should see the contents of the *TextBox* control in the *Label* control.
13. Click the CheckBox several times. Notice that nothing seems to happen. Make sure that the CheckBox is selected and then click the Button. Notice that the *CheckBox* control's *Text* property now contains the current date and time. The *CheckBox* does not have *AutoPostBack* set to true.
14. Type different text into the *TextBox*. Click RadioButton2. Notice that nothing happens because *AutoPostBack* is not enabled for the *RadioButton* controls. Click the *Button*. Notice that the *TextBox* is updated to RadioButton2 and the *Label* also contains RadioButton2. This behavior is predictable because the event that caused the PostBack always follows the events that did not cause the *AutoPostBack*.
15. Select the CheckBox and the RadioButtons and set the *AutoPostBack* to *true*.
16. Press F5 to run the Web application. The Web page is displayed.
17. Click the CheckBox. Notice that this control performs a PostBack, and the date and time are updated when the CheckBox is selected.
18. Click each of the *RadioButton* controls. Notice that these controls perform a PostBack and the *TextBox* is updated to show the *RadioButton* that was clicked.

Chapter 3

Exploring Specialized Server Controls

It wasn't that long ago when creating a calendar on a Web page was a time-consum ing task involving the creation of Hypertext Markup Language (HTML) tables with hyperlinks on each date and JavaScript to process the selection of a date. Today, with ASP.NET, common tasks such as creating a calendar are simple drag-and-drop operations.

The previous chapter provided an introduction to server controls and discussed some of the common Web server controls. This chapter explores the more specialized con trols that are available in ADO.NET 2.0.

Exam objectives in this chapter:

- Add and configure Web server controls.
    - Use the *AdRotator* Web server control to manage banners and pop-up windows.
    - Display a calendar on a Web page by using the *Calendar* Web server control.
    - Implement the *FileUpload* Web server control.
    - Display an image on a Web form by using the *Image* Web server control.
    - Implement a button on a Web form by using the *ImageButton* Web server control.
    - Define hotspot regions within an image by using the *ImageMap* Web server control.
    - Display a hyperlink style button on a Web Form by using the *LinkButton* Web server control.
    - Display lists of information by using controls that derive from the *ListControl* class.

- ❑ Create a Web Form with static text by using the *Literal* Web server control.
- ❑ Use the *Panel* Web server control to group controls on a page.
- ❑ Create a container for a group of *View* controls by using the *MultiView* Web server control.
- ❑ Use the *View* Web server control.
- ❑ Construct a table by using the *Table*, *TableRow*, and *TableCell* Web server controls.
- ❑ Create a wizard by using the *Wizard* Web server control to collect data through multiple steps of a process.
- ❑ Use the *XML* Web server control to create Extensible Markup Language (XML) data at the location of the control.
- ❑ Customize the appearance of ASP.NET server controls by using Web con trol templates.

- Implement data-bound controls.
  - ❑ Use tabular data source controls to return tabular data.
  - ❑ Use hierarchical data source controls to display hierarchical data.
  - ❑ Display data by using simple data-bound controls.
  - ❑ Display data by using composite data-bound controls.
  - ❑ Display data by using hierarchical data-bound controls.
  - ❑ Use the *FormView* control to display the values of a single table record from a data source.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic (VB) or C# and be comfortable with the following tasks:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed with SQL Server 2005 Express Edition and Internet Information Services (IIS).
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of HTML and client-side scripting.
- Know how to create a new Web site.
- Be able to add Web server controls to a Web page.

Real World

Glenn Johnson

I have seen many Web sites that attempt to collect lots of data by simply present ing the user with a Web page that contains a vertical list of *Label:TextBox* prompts. Many users become frustrated with the amount of data that needs to be entered. As a result, these sites have a high rate of abandonment.

Lesson 1: Exploring Specialized Web Server Controls

This lesson covers many of the specialized Web server controls, meaning controls that don't directly convert to single HTML tags and are in ASP.NET 2.0.

After this lesson, you will be able to:

- Use the following Web server controls:
  - ❑ *Literal*
  - ❑ *Table*, *TableRow*, and *TableCell*
  - ❑ *Image*
  - ❑ *ImageButton*
  - ❑ *ImageMap*
  - ❑ *Calendar*
  - ❑ *FileUpload*
  - ❑ *Panel*
  - ❑ *MultiView*
  - ❑ *View*
  - ❑ *Wizard*

Estimated lesson time: 60 minutes

The *Literal* Control

The *Literal* control is similar to the *Label* control, as both controls are used to display static text on the Web page. The *Literal* control does not inherit from *WebControl*, as shown in the *Literal* control's object model in Figure 3-1. The *Literal* control does not provide substantial functionality and does not add any HTML elements to the Web page where the *Label* is rendered as a <span> tag. This means that the *Literal* does not have a *Style* property, and you cannot apply any styles, including positioning, to its content.

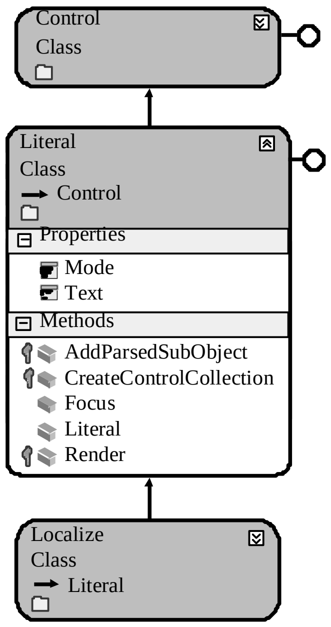


Figure 3-1 The *Literal* control object model.

Security Alert By default, populating the *Literal* control with data from untrusted sources can create Cross Site Scripting (XSS) vulnerabilities. Set the *Mode* property to *Encode* to provide HTML encoding of untrusted data that will be placed into the *Text* property.

The *Literal* control contains the *Mode* property, which is used to specify particular handling of the content of the *Text* property, as shown in Table 3-1.

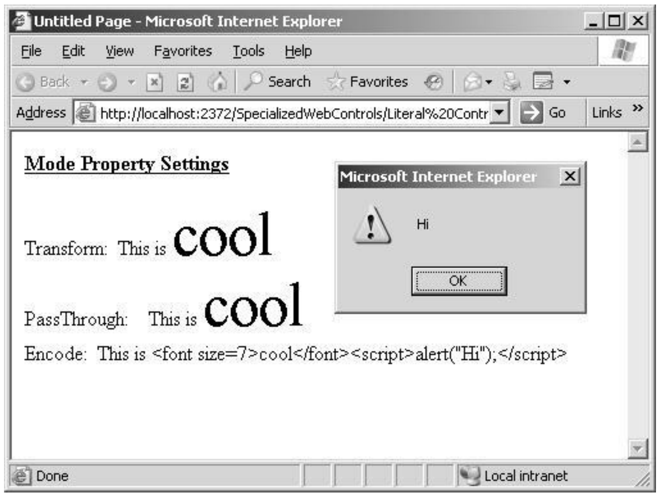
Table 3-1 The *Literal* Control's *Mode* Property

Mode	Description
PassThrough	The *Text* content is rendered as is.
Encode	The *Text* content is HTML-encoded.
Transform	The *Text* content is converted to match the markup lan guage of the requesting browser, such as HTML, Extensible Hypertext Markup Language (XHTML), Wireless Markup Language (WML), or Compact Hypertext Markup Lan guage (cHTML). If the markup language is HTML or XHTML, the content is passed through to the browser. For other markup languages, invalid tags are removed.

Take, for example, a Web page that was created and the words Transform, PassThrough, and Encode were added. A *Literal* control was placed beside each of the words. The following code was added to the code-behind page to demonstrate the use of the *Literal* control and the effect of the *Mode* property:

```
'VB
Partial Class LiteralControl
    Inherits System.Web.UI.Page

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
        Literal1.Text = _
            "This is <font size=7>cool</font><script>alert(""Hi"");</script>"
        Literal2.Text = _
            "This is <font size=7>cool</font><script>alert(""Hi"");</script>"
        Literal3.Text = _
            "This is <font size=7>cool</font><script>alert(""Hi"");</script>"
        Literal1.Mode = LiteralMode.Transform
        Literal2.Mode = LiteralMode.PassThrough
        Literal3.Mode = LiteralMode.Encode
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class LiteralControl : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        Literal1.Text =
            @"This is <font size=7>cool</font><script>alert(""Hi"");</script>";
        Literal2.Text =
            @"This is <font size=7>cool</font><script>alert(""Hi"");</script>";
        Literal3.Text =
            @"This is <font size=7>cool</font><script>alert(""Hi"");</script>";
        Literal1.Mode = LiteralMode.Transform;
        Literal2.Mode = LiteralMode.PassThrough;
        Literal3.Mode = LiteralMode.Encode;
    }
}
```

Figure 3-2 shows the rendered output of the *Literal* control when the Web page is dis played. The alert message was displayed twice: once for *Transform* and once for *PassThrough*.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/Literal%20Contr
Go Links
Microsoft Internet Explorer
Hi
OK
Done
Local intranet

Mode Property Settings

Transform: This is cool

PassThrough: This is cool

Encode: This is <font size=7>cool</font><script>alert("Hi");</script>

Figure 3-2 *Literal* controls rendered using different *Mode* settings.

The best use for the *Literal* control is in scenarios where you want to render text and controls directly into a page without any additional markup.

The *Table*, *TableRow*, and *TableCell* Controls

Tables provide a way to format information that is displayed on the Web page. The information can be tabular data, but it can also consist of graphics and controls that are to be displayed on the Web page.

NOTE .NET 2.0

The *Table*, *TableRow*, and *TableCell* controls are new in ASP.NET version 2.0.

Although you can configure the *Table* control to display static information while in Design view, the *Table* control's real power comes from the ability to programmati cally add *TableRow* and *TableCell* controls at run time. If you only need to display static information, consider using the HTML table tag instead.

Exam Tip An *HtmlTable* control can be created from the table tag by adding the *runat="server"* attribute to the tag and assigning an ID to the control, but the *Table* control is easier to use because it provides a programming model that is consistent with the *TableRow* and *TableCell* controls.

If you need to programmatically add rows and cells to a table at run time, the *Table* control may be the right choice, but *TableRow* and *TableCell* objects that are added to the *Table* control need to be programmatically re-created when *PostBack* occurs. If you need the rows and cells to survive *PostBacks*, you may want to consider using the *DataList* or *GridView* control. As a result, the *Table* control is usually considered to be best suited for control developers who use the table as part of a custom control that they build.

Security Alert By default, populating the *TableCell* control with data from untrusted sources can create XSS vulnerabilities. Be sure to HTML encode all data using either the *Server.HtmlEncode* or the *HttpUtility.HtmlEncode* method.

The *Table* control provides an object model that is consistent with other Web con trols. Figure 3-3 shows the *Table* control's object model.

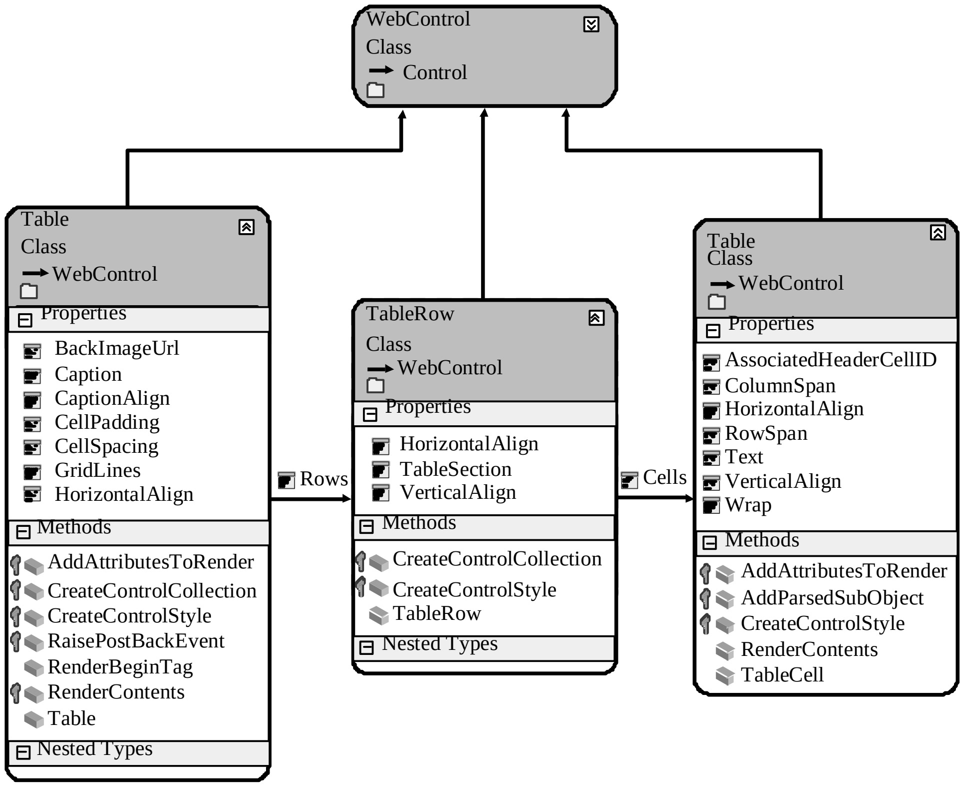


Figure 3-3 The *Table* control's object model.

Notice that the *Table* control contains a *Rows* collection property, which is a collection of *TableRow* controls. The *TableRow* control contains a *Cells* collection property, which is a collection of *TableCell* controls. You can programmatically add and delete *Table-Rows* and *TableCells* to these collections to build your *Table* control.

The *Table*, *TableRow*, and *TableCell* inherit from the *WebControl* class, which contains format properties such as *Font*, *BackColor*, and *ForeColor*. If you set these properties at the *Table*, you can override them in the *TableRow*, and the *TableRow* settings can be overridden in the *TableCell*.

As mentioned earlier, if you are writing a custom control, the *Table*, *TableRow*, and *TableCell* might be the classes for you, but if you are simply planning on dragging and dropping the *Table* onto the Web page, you should consider using one of the other list controls, such as the *Repeater*, *DataList*, or *GridView*, because these controls typically render as HTML tables and provide more functionality.

Adding Rows and Cells Dynamically to a *Table* Control

The following steps show how to dynamically add *TableCell* and *TableRow* objects to an existing *Table* control:

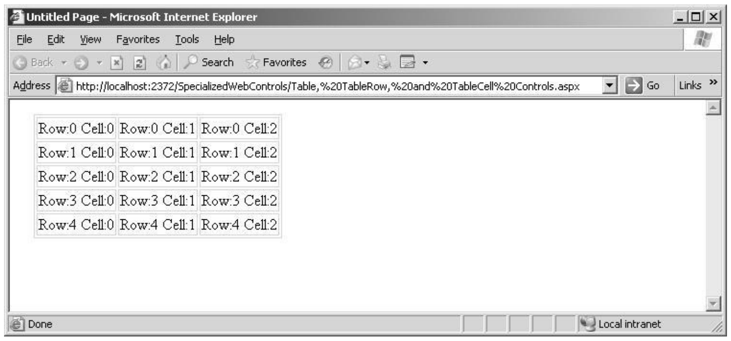
1. Create a *TableRow* object that corresponds to a row in the table.
2. Create a *TableCell* object and populate it with data by either setting the *Text* prop erty or by adding controls to the *TableCell* object's *Controls* collection.
3. Add the *TableCell* object that you created in step 2 to the *TableRow* object's *Cells* collection.
4. Repeat steps 2 and 3 for each cell that needs to be created in the row.
5. Add the *TableRow* objects that you created in step 1 to the *Table* object's *Rows* col lection.
6. Repeat steps 1 through 5, as necessary, for all rows and cells in the table.

In this example, a Web page was created and a *Table* control was added to the page. The following code was added to the code-behind page to demonstrate the dynamic addition of *TableRow* and *TableCell* controls to the *Table* control.

```
'VB
Partial Class Table__TableRow__and_TableCell_Controls
    Inherits System.Web.UI.Page

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      Table1.BorderWidth = 1
```

```
        For row As Integer = 0 To 4
            Dim tr As New TableRow()
            For column As Integer = 0 To 2
                Dim tc As New TableCell()
                tc.Text = String.Format("Row:{0} Cell:{1}", row, column)
                tc.BorderWidth = 1
                tr.Cells.Add(tc)
            Next column
            Table1.Rows.Add(tr)
        Next row
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Table__TableRow__and_TableCell_Controls : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
     Table1.BorderWidth = 1;
     for (int row = 0; row < 5; row++)
        {
            TableRow tr = new TableRow();
            for (int column = 0; column < 3; column++)
              {
                  TableCell tc = new TableCell();
                  tc.Text = string.Format("Row:{0} Cell:{1}", row, column);
                  tc.BorderWidth = 1;
                  tr.Cells.Add(tc);
              }
            Table1.Rows.Add(tr);
        }
    }
 }
```

In the code example, notice that the code starts by setting the *BorderWidth* property of the *Table* control to one that causes the *Table* to have a line around its outside edges. The *TableCell* objects also have their *BorderWidth* set to one that causes each *TableCell* to be outlined as well. When the Web page is displayed, it will look like the page shown in Figure 3-4.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/Table,%20TableRow,%20and%20TableCell%20Controls.aspx
Go Links
Done
Local intranet

Row:0 Cell:0	Row:0 Cell:1	Row:0 Cell:2
Row:1 Cell:0	Row:1 Cell:1	Row:1 Cell:2
Row:2 Cell:0	Row:2 Cell:1	Row:2 Cell:2
Row:3 Cell:0	Row:3 Cell:1	Row:3 Cell:2
Row:4 Cell:0	Row:4 Cell:1	Row:4 Cell:2

Figure 3-4 This Web page shows the result of dynamically creating *TableRow* and *TableCell* controls.

The *Image* Control

The *Image* control is used to display an image on a Web page. This control generates an *<img>* element when rendering to HTML. The *Image* control inherits directly from the Web control class, and the *ImageMap* and *ImageButton* inherit from the *Image* con trol, as shown in Figure 3-5.

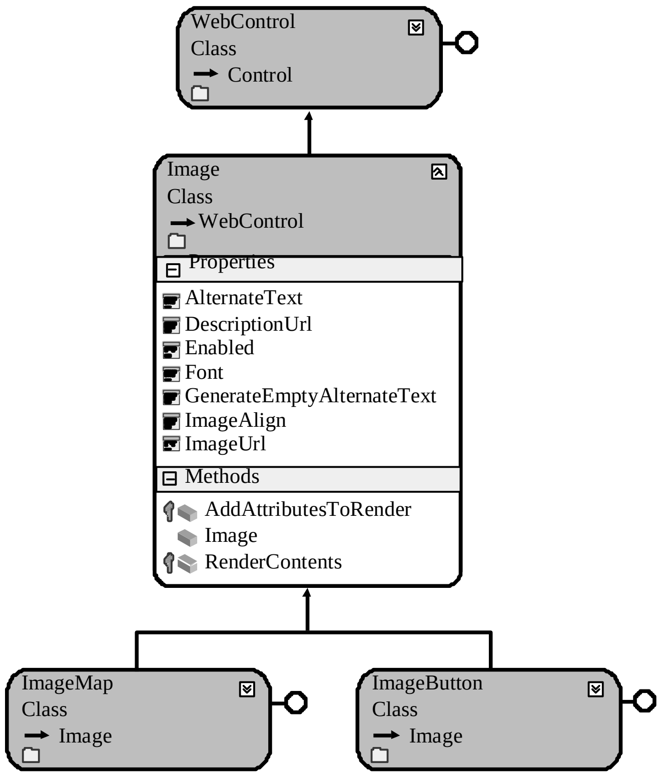


Figure 3-5 The *Image* control hierarchy.

The *Image* control's primary property, *ImageUrl*, indicates the path to the image that is downloaded from the browser and displayed. This property maps directly to the *href* attribute of the *<img>* element in HTML. It's important to understand that the *Image* is not embedded to the Web page; instead, when the browser encounters the *<img>* element with the *href* attribute, the browser initiates a separate request for the image from the server.

The *Image* control also contains a property called *AlternateText* that you can set to dis play a text message when the image is not available.

The *Image* control does not have a *Click* event, but in situations where the *Click* event is necessary, you can use the *ImageButton* or *ImageMap* instead. These controls allow you to retrieve the x- and y-coordinates of the user's click as well.

The *Image* control is represented as the *<asp:Image>* element in the HTML source and has no content, so you can write this element as a singleton (closing the tag with /> instead of using a separate closing tag).

The *ImageAlign* property can be set to *NotSet*, *Left*, *Right*, *Baseline*, *Top*, *Middle*, *Bottom*, *AbsBottom*, *AbsMiddle*, or *TextTop*. These settings specify the alignment of the image in relation to the other objects on the Web page.

The *DescriptionUrl* property is an accessibility feature that is used to provide further explanation of the content and meaning of the image when using nonvisual page readers. This property sets the *longdesc* attribute of the *<img>* element that is gener ated. This property should be set to the URL of a page that contains details of the image in text or audio format.

Setting the *GenerateEmptyAlternateText* property to true will add the attribute *alt=""* to the *<img>* element that the *Image* control generates. From the accessibility perspec tive, any image that does not contribute to the meaning of the page, such as a blank image or a page-divider image, should always carry this attribute, which causes non visual page readers to simply ignore the image.

Take the following example: A Web page was created and an *Image* control was added to the page. Also, an image file called Girl.gif was added to a new folder called images and an HTML page was created ImageDescription.htm, which contains a description that can be used by nonvisual page readers. The following code was added to the code-behind page to show how the *Image* control's properties can be set programmatically:

```
'VB
Partial Class Image_Control
      Inherits System.Web.UI.Page

  Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles Me.Load
       Image1.ImageUrl = "~/Images/Girl.gif"
       Image1.DescriptionUrl = "~/ImageDescription.htm"
       Image1.AlternateText = "This is a picture of a girl"
     End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Image_Control : System.Web.UI.Page
{
      protected void Page_Load(object sender, EventArgs e)
       {
        Image1.ImageUrl = "~/Images/Girl.gif";
        Image1.DescriptionUrl = "~/ImageDescription.htm";
        Image1.AlternateText = "This is a picture of a girl";
       }
}
```

This code is simply setting properties. The tilde (~) indicates the current Web appli cation folder. Figure 3-6 shows the rendered Web page, including the alternate text, which is displayed as a ToolTip.

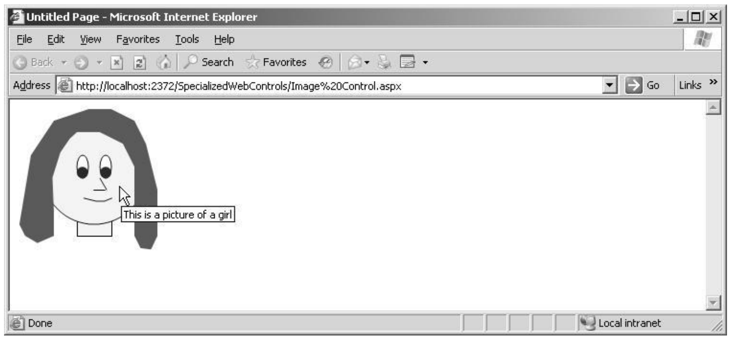

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/Image%20Control.aspx
Go Links
This is a picture of a girl
Done
Local intranet

Figure 3-6 The rendered *Image* control displaying the *AlternateText* property as a ToolTip.

The *ImageButton* Control

The *ImageButton* control is used to display a clickable image on a Web page that can be used to post back to the Web server when the image is clicked. This control gener ates an *<input type="image">* element when rendering to HTML. The *ImageButton* con trol inherits directly from the *Image* control class, as shown in Figure 3-7.

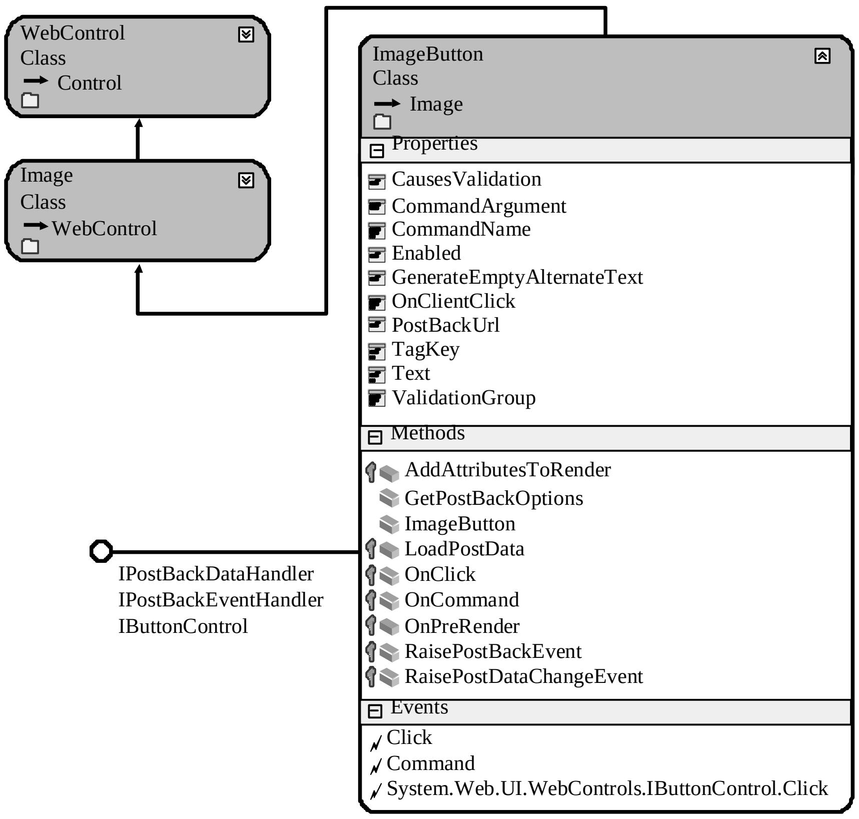


Figure 3-7 The *ImageButton* control hierarchy.

Like the *Image* control, the *ImageButton* control's primary property, *ImageUrl,* indi cates the path to an image that can be downloaded from the browser and displayed. This property maps directly to the *src* attribute of the *<input>* element in HTML.

Because the *ImageButton* inherits from the *Image* control, it also contains the *Alternate-Text*, *DescriptionUrl*, *ImageAlign*, and *GenerateEmptyAlternateText* properties.

The *ImageButton* control has a *Click* and *Command* event that functions like the *Button* control. The second argument of the *Click* event has a data type of *ImageClickEvent*

Args, which lets you retrieve the x- and y-coordinates of the user's click.

The *ImageButton* control is represented as the *<asp:ImageButton>* element in source view and has no content, so you can write this element as a singleton element.

Here's another example: A Web page was created and an *ImageButton* control was added to the page. This control also uses the same image file called Girl.gif and HTML page called ImageDescription.htm that were used in the previous *Image* control exam ple. The following code was added to the code-behind page to show how the *Image-Button* control's properties can be set programmatically and the *Click* event can be implemented.

```
'VB
Partial Class ImageButton_Control
    Inherits System.Web.UI.Page

    Protected Sub ImageButton1_Click(ByVal sender As Object, ByVal e As
System.Web.UI.ImageClickEventArgs) Handles ImageButton1.Click
        ImageButton1.AlternateText = _
            String.Format("Button Clicked at {0},{1}", e.X, e.Y)
    End Sub

  Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles Me.Load
        ImageButton1.ImageUrl = "~/Images/Girl.gif"
        ImageButton1.DescriptionUrl = "~/ImageDescription.htm"
        ImageButton1.AlternateText = "This is a picture of a girl"
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class ImageButton_Control : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
     {
      ImageButton1.ImageUrl = "~/Images/Girl.gif";
      ImageButton1.DescriptionUrl = "~/ImageDescription.htm";
      ImageButton1.AlternateText = "This is a picture of a girl";
     }
    protected void ImageButton1_Click(object sender, ImageClickEventArgs e)
    {
      ImageButton1.AlternateText =
            string.Format("Button Clicked at {0},{1}", e.X, e.Y);
    }
}
```

This code sets the *ImageButton* control properties in the *Page_Load* event handler. In the *ImageButton1_Click* event handler, the x- and y-coordinates are retrieved and placed into the *AlternateText* property, as shown in Figure 3-8.

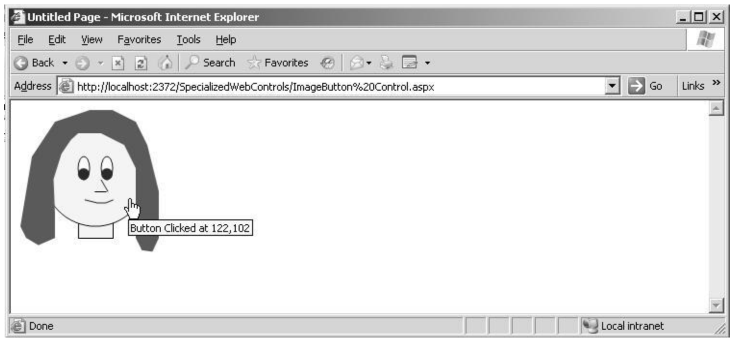

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/ImageButton%20Control.aspx
Go Links
Button Clicked at 122,102
Done
Local intranet

Figure 3-8 The rendered *ImageButton* displaying the *AlternateText* message after the *ImageButton* was clicked.

The *ImageMap* Control

The *ImageMap* control is used to display a clickable image on a Web page that can be used to post back to the Web server when the image is clicked. This control differs from the *ImageButton* control in that the *ImageMap* control allows you to define regions or "hot spots" that cause *PostBack*, whereas clicking anywhere on the *Image-Button* causes *PostBack*. This control generates an *<img usemap="#myMap">* element. In addition, a *<map name="myMap">* element with nested *<area>* elements is also cre ated when rendering to HTML. The *ImageMap* control inherits directly from the *Image* control class, as shown in Figure 3-9.

Like the *Image* control, the *ImageMap* control's primary property, *ImageUrl*, indicates the path to the image that can be downloaded from the browser and displayed. This property maps directly to the *src* attribute of the *<img>* element in HTML.

Since the *ImageMap* inherits from the *Image* control, it also contains the *AlternateText*, *DescriptionUrl*, *ImageAlign*, and *GenerateEmptyAlternateText* properties.

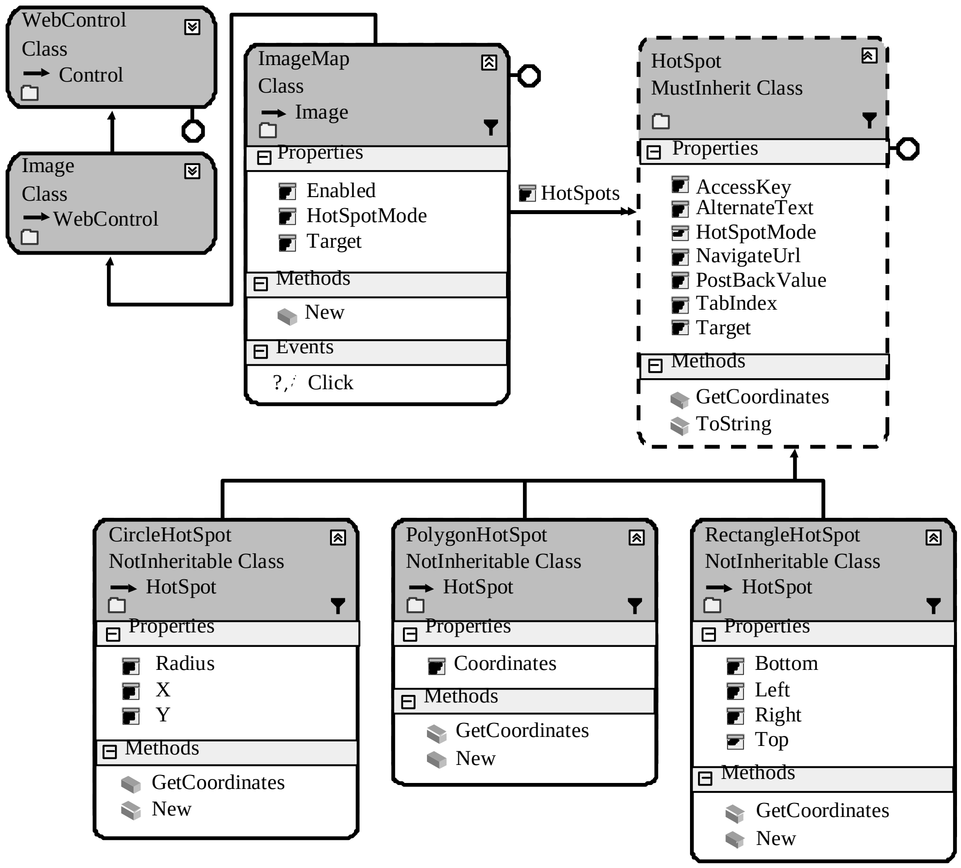


Figure 3-9 The *ImageMap* and *HotSpot* control hierarchy.

The *ImageMap* control has a *Click* event that functions like the *Button* control. The second argument of the *Click* event has a data type of *ImageMapEventArgs*, which lets you retrieve the *PostBackValue* of the associated hot spot that the user clicked.

In the source view, the *ImageMap* control is represented as the *<asp:ImageMap>* element and has nested hot spot elements that can be *CircleHotSpot*, *RectangleHotSpot*, and *PolygonHotSpot* elements.

Working with *HotSpot* Controls

A *hot spot* is a predefined area on an image that can be clicked to perform an action. Hot spots can be created to define areas on the image that are displayed by the *ImageMap* control. You can define many overlapping areas, with each layer based on the *HotSpot* definition order. The first *HotSpot* defined takes precedence over the last

HotSpot defined. The *HotSpot* object model is shown in Figure 3-9. The classes that inherit from the *HotSpot* are the *CircleHotSpot*, *RectangleHotSpot,* and *PolygonHotSpot*. Table 3-2 contains the list of *HotSpot* properties.

Table 3-2 *HotSpot* Properties

Property	Description
AccessKey	A tool that specifies the keyboard shortcut for a *HotSpot*. You can place only a single character into this property. If this property contains "C," for example, a Web user can press Alt+C to navigate to the *HotSpot*.
AlternateText	The text that is displayed for a *HotSpot* when the image is unavailable or renders to a browser that does not support images. This also becomes the *ToolTip*.
HotSpotMode	A tool that specifies the behavior of the *HotSpot* when it is clicked. Can be *NotSet*, *Inactive*, *Navigate*, or *PostBack*.
NavigateUrl	The URL to navigate to when a *HotSpot* object is clicked.
PostBackValue	The string that is passed back to the Web server and is avail able in the event argument data when the *HotSpot* is clicked.
TabIndex	The tab index number of the *HotSpot*.
Target	The target window or frame that displays the Web page and is linked to the *HotSpot*.

Understanding the *HotSpotMode* Property

The *HotSpotMode* property is used to specify how the *HotSpot* behaves when the *HotSpot* is clicked. You can specify the *HotSpotMode* on either the *HotSpot* or the *ImageMap* control. If you set the *HotSpotMode* on the *HotSpot* and the *ImageMap*, the *HotSpot* takes precedence. This means that you can specify the *HotSpotMode* on the *ImageMap* control to set a default *HotSpot* behavior, but the *HotSpotMode* of the *HotSpot* must be set to *NotSet* to inherit the behavior from the *HotSpot*.

Specifying *Navigate* for the *HotSpotMode* causes the *HotSpot* to navigate to a URL when the *HotSpot* is clicked. The *NavigateUrl* property specifies the URL to navigate to.

NOTE ***HotSpotMode* Default**

If the *ImageMap* and *HotSpot* have their *HotSpotModes* set to *NotSet*, the *HotSpots* default to *Navigate*.

Specifying *PostBack* for the *HotSpotMode* causes the *HotSpot* to generate a *PostBack* to the server when the *HotSpot* is clicked. The *PostBackValue* property specifies a string that is passed back to the Web server in the *ImageMapEventArgs* event data when the *HotSpot* is clicked and the *Click* event is raised.

Specifying *Inactive* for the *HotSpotMode* indicates that the *HotSpot* does not have any behavior when it is clicked. This is used to create an inactive *HotSpot* region within a larger active *HotSpot*, thus allowing you to create complex *HotSpot* zones within an *ImageMap* control. You must specify the inactive *HotSpot* before you designate the active *HotSpot* in the *ImageMap* control.

In this example, a Web page was created and a *Label* and *ImageMap* control were added to the page. The *ImageMap* control uses the same image file called Girl.gif and HTML page called ImageDescription.htm that were used in the previous *Image* and *ImageButton* control examples. The following code was added to the code-behind page to show how the *ImageMap* control's properties can be set programmatically and the *Click* event can be implemented to display the *HotSpot* that is clicked.

```
'VB
Partial Class ImageMap_Control
    Inherits System.Web.UI.Page

  Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles Me.Load
     ImageMap1.ImageUrl = "~/Images/Girl.gif"
     ImageMap1.DescriptionUrl = "~/ImageDescription.htm"
     ImageMap1.AlternateText = "This is a picture of a girl"
     ImageMap1.HotSpotMode = HotSpotMode.PostBack
     Dim chs As CircleHotSpot
     Dim rhs As RectangleHotSpot
     Dim phs As PolygonHotSpot
     chs = New CircleHotSpot()
     chs.X = 75
     chs.Y = 75
     chs.Radius = 6
     chs.PostBackValue = "Left Eye Center"
     ImageMap1.HotSpots.Add(chs)

     chs = New CircleHotSpot()
     chs.X = 100
     chs.Y = 75
     chs.Radius = 6
```

```
        chs.PostBackValue = "Right Eye Center"
        ImageMap1.HotSpots.Add(chs)

        phs = New PolygonHotSpot()
        phs.Coordinates = "76,57,82,64,81,76,76,82,71,76,70,63"
        phs.PostBackValue = "Left Eye"
        ImageMap1.HotSpots.Add(phs)

        phs = New PolygonHotSpot()
        phs.Coordinates = "99,57,105,64,104,76,99,82,94,76,93,63"
        phs.PostBackValue = "Right Eye"
        ImageMap1.HotSpots.Add(phs)

        rhs = New RectangleHotSpot()
        rhs.Top = 101
        rhs.Bottom = 110
        rhs.Left = 74
        rhs.Right = 110
        rhs.PostBackValue = "Mouth"
        ImageMap1.HotSpots.Add(rhs)

        phs = New PolygonHotSpot()
        phs.Coordinates = "92,82,101,95,85,95"
        phs.PostBackValue = "Nose"
        ImageMap1.HotSpots.Add(phs)

        phs = New PolygonHotSpot()
        phs.Coordinates = _
                "28,150,17,141,10,129,22,57,46,21,80,9," _
         + "103,9,129,22,141,47,152,93,152,142,144,156," _
         + "135,154,128,142,129,71,117,47,93,34,69,34," _
         + "51,56,42,81,44,140"
        phs.PostBackValue = "Hair"
        ImageMap1.HotSpots.Add(phs)

        chs = New CircleHotSpot()
        chs.X = 87
        chs.Y = 81
        chs.Radius = 50
        chs.PostBackValue = "Face"
        ImageMap1.HotSpots.Add(chs)

        rhs = New RectangleHotSpot()
        rhs.Top = 127
        rhs.Bottom = 142
        rhs.Left = 69
        rhs.Right = 107
        rhs.PostBackValue = "Neck"
        ImageMap1.HotSpots.Add(rhs)
    End Sub

    Protected Sub ImageMap1_Click(ByVal sender As Object, ByVal e As
System.Web.UI.WebControls.ImageMapEventArgs) Handles ImageMap1.Click
```

```
    Label1.Text = "You clicked the " + e.PostBackValue
  End Sub
End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class ImageMap_Control : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
     {
      ImageMap1.ImageUrl = "~/Images/Girl.gif";
      ImageMap1.DescriptionUrl = "~/ImageDescription.htm";
      ImageMap1.AlternateText = "This is a picture of a girl";
      ImageMap1.HotSpotMode = HotSpotMode.PostBack;
      CircleHotSpot chs;
      RectangleHotSpot rhs;
      PolygonHotSpot phs;

      chs = new CircleHotSpot();
      chs.X = 75;
      chs.Y = 75;
      chs.Radius = 6;
      chs.PostBackValue = "Left Eye Center";
      ImageMap1.HotSpots.Add(chs);

      chs = new CircleHotSpot();
      chs.X = 100;
      chs.Y = 75;
      chs.Radius = 6;
      chs.PostBackValue = "Right Eye Center";
      ImageMap1.HotSpots.Add(chs);

      phs = new PolygonHotSpot();
      phs.Coordinates = "76,57,82,64,81,76,76,82,71,76,70,63";
      phs.PostBackValue = "Left Eye";
      ImageMap1.HotSpots.Add(phs);

      phs = new PolygonHotSpot();
      phs.Coordinates = "99,57,105,64,104,76,99,82,94,76,93,63";
      phs.PostBackValue = "Right Eye";
      ImageMap1.HotSpots.Add(phs);
      rhs = new RectangleHotSpot();
      rhs.Top = 101;
      rhs.Bottom = 110;
      rhs.Left = 74;
      rhs.Right = 110;
      rhs.PostBackValue = "Mouth";
      ImageMap1.HotSpots.Add(rhs);

      phs = new PolygonHotSpot();
      phs.Coordinates = "92,82,101,95,85,95";
      phs.PostBackValue = "Nose";
      ImageMap1.HotSpots.Add(phs);

      phs = new PolygonHotSpot();
      phs.Coordinates =
          "28,150,17,141,10,129,22,57,46,21,80,9,"
      + "103,9,129,22,141,47,152,93,152,142,144,156,"
      + "135,154,128,142,129,71,117,47,93,34,69,34,"
      + "51,56,42,81,44,140";
      phs.PostBackValue = "Hair";
      ImageMap1.HotSpots.Add(phs);

      chs = new CircleHotSpot();
      chs.X = 87;
      chs.Y = 81;
      chs.Radius = 50;
      chs.PostBackValue = "Face";
      ImageMap1.HotSpots.Add(chs);

      rhs = new RectangleHotSpot();
      rhs.Top = 127;
      rhs.Bottom = 142;
      rhs.Left = 69;
      rhs.Right = 107;
      rhs.PostBackValue = "Neck";
      ImageMap1.HotSpots.Add(rhs);
     }

   protected void ImageMap1_Click(object sender, ImageMapEventArgs e)
   {
     Label1.Text = "You clicked the " + e.PostBackValue;
   }

}
```

In the sample code, clicking a *HotSpot* on the *ImageMap* causes a *PostBack* of the *PostBackValue* to the server. The *ImageMapEventArgs* contains the *PostBackValue*, which is placed into the *Text* property of the *Label*. Notice that many *HotSpot* objects overlap in this example. For example, the center of each eye overlaps the rest of that eye, and the eyes overlap the face. The hair also overlaps the face, and the face overlaps the neck.

Remember that the *HotSpot* objects that are added first override the later *HotSpots* in the *ImageMap* control's *HotSpots* collection. Figure 3-10 shows the *ImageMap* after the hair has been clicked.

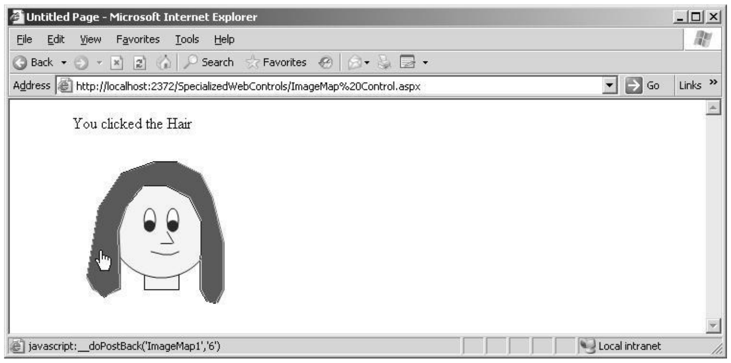

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/ImageMap%20Control.aspx
Go Links
You clicked the Hair
javascript:__doPostBack('ImageMap1','6')
Local intranet

Figure 3-10 The rendered *ImageMap* displaying the *PostBackValue* message in the Label after the hair was clicked on the *ImageMap*.

The *Calendar* Control

The *Calendar* control displays a calendar for either the current month or a selected month. It allows the user to select dates and move to the next or previous month. The *SelectionChanged* event causes a *PostBack* when the user selects a new date, and the *VisibleMonthChanged* event causes a *PostBack* when the user selects a different month to be viewed. This is a complex Web server control that generates a *<table>* element when rendering to HTML. The *Calendar* control inherits directly from the *WebControl* class, as shown in Figure 3-11.

The *Calendar* control is represented as the *<asp:Calendar>* element in source view and can contain style elements to change the look of the control.

The *Calendar* control has a *DayRender* event that allows you to add text or controls to the day being rendered. This allows you to use the *Calendar* control to display appointments and other controls for any date by inserting these items into the day that is being rendered.

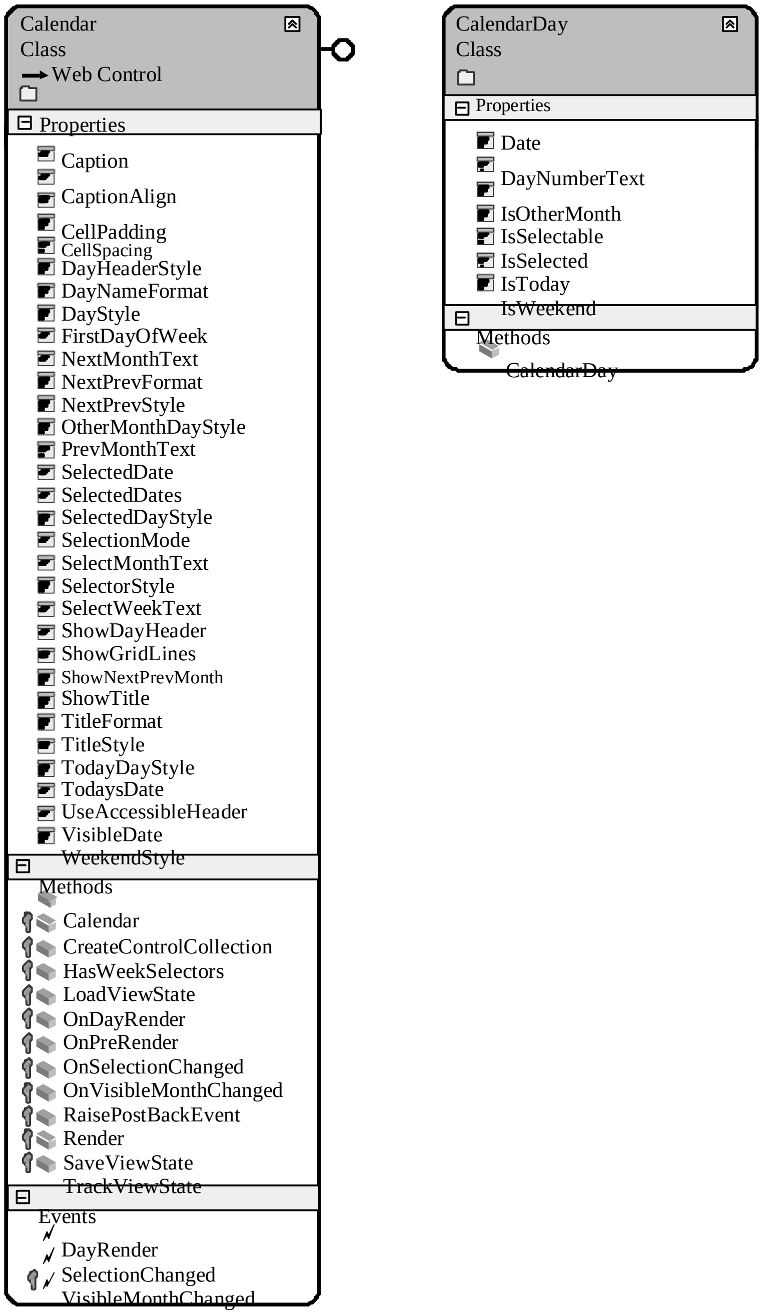


Figure 3-11 The *Calendar* control hierarchy.

The *Calendar* control contains many properties that can be used to adjust the format and behavior of this control. Table 3-3 contains a list of the *Calendar* properties and their associated descriptions.

Table 3-3 *Calendar* Properties

***Calendar* Property**	**Description**
Caption	The text that is rendered in the *Calendar*.
CaptionAlign	The alignment of the caption: *Top*, *Bottom*, *Left*, *Right*, or *NotSet*.
CellPadding	The space between each cell and the cell border.
CellSpacing	The spacing between each cell.
DayHeaderStyle	The style to be applied to days of the week.
DayNameFormat	The format for the names of the days of the week: *First-Letter*, *FirstTwoLetters*, *Full*, *Short*, *Shortest*.
DayStyle	The default style for a calendar day.
FirstDayOfWeek	The day of the week to display in the first column of the *Calendar* control.
NextMonthText	The text to be displayed in the next month navigation control; “>” is the default. This only works if *ShowNext-PrevMonth* property is *true*.
NextPrevFormat	The tool that sets the format of the next and previous navigation controls. Can be set to *CustomText* (default), *FullMonth* (for example, January), or *ShortMonth* (for example, Jan).
NextPrevStyle	The style to be applied to the next and previous naviga tion controls.
OtherMonthDayStyle	The tool that specifies the style for days on the calendar that are displayed and are not in the current month.
PrevMonthText	The text to be displayed in the previous month naviga tion control, which defaults as “<”. This only works if the *ShowNextPrevMonth* property is *true*.

Table 3-3 *Calendar* Properties

***Calendar* Property**	**Description**
SelectedDate	The date selected by the user. Can also be set by the user.
SelectedDates	A collection of *DataTime* values that represent all of the dates that were selected by the user. This property con tains only a single date if the *SelectionMode* property is set to *CalendarSelectionMode.Day*, which allows only single date selection.
SelectedDayStyle	The style of the selected day.
SelectionMode	A value that indicates how many dates can be selected. Value can be *Day*, *DayWeek*, *DayWeekMonth*, or *None*.
SelectMonthText	The text displayed for the month selection column. The default value is *“>>”*.
SelectorStyle	The style for the week and month selectors.
SelectWeekText	The text of the week selection in the week selector.
ShowDayHeader	An indicator that shows whether the day header should be displayed.
ShowGridLines	An indicator that tells whether grid lines should be displayed.
ShowNextPrevMonth	An indicator for whether the next and previous month selectors should be displayed.
ShowTitle	An indicator for whether the title should be displayed.
TitleFormat	A tool that sets the format for displaying the month (*Month*), or the month and year (*MonthYear*).
TitleStyle	The style for the title.
TodayDayStyle	The style of the today’s date.
TodaysDate	Today’s date.

Table 3-3 *Calendar* Properties

Calendar Property	Description
UseAccessibleHeader	A control which, when set to *true*, generates <*th*> for day headers (default), or, when set to *false*, generates <*td*> for day headers to be compatible with 1.0 of .NET Framework.
VisibleDate	A display that specifies which month to display in the *Calendar* control.
WeekendDayStyle	The style of weekend days.

The *Calendar* control can be used to select a single date, or multiple dates. The *SelectionMode* property can be set to one of the following settings:

- ***Day*** Allows selection of a single date.
- ***DayWeek*** Allows the selection of either a single date or a complete week.
- ***DayWeekMonth*** Allows selection of single date, a complete week, or the whole month.
- ***None*** Does not allow you to select any date.

After a selection is made, the *SelectionChanged* event handler lets you access the selected dates via the *SelectedDates* property. The *SelectedDate* property simply points to the date in *SelectedDates* collection.

Many people think that the *Calendar* control is only used as a date picker control, but the *Calendar* control can also be used to display a schedule. The trick to using the *Calendar* control to display scheduled items and special days is to make the con trol large enough to display text in each day, and then add *Label* controls (or other controls) to the *Cell* object's *Controls* collection in the *DayRender* event handler.

The following example shows how a *Calendar* control can be used as a schedule dis play showing special days. In this example, a Web page was created and a *Calendar* control was added to the page. The following code was added to the code-behind page to show how the *Calendar* control's properties can be set programmatically and the *Calendar* control events can be used.

'VB

```
Partial Class Calendar_Control
    Inherits System.Web.UI.Page
```

```
Dim schedule As New Hashtable()

Protected Sub Page_Load(ByVal sender As Object, _
         ByVal e As System.EventArgs) Handles Me.Load
   GetSchedule()
   Calendar1.Style.Add("position", "absolute")
   Calendar1.Style.Add("left", "5px")
   Calendar1.Style.Add("top", "50px")
   Calendar1.Caption = "Special Days"
   Calendar1.FirstDayOfWeek = WebControls.FirstDayOfWeek.Sunday
   Calendar1.NextPrevFormat = NextPrevFormat.ShortMonth
   Calendar1.TitleFormat = TitleFormat.MonthYear
   Calendar1.ShowGridLines = True
   Calendar1.DayStyle.HorizontalAlign = HorizontalAlign.Left
   Calendar1.DayStyle.VerticalAlign = VerticalAlign.Top
   Calendar1.DayStyle.Height = New Unit(75)
   Calendar1.DayStyle.Width = New Unit(100)
   Calendar1.OtherMonthDayStyle.BackColor = System.Drawing.Color.WhiteSmoke
   Calendar1.TodaysDate = New DateTime(2006, 12, 1)
   Calendar1.VisibleDate = Calendar1.TodaysDate
End Sub

Private Sub GetSchedule()
   schedule("11/23/2006") = "Thanksgiving"
   schedule("12/5/2006") = "Birthday"
   schedule("12/16/2006") = "First day of Chanukah"
   schedule("12/23/2006") = "Last day of Chanukah"
   schedule("12/24/2006") = "Christmas Eve"
   schedule("12/25/2006") = "Christmas"
   schedule("12/26/2006") = "Boxing Day"
   schedule("12/31/2006") = "New Year's Eve"
   schedule("1/1/2007") = "New Year's Day"
End Sub

Protected Sub Calendar1_SelectionChanged(ByVal sender As Object, _
         ByVal e As System.EventArgs) Handles Calendar1.SelectionChanged
   Response.Write("Selection changed to: " _
         + Calendar1.SelectedDate.ToShortDateString())
End Sub

Protected Sub Calendar1_VisibleMonthChanged(ByVal sender As Object, _
         ByVal e As System.Web.UI.WebControls.MonthChangedEventArgs) _
         Handles Calendar1.VisibleMonthChanged
   Response.Write("Month changed to: " + e.NewDate.ToShortDateString())
End Sub

Protected Sub Calendar1_DayRender(ByVal sender As Object, _
         ByVal e As System.Web.UI.WebControls.DayRenderEventArgs) _
         Handles Calendar1.DayRender

   If Not schedule(e.Day.Date.ToShortDateString()) Is Nothing Then
         Dim lit = New Literal()
         lit.Visible = True
```

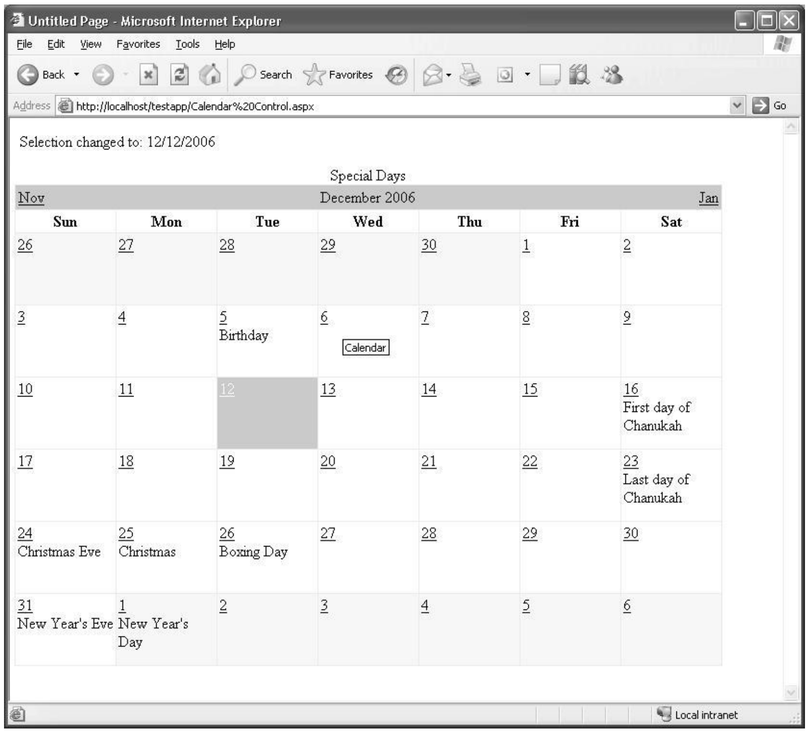
```
            lit.Text = "<br />"
            e.Cell.Controls.Add(lit)
            Dim lbl = New Label()
            lbl.Visible = True
            lbl.Text = CType(schedule(e.Day.Date.ToShortDateString()), String)
            e.Cell.Controls.Add(lbl)
        End If

    End Sub
End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Calendar_Control : System.Web.UI.Page
{
    Hashtable schedule = new Hashtable();

    protected void Page_Load(object sender, EventArgs e)
    {
      GetSchedule();
      Calendar1.Style.Add("position", "absolute");
      Calendar1.Style.Add("left", "5px");
      Calendar1.Style.Add("top", "50px");
      Calendar1.Caption = "Special Days";
      Calendar1.FirstDayOfWeek = FirstDayOfWeek.Sunday;
      Calendar1.NextPrevFormat = NextPrevFormat.ShortMonth;
      Calendar1.TitleFormat = TitleFormat.MonthYear;
      Calendar1.ShowGridLines = true;
      Calendar1.DayStyle.HorizontalAlign = HorizontalAlign.Left;
      Calendar1.DayStyle.VerticalAlign = VerticalAlign.Top;
      Calendar1.DayStyle.Height = new Unit(75);
      Calendar1.DayStyle.Width = new Unit(100);
      Calendar1.OtherMonthDayStyle.BackColor =
            System.Drawing.Color.WhiteSmoke;
      Calendar1.TodaysDate = new DateTime(2006, 12, 1);
      Calendar1.VisibleDate = Calendar1.TodaysDate;
    }

    private void GetSchedule()
    {
      schedule["11/23/2006"] = "Thanksgiving";
      schedule["12/5/2006"] = "Birthday";
      schedule["12/16/2006"] = "First day of Chanukah";
```

```
        schedule["12/23/2006"] = "Last day of Chanukah";
        schedule["12/24/2006"] = "Christmas Eve";
        schedule["12/25/2006"] = "Christmas";
        schedule["12/26/2006"] = "Boxing Day";
        schedule["12/31/2006"] = "New Year's Eve";
        schedule["1/1/2007"] = "New Year's Day";
    }

    protected void Calendar1_SelectionChanged(object sender, EventArgs e)
    {
        Response.Write("Selection changed to: "
                + Calendar1.SelectedDate.ToShortDateString());
    }

    protected void Calendar1_VisibleMonthChanged(object sender,
        MonthChangedEventArgs e)
    {
        Response.Write("Month changed to: " + e.NewDate.ToShortDateString());
    }

    protected void Calendar1_DayRender(object sender, DayRenderEventArgs e)
    {
        Literal lit = new Literal();
        lit.Visible = true;
        lit.Text = "<br />";
        e.Cell.Controls.Add(lit);

        if (schedule[e.Day.Date.ToShortDateString()] != null)
            {
                Label lbl = new Label();
                lbl.Visible = true;
                lbl.Text = (string)schedule[e.Day.Date.ToShortDateString()];
                e.Cell.Controls.Add(lbl);
            }
    }
}
```

This code sets the *Calendar* control properties, such as style and size, in the *Page_Load* event handler. A method called *GetSchedule* is added to populate a collection of spe cial dates. In the *Calendar1_DayRender* event handler, the Date and Cell of the day that is being rendered is available. If a special date is found, a *Label* is created that con tains the special date, and it is added to the *Cell* object's *Controls* collection. When the Web page is displayed, the special dates are rendered on the *Calendar* controls, as shown in Figure 3-12.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address http://localhost/testapp/Calendar%20Control.aspx
Go
Calendar
Local intranet

Selection changed to: 12/12/2006

Special Days

Nov			December 2006			Jan
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
26	27	28	29	30	1	2
3	4	5 Birthday	6	7	8	9
10	11	12	13	14	15	16 First day of Chanukah
17	18	19	20	21	22	23 Last day of Chanukah
24 Christmas Eve	25 Christmas	26 Boxing Day	27	28	29	30
31 New Year's Eve	1 New Year's Day	2	3	4	5	6

Figure 3-12 The rendered *Calendar* control displaying special days and having a selected date.

The *FileUpload* Control

The *FileUpload* control is used to display a TextBox and Browse button that allows a user to either type a file name and path, or click Browse and select a file and path. This control generates an *<input type="file">* element when rendering to HTML. The *FileUpload* control inherits directly from the *WebControl* class, as shown in Figure 3-13.

The *FileUpload* control is represented as the *<asp:FileUpload>* element in source view and has no content, so you can write this element as a singleton element.

The *FileUpload* control does not cause a *PostBack* to the Web server. After the user selects a file, the user needs to cause a *PostBack* via a different control, such as a *Button*. The *PostBack* causes the file to be uploaded to the server as posted data. At the server, the page code does not run until the file is uploaded to server memory.

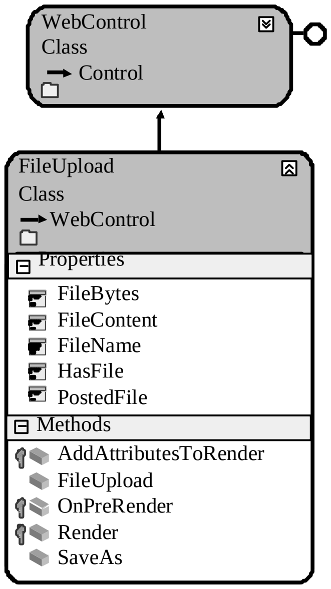


Figure 3-13 The *FileUpload* control hierarchy.

The following properties give you flexible ways to access the uploaded file:

- ***FileBytes*** The file is exposed as a byte array.
- ***FileContent*** The file is exposed as a stream.
- ***PostedFile*** The file is exposed as an object of type *HttpPostedFile*. This object has properties, such as *ContentType* and *ContentLength* properties.

You need to examine any file that is uploaded to determine if it should be saved; you can examine characteristics such as the file name, size, and MIME type. *MIME* stands for Multipurpose Internet Mail Extensions and specifies the type of file that is being uploaded. When you're ready to save the file, you can use the *SaveAs* method on the *FileUpload* control or the *HttpPostedFile* object.

You can save the file in any location for which you have permissions to create files. By default, the *requireRootedSaveAsPath* attribute of the *httpRuntime* configuration ele ment in the Web.config file is set to *true*, which means that you need to provide an absolute path to save the file. You can get an absolute path by using the *MapPath* method of the *HttpServerUtility* class and passing to the method the tilde (~) operator, which represents the application root folder.

The maximum size file that can be uploaded depends on the value of the *MaxRequest-Length* attribute of the *httpRuntime* configuration element in the Web.config file. If users attempt to upload a file that is larger than the *MaxRequestLength*, the upload fails.

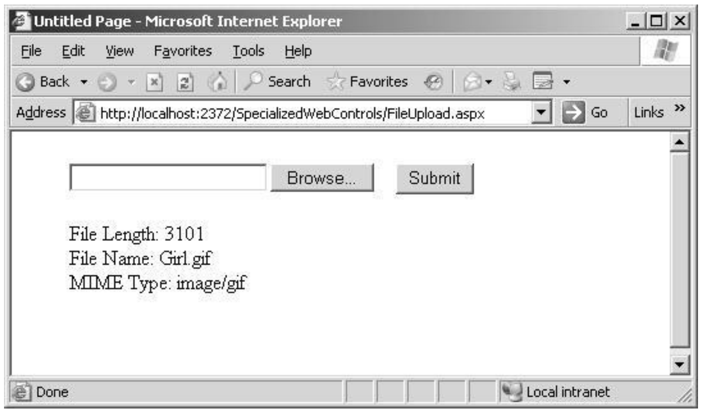
Security Alert The *FileUpload* control allows users to upload files but makes no attempt to vali date the safety of the uploaded files. The *FileUpload* control doesn't provide a means to filter the file types that can be uploaded by a user, but you can examine the file characteristics, such as the file name and extension, as well as the *ContentType*, after the file has been uploaded.

Although you can provide client-side script to examine the file that is being submitted, remember that client-side validation is a convenience for the honest user. A hacker can easily strip the Web page of client-side code to bypass this validation.

In this example, a Web page was created and a *FileUpload* control was added to the page. In addition, a *Button* was added to the Web page that is used to submit the file to the Web server via *PostBack*. A folder was added to the Web site called Uploads. The following code was added to the code-behind page to show how the *FileUpload* con trol's properties can be set programmatically, and a file can be uploaded and saved.

```
'VB
Partial Class FileUpload_Control
    Inherits System.Web.UI.Page

    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
        If (FileUpload1.HasFile) Then
            Label1.Text = "File Length: " _
                + FileUpload1.FileBytes.Length.ToString() _
                + "<br />" _
                + "File Name: " _
                + FileUpload1.FileName _
                + "<br />" _
                + "MIME Type: " _
                + FileUpload1.PostedFile.ContentType
            FileUpload1.SaveAs( _
                MapPath("~/Uploads/" + FileUpload1.FileName))
        Else
            Label1.Text = "No file received."
        End If
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class FileUpload : System.Web.UI.Page
{
    protected void Button1_Click(object sender, EventArgs e)
    {
      if (FileUpload1.HasFile)
        {
            Label1.Text = "File Length: "
                + FileUpload1.FileBytes.Length
                + "<br />"
                + "File Name: "
                + FileUpload1.FileName
                + "<br />"
                + "MIME Type: "
                + FileUpload1.PostedFile.ContentType;
            FileUpload1.SaveAs(
                MapPath("~/Uploads/" + FileUpload1.FileName));
        }
      else
        {
            Label1.Text = "No file received.";
        }
    }
}
```

The Web page is shown in Figure 3-14. When a file is selected and the Submit button is clicked, the code checks to see if a file has been uploaded. If a file has been uploaded, information about the file is placed into the *Label* control for display. The file is then saved to the Uploads folder. The Web site requires an absolute path, and *MapPath* performs the conversion from the relative path supplied to an absolute path. Finally, the file is saved.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/FileUpload.aspx
Go Links
Browse... Submit
Done
Local intranet

File Length: 3101
File Name: Girl.gif
MIME Type: image/gif

Figure 3-14 The *FileUpload* control after uploading a file.

The *Panel* Control

The *Panel* control is used as a control container and is useful when you have controls that you want to display and hide as a group. The *Panel* generates a *<div>* element when rendering as HTML. In source view, the Panel *control* is represented as the *<asp:Panel>* element and can contain many controls. The *Panel* control inherits directly from the *WebControl* class, as shown in Figure 3-15.

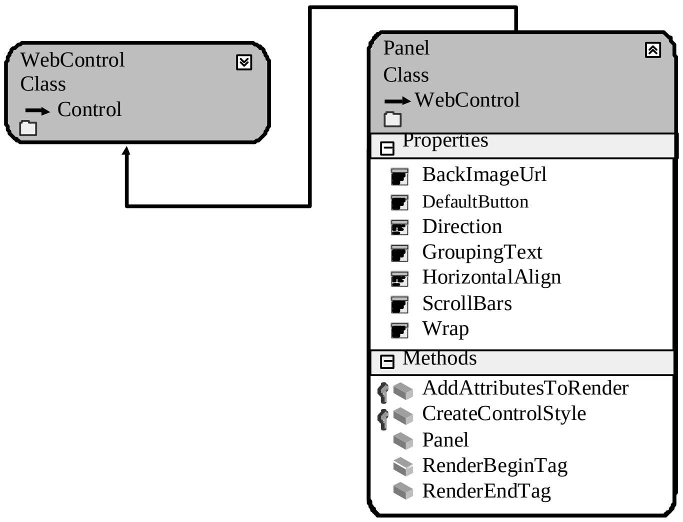


Figure 3-15 The *Panel* control hierarchy.

The *BackImageUrl* property can be used to display a background image in the *Panel* control. The *HorizontalAlignment* property lets you set the horizontal alignment of the controls that are in the *Panel*, and the *Wrap* property specifies whether items in the *Panel* automatically continue on the next line when a line is longer than the width of the *Panel* control. The *DefaultButton* property specifies the button that is clicked when the *Panel* control has focus and the user presses the Enter key. The *DefaultButton* prop erty can be set to the ID of any control that implements the *IButtonControl* interface.

In this example, a Web page was created and a *Panel* control was added to the page. A *Label* control, a *TextBox* control, and a *Button* control were inserted into the *Panel*. In addition, a *Button* was added to the Web page that is used to toggle the *Visible* prop erty's state of the *Panel* control, and *Button* controls were added to move the *Panel* left or right.

```
'VB
Partial Class Panel_Control
    Inherits System.Web.UI.Page

   Protected Sub Button2_Click(ByVal sender As Object, _
         ByVal e As System.EventArgs) Handles Button2.Click
     Panel1.Visible = Not Panel1.Visible
   End Sub

   Protected Sub Button3_Click(ByVal sender As Object, _
         ByVal e As System.EventArgs) Handles Button3.Click
     Dim left As New Unit(Panel1.Style("left"))
     left = New Unit(CType(left.Value, Double) - 10, left.Type)
     Panel1.Style("left") = left.ToString()
   End Sub

   Protected Sub Button4_Click(ByVal sender As Object, _
         ByVal e As System.EventArgs) Handles Button4.Click
     Dim left As New Unit(Panel1.Style("left"))
     left = New Unit(CType(left.Value, Double) + 10, left.Type)
     Panel1.Style("left") = left.ToString()
   End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Panel_Control : System.Web.UI.Page
```

```
{
    protected void Button2_Click(object sender, EventArgs e)
    {
      Panel1.Visible = !Panel1.Visible;
    }

    protected void Button3_Click(object sender, EventArgs e)
    {
      Unit left = new Unit(Panel1.Style["left"]);
      left = new Unit((double)left.Value - 10,left.Type);
      Panel1.Style["left"] = left.ToString();
    }
    protected void Button4_Click(object sender, EventArgs e)
    {
      Unit left = new Unit(Panel1.Style["left"]);
      left = new Unit((double)left.Value + 10, left.Type);
      Panel1.Style["left"] = left.ToString();
    }
}
```

The example Web page is shown in Figure 3-16. Clicking the *Show/Hide* button hides the *Panel* and all of its controls, and clicking again displays the *Panel* and its controls. When the Move Left or Move Right buttons are clicked, the current location of the *Panel* control is retrieved from the *Style* property and updated to move the *Panel* and its controls.

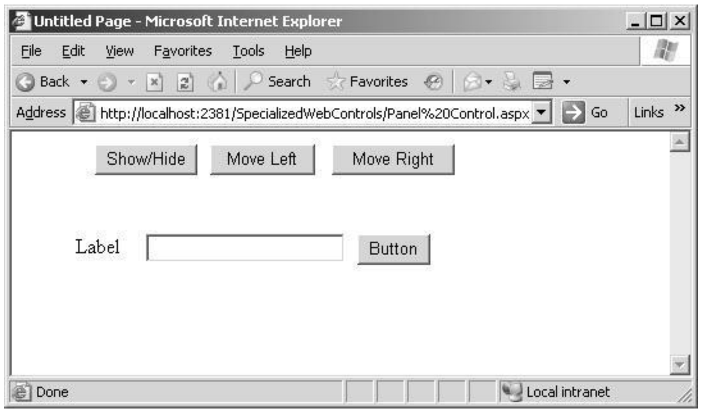

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2381/SpecializedWebControls/Panel%20Control.aspx Go Links
Show/Hide
Move Left
Move Right
Label
Button
Done
Local intranet

Figure 3-16 The *Panel* control with buttons to toggle visibility and move the *Panel* control.

The *MultiView* and *View* Controls

The *View* control is a control container; it's useful when you have controls that you want to display and hide as a group. It is also helpful when you hide one *View* con trol with its controls, because then you typically show a different *View* control. *View* controls are contained in a *MultiView* control. The *MultiView* and the *View* don't gen erate any elements when rendering as HTML because these controls are essentially server-side controls that manage the visibility of the child controls. In source view, the *MultiView* control is represented as the *<asp:MultiView>* element, and the *View* control is represented as the *<asp:View>* element. The *MultiView* and *View* controls inherit directly from the *Control* class, as shown in Figure 3-17.

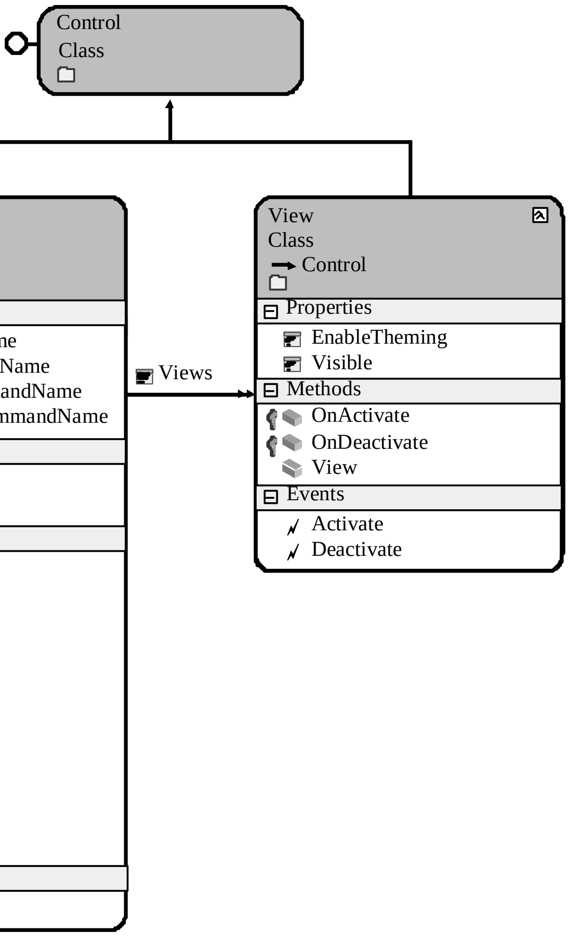


Figure 3-17 The *MultiView* and *View* control hierarchy.

NOTE .NET 2.0

The *MultiView* and *View* controls are new in ASP.NET version 2.0.

You can use the *ActiveViewIndex* property or the *SetActiveView* method to change the *View* programmatically. If the *ActiveViewIndex* is set to -1, no *View* controls are dis played. If you pass an invalid *View* or a null (Nothing) value into the *SetActiveView* method, an *HttpException* is thrown. Note that only one *View* control can be active at any time.

The *MultiView* control is also used to create wizards, where each *View* control in the *MultiView* control represents a different step or page in the wizard.

The *MultiView* control is also suitable for use when developing multiple-screen appli cations for mobile devices, as the *MultiView* control provides the same functionality as the ASP.NET mobile *Form* control in .NET Framework version 1.1.

In this example, a Web page was created and a *MultiView* control and three *View* con trols were added to the page. Next, a *Button* control was added to each of the *View* con trols. The *Button* controls were staggered within each *View* control to visually help identify the current active *View* control. The *Text* property of the *Button* control was set to *Button1*, *Button2*, and *Button3*, respectively, as shown in Figure 3-18.

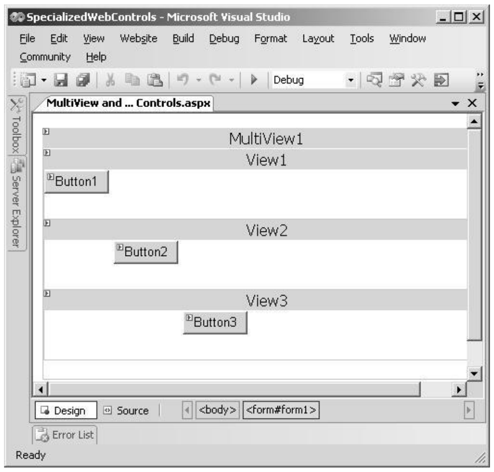

SpecializedWebControls - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window
Community Help
Debug
MultiView and ... Controls.aspx
MultiView1
View1
Button1
View2
Button2
View3
Button3
Design
Source
<body>
<form#form1>
Error List
Ready
Toolbox
Server Explorer

Figure 3-18 The *MultiView* and *View* control Web page contains a Button in each View.

After the controls were added to the Web page, the following code was added to the code-behind page:

```
'VB
Partial Class MultiView_and_View_Controls
    Inherits System.Web.UI.Page
    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
      MultiView1.ActiveViewIndex = 1
    End Sub

    Protected Sub Button2_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button2.Click
      MultiView1.ActiveViewIndex = 2
    End Sub

    Protected Sub Button3_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button3.Click
      MultiView1.SetActiveView(CType(Me.FindControl("View1"), View))
    End Sub

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      If (Not IsPostBack) Then
            MultiView1.ActiveViewIndex = 0
      End If
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class MultiView_and_View_Controls : System.Web.UI.Page
{
    protected void Button1_Click(object sender, EventArgs e)
    {
      MultiView1.ActiveViewIndex = 1;
    }
    protected void Button2_Click(object sender, EventArgs e)
    {
      MultiView1.ActiveViewIndex = 2;
    }
    protected void Button3_Click(object sender, EventArgs e)
    {
      MultiView1.SetActiveView((View)MultiView1.FindControl("View1"));
    }
    protected void Page_Load(object sender, EventArgs e)
    {
      if (!IsPostBack)
        {
          MultiView1.ActiveViewIndex = 0;
        }
    }
}
```

When the Web page is displayed, only *Button1* is visible, as shown in Figure 3-19. Clicking *Button1* changes the active view to *View2*, which displays *Button2*. Clicking *Button2* changes the active view to *View3*, which displays *Button3*. Clicking *Button3* changes the active view back to *View1*, which displays *Button1*.

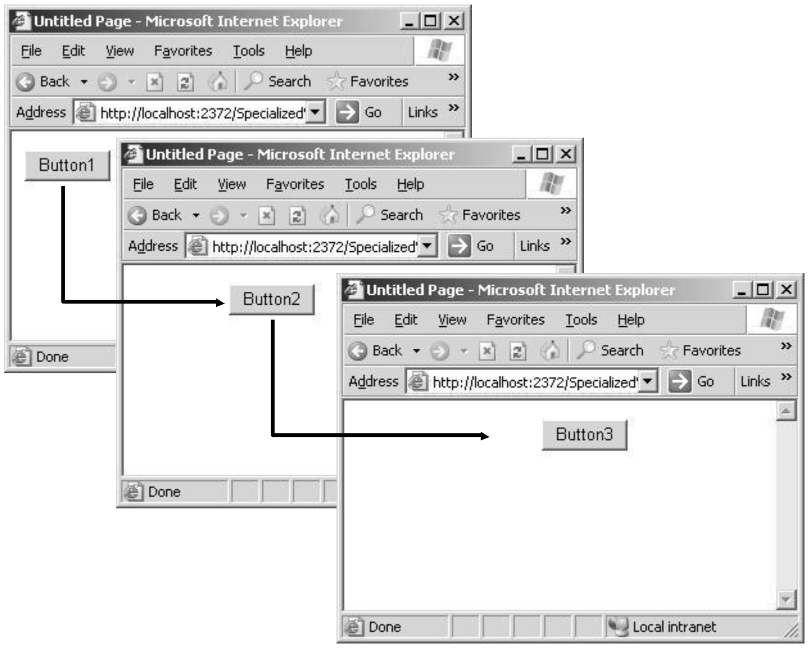

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/Specialized Go Links
Button1
Button2
Button3
Done
Local intranet

Figure 3-19 The *MultiView* is used to switch between the *View* controls.

The *Wizard* Control

The *Wizard* control is a complex control that is used to display a series of *WizardStep* controls to a user, one after the other. Probably the most significant use of the *Wizard* control is to prompt the user for a significant amount of data by breaking the data into logical chunks, or steps, and presenting the user with the steps that can be validated, either at the end or between steps. You certainly can accomplish the same result by using separate Web pages for each logical chunk of data, but the *Wizard* consolidates the data collection process into a single Web page.

More Info For more information about the *Wizard* control, visit *http://msdn2.microsoft.com /en-us/library/fs0za4w6.aspx*.

You can programmatically control which step is displayed, which means that you are not constrained to navigating through the steps in a linear fashion.

The *Wizard* control builds on the *MultiView* and *View* controls, providing logic to assure that only one *WizardStep* control is visible at a time and providing the ability to customize most aspects of the *Wizard* and *WizardStep* controls.

NOTE .NET 2.0

The *Wizard* control is new in ASP.NET version 2.0.

The *Wizard* control inherits from the *Control* class, and the *BaseWizardStep* inherits from *View*, as shown in Figure 3-20. The *Wizard* control has a *WizardSteps* collection of steps that contains the user interface for each step that is created by the developer. The built-in navigation capabilities determine which buttons to display based on the *StepType* value.

The *Wizard* control contains a header area that can be customized to display informa tion specific to the step that the user is currently on. The *Wizard* control also con tains a sidebar area that can be used to quickly navigate to steps in the control. As you can see from the many styles than can be assigned to parts of the *Wizard* con trol, the *Wizard* control can be significantly customized.

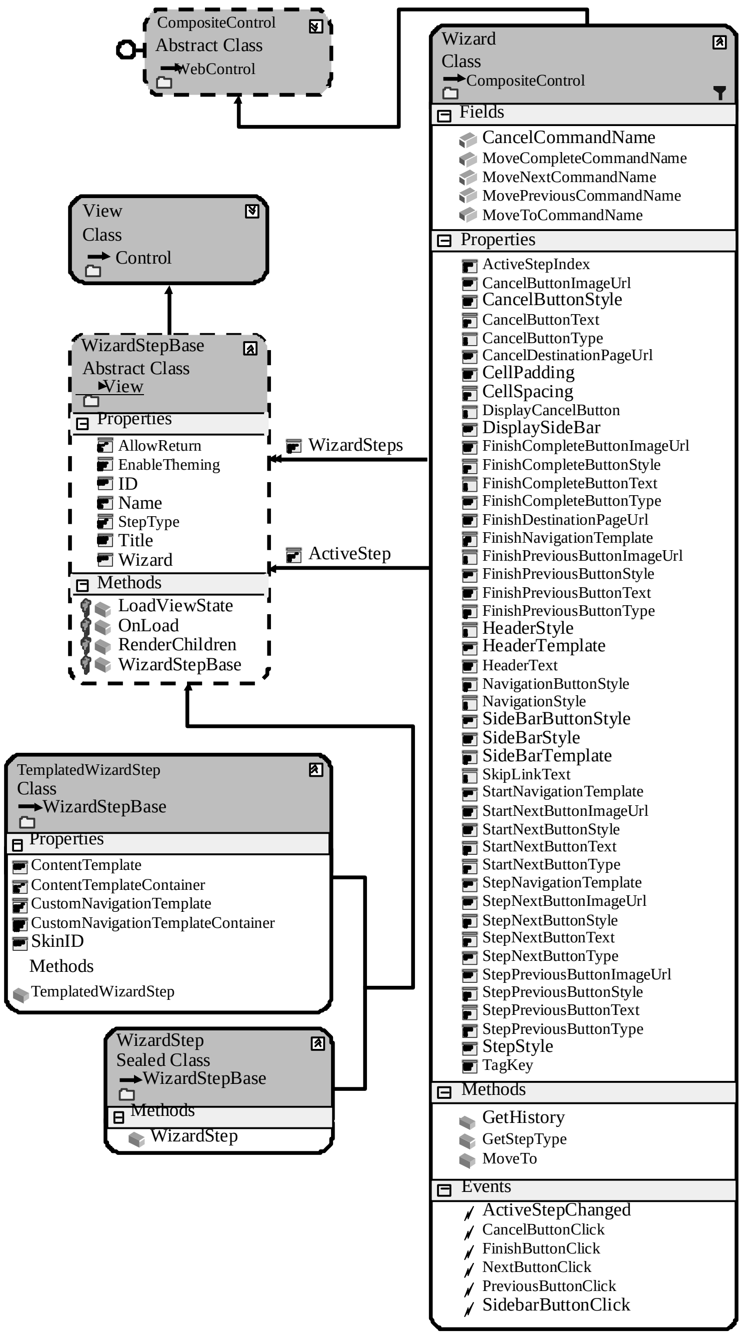


Figure 3-20 The *Wizard* and *WizardStep* control hierarchy.

The *BaseWizardStep* contains the *StepType* property that can be set to one of the fol lowing values:

- ***WizardStepType.Auto*** This renders navigation buttons based on the location of the set within the *WizardSteps* collection property of the *Wizard*. This is the default.
- ***WizardStepType.Complete*** This is the last step to appear. No navigation buttons are rendered.
- ***WizardStepType.Finish*** This is the final data-collection step; the Finish and Pre vious buttons are rendered for navigation.
- ***WizardStepType.Start*** This is the first one to appear, and only the Next button is rendered.
- ***WizardStepType.Step*** This is a step between the Start and the Finish step. The Previous and Next buttons are rendered.

This is an example of a wizard that gives the user the ability to select options when selecting a vehicle. In a typical real vehicle-selection scenario, many more options are available, thus dictating the need to simplify the option selection for the user.

To create this example, a Web page was created and a *Wizard* control was added to the page. *WizardStep* controls were added for exterior, interior, options, and summary. The exterior selection step contains three *RadioButton* controls for selection of red, blue, or black exterior. The interior selection step contains two *RadioButton* controls for selection of leather or cloth seats. The options selection step contains *CheckBox* controls for selection of AM/FM radio, heated seats, and air freshener. The summary step contains a *Label* control that is populated with the selections that were made in the previous steps. The populated *WizardStep* controls are shown in Figure 3-21.

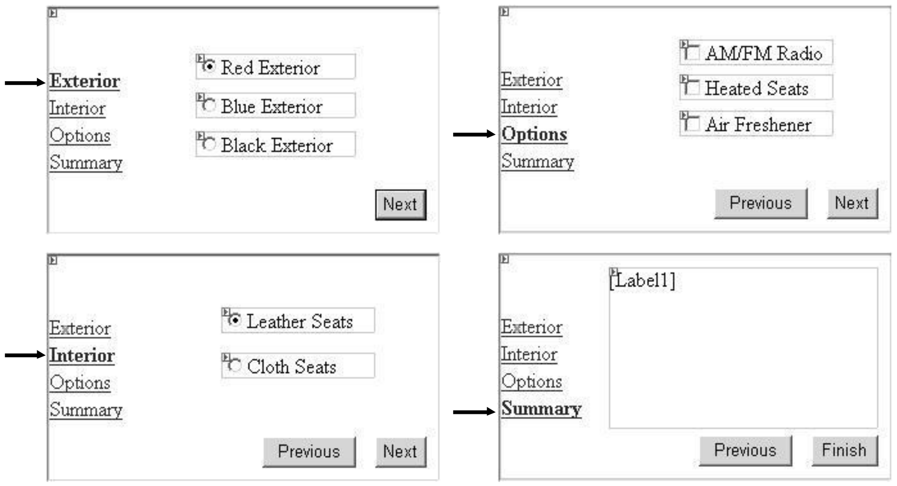


Figure 3-21 The *WizardStep* controls are populated with the controls to be displayed to the user.

After the *WizardStep* controls were created and each step was populated, code was added to the code-behind page to populate the *Label* control in the summary step. Also, code was added to the *Form_Load* event handler to assure that the *Wizard* starts at the first step, and finally, code was added to the *Wizard1_FinishButtonClick* event handler to display the results. The code-behind page is as follows:

```
'VB
Partial Class Wizard_Control
    Inherits System.Web.UI.Page

    Protected Sub Wizard1_FinishButtonClick(ByVal sender As Object, _
           ByVal e As System.Web.UI.WebControls.WizardNavigationEventArgs) Handles
Wizard1.FinishButtonClick

      Wizard1.Visible = False
      Response.Write("Finished<br />" + Label1.Text)
    End Sub

    Protected Sub Wizard1_NextButtonClick(ByVal sender As Object, _
           ByVal e As System.Web.UI.WebControls.WizardNavigationEventArgs) Handles
Wizard1.NextButtonClick

      If (Wizard1.WizardSteps(e.NextStepIndex).Title = "Summary") Then
           Label1.Text = String.Empty
           For Each ws As WizardStep In Wizard1.WizardSteps
                For Each c As Control In ws.Controls
                  If (TypeOf c Is System.Web.UI.WebControls.CheckBox) Then
                       Dim cb As CheckBox = CType(c, CheckBox)
                       If (cb.Checked) Then
```

```
                        Label1.Text += cb.Text + "<br />"
                    End If
                End If
            Next
        Next
    End If
  End Sub

  Protected Sub Page_Load(ByVal sender As Object, _
        ByVal e As System.EventArgs) _
        Handles Me.Load
    If Not IsPostBack Then
        Wizard1.ActiveStepIndex = 0
    End If
  End Sub

End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Wizard_Control : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
     if (!IsPostBack)
        {
         Wizard1.ActiveStepIndex = 0;
        }
    }
  protected void Wizard1_FinishButtonClick(object sender,
    WizardNavigationEventArgs e)
  {
    Wizard1.Visible = false;
    Response.Write("Finished<br />" + Label1.Text);
  }
  protected void Wizard1_NextButtonClick(object sender,
    WizardNavigationEventArgs e)
  {
    if (Wizard1.WizardSteps[e.NextStepIndex].Title == "Summary")
      {
        Label1.Text = String.Empty;
        foreach (WizardStep ws in Wizard1.WizardSteps)
```

```
                {
                    foreach (Control c in ws.Controls)
                    {
                      if (c is CheckBox)
                        {
                            CheckBox cb = (CheckBox)c;
                            if (cb.Checked)
                              {
                                  Label1.Text += cb.Text + "<br />";
                              }
                        }
                    }
                 }
             }
         }
}
```

When the Web page is displayed, the user sees the first (Exterior) step, as shown in Figure 3-21. The user can go from step to step, and finally, press the Finish button. In the Summary step, the *Label* control displays the current selections. After the user presses the Finish button, the *Wizard* control is hidden and the summary information is displayed.

The *Xml* Control

The *Xml* control is used to display the contents of an XML document or the results of executing an Extensible Stylesheet Language (XSL) Transform. The *Xml* control hier archy is shown in Figure 3-22.

The XML document to display is specified by setting either the *DocumentSource* prop erty or the *DocumentContent* property. The *DocumentSource* property accepts a string that specifies the location of an XML file to be loaded into the control. The *Document-Content* property accepts a string that contains actual XML content. If the *Document-Content* and the *DocumentSource* are both set, the last property that is set is the property that is used.

The *TransformSource* property accepts an optional string that contains the location of an XSL transformation file to apply to the XML document. The *Transform* property accepts a *Transform* object that can be used to perform the transformation as well. If both of these properties are set, the last property set is used.

The *Xml* control also contains the *TransformArgumentList* property, which is used to pass arguments to the XSL transformation.

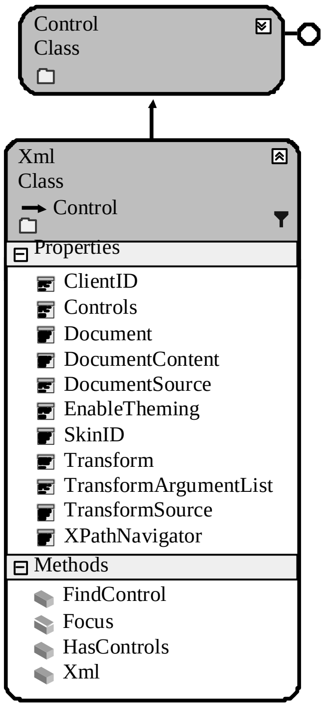


Figure 3-22 The *Xml* control hierarchy.

The following is an example of using the *Xml* control to display the contents of an XML file after applying an XSL transformation. This XML file and the XSL transfor mation file are as follows:

XML File – CarList.xml

```
<?xml version="1.0" encoding="utf-8" ?>
<CarList>
    <Car Vin="1A59B" Make="Chevrolet" Model="Impala" Year="1963" Price="1125.00" />
   <Car Vin="9B25T" Make="Ford" Model="F-250" Year="1970" Price="1595.00" />
   <Car Vin="3H13R" Make="BMW" Model="Z4" Year="2006" Price="55123.00" />
    <Car Vin="7D67A" Make="Mazda" Model="Miata" Year="2003" Price="28250.00" />
   <Car Vin="4T21N" Make="VW" Model= "Beetle" Year="1956" Price="500.00" />
</CarList>
```

XSL Transformation File – CarList.xsl

```
<?xml version="1.0" encoding="utf-8" ?>
<xsl:stylesheet version="1.0"
xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
xmlns:msxsl="urn:schemas-microsoft-com:xslt"
xmlns:labs="http://labs.com/mynamespace">
```

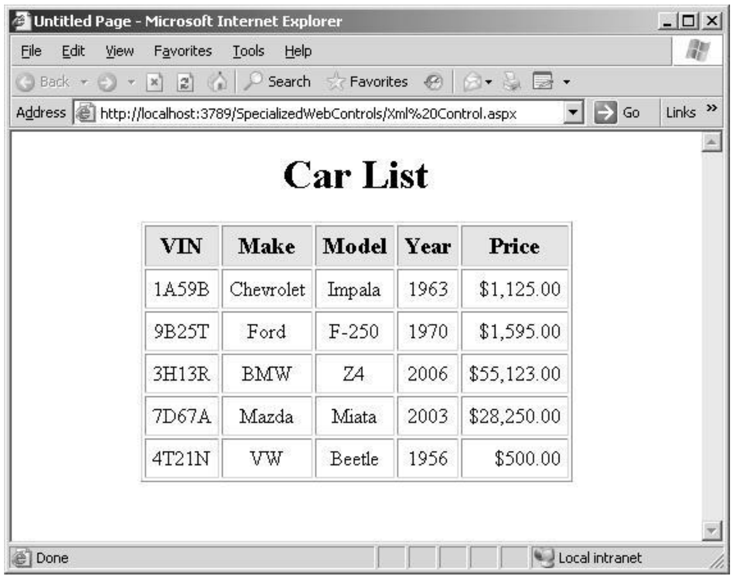
```
<xsl:template match="/">
  <html>
        <head>
              <title>Car List</title>
        </head>
        <body>
              <center>
                <h1>Car List</h1>
                <xsl:call-template name="CreateHeading"/>
              </center>
        </body>
  </html>
</xsl:template>

<xsl:template name="CreateHeading">
  <table border="1" cellpadding="5">
        <tr >
              <th bgcolor="yellow">
                <font size="4" >
                      <b>VIN</b>
                </font>
              </th>
              <th bgcolor="yellow">
                <font size="4" >
                      <b>Make</b>
                </font>
              </th>
              <th  bgcolor="yellow">
                <font size="4" >
                      <b>Model</b>
                </font>
              </th>
              <th  bgcolor="yellow">
                <font size="4">
                      <b>Year</b>
                </font>
              </th>
              <th  bgcolor="yellow">
                <font size="4" >
                      <b>Price</b>
                </font>
              </th>
        </tr>
        <xsl:call-template name="CreateTable"/>
  </table>
</xsl:template>

<xsl:template name="CreateTable">
  <xsl:for-each select="/CarList/Car">
        <tr>
              <td align="center">
                <xsl:value-of select="@Vin"/>
              </td>
```

```
                    <td align="center">
                      <xsl:value-of select="@Make"/>
                    </td>
                    <td>
                      <xsl:value-of select="@Model"/>
                    </td>
                    <td>
                      <xsl:value-of select="@Year"/>
                    </td>
                    <td align="right">
                      <xsl:value-of select="format-number(@Price,'$#,##0.00')"/>
                    </td>
                </tr>
        </xsl:for-each>
      </xsl:template>
</xsl:stylesheet>
```

In this example, an *Xml* control was added to a Web page and the following code was added to the code-behind page to display the XML file after applying the XSL transformation:

```
'VB
Partial Class Xml_Control
      Inherits System.Web.UI.Page

  Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles Me.Load
        Xml1.DocumentSource = "~/App_Data/CarList.xml"
        Xml1.TransformSource = "~/App_Data/CarList.xsl"
      End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Xml_Control : System.Web.UI.Page
{
      protected void Page_Load(object sender, EventArgs e)
        {
         Xml1.DocumentSource = "~/App_Data/CarList.xml";
         Xml1.TransformSource = "~/App_Data/CarList.xsl";
        }
}
```

When the Web page is displayed, the XML and XSL files are loaded and the resulting transformation is shown in Figure 3-23.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3789/SpecializedWebControls/Xml%20Control.aspx
Go Links
Done
Local intranet

Car List

VIN	Make	Model	Year	Price
1A59B	Chevrolet	Impala	1963	$1,125.00
9B25T	Ford	F-250	1970	$1,595.00
3H13R	BMW	Z4	2006	$55,123.00
7D67A	Mazda	Miata	2003	$28,250.00
4T21N	VW	Beetle	1956	$500.00

Figure 3-23 The result of applying the XSL transformation to the XML file.

Quick Check

1. What control provides the best implementation of a schedule of special dates?
2. You want to create a Web page that prompts the user to input lots of data, and you want the data input to be spread across multiple screens. What is the best control to use to implement this solution on a single Web page?
3. Your customer wants the home page to contain an image of the world and require users to click their specific countries. This redirects the users to the Web sites for their respective countries. What control will you use?

Quick Check Answers

1. The *Calendar* control
2. The *Wizard* control
3. The *ImageMap* control

Lab: Work with Specialized Web Controls

In this lab, you use the specialized Web controls that have been defined in this lesson to create a Web page for selecting a room in your house that needs to be serviced and a service date.

� Exercise 1: Create the Web Site and Add the Controls

In this exercise, you create the Web site and add the controls to the site.

1. Open Microsoft Visual Studio 2005 and create a new Web site, called UsingSpe cializedControls, using your preferred programming language. Create the new Web site so that a Web page called Default.aspx is displayed.
2. Add a *Wizard* control to the Default.aspx Web page so that it displays the Wizard Tasks window.
3. In the Wizard Tasks window, click Add/Remove Wizard Steps to display the WizardStep Collection Editor.
4. Change the *Title* property of step 1 to **Select Room**.
5. Change the *Title* property of step 2 to **Service Date**.
6. Click the Add button to add another step and change its *Title* property to **Sum mary**. Click OK to close the WizardStep Collection Editor.
7. In the Solution Explorer window, right-click the project node and click New Folder. Rename the folder **Images**.
8. Add the following files to the Images folder. These files are available in sample code on this book's CD-ROM.
   - ❑ House Dining Room.gif
   - ❑ House Family Rooom.gif
   - ❑ House Foyer.gif
   - ❑ House Kitchen.gif
   - ❑ House Office.gif
   - ❑ House.gif
9. In Design view, click the *Wizard* control, set the *Height* property to 250px, and set the *Width* property to 425px.

10. In Design view, click the link for Select Room in the *Wizard* control to assure that this is the current step.
11. Add an *ImageMap* control to this step. After adding the *ImageMap* control, press Enter twice and type **Room Selected:**. After the text, add a *Label* control and remove its text from the *Text* property. Regardless of the language you choose, your ASPX source for this step should look like the following:

ASPX Source – Select Room

```
<asp:WizardStep runat="server" Title="Select Room">
    <br />&nbsp;
    <asp:ImageMap ID="ImageMap1" runat="server"
      ImageUrl="~/Images/House.gif">
    </asp:ImageMap>
    <br /><br />&nbsp;&nbsp;
    Room Selected:
    <asp:Label ID="Label1" runat="server"></asp:Label>
</asp:WizardStep>
```

12. In Design view, click the Service Date link in the *Wizard* control to make this the active step.
13. In this step, press Enter, type **Select Service Date:**, and press Enter again. Add a *Calendar* control. Your ASPX source for this step should look like the following:

ASPX Source – Service Date

```
<asp:WizardStep runat="server" Title="Service Date">
   <br />Select Service Date:<br />&nbsp;
    <asp:Calendar ID="Calendar1" runat="server" >
    </asp:Calendar>
</asp:WizardStep>
```

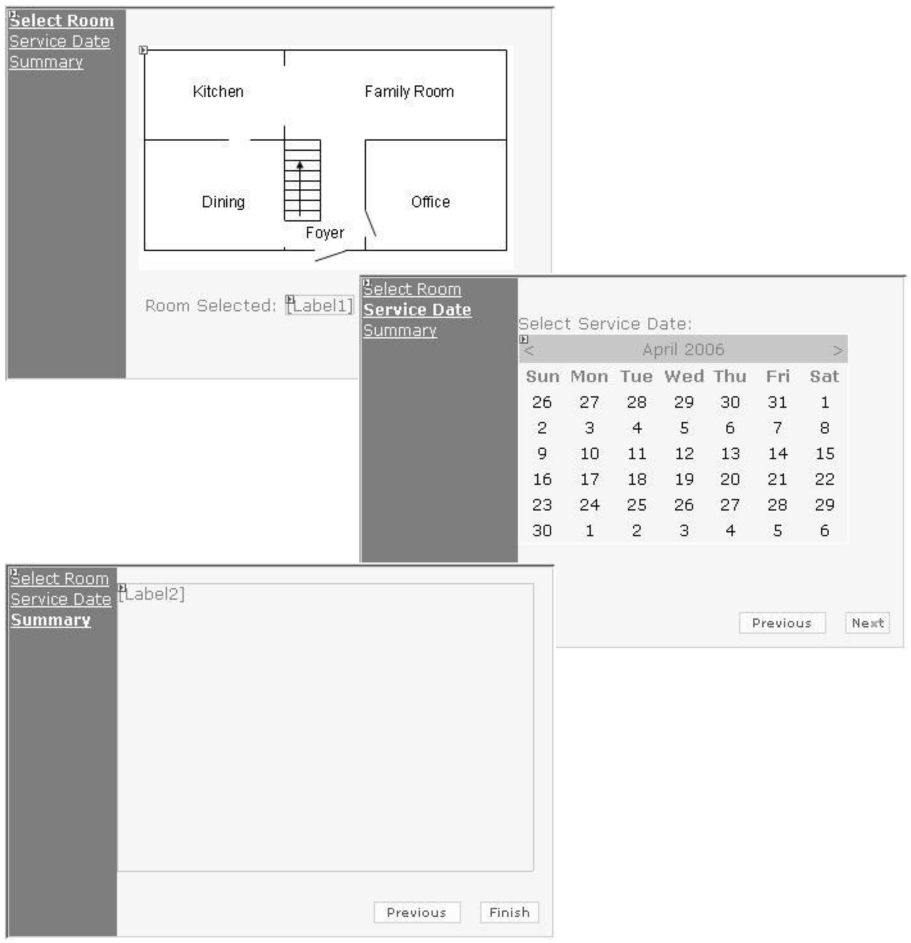
14. In Design view, click the Summary link in the *Wizard* control to make this the active step.

    In this step, add a *Label* control and size it to the fill the *WizardStep* control. Your ASPX source for this step should look like the following:

ASPX Source – Service Date

```
<asp:WizardStep runat="server" Title="Summary">
    <asp:Label ID="Label2" runat="server" Height="225px" Width="325px">
    </asp:Label>
</asp:WizardStep>
```

15. In the Wizard Tasks window, click AutoFormat. Click Professional and click OK. The final result is shown in Figure 3-24.



Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	1	2	3	4	5	6

Figure 3-24 The completed Wizard user interface.

� **Exercise 2: Add to the Code-Behind Page**

In this exercise, you add code to the code-behind page to initialize the Wizard and the ImageMap hot spots and display a summary after the Wizard has completed its actions.

1. In Design view, double-click an empty area of the Web page to go to the code-behind page and insert the *Page_Load* event handler.
2. In the *Page_Load* event handler, add an *if* statement that tests whether the Web page is posted back. Inside the *if* statement, add code to set the *ActiveStepIndex* of the *Wizard* to the first *WizardStep*. Also add code to set the HotSpot mode of the ImageMap to perform a *PostBack*. Finally, declare a local *RectangularHotSpot*

variable and add code to create hot spots, as described in Table 3-4.

Table 3-4 ***RectangularHotSpot* Controls**

PostBackValue	Left	Top	Right	Bottom
Kitchen	4	3	113	73
Family Room	113	3	286	73
Dining Room	4	73	113	160
Office	176	73	286	160
Foyer	113	73	176	160

3. In Design view, double-click the ImageMap to create the *ImageMap1_Click* event handler in the code-behind page. Add code to this method that places the *Post-BackValue* into *Label2*. Also add code that changes the *ImageUrl* of the ImageMap to display the current room that has been selected.
4. In Design view, double-click the *Wizard* to add the *Wizard1_FinishButtonClick* event handler in the code-behind page. In this method, add code to hide the *Wiz ard* and display a thank-you message.
5. In Design view, select the *Wizard* and click the Events button in the Properties window. Double-click the *ActiveStepChanged* event to add the *Wizard1_Active-StepChanged* event handler. Add code to this method to find out if the active step is the summary, and if it is, populate *Label2* with a message that shows the cur rent selection. Your final code-behind page should look like the following:

```
'VB
Partial Class _Default
    Inherits System.Web.UI.Page

   Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Me.Load
        If (Not IsPostBack) Then
            Wizard1.ActiveStepIndex = 0
            ImageMap1.HotSpotMode = HotSpotMode.PostBack
            Dim hs As RectangleHotSpot
            hs = New RectangleHotSpot()
            hs.PostBackValue = "Kitchen"
            hs.Left = 4
            hs.Top = 3
            hs.Right = 113
            hs.Bottom = 73
            ImageMap1.HotSpots.Add(hs)
            hs = New RectangleHotSpot()
            hs.PostBackValue = "Family Room"
            hs.Left = 113
            hs.Top = 3
            hs.Right = 286
            hs.Bottom = 73
            ImageMap1.HotSpots.Add(hs)
            hs = New RectangleHotSpot()
            hs.PostBackValue = "Dining Room"
            hs.Left = 4
            hs.Top = 73
            hs.Right = 113
            hs.Bottom = 160
            ImageMap1.HotSpots.Add(hs)
            hs = New RectangleHotSpot()
            hs.PostBackValue = "Office"
            hs.Left = 176
            hs.Top = 73
            hs.Right = 286
            hs.Bottom = 160
            ImageMap1.HotSpots.Add(hs)
            hs = New RectangleHotSpot()
            hs.PostBackValue = "Foyer"
            hs.Left = 113
            hs.Top = 73
            hs.Right = 176
            hs.Bottom = 160
            ImageMap1.HotSpots.Add(hs)
  End If
End Sub

Protected Sub ImageMap1_Click(ByVal sender As Object, _
            ByVal e As System.Web.UI.WebControls.ImageMapEventArgs) _
            Handles ImageMap1.Click
  Label1.Text = e.PostBackValue
  ImageMap1.ImageUrl = "~/Images/House " _
             + e.PostBackValue + ".gif"
End Sub

Protected Sub Wizard1_FinishButtonClick(ByVal sender As Object, _
            ByVal e As System.Web.UI.WebControls.WizardNavigationEventArgs) _
            Handles Wizard1.FinishButtonClick
  Wizard1.Visible = False
  Response.Write("Thank you for your order")
End Sub

Protected Sub Wizard1_ActiveStepChanged(ByVal sender As Object, _
            ByVal e As System.EventArgs) _
            Handles Wizard1.ActiveStepChanged
  If (Wizard1.ActiveStep.Title = "Summary") Then
            Label2.Text = "Summary Info:<br />" _
             + "Room: " + Label1.Text + "<br />" _
             + "Delivery Date: " _
             + Calendar1.SelectedDate.ToShortDateString()
```

```
        End If
      End Sub

End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class _Default : System.Web.UI.Page
{
       protected void Page_Load(object sender, EventArgs e)
        {
         if (!IsPostBack)
              {
                 Wizard1.ActiveStepIndex = 0;
                 ImageMap1.HotSpotMode = HotSpotMode.PostBack;
                 RectangleHotSpot hs;
                 hs = new RectangleHotSpot();
                 hs.PostBackValue = "Kitchen";
                 hs.Left = 4;
                 hs.Top = 3;
                 hs.Right = 113;
                 hs.Bottom = 73;
                 ImageMap1.HotSpots.Add(hs);
                 hs = new RectangleHotSpot();
                 hs.PostBackValue = "Family Room";
                 hs.Left = 113;
                 hs.Top = 3;
                 hs.Right = 286;
                 hs.Bottom = 73;
                 ImageMap1.HotSpots.Add(hs);
                 hs = new RectangleHotSpot();
                 hs.PostBackValue = "Dining Room";
                 hs.Left = 4;
                 hs.Top = 73;
                 hs.Right = 113;
                 hs.Bottom = 160;
                 ImageMap1.HotSpots.Add(hs);
                 hs = new RectangleHotSpot();
                 hs.PostBackValue = "Office";
                 hs.Left = 176;
                 hs.Top = 73;
                 hs.Right = 286;
                 hs.Bottom = 160;
```

```
            ImageMap1.HotSpots.Add(hs);
            hs = new RectangleHotSpot();
            hs.PostBackValue = "Foyer";
            hs.Left = 113;
            hs.Top = 73;
            hs.Right = 176;
            hs.Bottom = 160;
            ImageMap1.HotSpots.Add(hs);
        }
    }

    protected void Wizard1_FinishButtonClick(
      object sender, WizardNavigationEventArgs e)
    {
      Wizard1.Visible = false;
      Response.Write("Thank you for your order");
    }

    protected void Wizard1_ActiveStepChanged(
      object sender, EventArgs e)
    {
      if (Wizard1.ActiveStep.Title=="Summary")
         {
            Label2.Text = "Summary Info:<br />"
             + "Room: " + Label1.Text + "<br />"
             + "Delivery Date: "
             + Calendar1.SelectedDate.ToShortDateString();
         }
    }

    protected void ImageMap1_Click(
      object sender, ImageMapEventArgs e)
    {
      Label1.Text = e.PostBackValue;
      ImageMap1.ImageUrl = "~/Images/House "
             + e.PostBackValue + ".gif";
    }
}
```

6. Test the Web page by pressing F5 to display the page.
7. Try clicking each room and observe the results. You should see the image and the label should update to show the selected room.
8. Click the Service Date link or the Next button to display the *Calendar* control. Click a date.
9. Click the Summary link or the Next button to display a summary of your selections.
10. Click the Finish button to see the thank-you message.

Lesson 2: Working with Data-Bound Web Server Controls

The next chapter covers ADO.NET and XML, so we need to cover data-bound con trols in this chapter so we can use them in the examples for ADO.NET and XML.

This lesson explores data binding and the Web server controls that are used in ASP.NET 2.0 to bind, or connect, to data.

After this lesson, you will be able to:

- Use the following Web server controls:
  - ❑ *ListControl*, and its child classes
  - ❑ *AdRotator*
  - ❑ *XML*
  - ❑ *GridView*
  - ❑ *FormView*
  - ❑ *TreeView*
  - ❑ *Menu*

Estimated lesson time: 60 minutes

Using a Collection to Perform Data-Binding

To keep things simple, the examples in this lesson use a collection of *Car* objects that can be bound to a control. The *Car* class is shown in the following code sample:

```
'VB
Imports Microsoft.VisualBasic
Imports System.Collections.Generic

Public Class Car
    Public Sub New(ByVal vin As String, ByVal make As String, _
            ByVal model As String, ByVal year As Integer, _
            ByVal price As Decimal)
      Me.Vin = vin : Me.Make = make : Me.Model = model
      Me.Year = year : Me.Price = price
    End Sub

    Public Property Vin() As String
      Get
            Return _vin
      End Get
      Set(ByVal value As String)
            _vin = value
      End Set
End Property
Private _vin As String

Public Property Make() As String
  Get
       Return _make
  End Get
  Set(ByVal value As String)
       _make = value
  End Set
End Property
Private _make As String

Public Property Model() As String
  Get
       Return _model
  End Get
  Set(ByVal value As String)
       _model = value
  End Set
End Property
Private _model As String

Public Property Year() As Decimal
  Get
       Return _year
  End Get
  Set(ByVal value As Decimal)
       _year = value
  End Set
End Property
Private _year As Decimal

Public Property Price() As Decimal
  Get
       Return _price
  End Get
  Set(ByVal value As Decimal)
       _price = value
  End Set
End Property
Private _price As Decimal

Public Shared Function GetList() As List(Of Car)
  Dim carList As New List(Of Car)
  carList.Add(New Car("1A59B", "Chevrolet", "Impala", 1963, 1125.0))
  carList.Add(New Car("9B25T", "Ford", "F-250", 1970, 1595.0))
  carList.Add(New Car("3H13R", "BMW", "Z4", 2006, 55123.0))
  carList.Add(New Car("7D67A", "Mazda", "Miata", 2003, 28250.0))
  carList.Add(New Car("4T21N", "VW", "Beetle", 1956, 500.0))
  Return carList
End Function
End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
using System.Collections.Generic;

/// <summary>
/// Summary description for Car
/// </summary>
public class Car
{
    public Car() { }

public Car(string vin, string make, string model, int year, decimal price)
{
      Vin = vin;  Make = make; Model = model; Year = year; Price = price;
}

    public string Vin
    {
      get { return vin; }
      set { vin = value; }
    }
    private string vin;

    public string Make
    {
      get { return make; }
      set { make = value; }
    }
    private string make;

    public string Model
    {
      get { return model; }
      set { model = value; }
    }
    private string model;

    public int Year
    {
      get { return year; }
      set { year = value; }
    }
    private int year;

    public decimal Price
    {
      get { return price; }
      set { price = value; }
    }
    private decimal price;

    public static List<Car> GetList()
    {
      List<Car> carList = new List<Car>();
      carList.Add(new Car("1A59B","Chevrolet", "Impala", 1963, 1125.00M));
      carList.Add(new Car("9B25T","Ford", "F-250", 1970, 1595.00M));
      carList.Add(new Car("3H13R","BMW", "Z4", 2006, 55123.00M));
      carList.Add(new Car("7D67A","Mazda", "Miata", 2003, 28250.00M));
      carList.Add(new Car("4T21N","VW", "Beetle", 1956, 500.00M));
      return carList;
    }

}
```

Notice that the *GetList* method returns a list of *Car* objects that can be used as needed.

Introducing Data-Bound Controls

Data-bound controls are controls that need to bind, or connect, to data. The data-bound controls are classified as simple, composite, or hierarchical controls. Simple data-bound controls are the controls that inherit from the *ListControl* and the *AdRotator* controls. Composite data-bound controls are classes that inherit from *Composite-DataBoundControl*, such as the *GridView*, *DetailsView*, and *FormsView* controls. Hier archical data-bound controls are the *Menu* and *TreeView* controls.

The .NET framework provides several base classes that are used to provide common properties and behavior for the concrete data-bound controls. Figure 3-25 shows the hierarchy of the base classes.

The *HierarchicalDataBoundControl* inherits from the *BaseDataBoundControl* and is the parent class to controls that display hierarchical data, such as the *Menu* and *TreeView* controls.

The *DataBoundControl* inherits from the *BaseDataBoundControl* and is the parent class to the *CompositeDataBoundControl* and the *ListControl*, which are parent classes to other controls that display tabular data, such as the *GridView* and *DropDownList*. The *DataBoundControl* control's *DataMember* property is a string data type that is used when the *DataSource* contains more than one tabular result set. In this scenario, the *DataMember* property is set to the name of the tabular result set that is to be displayed.

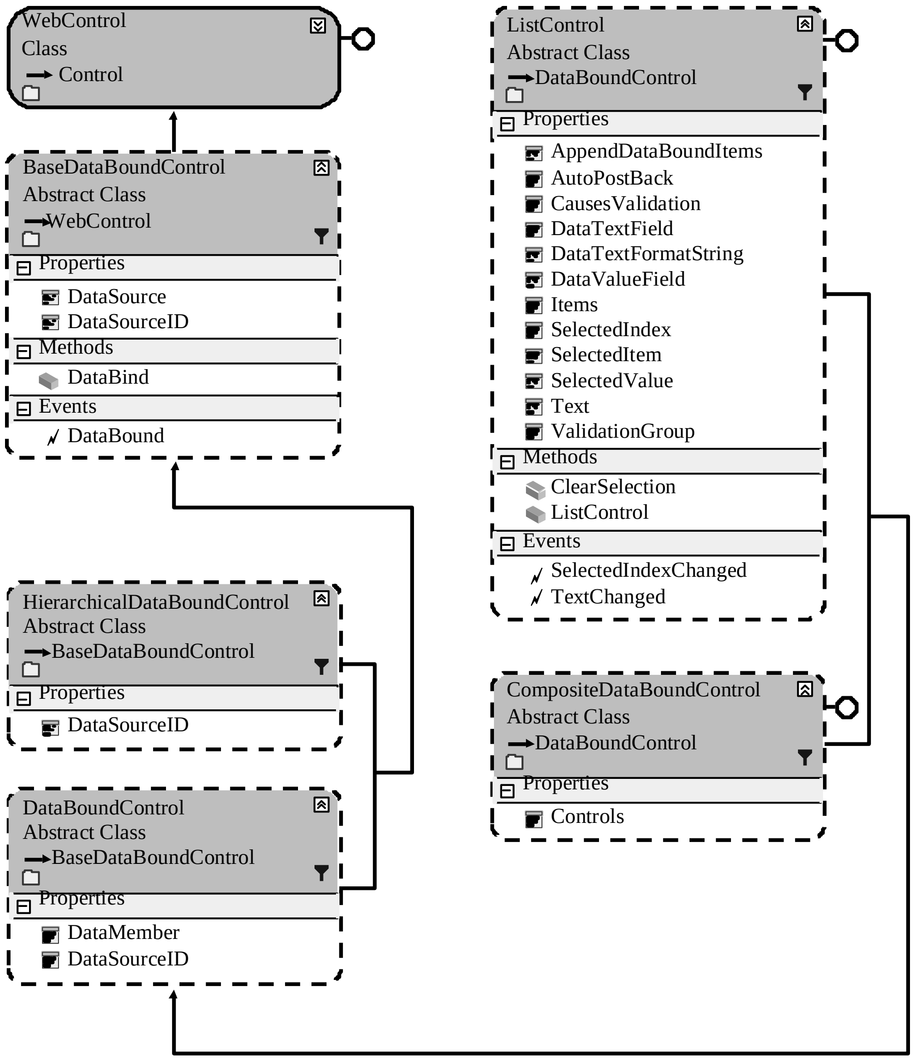


Figure 3-25 The base data-bound class hierarchy.

The *DataBoundControl* class has a method called *DataBind*. You call this method when the data is ready to be read from the data source. When this method is called on a con trol, this method is recursively called on all child controls. Calling the *DataBind* method on the Web page recursively calls the *DataBind* method on all controls on the Web page.

Using *DataSource* Objects

The *BaseDataBoundControl* is the first control in the hierarchy, inheriting from *WebControl*. The class contains the *DataSource* and *DataSourceID* properties. The *DataSource* property gets or sets the object that the data-bound control uses to retrieve a list of data items. The *DataSource* object is typically an instance of a class that implements *IEnumerable*, *IListSource*, *IDataSource*, or *IHierarchicalDatasource*. The *DataSourceID* property gets or sets the ID of a control that contains the source of the data, such as the *SqlDataSource* control. You typically set either the *DataSource* or the *DataSourceID*. If both properties are set, the *DataSourceID* takes precedence. The data-bound control automatically connects to the data source control at run time by calling the *DataBind* method on this control, which also raises the *DataBound* method.

NOTE .NET 2.0

Graphical User Interface (GUI)-based data sources are new in ASP.NET version 2.0.

The GUI-based data sources are controls that inherit from *DataSourceControl* or *HierarchicalDataSourceControl* and implement the *IDataSource* and *IListSource* inter faces. These controls provide a consistent means to bind any data source to a data-bound control. The class hierarchies for the *DataSourceControl* and *Hierarchical-DataSourceControl* are shown in Figure 3-26.

The following is a description of each of the GUI-based data sources that you can use to bind, or connect, to a data-bound control:

- **AccessDataSource** Provides binding to a Microsoft Access database file that has the .mdb extension.
- **SqlDataSource** Provides binding to an Open Database Connectivity (ODBC), Object Linking and Embedding Database (OLEDB), SQL Server, Oracle, or other database that uses Structured Query Language (SQL). You can even attach to a SQL Server database file by simply including it in your project.
- **XmlDataSource** Provides binding to an XML file in your project folder. You can specify a transform file that can be used to modify the XML file before it is bound to a control. You can also provide an XPath expression to retrieve a subset of the data in the XML file.
- **ObjectDataSource** Provides binding to an object. The ObjectDataSource can connect to a middle-tier business object or *DataSet* object in the Bin or App_Code directory of your application. When using this option, you can select

a class that you have access to, and an instance of the class is created for you each time that data is required. In addition to selecting a class, you must choose the methods you want to execute to select, insert, update, and delete. The select method should return a single object that implements *IEnumerable*, *IListSource*, *IDataSource*, or *IHierarchicalDatasource*. This means that a *DataTable* object, a *DataSet* object, or a collection object can be used. If the select method returns a *DataSet* object, the first *DataTable* object in the *DataSet* is used.

- **SitemapDataSource** You can connect to the site navigation tree for your applica tion. This option requires a valid sitemap file at the application root.

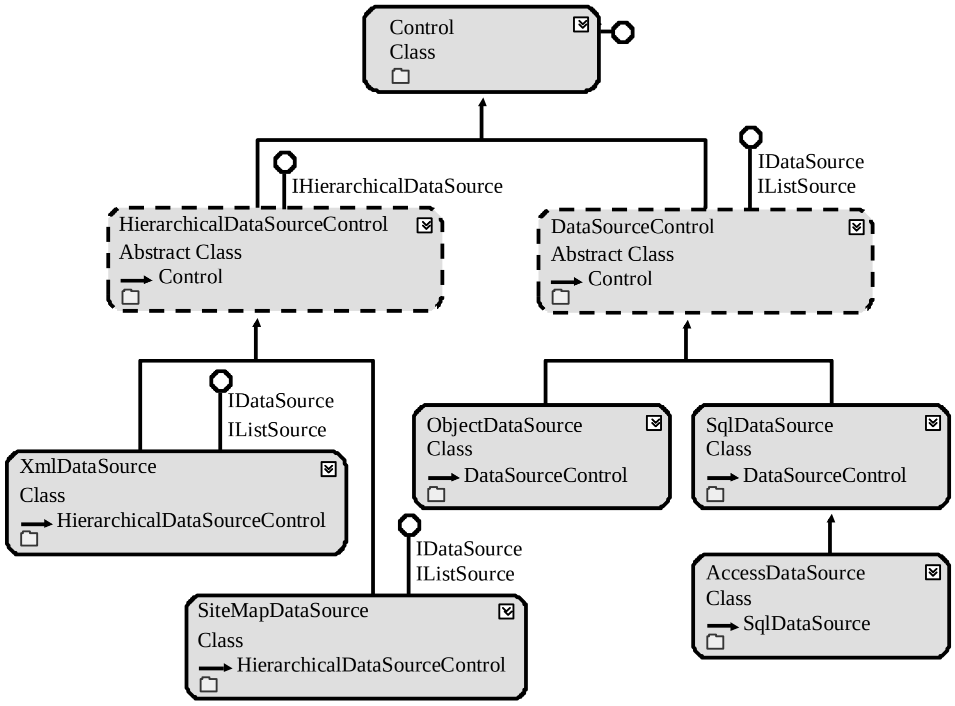


Figure 3-26 The *DataSourceControl* and *HierarchicalDataSourceControl* class hierarchy.

Mapping Fields to Templates

Templated binding can be used on controls that support templates. A template con trol is a control that has no default user interface. The control simply provides the mechanism for binding to data. The developer supplies the user interface in the form of inline templates. The template can contain declarative elements such as HTML and Dynamic Hypertext Markup Language (DHTML). The template can also contain

ASP.NET data-binding syntax to insert data from the data source. Controls that sup port templates include *GridView*, *DetailsView*, and *FormView*. A typical control may allow the following templates to be programmed:

- **HeaderTemplate** This is an optional header, which is rendered at the top of the control.
- **FooterTemplate** This is an optional footer, which is rendered at the bottom of the control.
- **ItemTemplate** The item template is rendered for each row in the data source.
- **AlternatingItemTemplate** This is an optional alternating item template; if imple mented, every other row is rendered using this template.
- **SelectedItemTemplate** This is an optional selected item template; if imple mented, the template is used to render a row that has been selected.
- **SeparatorTemplate** This is an optional separator template that defines the sepa ration of each item and alternate item.
- **EditItemTemplate** This is an optional edit item template that is used to render a row that is in edit mode. This usually involves displaying the data in a *TextBox* instead of a *Label* control.

Using the *DataBinder* Class

The *DataBinder* class provides a static method called *Eval*, which can simplify access to data, especially when you are using templated controls. The *Eval* method uses reflection to perform a lookup of the *DataItem* property's underlying type by looking at the type metadata that is stored in the type's assembly. After the metadata is retrieved, the *Eval* method determines how to connect to the given field. The end result is that *Eval* provides a consistent method of binding to the data. The following code shows the binding to the *Vin* property of the *Car* object:

```
<%# Eval("Vin") %>
```

The *Eval* method provides an overloaded method that allows a format string to be assigned. The *Price* can be modified to provide currency formatting, as shown in the following code:

```
<%# Eval("Vin", "{0:C}" ) %>
```

The problem with the *Eval* method is that it provides one-way, or read-only binding, but the new *Bind* method fixes that problem.

NOTE .NET 2.0

The *Bind* method is new in ASP.NET version 2.0.

The *Bind* method provides two-way data binding, which makes this method desirable for use when editing or inserting records. Just like the *Eval* method, the *Bind* method has two overloads, which means that you can use it with or without the *"format"* parameter. The following code shows the use of the *Bind* method to the *Vin* property of the *Car* object:

```
<%# Bind("Vin") %>
```

The *Bind* method provides an overloaded method that allows a format string to be assigned. The *Price* can be modified to provide currency formatting, as shown in the following code:

```
<%# Bind("Vin", "{0:C}" ) %>
```

Notice that the syntax for the *Bind* method is the same as for the *Eval* method. Also, the *GridView*, *DetailsView*, and *FormView* controls are the only controls that allow use of the *Bind* method.

NOTE Be Sure to Set the ID

A control that is data-bound using the *Bind* syntax must have the *ID* property set to a user-defined value.

Exploring the *ListControl*

The *ListControl* is an abstract base class that provides common functionality for its inherited classes, as shown in Figure 3-27. The *ListControl* contains an *Items* collec tion, which is a collection of *ListItem* objects. The *ListItem* contains a *Text* property that is displayed to the user and a *Value* property that is posted back to the Web server. The *ListItem* objects can be populated by adding new *ListItems* objects in code or by setting the *DataSource* and *DataMember* properties. If you set the *DataSource* and *DataMember* properties, you can choose the fields in your tabular result that you will bind to the *ListItem.Text* and *ListItem.Value* properties by setting the *DataTextField* and *DataValue-Field* properties, respectively. The text displayed for each item in the list control can be formatted by setting the *DataTextFormatString* property.

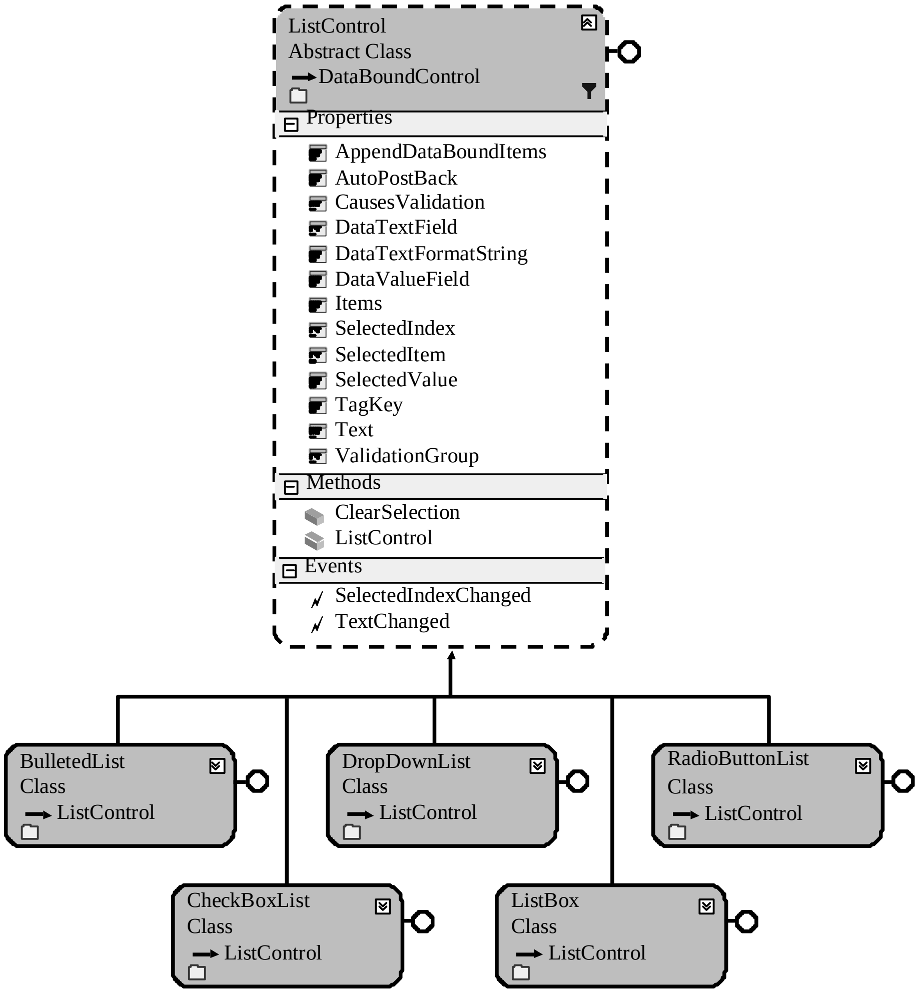


Figure 3-27 The *ListControl* class hierarchy.

The *SelectedIndex* property lets you get or set the index of the selected item in the *ListControl*. Using the *SelectedItem* property, you can access the selected *ListItem* object's properties. If you only need to access the value of the selected *ListItem*, use the *SelectedValue* property. The *ListControl* also provides the *SelectedIndexChanged* event, which is raised when the selection in the list control changes between posts to the server.

NOTE .NET 2.0

AppendDataBoundItems is new in ASP.NET version 2.0.

The *ListControl* also contains a new property called *AppendDataBoundItems* that can be set to *true* to keep all items that are currently in the *ListControl* in addition to appending the items from the data binding. Setting this property to *false* clears the *Items* property prior to binding the data.

The *DropDownList* Control

The *DropDownList* control is used to display a list of items to the user who can make a single selection. The *DropDownList* control inherits from the *ListControl* control, as shown in Figure 3-28.

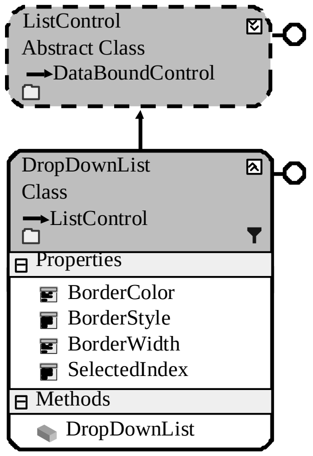


Figure 3-28 The *DropDownList* control hierarchy.

The *Items* collection contains the collection of *ListItem* objects contained in the *DropDownList* control. To determine the item that is selected, you can retrieve the *SelectedValue*, *SelectedItem*, or *SelectedIndex* property.

Security Alert By default, populating the *DropDownList* control with data from an untrusted source can create XSS vulnerabilities. Be sure to HtmlEncode untrusted data that is placed into each *ListItem*.

The following example shows how to data-bind the *DropDownList* control to the *Car* collection. The Web page contains a *DropDownList* control, a *Button* control, and a *Label* control:

```
'VB
Imports System.Collections.Generic
```

```
Partial Class DropDownList_Control
     Inherits System.Web.UI.Page

    Private carList As List(Of Car) = Car.GetList()

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      If Not IsPostBack Then
            DropDownList1.DataSource = carList
            DropDownList1.DataTextField = "Price"
            DropDownList1.DataValueField = "Price"
            DropDownList1.DataTextFormatString = "Price: {0:C}"
            DropDownList1.DataBind()
      End If
    End Sub


    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
      Label1.Text = DropDownList1.SelectedValue
    End Sub
End Class
```

```
//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
//added
using System.Collections.Generic;

public partial class DropDownList_Control : System.Web.UI.Page
{
    private List<Car> carList = Car.GetList();

    protected void Page_Load(object sender, EventArgs e)
    {
      if (!IsPostBack)
         {
            DropDownList1.DataSource = carList;
            DropDownList1.DataTextField = "Price";
            DropDownList1.DataValueField = "Price";
            DropDownList1.DataTextFormatString = "Price: {0:C}";
            DropDownList1.DataBind();
         }
    }
    protected void Button1_Click(object sender, EventArgs e)
    {
      Label1.Text = DropDownList1.SelectedValue;
    }
}
```

In the example shown in Figure 3-29, the user makes a selection in the *DropDownList* control, and the *Button* control is clicked to display the results in the *Label* control. Note that the *DropDownList* control is being populated only on the first request for the Web page. If the *DropDownList* control is repopulated, the selected item is dis carded, resulting in no item being selected.

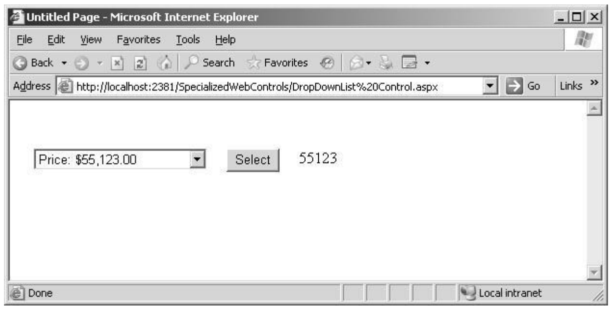

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2381/SpecializedWebControls/DropDownList%20Control.aspx Go Links
Price: $55,123.00
Select
55123
Done
Local intranet

Figure 3-29 The *DropDownList* control with an item selected and copied to the *Label* control.

The *ListBox* Control

The *ListBox* control is used to display a list of items to the user, who can make a single selection or multiple selections. The *ListBox* control inherits from the *ListControl* con trol, as shown in Figure 3-30. The *SelectionMode* property is used to enable multiple-item selection by setting this property to *ListSelectionMode.Multiple*.

The *ListBox* control has the *Rows* property, which is used to specify the height of the *ListBox* control, based on specifying the quantity of data items to display.

The *Items* collection contains the collection of *ListItem* objects contained in the *ListBox* control. To determine the items that are selected, you can enumerate the *ListItem* objects in the *Items* collection by examining the *Selected* value for each *ListItem* element.

Security Alert By default, populating the *ListBox* control with data from an untrusted source can create XSS vulnerabilities. Be sure to HtmlEncode untrusted data that will be placed into each *ListItem*.

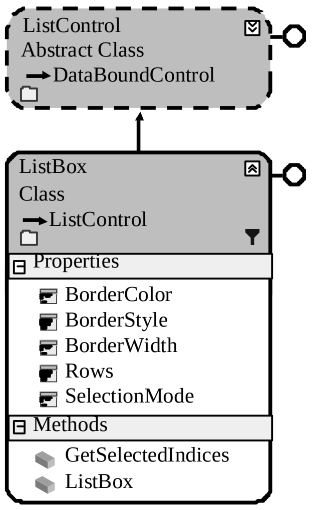


Figure 3-30 The *ListBox* control hierarchy.

The following example shows how to data-bind the *ListBox* control to the *Car* collec tion. The Web page contains two *ListBox* controls with a *Button* control between them. The *ListBox* controls have their *SelectionMode* properties set to *Multiple*.

'VB

```
Imports System.Collections.Generic

Partial Class ListBox_Control
    Inherits System.Web.UI.Page

    Private carList As List(Of Car) = Car.GetList()

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      ListBox1.SelectionMode = ListSelectionMode.Multiple
      ListBox2.SelectionMode = ListSelectionMode.Multiple
      If Not IsPostBack Then
            ListBox1.DataSource = carList
            ListBox1.DataTextField = "Price"
            ListBox1.DataValueField = "Price"
            ListBox1.DataTextFormatString = "Price: {0:C}"
            ListBox1.DataBind()
      End If
    End Sub

    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
      For Each item As ListItem In ListBox1.Items
            If item.Selected Then
                  ListBox2.Items.Add(item)
            End If
        Next
        ListBox2.DataBind()
      End Sub
End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
//added
using System.Collections.Generic;

public partial class ListBox_Control : System.Web.UI.Page
{
      private List<Car> carList = Car.GetList();

      protected void Page_Load(object sender, EventArgs e)
      {
        ListBox1.SelectionMode = ListSelectionMode.Multiple;
        ListBox2.SelectionMode = ListSelectionMode.Multiple;
        if (!IsPostBack)
            {
                ListBox1.DataSource = carList;
                ListBox1.DataTextField = "Price";
                ListBox1.DataValueField = "Price";
                ListBox1.DataTextFormatString = "Price: {0:C}";
                ListBox1.DataBind();
            }
      }

      protected void Button1_Click(object sender, EventArgs e)
      {
        foreach (ListItem item in ListBox1.Items)
            {
                if (item.Selected)
                  {
                        ListBox2.Items.Add(item);
                  }
            }
        ListBox2.DataBind();
      }
}
```

In the example shown in Figure 3-31, the user makes selections in the first *ListBox* control and clicks the *Button* control to display the results in the second *ListBox* con trol. Note that the first *ListBox* control is only being populated on the first request for the Web page. If the *ListBox* control is repopulated, the selected items are discarded, resulting in no items being selected.

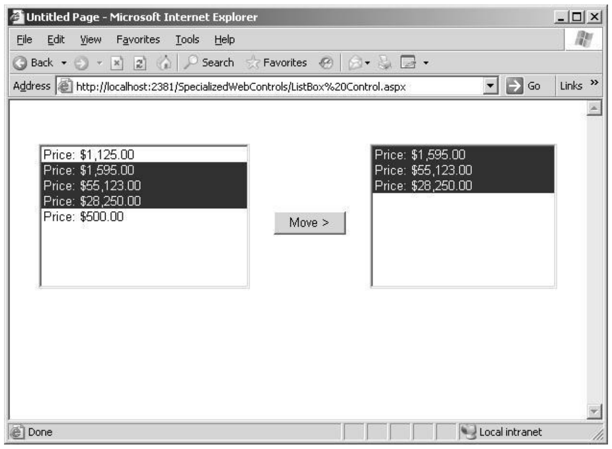


Figure 3-31 The *ListBox* control with items selected and copied to the second control.

The *CheckBoxList* and *RadioButtonList* Controls

The *CheckBoxList* and *RadioButtonList* controls are very similar and are used to display lists of items to the users, who can make single selections (*RadioButtonList*) or multi ple selections (*CheckBoxList*). These controls inherit from the *ListControl* control, as shown in Figure 3-32.

These controls contain a *RepeatColumns* property that is used to size the control hor izontally. In addition, the *RepeatDirection* can be set to *Vertical* or *Horizontal* to indi cate which way the data is rendered.

The *Items* collection contains the collection of *ListItem* objects, which are inside the *CheckBoxList* and the *RadioButtonList* controls. Use the *SelectedValue* property to deter mine the item that has been selected for the *RadioButtonList*. To find the selected *CheckBoxList* items, you can enumerate the *ListItem* objects in the *Items* collection by examining the value of the *Selected* property for each *ListItem* element.

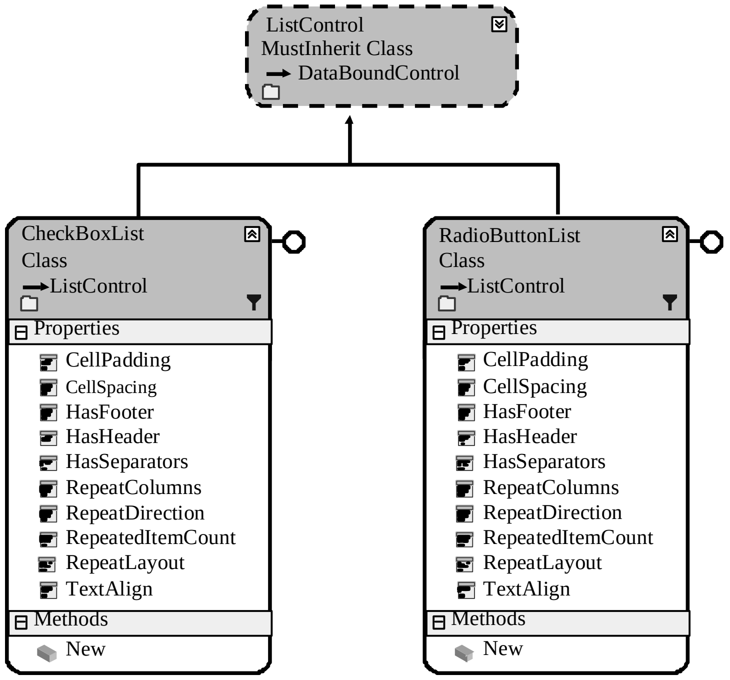


Figure 3-32 The *CheckBoxList* and *RadioButtonList* control hierarchy.

Security Alert By default, populating the *CheckBoxList* and *RadioButtonList* controls with data from an untrusted source can create XSS vulnerabilities. Be sure to HtmlEncode untrusted data that will be placed into each *ListItem*.

The following example shows how to data-bind the *CheckBoxList* and *RadioButtonList* controls to the *Car* collection. The Web page contains one of each of the controls, plus a *ListBox* control. All of these controls have been bound to the *Car* collection. The *ListBox* shows the order of the *Car* collection. The *CheckBoxList* has the *Repeat-Columns* set to 3 and the *RepeatDirection* set to *Horizontal*. The *RadioButtonList* also has the *RepeatColumns* set to 3, but the *RepeatDirection* property is set to *Vertical*.

```
'VB
Imports System.Collections.Generic

Partial Class CheckBoxList_and_RadioButtonList_Controls
    Inherits System.Web.UI.Page

    Private carList As List(Of Car) = Car.GetList()

  Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles Me.Load
```

```
      RadioButtonList1.RepeatColumns = 3
      RadioButtonList1.RepeatDirection = RepeatDirection.Vertical
      CheckBoxList1.RepeatColumns = 3
      CheckBoxList1.RepeatDirection = RepeatDirection.Horizontal

      If Not IsPostBack Then
          If Not IsPostBack Then
              ListBox1.DataSource = carList
              ListBox1.DataTextField = "Make"
              ListBox1.DataValueField = "Price"
              RadioButtonList1.DataSource = carList
              RadioButtonList1.DataTextField = "Make"
              RadioButtonList1.DataValueField = "Price"
              CheckBoxList1.DataSource = carList
              CheckBoxList1.DataTextField = "Make"
              CheckBoxList1.DataValueField = "Price"
              DataBind()
          End If
      End If
    End Sub

End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
//added
using System.Collections.Generic;

public partial class CheckBoxList_and_RadioButtonList_Controls : System.Web.UI.Page
{
    private List<Car> carList = Car.GetList();

    protected void Page_Load(object sender, EventArgs e)
    {
      RadioButtonList1.RepeatColumns = 3;
      RadioButtonList1.RepeatDirection = RepeatDirection.Vertical;
      CheckBoxList1.RepeatColumns = 3;
      CheckBoxList1.RepeatDirection = RepeatDirection.Horizontal;
      if (!IsPostBack)
         {
            ListBox1.DataSource = carList;
            ListBox1.DataTextField = "Make";
            ListBox1.DataValueField = "Price";
            RadioButtonList1.DataSource = carList;
            RadioButtonList1.DataTextField = "Make";
            RadioButtonList1.DataValueField = "Price";
            CheckBoxList1.DataSource = carList;
            CheckBoxList1.DataTextField = "Make";
            CheckBoxList1.DataValueField = "Price";
            DataBind();
        }
    }
}
```

In the example shown in Figure 3-33, the user makes selections in the first *ListBox* control and the *Button* control is clicked to display the results in the second *ListBox* control. Note that the first *ListBox* control is only populated on the first request for the Web page. If the *ListBox* control is repopulated, the selected items are discarded, resulting in no items being selected.

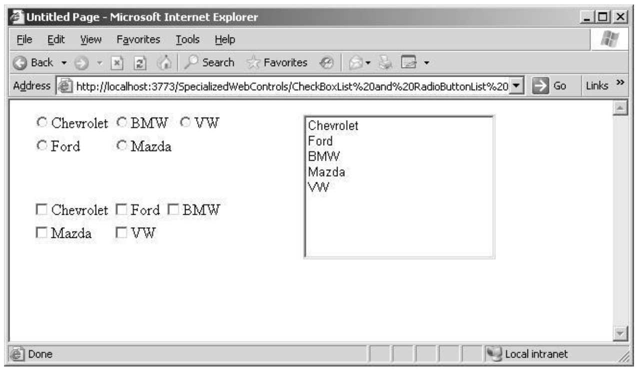

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3773/SpecializedWebControls/CheckBoxList%20and%20RadioButtonList%20
Go Links
Chevrolet BMW VW
Ford Mazda
Chevrolet Ford BMW
Mazda VW
Chevrolet
Ford
BMW
Mazda
VW
Done
Local intranet

Figure 3-33 The *CheckBoxList* and *RadioButtonList* controls, showing the use of the Repeat-Columns and RepeatDirection.

The *BulletedList* Control

The *BulletedList* control displays an unordered or ordered list of items that renders as HTML *ul* or *ol* elements, respectively. The *BulletedList* control inherits from the *ListControl* control, as shown in Figure 3-34. This control renders as either bullets or numbers based on the *BulletStyle* property.

If the control is set to render as bullets, you can select the bullet style of *Disc*, *Circle*, or *Square*. Note that the *BulletStyle* settings are not compatible with all browsers. A cus tom image can be displayed instead of the bullet.

If the *BulletList* control is set to render numbers, you can set the *BulletStyle* to *Lower-Alpha*, *UpperAlpha*, *LowerRoman*, and *UpperAlpha* fields. You can also set the *FirstBullet-Number* property to specify the starting number for the sequence.

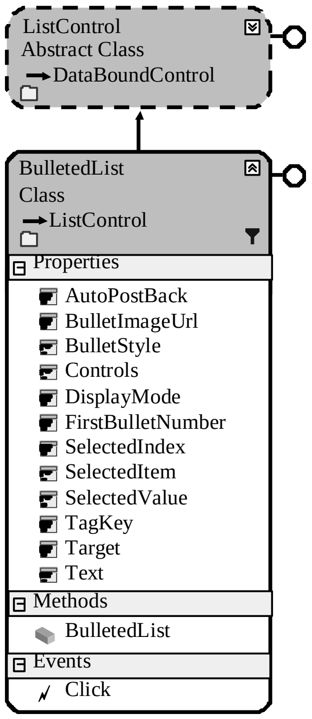


Figure 3-34 The *BulletedList* control hierarchy.

The *DisplayMode* property can be set to *Text*, *LinkButton*, or *HyperLink*. If set to *LinkButton* or *HyperLink*, the control performs a PostBack when a user clicks an item to raise the *Click* event.

Security Alert By default, populating the *BulletedList* control with data from an untrusted source can create XSS vulnerabilities. Be sure to HtmlEncode untrusted data that is placed into each *ListItem*.

The following example shows how to data-bind the *BulletedList* control to the *Car* col lection. The Web page contains a *BulletedList* control and two *ListBox* controls. The first *ListBox* control contains the list of *BulletStyle* options and the second *ListBox* con tains the *DisplayMode* settings. These *ListBox* controls demonstrate the formatting options that are available.

```
'VB
Imports System.Collections.Generic

Partial Class BulletedList_Control
```

```
    Inherits System.Web.UI.Page

    Private carList As List(Of Car) = Car.GetList()

    Protected Sub ListBox1_SelectedIndexChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles ListBox1.SelectedIndexChanged
        BulletedList1.BulletStyle = _
            CType([Enum].Parse( _
            GetType(BulletStyle), _
            ListBox1.SelectedValue), BulletStyle)
    End Sub

    Protected Sub ListBox2_SelectedIndexChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles ListBox2.SelectedIndexChanged
        BulletedList1.DisplayMode = _
            CType([Enum].Parse( _
            GetType(BulletedListDisplayMode), _
            ListBox2.SelectedValue), BulletedListDisplayMode)
    End Sub

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
        ListBox1.AutoPostBack = True
        ListBox2.AutoPostBack = True
        If (Not IsPostBack) Then
            BulletedList1.DataSource = carList
            BulletedList1.DataTextField = "Make"
            BulletedList1.DataValueField = "Price"
            ListBox1.DataSource = _
                [Enum].GetNames(GetType(BulletStyle))
            ListBox2.DataSource = _
                [Enum].GetNames(GetType(BulletedListDisplayMode))
            DataBind()
        End If

    End Sub
End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
//added
using System.Collections.Generic;
```

```
public partial class BulletedList_Control : System.Web.UI.Page
{
    private List<Car> carList = Car.GetList();

     protected void Page_Load(object sender, EventArgs e)
      {
       ListBox1.AutoPostBack = true;
       ListBox2.AutoPostBack = true;
       if (!IsPostBack)
           {
             BulletedList1.DataSource = carList;
             BulletedList1.DataTextField = "Make";
             BulletedList1.DataValueField = "Price";
             ListBox1.DataSource =
                    Enum.GetNames(typeof(BulletStyle));
             ListBox2.DataSource =
                    Enum.GetNames(typeof(BulletedListDisplayMode));
             DataBind();
           }
      }

    protected void ListBox1_SelectedIndexChanged(object sender,
      EventArgs e)
    {
      BulletedList1.BulletStyle =
              (BulletStyle)Enum.Parse(
              typeof(BulletStyle),
              ListBox1.SelectedValue);
    }
    protected void ListBox2_SelectedIndexChanged(object sender,
      EventArgs e)
    {
      BulletedList1.DisplayMode =
              (BulletedListDisplayMode)Enum.Parse(
              typeof(BulletedListDisplayMode),
              ListBox2.SelectedValue);
    }

}
```

In the example shown in Figure 3-35, you can select a *BulletStyle* and a *DisplayMode* to see the rendered output. Keep in mind that the *BulletStyle* settings are not compatible with all browsers.

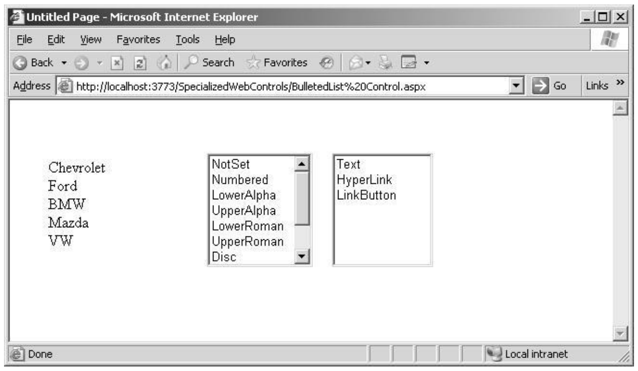

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3773/SpecializedWebControls/BulletedList%20Control.aspx
Go Links
Chevrolet
Ford
BMW
Mazda
VW
NotSet
Numbered
LowerAlpha
UpperAlpha
LowerRoman
UpperRoman
Disc
Text
HyperLink
LinkButton
Done
Local intranet

Figure 3-35 The *BulletedList* control has different setting options available.

The *AdRotator* Control

The *AdRotator* control is used to display randomly selected advertisement banners on a Web page. In Source view, the *AdRotator* control is created as an *<asp:AdRotator>* element. This control generates *<a>* and *<img>* elements when rendering to HTML. The *AdRotator* control inherits directly from the *DataBoundControl* class, as shown in Figure 3-36.

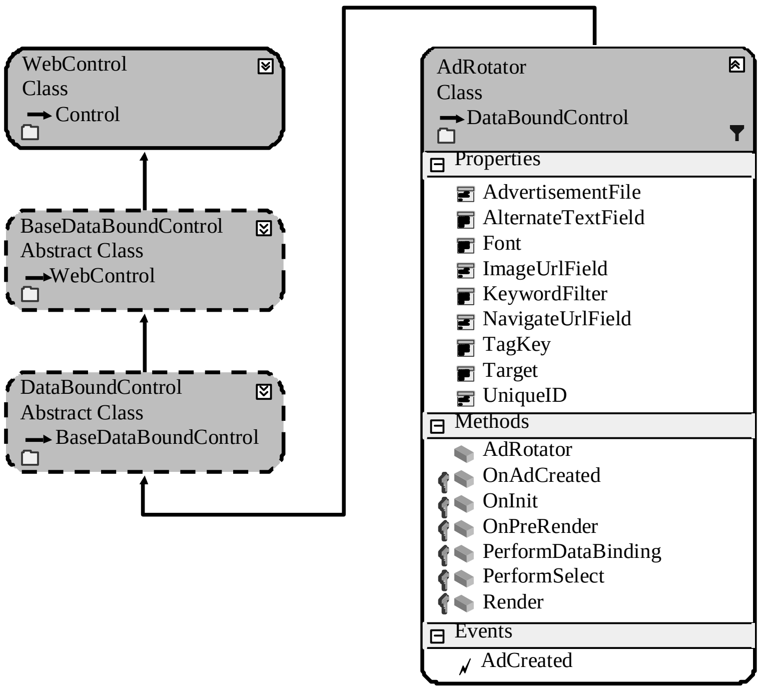


Figure 3-36 The *AdRotator* control hierarchy.

The advertisement information can be retrieved from an XML file or from a data base. Table 3-5 describes the elements that can be placed in the XML file for each advertisement.

Table 3-5 Ad Elements

Element Name	Description
Keyword	The category key of the ad. This can be used to filter for spe cific ads.
ImageUrl	The URL of the advertisement image to display.
NavigateUrl	The URL to navigate to when the ad is clicked.
AlternateText	The text to display if the image is unavailable; is displayed as a ToolTip.
Impressions	A number that is used to weight the frequency of this ad being displayed. The sum of all of the impressions values must be less than 2,048,000,000.
Height	This is an optional value that specifies the pixel height of the ad. This value overrides the *AdRotator Height* property.
Width	This is an optional value that specifies the pixel width of the ad. This value overrides the *AdRotator Width* property.

You must be careful with the configuration, naming, and location of the advertise ment file to assure that you don't cause security vulnerabilities. Listed below are some guidelines for this file:

1. Locate the advertisement file in the App_Data folder because ASP.NET does not allow browsers to request files in this folder.
2. Use a file extension, such as .config, that ASP.NET does not allow a browser to request.
3. Set permissions on the advertisement file to allow the ASP.NET account to have read-only access.
4. The ad file is not validated by the *AdRotator* control, so always check the data to assure that it does not contain malicious scripts before the data is released to production.

The *Impressions* element controls the frequency of advertisement display. A higher number increases the frequency relative to other advertisements in the file.

In this example, a Web page was created and an *AdRotator* control was added to the page. The advertisement file contains ad entries for Adventure Works, Contoso, and Northwind Traders. Listed below is the XML file, which was placed into the App_Data folder.

Sample Ads.config XML File

```
<?xml version="1.0" encoding="utf-8" ?>
<Advertisements
 xmlns="http://schemas.microsoft.com/AspNet/AdRotator-Advertisement-File-1.2">
    <Ad xmlns="">
      <Keyword>AdventureWorks</Keyword>
      <ImageUrl>~/images/AdventureWorks.gif</ImageUrl>
      <NavigateUrl>http://www.adventure-works.com</NavigateUrl>
      <AlternateText>Ad for Adventure Works Web site</AlternateText>
      <Impressions>100</Impressions>
    </Ad>
    <Ad xmlns="">
      <Keyword>Contoso</Keyword>
      <ImageUrl>~/images/Contoso.gif</ImageUrl>
      <NavigateUrl>http://www.contoso.com/</NavigateUrl>
      <AlternateText>Ad for Contoso Ltd. Web site</AlternateText>
      <Impressions>100</Impressions>
    </Ad>
    <Ad xmlns="">
      <Keyword>Northwind</Keyword>
      <ImageUrl>~/images/NorthwindTraders.gif</ImageUrl>
      <NavigateUrl>http://http://www.northwindtraders.com</NavigateUrl>
      <AlternateText>Ad for Northwind Traders Web site</AlternateText>
      <Impressions>50</Impressions>
    </Ad>
</Advertisements>
```

Next, full banner images (468 pixels wide by 60 pixels high) were added to the Images folder for Adventure Works, Contoso, and Northwind Traders, and the follow ing code was added to the code-behind page to configure that *AdRotator* control:

'VB

```
Partial Class AdRotator_Control
     Inherits System.Web.UI.Page

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      AdRotator1.AdvertisementFile = "~/App_Data/Ads.config"
      AdRotator1.Height = 60
```

```
        AdRotator1.Width = 468
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class AdRotator_Control : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
      {
        AdRotator1.AdvertisementFile = "~/App_Data/Ads.config";
        AdRotator1.Height = 60;
        AdRotator1.Width = 468;
      }
}
```

When this Web page is displayed, one of the advertisements is displayed, as shown in Figure 3-37.

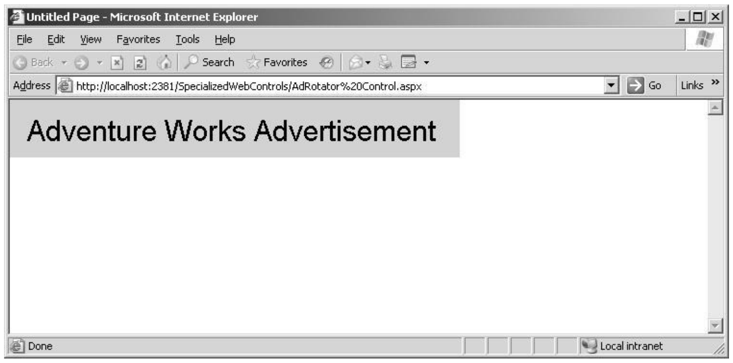

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2381/SpecializedWebControls/AdRotator%20Control.aspx
Go Links
Adventure Works Advertisement
Done
Local intranet

Figure 3-37 The rendered *AdRotator* displays an advertisement.

The *CompositeDataBoundControl* Control

The *CompositeDataBoundControl* control serves as a base class for controls that con tain other data-bound controls. The most significant aspect of this class is that it implements the *INamingContainer* interface, which means that an inheritor of this class is a naming container for its child controls.

The classes that inherit from *CompositeDataBoundControl* are *FormsView*, *DetailsView*, and *GridView*, as shown in Figure 3-38. These controls are introduced in this lesson and will be further discussed as they are used with ADO.NET in Chapter 4, “Using ADO.NET and XML with ASP.NET.”

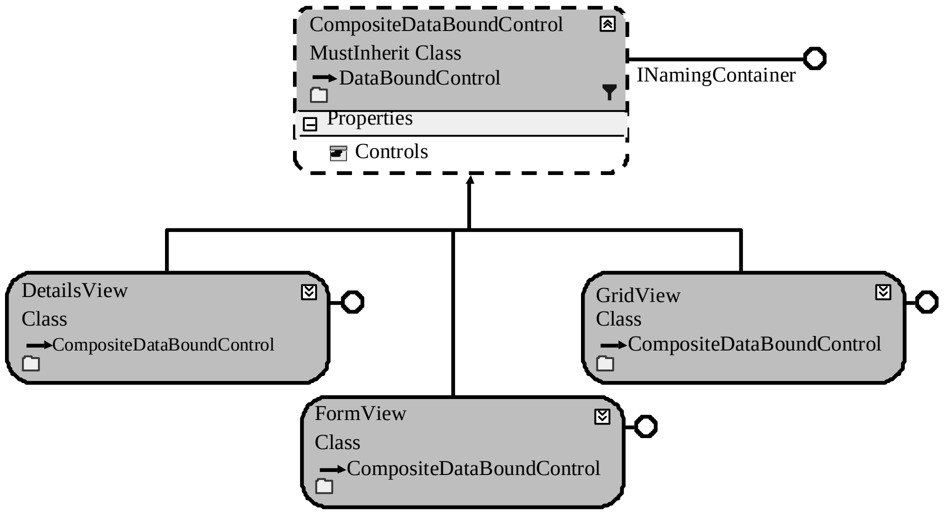


Figure 3-38 The *CompositeDataBoundControl* class hierarchy.

The *GridView* Control

The *GridView* control is used to display data in a tabular, rows-and-columns format. The *GridView* renders in the browser as an HTML table. The *GridView* control makes it easy to configure features such as paging, sorting, and editing without having to write much, if any, code. The *GridView* class hierarchy is shown in Figure 3-39.

NOTE .NET 2.0

The *GridView* is new in ASP.NET version 2.0.

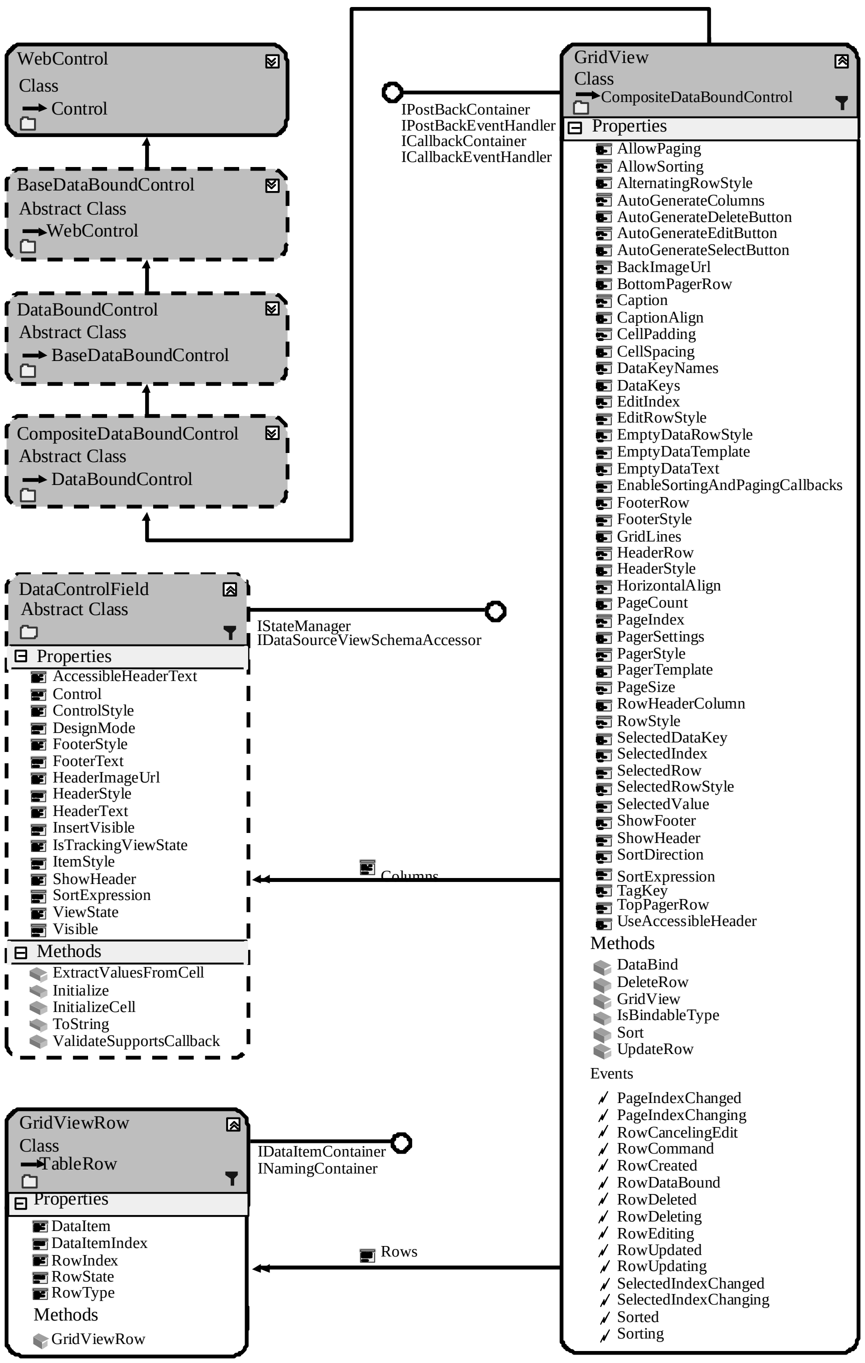


Figure 3-39 The *GridView* class hierarchy.

The basic structure of the *GridView* is shown in Figure 3-40. The *GridView* control con sists of a collection of *GridViewRow* (row) objects and a collection of *DataControlField* (column) objects. The *GridViewRow* object inherits from the *TableRow* object, which contains the *Cells* property, which is a collection of *DataControlFieldCell* objects.

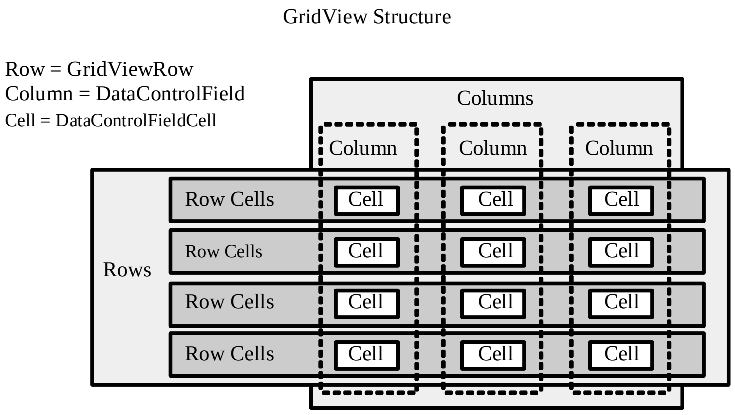


Figure 3-40 The basic *GridView* control structure.

Although the *GridViewRow* object holds the collection of cells, each *DataControl-Field* (column) object provides the behavior to initialize cells of a specific type in the *DataControlField* object's *InitializeCell* method. The column classes that inherit from *DataControlField* override the *InitializeCell* method. The *GridView* control has an *InitializeRow* method that is responsible for creating a new *GridViewRow* and the row's cells by making calls to the overridden *InitializeCell* method when the row is being created.

The *DataControlField* class hierarchy is shown in Figure 3-41. The derived classes are used to create a *DataControlFieldCell* with the proper contents. Remember that you don't define cell types for your *GridView* control; you define column types and your column object supplies a cell object to the row using the *InitializeCell* method.

The *DataControlField* class hierarchy shows the different column types that are avail able in a *GridView* control.

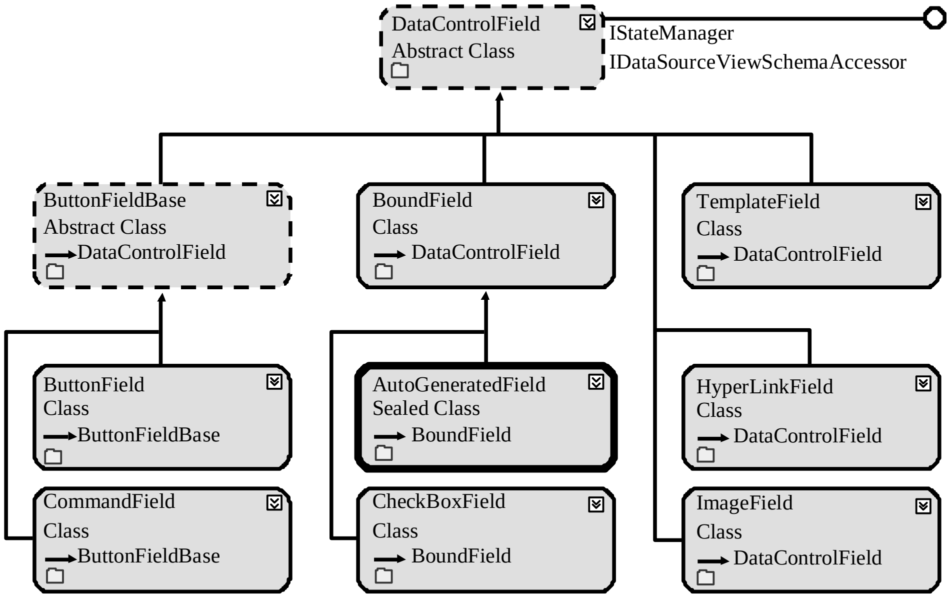


Figure 3-41 The *DataControlField* class hierarchy.

Using Styles to Format the *GridView* Control

You use styles to format the *GridView*. Figure 3-42 shows the style hierarchy. The *Row-Created* and *RowDataBound* events can be used to control the style programmatically. In either of these event handlers, the *Cells* collection on the newly created row can be used to apply a style to a single cell in the row. The difference between the two events is that the *RowCreated* event takes place first, but the data is not available at this time. You can use the *RowDataBound* event when you need to apply a different style to a cell based on the data in the cell. These events fire after the styles are applied, which means you can override any existing styles. Applying a different style to a cell based on the data in the cell allows you to apply business rules to determine whether a cell should stand out from other cells (such as making negative “quantity on hand” num bers red, but only when an item is shipped more than once per month).

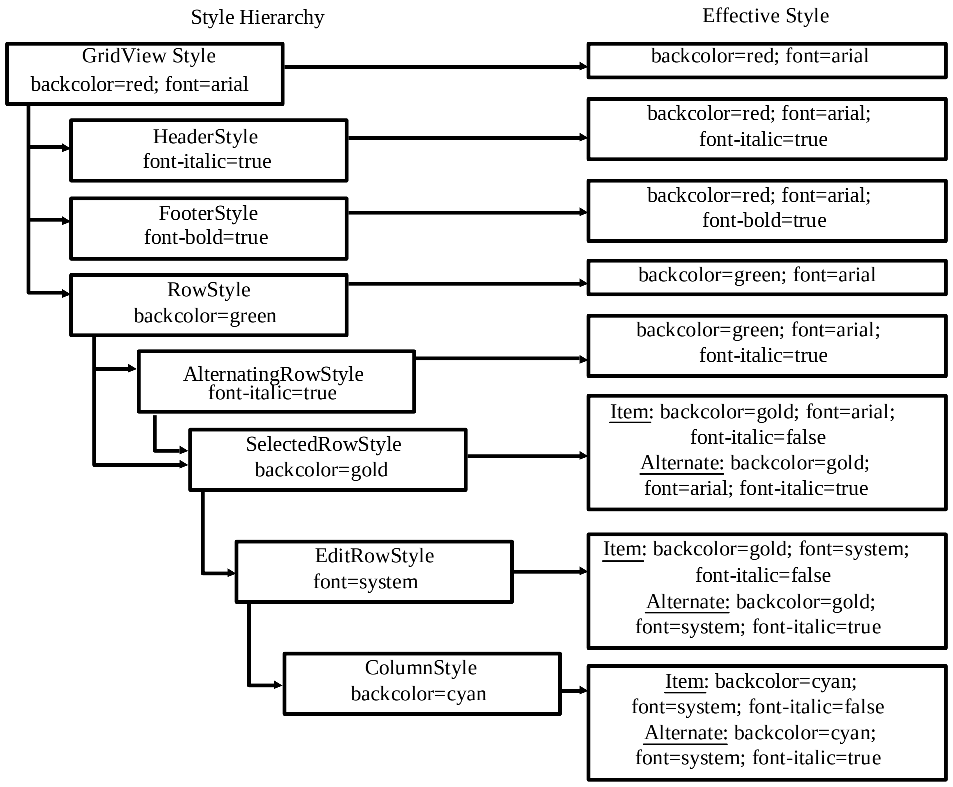

Style Hierarchy
Effective Style
GridView Style
backcolor=red; font=arial
HeaderStyle
font-italic=true
FooterStyle
font-bold=true
RowStyle
backcolor=green
AlternatingRowStyle
font-italic=true
SelectedRowStyle
backcolor=gold
EditRowStyle
font=system
ColumnStyle
backcolor=cyan
backcolor=red; font=arial
backcolor=red; font=arial; font-italic=true
backcolor=red; font=arial; font-bold=true
backcolor=green; font=arial
backcolor=green; font=arial; font-italic=true
Item: backcolor=gold; font=arial; font-italic=false
Alternate: backcolor=gold; font=arial; font-italic=true
Item: backcolor=gold; font=system; font-italic=false
Alternate: backcolor=gold; font=system; font-italic=true
Item: backcolor=cyan; font=system; font-italic=false
Alternate: backcolor=cyan; font=system; font-italic=true

Figure 3-42 The *GridView* style hierarchy.

The following is an example of using the *GridView* with an *ObjectDataSource* to browse and edit data. This example uses a newly created class called *CarList* to connect to the *ObjectDataSource* control. The *CarList* class file is added and the code is as follows:

```
'VB
Imports Microsoft.VisualBasic
Imports System.Collections.Generic

Public Class CarList

    Private Shared carList As List(Of Car)

    Public Shared Sub Initialize()
      carList = Car.GetList()
    End Sub
    Public Function [Select]() As List(Of Car)
        Return carList
    End Function

    Public Sub Update(ByVal updateCar As Car)
        current = updateCar
        Dim carFound As Car = carList.Find(AddressOf MatchId)
        carFound.Make = updateCar.Make
        carFound.Model = updateCar.Model
        carFound.Year = updateCar.Year
        carFound.Price = updateCar.Price
    End Sub

    Private current As Car
    Private Function MatchId(ByVal _car As Car) As Boolean
        Return IIf(current.Vin = _car.Vin, True, False)
    End Function

    Public Sub Insert(ByVal _car As Car)
        carList.Add(_car)
    End Sub

    Public Sub Delete(ByVal deleteCar As Car)
        current = deleteCar
        Dim carFound As Car = carList.Find(AddressOf MatchId)
        carList.Remove(carFound)
    End Sub

    Public Function Count() As Integer
        Return carList.Count
    End Function
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
//added
using System.Collections.Generic;

/// <summary>
/// Summary description for EmployeeList
/// </summary>
public class CarList
{
    private static List<Car> carList;
public static void Initialize()
{
    carList = Car.GetList();
}

    public List<Car> Select()
    {
      return carList;
    }

    public void Update(Car updateCar)
    {
      Car carFound = carList.Find(
            delegate(Car car) { return car.Vin == updateCar.Vin; });
      carFound.Make = updateCar.Make;
      carFound.Model = updateCar.Model;
      carFound.Year = updateCar.Year;
      carFound.Price = updateCar.Price;
    }

    public void Insert(Car car)
    {
      carList.Add(car);
    }

    public void Delete(Car deleteCar)
    {
      Car carFound = carList.Find(
            delegate(Car car) { return car.Vin == deleteCar.Vin; });
      carList.Remove(carFound);
    }

    public int Count()
    {
      return carList.Count;
    }
}
```

A *GridView* control, *ObjectDataSource*, and *Button* are added to a Web page. The *Object-DataSource* is configured to use the *CarList* as its data source. The *GridView* control is configured to use the *ObjectDataSource* as its data source. The *Button* is used to popu late the *CarList* with sample data because the *GridView* control does not natively sup port the ability to add to the data source. The following is the declarative markup for the Web page form element that works with VB.NET and C#:

ASPX Declarative Markup

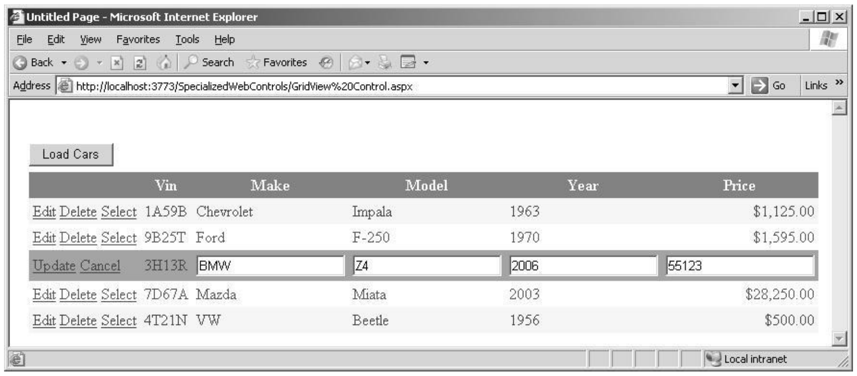
```
<form id="form1" runat="server">
    <div>
      <asp:ObjectDataSource ID="ObjectDataSource1" runat="server"
            DataObjectTypeName="Car" TypeName="CarList"
            SelectMethod="Select" UpdateMethod="Update"
            DeleteMethod="Delete" InsertMethod="Insert">
            <InsertParameters>
                <asp:Parameter Name="vin" Type="String" />
                <asp:Parameter Name="make" Type="String" />
                <asp:Parameter Name="model" Type="String" />
                <asp:Parameter Name="year" Type="Int32" />
                <asp:Parameter Name="price" Type="Decimal" />
            </InsertParameters>
        </asp:ObjectDataSource>
        <asp:GridView ID="GridView1" runat="server"
            Style="z-index: 100; left: 20px; position: absolute; top: 75px"
            AllowPaging="True" AutoGenerateColumns="False"
            DataSourceID="ObjectDataSource1" Width="135px" CellPadding="4"
            DataKeyNames="Vin" ForeColor="#333333" GridLines="None">
            <Columns>
                <asp:CommandField ShowDeleteButton="True"
                  ShowEditButton="True" ShowSelectButton="True" />
                <asp:BoundField DataField="Vin" HeaderText="Vin"
                  SortExpression="Vin" ReadOnly="True" />
                <asp:BoundField DataField="Make" HeaderText="Make"
                  SortExpression="Make" />
                <asp:BoundField DataField="Model" HeaderText="Model"
                  SortExpression="Model" />
                <asp:BoundField DataField="Year" HeaderText="Year"
                  SortExpression="Year" />
                <asp:BoundField DataField="Price" DataFormatString="{0:C}"
                  HeaderText="Price" HtmlEncode="False"
                  SortExpression="Price">
                  <ItemStyle HorizontalAlign="Right" />
                </asp:BoundField>
            </Columns>
            <FooterStyle BackColor="#5D7B9D" Font-Bold="True"
                ForeColor="White" />
            <RowStyle BackColor="#F7F6F3" ForeColor="#333333" />
            <EditRowStyle BackColor="#999999" />
            <SelectedRowStyle BackColor="#E2DED6" Font-Bold="True"
                ForeColor="#333333" />
            <PagerStyle BackColor="#284775" ForeColor="White"
                HorizontalAlign="Center" />
            <HeaderStyle BackColor="#5D7B9D" Font-Bold="True"
                ForeColor="White" />
            <AlternatingRowStyle BackColor="White" ForeColor="#284775" />
        </asp:GridView>
        &nbsp; &nbsp;
        <asp:Button ID="Button1" runat="server" OnClick="Button1_Click"
            Style="z-index: 102; left: 20px; position: absolute; top: 45px"
            Text="Load Cars" />
    </div>
</form>
```

In the declarative markup, the *ObjectDataSource* is configured to use the *CarList* class, which is a collection of *Car* objects. The *GridView* is configured to allow editing, delet ing, and selecting *Car* rows. The *Vin* property is configured to display as read-only, and the *Price* property is configured to be right-aligned and display as currency.

The code-behind page only contains code to populate the car list when the *Button* con trol is clicked, as follows:

```
'VB
Partial Class GridView_Control
    Inherits System.Web.UI.Page

    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
        CarList.Initialize()
        GridView1.DataBind()
    End Sub

End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class GridView_Control : System.Web.UI.Page
{
    protected void Button1_Click(object sender, EventArgs e)
    {
        CarList.Initialize();
        GridView1.DataBind();
    }
}
```

When this Web page is executed and displayed, the Web page displays only the *Button* control. Click the *Button* to populate the *CarList* collection and display the contents in the *GridView*. Click the Edit link on one of the rows to place the row into edit mode, as shown in Figure 3-43.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3773/SpecializedWebControls/GridView%20Control.aspx
Go Links
Load Cars
Local intranet

	Vin	Make	Model	Year	Price
Edit Delete Select	1A59B	Chevrolet	Impala	1963	$1,125.00
Edit Delete Select	9B25T	Ford	F-250	1970	$1,595.00
Update Cancel	3H13R	BMW	Z4	2006	55123
Edit Delete Select	7D67A	Mazda	Miata	2003	$28,250.00
Edit Delete Select	4T21N	VW	Beetle	1956	$500.00

Figure 3-43 The *GridView* control in edit mode is populated from an *ObjectDataSource* and *CarList* object.

The *DetailsView* Control

The *DetailsView* control is used to display the values of a single record from a data source in an HTML table, where each table row represents a field of the record. The *DetailsView* control allows you to edit, delete, and insert records. If the *AllowPaging* property is set to *true*, the *DetailsView* can be used by itself to navigate the data source, but the *DetailsView* can also be used in combination with other controls, such as the *GridView*, *ListBox*, or *DropDownList*, for scenarios in which you want to display a mas ter detail. The *DetailsView* class hierarchy is shown in Figure 3-44.

NOTE .NET 2.0

The *DetailsView* is new in ASP.NET version 2.0.

The *DetailsView* does not support sorting, whereas the *GridView* does. The *GridView* does not support inserting new records, whereas the *DetailsView* does.

The *DetailsView* supports the same formatting options that are available with the *Grid-View* control. You can format the *DetailsView* control using the *HeaderStyle*, *RowStyle*, *AlternatingRowStyle*, *CommandRowStyle*, *FooterStyle*, *PagerStyle*, and *EmptyDataRowStyle* properties.

The following is an example of using the *DetailsView* to display the *CarList* collection that was defined in the previous *GridView* example. This example is very much like the *GridView* example, but the *DetailsView* control is used instead, so you can easily see the differences between the controls.

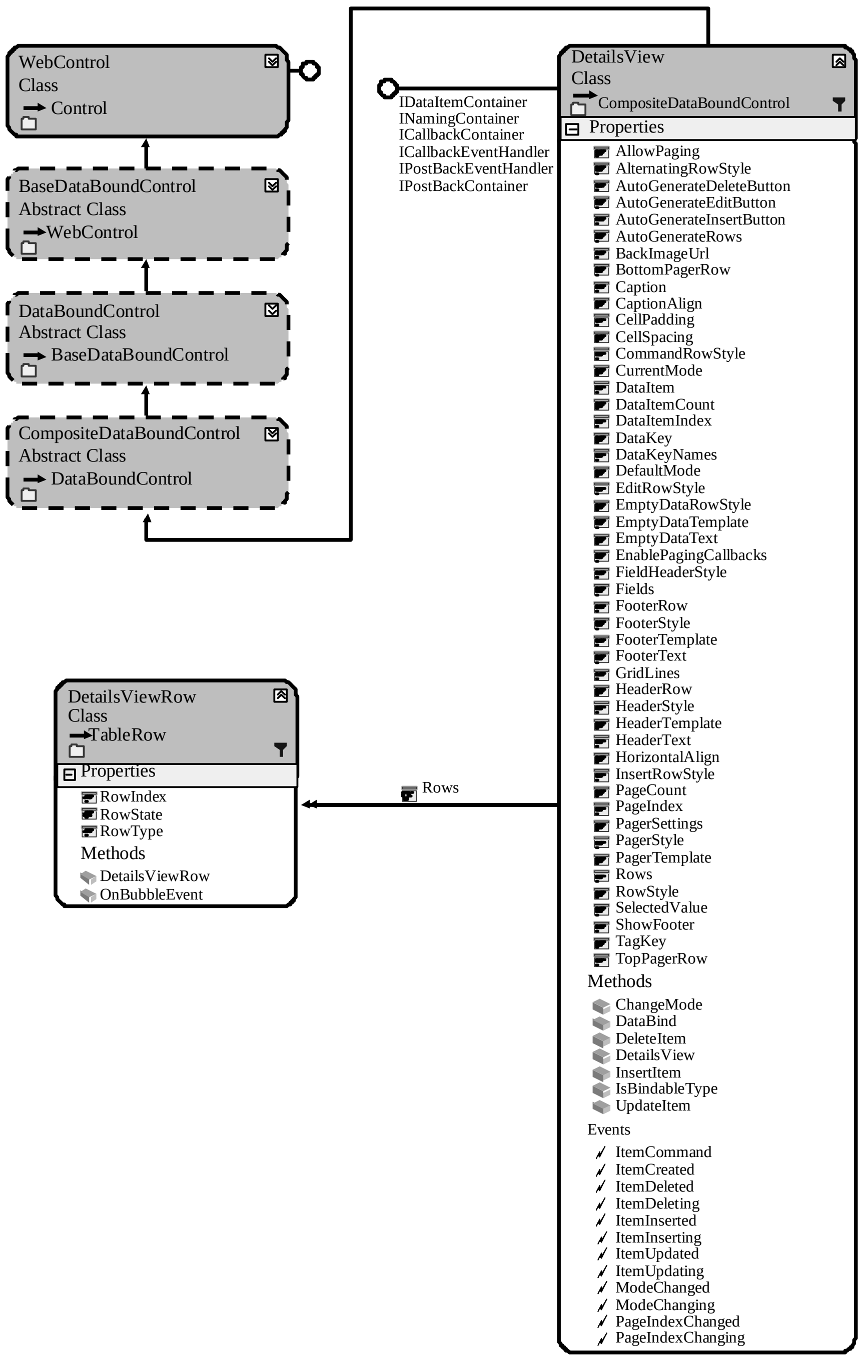


Figure 3-44 The *DetailsView* class hierarchy.

The code for the *CarList* class must be added as shown in the previous *GridView* example. A *DetailsView*, *ObjectDataSource*, and *Button* control are added to the Web page and configured. The following is the Web page markup, showing everything inside the form element:

ASPX Declarative Markup

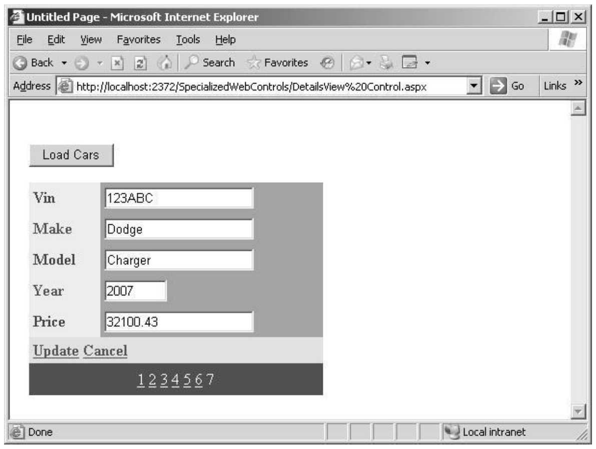
```
<form id="form1" runat="server">
    <div>
      <asp:ObjectDataSource ID="ObjectDataSource1" runat="server"
              DataObjectTypeName="Car" TypeName="CarList"
              SelectMethod="Select" UpdateMethod="Update"
              DeleteMethod="Delete" InsertMethod="Insert">
      </asp:ObjectDataSource>
      <asp:Button ID="Button1" runat="server" OnClick="Button1_Click"
              Style="z-index: 101; left: 20px; position: absolute; top: 45px"
              Text="Load Cars" />
      <asp:DetailsView ID="DetailsView1" runat="server"
              AllowPaging="True" CellPadding="4"
              DataSourceID="ObjectDataSource1" ForeColor="#333333"
              GridLines="None" Height="50px"
              Style="z-index: 103; left: 20px;
                    position: absolute; top: 85px" Width="305px"
              AutoGenerateRows="False" DataKeyNames="Vin">
              <FooterStyle BackColor="#5D7B9D" Font-Bold="True"
                    ForeColor="White" />
              <CommandRowStyle BackColor="#E2DED6" Font-Bold="True" />
              <EditRowStyle BackColor="#999999" />
              <RowStyle BackColor="#F7F6F3" ForeColor="#333333" />
              <PagerStyle BackColor="#284775" ForeColor="White"
                    HorizontalAlign="Center" />
              <Fields>
                    <asp:BoundField DataField="Vin" HeaderText="Vin"
                      SortExpression="Vin" ReadOnly="True" />
                    <asp:BoundField DataField="Make" HeaderText="Make"
                      SortExpression="Make" />
                    <asp:BoundField DataField="Model" HeaderText="Model"
                      SortExpression="Model" />
                    <asp:BoundField DataField="Year" HeaderText="Year"
                      SortExpression="Year" />
                    <asp:BoundField DataField="Price" HeaderText="Price"
                      SortExpression="Price" DataFormatString="{0:C}"
                      HtmlEncode="False" >
                      <ItemStyle HorizontalAlign="Right" />
                    </asp:BoundField>
                    <asp:CommandField ShowDeleteButton="True"
                      ShowEditButton="True" ShowInsertButton="True" />
              </Fields>
              <FieldHeaderStyle BackColor="#E9ECF1" Font-Bold="True" />
              <HeaderStyle BackColor="#5D7B9D" Font-Bold="True"
                    ForeColor="White" />
              <AlternatingRowStyle BackColor="White" ForeColor="#284775" />
    </asp:DetailsView>
  </div>
</form>
```

In the declarative markup, the *ObjectDataSource* is configured to use the *CarList* class, which is a collection of *Car* objects. The *DetailsView* is configured to allow editing, deleting, and inserting *Car* rows. The *Vin* property is configured to display as read-only, and the *Price* property is configured to be right-aligned and displayed as cur rency.

The code-behind page only contains code to populate the car list when the *Button* con trol is clicked, as follows:

```
'VB
Partial Class DetailsView_Control
    Inherits System.Web.UI.Page

  Protected Sub Button1_Click(ByVal sender As Object, _
          ByVal e As System.EventArgs) Handles Button1.Click
    CarList.Initialize()
    DetailsView1.DataBind()
  End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class DetailsView_Control : System.Web.UI.Page
{
  protected void Button1_Click(object sender, EventArgs e)
  {
    CarList.Initialize();
    DetailsView1.DataBind();
  }
}
```

When this Web page is executed and displayed, the Web page displays only the *Button* control unless you have already populated the *CarList*. Click the *Button* to populate the *CarList* collection and display the contents in the *DetailsView*. Click the New link on the bottom of the control to add a new row and place the row into edit mode, as shown in Figure 3-45.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/DetailsView%20Control.aspx Go Links
Load Cars
Done
Local intranet

Vin 123ABC
Make Dodge
Model Charger
Year 2007
Price 32100.43
Update Cancel
1 2 3 4 5 6 7

Figure 3-45 The *DetailsView* control in edit mode after clicking the New link is populated from an *ObjectDataSource* and *CarList* object.

The *FormView* Control

Like the *DetailsView*, the *FormView* control is used to display a single record from a data source, except that it displays user-defined templates instead of row fields. Dif ferent user-defined templates can be assigned for viewing, editing, and updating records. Creating your own templates gives you the greatest flexibility in controlling how the data is displayed. Figure 3-46 shows the *FormView* class hierarchy.

NOTE .NET 2.0

The *FormView* is new in ASP.NET version 2.0.

Although the *FormView* control gives you the greatest flexibility when choosing whether to use the *GridView*, *DetailsView*, or *FormView*, you have the most work to do when setting up the *FormView*, so you should take a close look at the *GridView* and *DetailsView* before choosing this control.

The following is an example of using the *FormView* control to display the *CarList* col lection that was defined in the previous *GridView* example. This example is very much like the *DetailsView* example, but the *FormView* control is used instead, which allows you to compare the *GridView*, *DetailsView*, and *FormView* controls.

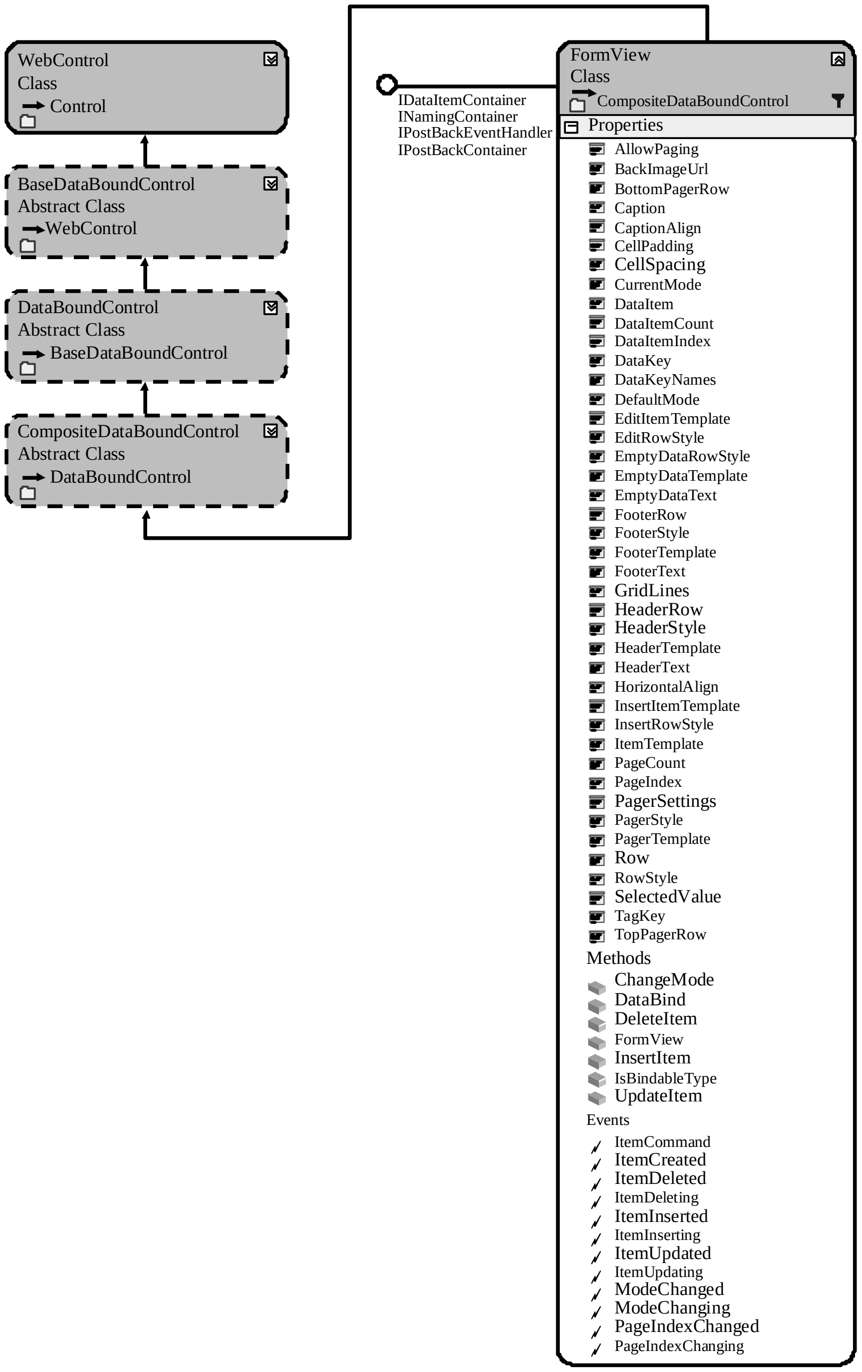


Figure 3-46 The *FormView* class hierarchy.

The code for the *CarList* class must be added as shown in the prior *GridView* example. A *FormView*, *ObjectDataSource*, and *Button* control are added to the Web page and con figured. The following is the Web page markup, showing everything inside the form element:

ASPX Declarative Markup

```
<form id="form1" runat="server">
     <div>
       <asp:ObjectDataSource ID="ObjectDataSource1" runat="server"
              DataObjectTypeName="Car" TypeName="CarList"
              SelectMethod="Select" UpdateMethod="Update"
              DeleteMethod="Delete" InsertMethod="Insert">
       </asp:ObjectDataSource>
       <br /> <br /> <br /> &nbsp; &nbsp; &nbsp; &nbsp;
       <asp:Button ID="Button1" runat="server" OnClick="Button1_Click"
              Style="z-index: 101; left: 20px; position: absolute; top: 45px"
              Text="Load Cars" />
     </div>
     <asp:FormView ID="FormView1" runat="server" AllowPaging="True"
       DataKeyNames="Vin" DataSourceID="ObjectDataSource1"
       Width="100%">
       <ItemTemplate>
             <table>
             <tr ><td align="center"><hr />
              <span style="font-weight: bold; color: blue">VIN:</span>&nbsp;
              <asp:Label ID="VinLabel"  Width="105px" runat="server"
                    Text='<%# Eval("Vin") %>'>
              </asp:Label>&nbsp;&nbsp;
              <span style="font-weight: bold; color: blue">Make:</span>&nbsp;
              <asp:Label ID="MakeLabel" Width="105px" runat="server"
                    Text='<%# Eval("Make") %>'>
              </asp:Label>&nbsp;&nbsp;
              <span style="font-weight: bold; color: blue">Model:</span>&nbsp;
              <asp:Label ID="ModelLabel" Width="105px" runat="server"
                    Text='<%# Eval("Model") %>'>
              </asp:Label>&nbsp;&nbsp;
             <span style="font-weight: bold; color: blue">Year:</span>&nbsp;
              <asp:Label ID="YearLabel" Width="105px" runat="server"
                    Text='<%# Eval("Year") %>'>
              </asp:Label><br /></td></tr>
              <tr ><td align="center">
              <span style="font-weight: bold; font-size: x-large; color: blue">
                    Price: </span>
              <span style="font-weight: bold; font-size: x-large">&nbsp;
              <asp:Label   ID="PriceLabel"  Width="105px"  runat="server"
                    Text='<%# Eval("Price","{0:C}") %>'>
              </asp:Label></span></td></tr>
              <tr><td align="center"><hr />
                    <asp:LinkButton ID="LinkButton1" runat="server"
                      CausesValidation="False" CommandName="Edit" Text="Edit">
                    </asp:LinkButton>
```

```
                <asp:LinkButton ID="LinkButton2" runat="server"
                  CausesValidation="False" CommandName="New" Text="New">
                </asp:LinkButton>
                <asp:LinkButton ID="LinkButton3" runat="server"
                  CausesValidation="False" CommandName="Delete" Text="Delete">
                </asp:LinkButton> </td></tr> </table>
</ItemTemplate>
<EditItemTemplate>
        <table>
        <tr><td align="center"><hr />
         <span style="font-weight: bold; color: blue">VIN:</span>&nbsp;
         <asp:Label ID="VinLabel"  Width="105px" runat="server"
                Text='<%# Eval("Vin") %>'>
         </asp:Label>&nbsp;&nbsp;
         <span style="font-weight: bold; color: blue">Make:</span>&nbsp;
         <asp:TextBox ID="EditMakeTextBox" Width="100px" runat="server"
                Text='<%# Bind("Make") %>'>
         </asp:TextBox>&nbsp;&nbsp;
         <span style="font-weight: bold; color: blue">Model:</span>&nbsp;
         <asp:TextBox ID="EditModelTextBox" Width="100px" runat="server"
                Text='<%# Bind("Model") %>'>
         </asp:TextBox>&nbsp;&nbsp;
         <span style="font-weight: bold; color: blue">Year:</span>&nbsp;
         <asp:TextBox ID="EditYearTextBox" Width="100px" runat="server"
                Text='<%# Bind("Year") %>'>
         </asp:TextBox><br />&nbsp;&nbsp; </td></tr>
         <tr><td align="center">
         <span style="font-weight: bold; font-size: large; color: blue">
                Price: </span>
         <span style="font-weight: bold; font-size: large">&nbsp;
         <asp:TextBox ID="EditPriceTextBox" Width="100px" runat="server"
                Text='<%# Bind("Price") %>'>
         </asp:TextBox></span></td></tr>
         <tr><td align="center"><hr />
          <asp:LinkButton ID="LinkButton1" runat="server"
                 CausesValidation="True" CommandName="Update" Text="Update">
          </asp:LinkButton>
          <asp:LinkButton ID="LinkButton2" runat="server"
                 CausesValidation="False" CommandName="Cancel" Text="Cancel">
          </asp:LinkButton></td></tr></table>
</EditItemTemplate>
<EmptyDataTemplate>
        <table width="655px">
        <tr><td align="center" ><hr />
         <span style="font-weight: bold; font-size: x-large; color: blue">
                No Cars For Sale - Chack Back Soon! </span>
         <tr><td align="center"><hr />
                <asp:LinkButton ID="LinkButton2" runat="server"
                  CausesValidation="False" CommandName="New" Text="New">
                </asp:LinkButton></td></tr></table>
</EmptyDataTemplate>
<InsertItemTemplate>
         <table>
```

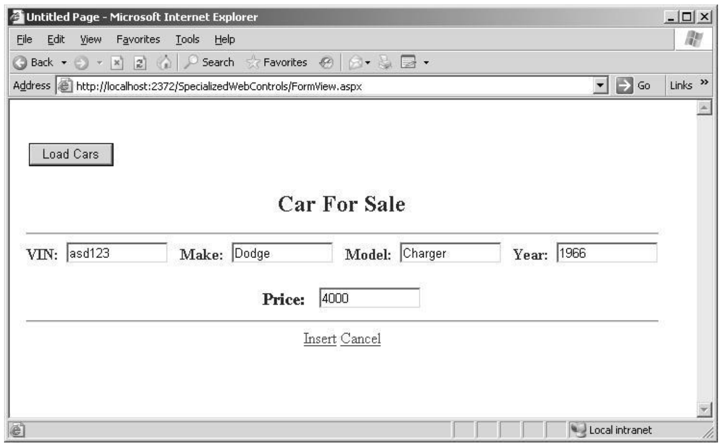
```
             <tr><td align="center"><hr />
             <span style="font-weight: bold; color: blue">VIN:</span>&nbsp;
             <asp:TextBox ID="InsertVinTextBox" Width="100px" runat="server"
                   Text='<%# Bind("Vin") %>'>
             </asp:TextBox>&nbsp;&nbsp;
             <span style="font-weight: bold; color: blue">Make:</span>&nbsp;
             <asp:TextBox ID="InsertMakeTextBox" Width="100px" runat="server"
                   Text='<%# Bind("Make") %>'>
             </asp:TextBox>&nbsp;&nbsp;
             <span style="font-weight: bold; color: blue">Model:</span>&nbsp;
             <asp:TextBox ID="InsertModelTextBox" Width="100px" runat="server"
                   Text='<%# Bind("Model") %>'>
             </asp:TextBox>&nbsp;&nbsp;
             <span style="font-weight: bold; color: blue">Year:</span>&nbsp;
             <asp:TextBox ID="InsertYearTextBox" Width="100px" runat="server"
                   Text='<%# Bind("Year") %>'>
             </asp:TextBox><br />&nbsp;&nbsp; </td></tr>
             <tr><td align="center">
             <span style="font-weight: bold; font-size: large; color: blue">
               Price: </span>
             <span style="font-weight: bold; font-size: large">&nbsp;
               <asp:TextBox ID="InsertPriceTextBox" Width="100px" runat="server"
                     Text='<%# Bind("Price") %>'></asp:TextBox></span></td></tr>
             <tr><td align="center"><hr />
               <asp:LinkButton ID="LinkButton1" runat="server"
                     CausesValidation="True" CommandName="Insert" Text="Insert">
               </asp:LinkButton>
               <asp:LinkButton ID="LinkButton2" runat="server"
                     CausesValidation="False" CommandName="Cancel" Text="Cancel">
               </asp:LinkButton></td></tr></table>
      </InsertItemTemplate>
      <HeaderTemplate>
             <table><tr><td align="center">
             <span style="font-weight: bold; font-size: x-large; color: blue">
               Car For Sale</span></td></tr>
             <tr><td>
      </HeaderTemplate>
      <FooterTemplate>
             </td></tr></table>
      </FooterTemplate>
    </asp:FormView>
    &nbsp;&nbsp;&nbsp;&nbsp;&nbsp;&nbsp;<br />
</form>
```

In the declarative markup, the *ObjectDataSource* is configured to use the *CarList* class, which is a collection of *Car* objects. The *FormView* control is configured to allow edit ing, deleting, and inserting *Car* rows. The *Vin* property is configured to display as read-only when editing, and the *Price* property is configured to display as currency. To show that you have lots of flexibility using templates with this control, the header, footer, item, edit item, insert item, and empty data templates are configured.

The code-behind page only contains code to populate the car list when the *Button* con trol is clicked, as follows:

```
'VB
Partial Class FormView_Control
    Inherits System.Web.UI.Page

    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
        CarList.Initialize()
        FormView1.DataBind()
    End Sub

End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class FormView : System.Web.UI.Page
{
    protected void Button1_Click(object sender, EventArgs e)
    {
        CarList.Initialize();
        FormView1.DataBind();
    }
}
```

When this Web page is executed and displayed, the Web page displays the *Button* con trol and the empty data template unless you have already populated the *CarList*. Click the *Button* to populate the *CarList* collection and display the contents in the *FormView*, using the item template. Click the New link on the bottom of the control to add a new row and place the row into edit mode, as shown in Figure 3-47.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/FormView.aspx
Go Links
Load Cars
Local intranet

Car For Sale

VIN: asd123 Make: Dodge Model: Charger Year: 1966

Price: 4000

Insert Cancel

Figure 3-47 The *FormView* control in edit mode after clicking the New link is populated from an *ObjectDataSource* and *CarList* object.

The *HierarchicalDataBoundControl* Control

The *HierarchicalDataBoundControl* control serves as a base class for controls that ren der data in a hierarchical fashion. The classes that inherit from *HierarchicalDataBound-Control* are *TreeView* and *Menu*, as shown in Figure 3-48.

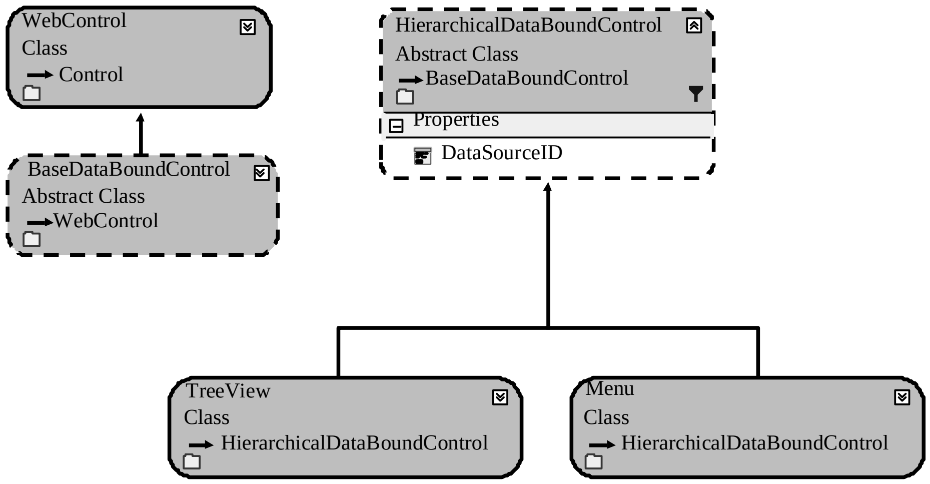


Figure 3-48 The *HierarchicalDataBoundControl* class hierarchy.

The *TreeView* Control

The *TreeView* is a data-bound control that is used to display hierarchical data, such as a listing of files and folders, or a table of contents in a tree structure. The nodes of this control can be bound to XML, tabular, or relational data. This control can also provide site navigation when used with the *SiteMapDataSource* control. The *TreeView* control class hierarchy is shown in Figure 3-49.

NOTE .NET 2.0

The *TreeView* is new in ASP.NET version 2.0.

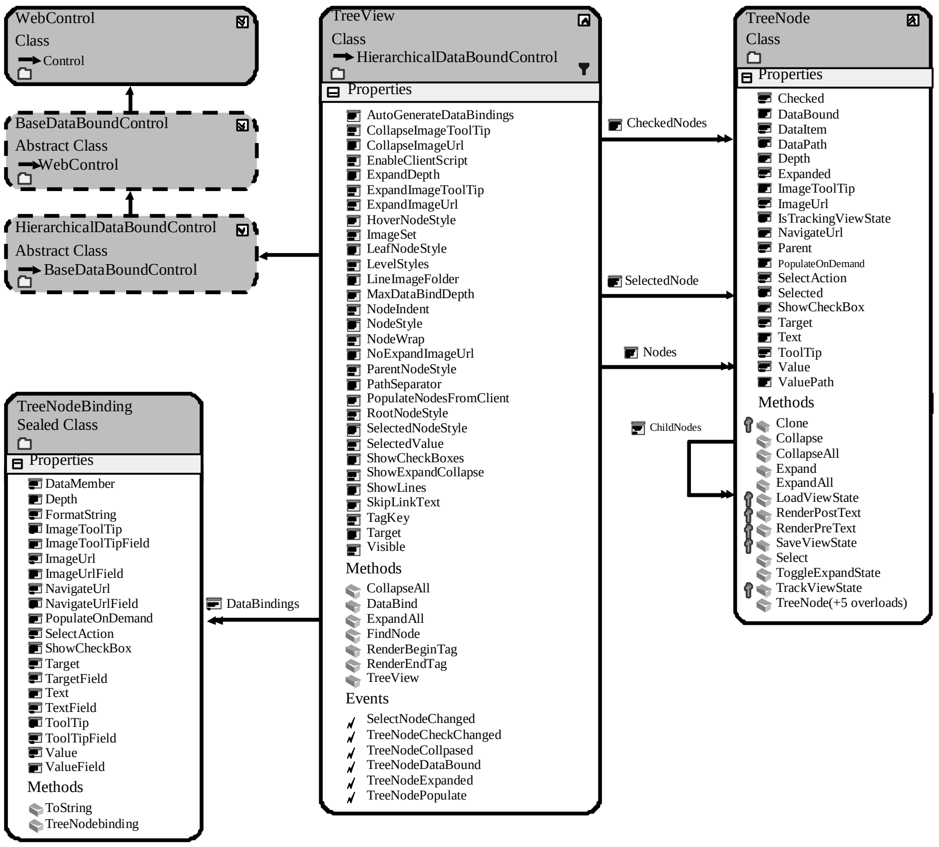


Figure 3-49 The *TreeView* control hierarchy.

You can programmatically access and control the properties of the *TreeView* control. The *TreeView* can also be populated via client-side script on Internet Explorer 5.0 and later, and on Netscape 6.0 and later. In addition, nodes can be displayed as either plain text or hyperlinks, and you can optionally display a check box next to each node.

Each entry in the tree is called a node and is represented by a *TreeNode* object. A node that contains other nodes is called a *parent node*. A node that is contained by another node is called a *child node*. A node can be a parent node and a child node. A node that has no children is called a *leaf node*. A node that is not contained by any other node but is the ancestor to all the other nodes is the *root node*.

The typical *TreeView* tree structure has only one root node, but you can add multiple root nodes to the tree structure. This means that you can display a tree hierarchy with out being forced to have a single root node.

The *TreeNode* has a *Text* property that is populated with the data that is to be dis played. The *TreeNode* also has a *Value* property that is used to store the data that is posted back to the Web server.

A node can be configured to be a selection node or a navigation node by setting the *NavigateUrl* property. If the *NavigateUrl* property is set to an empty string (*string.Empty*), it is a selection node, where clicking the node simply selects it. If the *NavigateUrl* property is not set to an empty string, it is a navigation node, where click ing the node attempts to navigate to the location that is specified by the *NavigateUrl* property.

Populating the *TreeView* Control

The *TreeView* control can be populated using static data or by data binding to the control. To populate the *TreeView* control with static data, you can use declarative syntax by placing opening and closing *<Nodes>* tags in the *TreeView* element, and then creating a structure of nested *<asp:TreeNode>* elements within the *<Nodes>* element. Each *<asp:TreeNode>* has properties that you can set by adding attributes to the *<asp:TreeNode>* element.

To use data binding to populate the *TreeView* control, you can use any data source that implements the *IHierarchicalDataSource* interface, such as an *XmlDataSource* control or a *SiteMapDataSource* control. Simply set the *DataSourceID* property of the *TreeView* control to the ID value of the data source control, and the *TreeView* control automati cally binds to the specified data source control.

You can also bind to an *XmlDocument* object or a *DataSet* object that contains *DataRelation* objects by setting the *DataSource* property of the *TreeView* control to the data source, and then calling the *DataBind* method.

The *TreeView* control contains a *DataBindings* property that is a collection of *TreeNodeBinding* objects that define the binding between a data item and the *TreeNode*. You can specify the criteria for binding and the data item property to display in the node. This is useful when binding to XML elements where you are interested in binding to an attribute of the element.

Security Alert The *TreeView* control performs client-side JavaScript callbacks when expanding nodes. A malicious user can craft a callback to get *TreeView* data that you may have tried to hide using the *MaxDataBindDepth* property, so don't use the *MaxDataBindDepth* as a means to hide sen sitive data.

The following is an example of using the *TreeView* control to display customer data from a new file called Customers.xml, which contains a list of customers, their orders and invoices, and the order items for each order. This data is stored in a hierarchical format in the XML file. The Customers.xml file looks like the following:

Customers.xml File

```
<?xml version="1.0" encoding="utf-8" ?>
<Customers>
   <Customer CustomerId="1" Name="Northwind Traders">
    <Orders>
        <Order OrderId="1" ShipDate="06-22-2006">
            <OrderItems>
              <OrderItem OrderItemId="1" PartNumber="123"
                  PartDescription="Large Widget" Quantity="5"
                  Price="22.00" />
              <OrderItem OrderItemId="2" PartNumber="234"
                  PartDescription="Medium Widget" Quantity="2"
                  Price="12.50" />
            </OrderItems>
        </Order>
        <Order OrderId="2" ShipDate="06-25-2006">
            <OrderItems>
              <OrderItem OrderItemId="5" PartNumber="432"
                  PartDescription="Small Widget" Quantity="30"
                  Price="8.99" />
              <OrderItem OrderItemId="4" PartNumber="234"
                  PartDescription="Medium Widget" Quantity="2"
                  Price="12.50" />
            </OrderItems>
        </Order>
    </Orders>
```

```
      <Invoices>
            <Invoice InvoiceId="6" Amount="99.37" />
            <Invoice InvoiceId="7" Amount="147.50" />
      </Invoices>
    </Customer>
    <Customer CustomerId="2" Name="Tailspin Toys">
      <Orders>
            <Order OrderId="8" ShipDate="07-11-2006">
                  <OrderItems>
                    <OrderItem OrderItemId="9" PartNumber="987"
                          PartDescription="Combo Widget" Quantity="2"
                          Price="87.25" />
                    <OrderItem OrderItemId="10" PartNumber="654"
                          PartDescription="Ugly Widget" Quantity="1"
                          Price="2.00" />
                  </OrderItems>
            </Order>
            <Order OrderId="11" ShipDate="08-21-2006">
                  <OrderItems>
                    <OrderItem OrderItemId="12" PartNumber="999"
                          PartDescription="Pretty Widget" Quantity="50"
                          Price="78.99" />
                    <OrderItem OrderItemId="14" PartNumber="575"
                          PartDescription="Tiny Widget" Quantity="100"
                          Price="1.20" />
                  </OrderItems>
            </Order>
      </Orders>
      <Invoices>
            <Invoice InvoiceId="26" Amount="46.58" />
            <Invoice InvoiceId="27" Amount="279.15" />
      </Invoices>
    </Customer>
</Customers>
```

An *XmlDataSource* and a *TreeView* control are added to the Web page and configured. The following is the Web page markup, showing everything inside the form element:

ASPX Declarative Markup

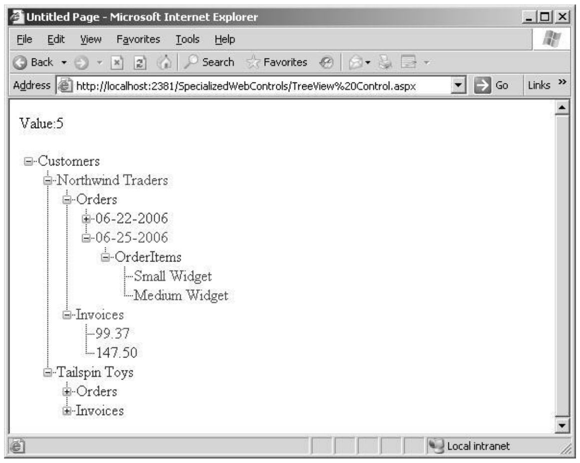
```
<form id="form1" runat="server">
    <div>
      <asp:XmlDataSource ID="XmlDataSource1" runat="server"
            DataFile="~/App_Data/Customers.xml">
      </asp:XmlDataSource>
      <asp:TreeView ID="TreeView1" runat="server"
            DataSourceID="XmlDataSource1"
            ShowLines="True" ExpandDepth="0">
            <DataBindings>
              <asp:TreeNodeBinding DataMember="Customer"
                  TextField="Name" ValueField="CustomerId" />
              <asp:TreeNodeBinding DataMember="Order"
                  TextField="ShipDate" ValueField="OrderId" />
```

```
                <asp:TreeNodeBinding DataMember="OrderItem"
                     TextField="PartDescription" ValueField="OrderItemId" />
                <asp:TreeNodeBinding DataMember="Invoice"
                     TextField="Amount" ValueField="InvoiceId"
                     FormatString="{0:C}" />
              </DataBindings>
      </asp:TreeView>
    </div>
</form>
```

In this example, the configuration was kept to a minimum, but configuration was required in order to display information that is more important than the XML ele ment name, such as the customer's name instead of the XML element name (Cus tomer). The following code was added to the code-behind page to simply display the value of the selected node:

```
'VB
Partial Class TreeView_Control
     Inherits System.Web.UI.Page

    Protected Sub TreeView1_SelectedNodeChanged(ByVal sender As Object, _
              ByVal e As System.EventArgs) Handles TreeView1.SelectedNodeChanged
      Response.Write("Value:" + TreeView1.SelectedNode.Value)
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class TreeView_Control : System.Web.UI.Page
{
    protected void TreeView1_SelectedNodeChanged(object sender, EventArgs e)
    {
      Response.Write("Value:" + TreeView1.SelectedNode.Value);
    }
}
```

When the Web page is displayed, the *Customers* node is visible, but you can click the plus (+) sign to expand the node as shown in Figure 3-50.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2381/SpecializedWebControls/TreeView%20Control.aspx
Go Links
Local intranet

```
Value:5

⊟-Customers
  ⊟-Northwind Traders
    ⊟-Orders
      ⊞-06-22-2006
      ⊟-06-25-2006
        ⊟-OrderItems
          ├-Small Widget
          └-Medium Widget
    ⊟-Invoices
      ├-99.37
      └-147.50
  ⊟-Tailspin Toys
    ⊞-Orders
    ⊞-Invoices
```

Figure 3-50 The *TreeView* displays the nodes as configured.

The *Menu* Control

The *Menu* control is a data-bound control that is used to display hierarchical data in the form of a menu system. The *Menu* control is often used in combination with a *SiteMapDataSource* control for navigating a Web site. The *Menu* control class hierarchy is shown in Figure 3-51.

NOTE .NET 2.0

The *Menu* is new in ASP.NET version 2.0.

The *Menu* control can be populated using static data or by data binding to the con trol. To populate the *Menu* control with static data, you can use declarative syntax by placing opening and closing <*Items*> tags in the *Menu* element, and then you can create a structure of nested <*asp:MenuItem*> elements within the <*Items*> element. Each <*asp:MenuItem*> has properties that you can set by adding attributes to the <*asp:MenuItem*> element.

To use data binding to populate the *Menu* control, you can use any data source that implements the *IHierarchicalDataSource* interface, such as an *XmlDataSource* control or a *SiteMapDataSource* control. Simply set the *DataSourceID* property of the *Menu* control to the ID value of the data source control, and the *Menu* control automatically binds to the specified data source control.

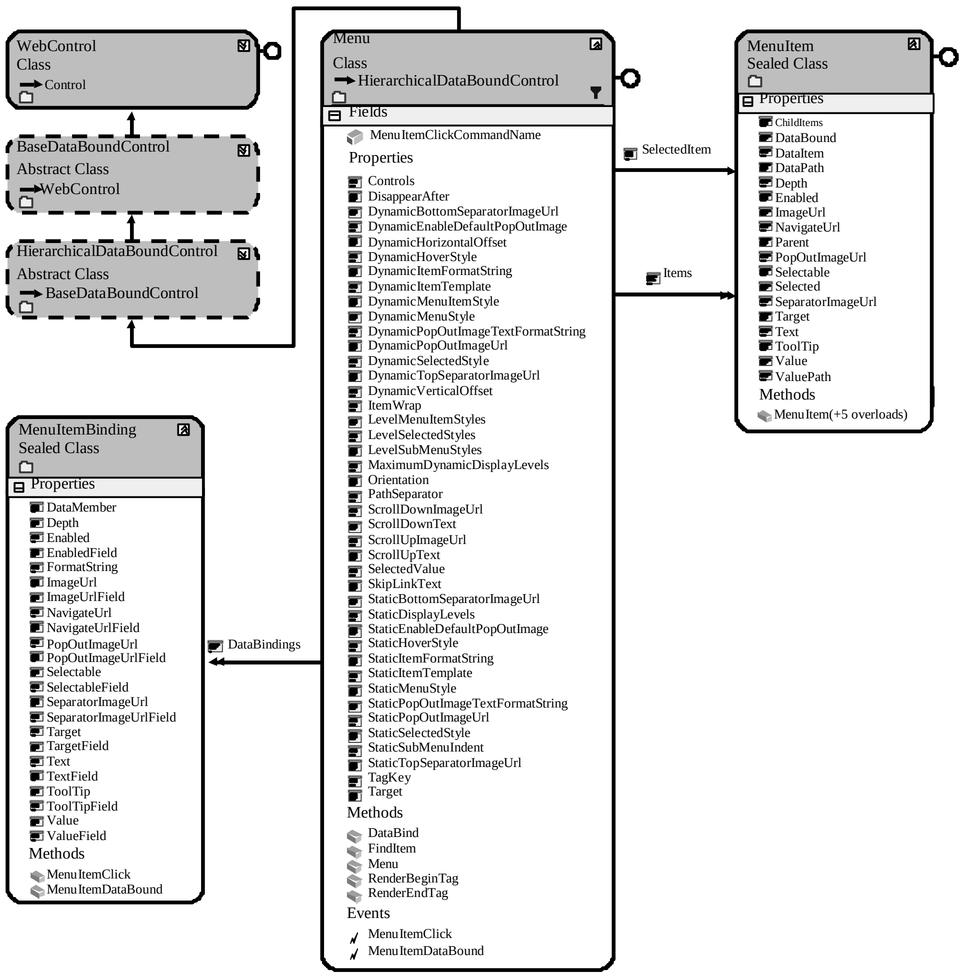


Figure 3-51 The *Menu* control hierarchy.

You can also bind to an *XmlDocument* object or a *DataSet* object that contains *DataRelation* objects by setting the *DataSource* property of the *Menu* control to the data source, and then call the *DataBind* method.

The *Menu* control contains a *DataBindings* property that is a collection of *MenuItem-Binding* objects that define the binding between data items and *TreeNodes*. You can specify the criteria for binding and the data item properties to display in the nodes. This is useful when binding to XML elements where you are interested in binding to an attribute of the element.

The following is an example of using the *Menu* control to display menu data from a new file called MenuItems.xml, which contains a list of the menu items to be dis played. The data is stored in a hierarchical format in the XML file. The MenuItems.xml file looks like the following:

MenuItems.xml File

```
<?xml version="1.0" encoding="utf-8" ?>
<MenuItems>
    <Home display="Home"  url="~/" />
    <Products display="Products" url="~/products/">
      <SmallWidgets display="Small Widgets"
            url="~/products/smallwidgets.aspx" />
      <MediumWidgets display="Medium Widgets"
            url="~/products/mediumwidgets.aspx" />
      <BigWidgets display="Big Widgets"
            url="~/products/bigwidgets.aspx" />
    </Products>
    <Support display="Support"  url="~/Support/">
      <Downloads display="Downloads"
            url="~/support/downloads.aspx" />
      <FAQs display="FAQs"
            url="~/support/faqs.aspx" />
    </Support>
    <AboutUs display="About Us" url="~/aboutus/">
      <Company display="Company"
            url="~/aboutus/company.aspx" />
      <Locations display="Location"
            url="~/aboutus/locations.aspx" />
    </AboutUs>
</MenuItems>
```

An *XmlDataSource*, a *Menu*, and a *Label* control are added to the Web page. The *XmlDataSource* is configured to use the XML file. The *Menu* control is configured to use the *XmlDataSource*. The following is the Web page markup, showing every thing inside the form element:

ASPX Declarative Markup

```
<form id="form1" runat="server">
    <div>
      <asp:Menu ID="Menu1" runat="server" DataSourceID="XmlDataSource1"
            OnMenuItemClick="Menu1_MenuItemClick">
      </asp:Menu>
      <asp:XmlDataSource ID="XmlDataSource1" runat="server"
            DataFile="~/App_Data/MenuItems.xml"
            XPath="/MenuItems/*"></asp:XmlDataSource>
        <br />
    </div>
    <asp:Label ID="Label1" runat="server" Text="Label"></asp:Label>
</form>
```

In this example, showing the *MenuItems* root node in the XML file was not desirable, so an XPath expression was supplied to retrieve the nodes that exist under the *Menu-Items* element. The following code was added to the code-behind page to simply dis play the *ValuePath* property of the selected *MenuItem*:

```
'VB
Partial Class Menu_Control
    Inherits System.Web.UI.Page

    Protected Sub Menu1_MenuItemClick(ByVal sender As Object, _
            ByVal e As System.Web.UI.WebControls.MenuEventArgs) _
            Handles Menu1.MenuItemClick
        Label1.Text = e.Item.ValuePath
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class Menu_Control : System.Web.UI.Page
{
    protected void Menu1_MenuItemClick(object sender, MenuEventArgs e)
    {
        Label1.Text = e.Item.ValuePath;
    }
}
```

When the Web page is displayed, the *Menu* displays and you can hover above a menu item to see its child menu items, as shown in Figure 3-52.

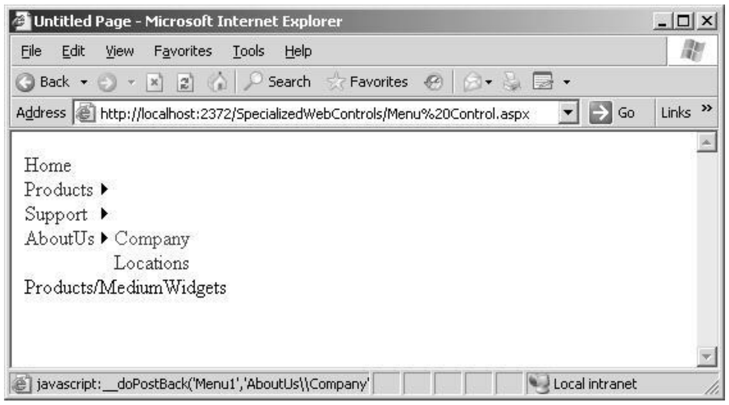

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2372/SpecializedWebControls/Menu%20Control.aspx Go Links
Home
Products
Support
AboutUs Company
Locations
Products/MediumWidgets
javascript:__doPostBack('Menu1','AboutUs\\Company')
Local intranet

Figure 3-52 The *Menu* displays the nodes as configured.

Quick Check

1. What method should you call on a data-bound control when the data is ready to be read from the data source?
2. What method is used in a *FormView* to perform a two-way data binding?
3. What GUI object can provide a data source that allows you to connect mid dle-tier objects to data-bound controls?
4. What must you do to minimize cross-site scripting vulnerabilities when dis playing untrusted data in a *RadioButtonList* control?

Quick Check Answers

1. The *DataBind* method.
2. The *Bind* method.
3. The *ObjectDataSource* control.
4. You must HtmlEncode the data.

Lab: Use the *GridView* and *DetailsView* Controls

In this lab, you use the *GridView* and *DetailsView* controls together to create a master/ detail page. The *GridView* is used to display a list of customer names and IDs, with a select link for each customer. The *DetailsView* displays all of the customer information for editing while providing the ability to add new customers.

� Exercise 1: Create the *Site* and the *Data* Classes

In this exercise, you create a new Web site and add the data classes for the customers.

1. Open Visual Studio 2005 and create a new Web site called **UsingDataBound-Controls**, using your preferred programming language. When the new Web site is created, a Web page called Default.aspx is displayed.
2. In the Solution Explorer, right-click the Web Site and select Add New Item. Add a class, and name it **Customer**. You will be prompted to add this into an App_Code folder; click Yes.
3. Add public properties and private fields for the following customer attributes:

Property	DataType
Id	*Int32*
Name	*String*
City	*String*
State	*String*
Phone	*String*

4. Keep the existing parameterless constructor, and add a constructor for the class that accepts all of the data that was defined in the previous step. The *Customer* class should look like the following:

```
'VB
Imports Microsoft.VisualBasic

Public Class Customer

    Public Property Id() As Integer
      Get
          Return _id
      End Get
      Set(ByVal value As Integer)
          _id = value
      End Set
    End Property
    Private _id As Integer

    Public Property Name() As String
      Get
          Return _name
      End Get
```

```
        Set(ByVal value As String)
            _name = value
        End Set
    End Property
    Private _name As String

    Public Property City() As String
        Get
            Return _city
        End Get
        Set(ByVal value As String)
            _city = value
        End Set
    End Property
    Private _city As String

    Public Property State() As String
        Get
            Return _state
        End Get
        Set(ByVal value As String)
            _state = value
        End Set
    End Property
    Private _state As String

    Public Property Phone() As String
        Get
            Return _phone
        End Get
        Set(ByVal value As String)
            _phone = value
        End Set
    End Property
    Private _phone As String

    Public Sub New()
    End Sub

    Public Sub New(ByVal _id As Integer, ByVal _name As String, _
            ByVal _city As String, ByVal _state As String, ByVal _phone As String)
        Id = _id : Name = _name : City = _city
        State = _state : Phone = _phone
    End Sub

End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public class Customer
{
    public Int32 Id
    {
      get { return id; }
      set { id = value; }
    }
    private Int32 id;

    public string Name
    {
      get { return name; }
      set { name = value; }
    }
    private string name;

    public string City
    {
      get { return city; }
      set { city = value; }
    }
    private string city;

    public string State
    {
      get { return state; }
      set { state = value; }
    }
    private string state;

    public string Phone
    {
      get { return phone; }
      set { phone = value; }
    }
    private string phone;

public Customer()
{
}

    public Customer(int id, string name, string city,
      string state, string phone)
    {
      Id = id; Name = name; City = city;
      State = state; Phone = phone;
    }
}
```

5. Add another class to the App_Code folder called **CustomerList**. Add a private shared field (in C#, use static keyword) called **custList** and initialize it.
6. Add a method called **Select** that returns the *custList*.
7. Add a method called **Update** that accepts a *Customer* as a parameter. Search the *custList* for a match based on the the *Id* property. After finding the customer, update all of the properties except the *Id*. (Hint: In C#, the search can be per formed using an anonymous method, but in VB.NET, you need to create a helper method to perform the find.)
8. Add a method called **Insert** that accepts a *Customer* parameter. In this method, add the *Customer* to the *custList*.
9. Add a method called **Delete** that accepts a *Customer* parameter. In this method, find the matching *Customer* object and delete it.
10. Add a method called **SelectSingle** that accepts an *id* as *Int32* parameter. In this method, return nothing (in C#, null) if the *id* parameter is -1; else, return the cus tomer whose *Id* property matches the *id* parameter.

    Your *CustomerList* should look like the following:

```
'VB
Imports Microsoft.VisualBasic
Imports System.Collections.Generic

Public Class CustomerList

   Private Shared custList As New List(Of Customer)()

   Public Function [Select]() As List(Of Customer)
     Return custList
   End Function

   Public Function SelectSingle(ByVal selectCustomerId As Integer) As Customer
     If selectCustomerId = -1 Then Return Nothing
     current = New Customer() : current.Id = selectCustomerId
     Return custList.Find(AddressOf MatchId)
   End Function

   Public Sub Update(ByVal updateCustomer As Customer)
     current = updateCustomer
     Dim customerFound As Customer = custList.Find(AddressOf MatchId)
     customerFound.Id = updateCustomer.Id
     customerFound.Name = updateCustomer.Name
     customerFound.City = updateCustomer.City
     customerFound.State = updateCustomer.State
     customerFound.Phone = updateCustomer.Phone
   End Sub
```

```
    Private current As Customer
    Private Function MatchId(ByVal _customer As Customer) As Boolean
      Return IIf(current.Id = _customer.Id, True, False)
    End Function

    Public Sub Insert(ByVal _customer As Customer)
      custList.Add(_customer)
    End Sub

    Public Sub Delete(ByVal deleteCustomer As Customer)
      current = deleteCustomer
      Dim customerFound As Customer = custList.Find(AddressOf MatchId)
      custList.Remove(customerFound)
    End Sub

End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;
using System.Collections.Generic;

public class CustomerList
{
    private static List<Customer> custList = new List<Customer>();

    public List<Customer> Select()
    {
      return custList;
    }

    public Customer SelectSingle(int selectCustomerId)
    {
      if (selectCustomerId == -1) return null;
      return custList.Find(
            delegate(Customer customer)
            { return customer.Id == selectCustomerId; });
    }

    public void Update(Customer updateCustomer )
    {
      Customer customerFound = custList.Find(
            delegate(Customer customer)
            { return customer.Id == updateCustomer.Id; });
      customerFound.Id = updateCustomer.Id;
      customerFound.Name = updateCustomer.Name;
```

```
            customerFound.City = updateCustomer.City;
            customerFound.State = updateCustomer.State;
            customerFound.Phone = updateCustomer.Phone;
        }

        public void Insert(Customer _customer)
        {
            custList.Add(_customer);
        }

        public void Delete(Customer deleteCustomer)
        {
            Customer customerFound = custList.Find(
                    delegate(Customer customer)
                    { return customer.Id == deleteCustomer.Id; } );
            custList.Remove(customerFound);
        }
    }
```

11. Build the Web site to assure that there are no errors.

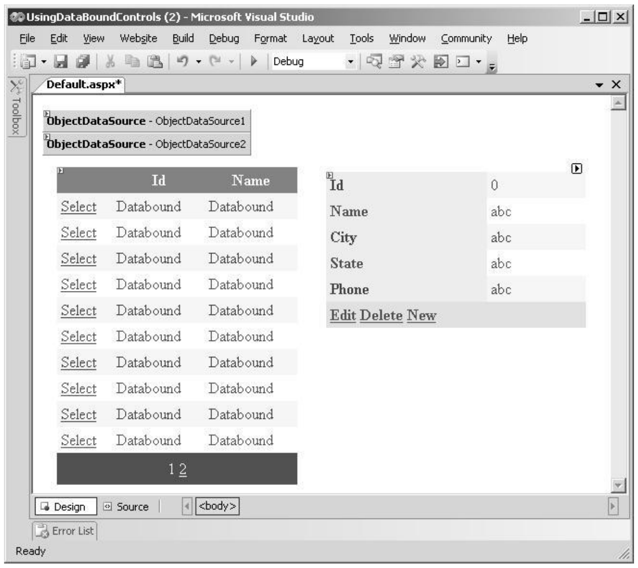
� **Exercise 2: Add and Configure the Controls**

In this exercise, you create a new Web site and add the data classes for the customers.

1. Open Visual Studio 2005 and open the Web site called UsingDataBoundCon trols that you created in the previous exercise. Alternatively, you can open the completed Lesson 2, Exercise 1 project from the CD.
2. Open the Default.aspx Web page in Design view.
3. Drag and drop two *ObjectDataSource* controls, a *GridView*, and a *DetailsView* onto the Web page.
4. Click the symbol in the upper-left corner of the *ObjectDataSource1* control to dis play the ObjectDataSource Tasks window. Click Configure Data Source link to start the Wizard.
5. In the Choose Business Object screen, select the CustomerList, and click Next.
6. In the Define Data Methods screen, choose the *Select* method for the Select tab. On the Update tab, select the *Update* method. On the Insert tab, select the *Insert* method, and on the Delete tab, select the *Delete* method. Click Finish.
7. Click the symbol in the upper-left corner of the *ObjectDataSource2* control to dis play the ObjectDataSource Tasks window. Click Configure Data Source link to start the Wizard.
8. In the Choose Business Object screen, select the CustomerList, and click Next.

9. In the Define Data Methods screen, choose the *SelectSingle* method for the Select tab. When prompted for the *select* parameter, set the Parameter Source to Con trol, the Control ID to GridView1, and set a Default Value of -1. On the Update tab, select the *Update* method. On the Insert tab, select the *Insert* method, and on the Delete tab, select the *Delete* method. Click Finish.
10. Click the symbol in the upper-left corner of the *GridView* control to display the GridView Tasks window. Choose ObjectDataSource1 as the Data Source.
11. Click Enable Paging and Enable Selection.
12. Click Edit Columns. Delete all the fields from the Selected Fields list except Select, Id, and Name.
13. In the GridView Properties window, set the DataKeyNames to Id.
14. Set the *EnableViewState* property to *false*.
15. Right-click the GridView and click AutoFormat. Select the Professional format and click OK.
16. Click the symbol in the upper-left corner of the *DetailsView* control to display the DetailsView Tasks window. Choose ObjectDataSource2 as the Data Source.
17. Click Enable Inserting, Enable Editing, and Enable Deleting.
18. Click Edit Fields and order the fields as Id, Name, City, State, and Phone.
19. Click the Id field and set the *ReadOnly* property to *true*.
20. Click Edit Templates and select the EmptyData Template. Type **No Customer Selected** and add a *LinkButton*. Set the *LinkButton* control's *CausesValidation* property to *false*. Set its *CommandName* property to New. Set its *Text* property to New. In the DetailView Tasks window, click End Template Editing.
21. In the DetailsView Properties window, set the DataKeyNames to Id.
22. Right-click the DetailsView and click AutoFormat. Select the Professional format and click OK.

    The completed Web page is shown in Figure 3-53.


UsingDataBoundControls (2) - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window Community Help
Debug
Default.aspx*
Toolbox
Design
Source
<body>
Error List
Ready

ObjectDataSource - ObjectDataSource1
ObjectDataSource - ObjectDataSource2

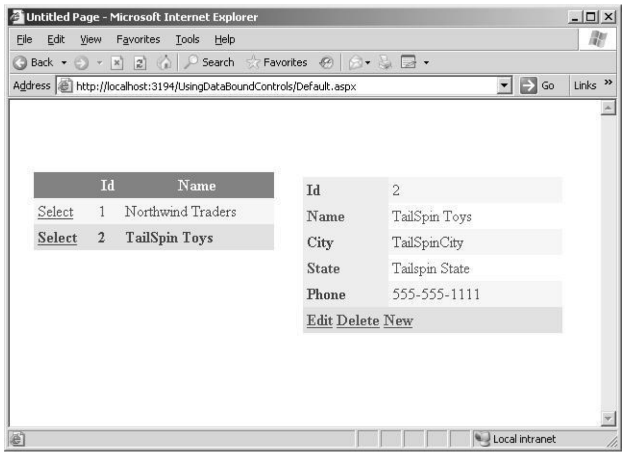
	Id	Name
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound
Select	Databound	Databound

1 2

Id	0
Name	abc
City	abc
State	abc
Phone	abc
Edit Delete New	

Figure 3-53 The completed master/detail form.

23. Press F5 to run the Web application.
24. No customers exist, so you should see the message that states that no customer has been selected. Click New LinkButton, and enter several customers.
25. Notice that the *GridView* is updated to show the added customers.
26. In the *GridView*, click one of the Select links. This causes the details to be dis played in the *DetailsView*, as shown in Figure 3-54.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3194/UsingDataBoundControls/Default.aspx
Go Links
Local intranet

	Id	Name
Select	1	Northwind Traders
Select	**2**	**TailSpin Toys**

Id	2
Name	TailSpin Toys
City	TailSpinCity
State	Tailspin State
Phone	555-555-1111
Edit Delete New	

Figure 3-54 Clicking the Select link on the *GridView* displays the customer in the *DetailsView* control.

Chapter 4

Using ADO.NET and XML with ASP.NET

Probably the most important facet of any application is the retrieval and storage of data. At the end of the day, virtually all applications exist for the purpose of data retrieval or data storage.

The previous chapter covered data-bound controls and demonstrated their uses with object data, primarily using the objects and the ObjectDataSource to populate the control.

This chapter covers the classes that are available in ADO.NET, which are split into two categories: connected and disconnected. Like the data-bound controls that were cov ered in the previous chapter, you can use the disconnected classes without ever con necting to a database, while the connected classes are specific to the database that you're connecting to. Figure 4-1 shows the major disconnected and connected classes. This chapter covers these classes as well as other ADO.NET classes.

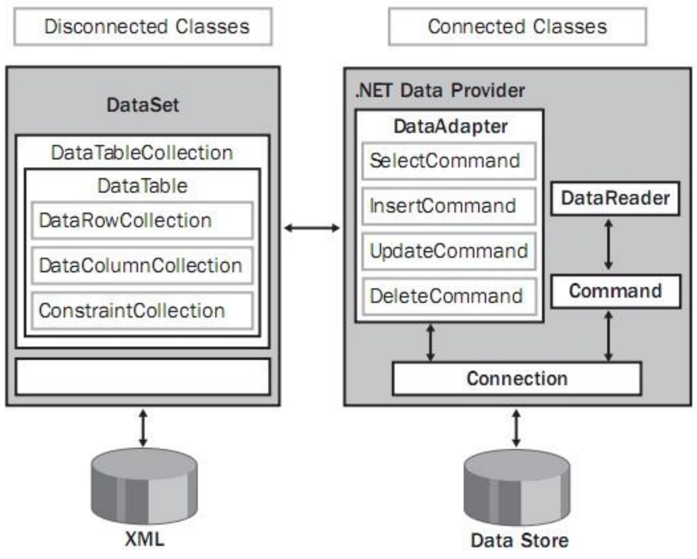


Figure 4-1 The major disconnected and connected classes.

The use of Extensible Markup Language (XML) is rapidly growing among companies that read and write data to XML files and also those that send and receive data in XML formatted messages. This chapter also covers the classes that are available in XML and their roles in providing data storage and retrieval.

Exam objectives in this chapter:

- Manage connections and transactions of databases.
  - Configure a connection to a database graphically by using the Connection Wizard.
  - Configure a connection by using the Server Explorer.
  - Configure a connection to a database by using the *connection* class.
  - Connect to a database by using specific database *connection* objects.
  - Enumerate through instances of Microsoft SQL Server by using the *DbProviderFactories.GetFactoryClasses* method.
  - Open a connection by using the *Open* method of a *connection* object.
  - Close a connection by using the *connection* object.
  - Secure a connection to protect access to your data source.
  - Create a connection designed for reuse in a connection pool.
  - Control connection pooling by configuring *ConnectionString* values based on database type.
  - Use *connection* events to detect database information.
  - Handle connection exceptions when connecting to a database.
  - Perform transactions using the ADO.NET *Transaction* object.
- Create, delete, and edit data in a connected environment.
  - Retrieve data by using a *DataReader* object.
  - Build SQL commands visually in Server Explorer.
  - Build SQL commands in code.
  - Create parameters for a *command* object.
  - Perform database operations by using a *command* object.

  - Retrieve data from a database by using a *command* object.
  - Perform asynchronous operations by using a *command* object.
  - Perform bulk copy operations to copy data to a SQL Server computer.
  - Store and retrieve binary large object (BLOB) data types in a database.
- Create, delete, and edit data in a disconnected environment.
  - Create an instance of the *DataSet* class programmatically.
  - Create a *DataSet* graphically.
  - Create a *DataSet* programmatically.
  - Add a *DataTable* to a *DataSet*.
  - Add a relationship between tables.
  - Navigate a relationship between tables.
  - Merge *DataSet* contents.
  - Copy *DataSet* contents.
  - Create a strongly typed *DataSet*.
  - Create *DataTables*.
  - Manage data within a *DataTable*.
  - Create and use *DataViews*.
  - Represent data in a *DataSet* by using XML.
  - Access an ADO Recordset or Record by using the *OleDbDataAdapter* object.
  - Generate *DataAdapter* commands automatically by using the *Command-Builder* object.
  - Generate *DataAdapter* commands programmatically.
  - Populate a *DataSet* by using a *DataAdapter*.
  - Update the database by using a *DataAdapter*.
  - Resolve conflicts between a *DataSet* and a database by using the *Data-Adapter*.

    - Respond to changes made to data at the data source by using *DataAdapter* events.
    - Perform batch operations by using *DataAdapters*.
- Manage XML data with the XML Document Object Model (DOM).
    - Read XML data into the DOM by using the *Load* method.
    - Modify an XML document by adding and removing nodes.
    - Modify nodes in an XML document.
    - Write data in XML format from the DOM.
    - Work with nodes in the XML DOM by using *XmlNamedNodeMap* and the *XmlNodeList*.
    - Handle *DOM* events.
    - Modify XML declaration.
- Read and write XML data by using the *XmlReader* and *XmlWriter*.
    - Read XML data by using the *XmlReader*.
    - Read all XML element and attribute content.
    - Read specific element and attribute content.
    - Read XML data by using the *XMLTextReader* class.
    - Read node trees by using the *XmlNodeReader*.
    - Validate XML data by using the *XmlValidatingReader*.
    - Write XML data by using the *XmlWriter*.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic or C# and be comfortable with the following tasks:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed with Microsoft SQL Server 2005 Express Edition.
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.
- Be able to add Web server controls to a Web page.
- Be familiar with SQL Server.

Real World

Glenn Johnson

Developers spend lots of time creating controls that are specific to the tasks that need to be accomplished, but in many cases, the specialized data-bound controls that are built-in can be used with simple formatting and configuration changes.

Lesson 1: Using the ADO.NET Disconnected Classes

This lesson covers the disconnected data access classes that are instantiated within the Web application and can be used without ever connecting to a data store. When working with disconnected data, you must at least use the *DataTable* object, so this lesson starts by covering the *DataTable* and the objects that the *DataTable* object works with. After covering the *DataTable*, the *DataSet* and the *DataTableReader*, this chapter covers objects.

After this lesson, you will be able to:

- Identify and use the following disconnected data classes in your Web application:
  - *DataTable*
  - *DataColumn*
  - *DataRow*

Estimated lesson time: 60 minutes

Getting Started with the *DataTable* Object

The *DataTable* object represents tabular data as rows, columns, and constraints. Use the *DataTable* object to hold data in memory while performing disconnected data operations. The *DataTable* object can be explicitly created by instantiating the *Data-Table* class, adding *DataColumn* objects that define the data to be held, and then add ing *DataRow* objects, which are objects that contain the data. The *DataTable* object must contain *DataColumn* objects before any data can be added to the *DataTable* object. The *DataColumn* objects also contain *constraints*, which maintain data integrity by limiting the data that can be placed into a column. The following code creates an employee *DataTable* and adds *DataColumn* objects:

'VB

```
Private Function GetDataTable() As DataTable
    'Create the DataTable named "Employee"
    Dim employee As New DataTable("Employee")

    'Add the DataColumn using all properties
    Dim eid As New DataColumn("Eid")
    eid.DataType = GetType(String)
    eid.MaxLength = 10
    eid.Unique = True
    eid.AllowDBNull = False
    eid.Caption = "EID"
    employee.Columns.Add(eid)

    'Add the DataColumn using defaults
    Dim firstName As New DataColumn("FirstName")
    firstName.MaxLength = 35
    firstName.AllowDBNull = False
    employee.Columns.Add(firstName)
    Dim lastName As New DataColumn("LastName")
    lastName.AllowDBNull = False
    employee.Columns.Add(lastName)

    'Add the decimal DataColumn using defaults
    Dim salary As New DataColumn("Salary", GetType(Decimal))
    salary.DefaultValue = 0.0
    employee.Columns.Add(salary)

    'Derived column using expression
     Dim lastNameFirstName As New DataColumn("LastName and FirstName")
    lastNameFirstName.DataType = GetType(String)
    lastNameFirstName.MaxLength = 70
    lastNameFirstName.Expression = "lastName + ', ' + firstName"
    employee.Columns.Add(lastNameFirstName)

    Return employee
End Function
```

//C#

```
private DataTable GetDataTable()
{
    //Create the DataTable named "employee"
    DataTable employee = new DataTable("Employee");

    //Add the DataColumn using all properties
    DataColumn eid = new DataColumn("Eid");
    eid.DataType = typeof(string);
    eid.MaxLength = 10;
    eid.Unique = true;
    eid.AllowDBNull = false;
    eid.Caption = "EID";
    employee.Columns.Add(eid);

    //Add the DataColumn using defaults
    DataColumn firstName = new DataColumn("FirstName");
    firstName.MaxLength = 35;
    firstName.AllowDBNull = false;
    employee.Columns.Add(firstName);
    DataColumn lastName = new DataColumn("LastName");
    lastName.AllowDBNull = false;
    employee.Columns.Add(lastName);
```

```
        //Add the decimal DataColumn using defaults
        DataColumn salary = new DataColumn("Salary", typeof(decimal));
        salary.DefaultValue = 0.00m;
        employee.Columns.Add(salary);

        //Derived column using expression
        DataColumn lastNameFirstName = new DataColumn("LastName and FirstName");
        lastNameFirstName.DataType = typeof(string);
        lastNameFirstName.MaxLength = 70;
        lastNameFirstName.Expression = "lastName + ', ' + firstName";
        employee.Columns.Add(lastNameFirstName);

        return employee;
}
```

In this example, the *DataType* is a string for all *DataColumn* objects except salary, which is a *decimal* object that contains currency. The *MaxLength* property constrains the length of string data. The string data is truncated if you exceed this length and no exception is thrown. If the *Unique* property is set to *true*, an index is created to prevent duplication of entries. The *AllowDBNull* property is set to *false* to mandate the popu lation of the column with data. The *Caption* property is a string that holds the column heading that is to be displayed when this *DataTable* object is used with Web server controls. The *lastNameFirstName DataColumn* object shows how an expression col umn is created, in this case, by assigning an expression. *Expression columns* are also known as calculated or derived columns. Adding a derived column is especially ben eficial when data is available but not in the correct format.

The following is a list of the default values for *DataColumn* properties if you create a *DataColumn* without specifying a value for a property:

- ***DataType*** String
- ***MaxLength*** –1, which means that no maximum length check is performed
- ***Unique*** False, which allows duplicate values
- ***AllowDBNull*** True, which means that the *DataColumn* does not need to have a value
- ***Caption*** The *DataColumn* object, which is the *ColumnName* property value

Creating Primary Key Columns

The *primary key* of a *DataTable* object consists of one or more columns, which have data that provides a unique identity for each data row. In the Employee example, the employee identification (Eid) is considered to be a unique key that can be used to retrieve the data for a given employee. In some scenarios, a unique key might require combining two or more fields to achieve uniqueness. For example, a sales order typi cally contains line items. The primary key for each of the Line Item rows would typi cally be a combination of the order number and the line number. The *PrimaryKey* property must be set to an array of *DataColumn* objects to accommodate composite (multiple) keys. The following code shows how to set the *PrimaryKey* property for the Employee *DataTable* object:

```
'VB
'Set the Primary Key
employee.PrimaryKey = new DataColumn(){eid}

//C#
//Set the Primary Key
employee.PrimaryKey = new DataColumn[] {eid};
```

Adding Data with *DataRow* Objects

After the *DataTable* is created with its schema, the *DataTable* is populated by adding *DataRow* objects. A *DataRow* object is created by a *DataTable* because the *DataRow* must conform to constraints of the *DataTable* object's columns.

Adding Data to the *DataTable* The *DataTable* object contains a *Rows* collection, which contains a collection of *DataRow* objects. You can insert data into the *Rows* col lection by using the *Add* method on the *Rows* collection or by using the *Load* method on the *DataTable* object.

The *Add* method contains an overload that accepts an array of objects instead of a *DataRow* object. The array of objects must match the quantity and data type of *Data-Column* objects in the *DataTable*.

The *Load* method can be used to update existing *DataRow* objects or load new *DataRow* objects. The *PrimaryKey* property must be set so the *DataTable* object can locate the *DataRow* that is to be updated. The *Load* method expects an array of objects and a *LoadOption* enumeration value that has one of the following values:

- ***OverwriteRow*** Overwrites the original *DataRowVersion* and the current *DataRowVersion* and changes the *RowState* to *Unchanged*. New rows also have the *RowState* of *Unchanged*.
- ***PreserveCurrentValues* (default)** Overwrites the original *DataRowVersion*, but does not modify the current *DataRowVersion*. New rows have the *RowState* of *Unchanged* as well.

- ***UpdateCurrentValues*** Overwrites the current *DataRowVersion*, but does not mod ify the original *DataRowVersion*. New rows have the *RowState* of *Added*. Rows that had a *RowState* of *Unchanged* have the *RowState* of *Unchanged* if the current *DataRowVersion* is the same as the original *DataRowVersion*, but if they are differ ent, the *RowState* is *Modified*.

The following code snippet demonstrates the methods of creating and adding data to the employee *DataTable*:

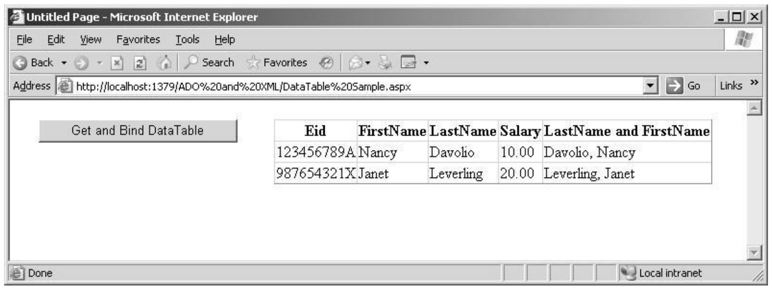
```
'VB
'Add New DataRow by creating the DataRow first
Dim newemployee As DataRow = employee.NewRow()
newemployee("Eid") = "123456789A"
newemployee("FirstName") = "Nancy"
newemployee("LastName") = "Davolio"
newemployee("Salary") = 10.0
employee.Rows.Add(newemployee)

'Add New DataRow by simply adding the values
employee.Rows.Add("987654321X", "Andrew", "Fuller", 15.0)

'Load DataRow, replacing existing contents, if existing
employee.LoadDataRow( _
    New Object() {"987654321X", "Janet", "Leverling", 20.0}, _
    LoadOption.OverwriteChanges)

//C#
//Add New DataRow by creating the DataRow first
DataRow newemployee = employee.NewRow();
newemployee["Eid"] = "123456789A";
newemployee["FirstName"] = "Nancy";
newemployee["LastName"] = "Davolio";
newemployee["Salary"] = 10.00m;
employee.Rows.Add(newemployee);

//Add New DataRow by simply adding the values
employee.Rows.Add("987654321X", "Andrew", "Fuller", 15.00m);

//Load DataRow, replacing existing contents, if existing
employee.LoadDataRow(
    new object[] { "987654321X", "Janet", "Leverling", 20.00m },
    LoadOption.OverwriteChanges);
```

This code adds new *DataRow* objects to the Employee *DataTable*. The first example explicitly creates a new *DataRow* using the *NewRow* method on the Employee *Data-Table*. The next example adds a new *DataRow* by simply passing the values into the *employee.Rows.Add* method. Remember that nothing has been permanently stored to a database. We will cover that later in this chapter.

Binding to the *DataTable* A *DataTable* object is bound to any of the data-bound con
trols by assigning it to the *DataSource* property of the data-bound control and execut
ing the *DataBind* method of the control to render the data as follows:

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) _
        Handles Button1.Click
    'add grid to form
    Dim gv As New GridView()
    gv.Style.Add("position", "absolute")
    gv.Style.Add("left", "275px")
    gv.Style.Add("top", "20px")
    gv.EnableViewState = false
    form1.Controls.Add(gv)
   'get the table and display
    gv.DataSource = GetDataTable()
    gv.DataBind()
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    //add grid to form
    GridView gv  = new GridView();
    gv.Style.Add("position", "absolute");
    gv.Style.Add("left", "275px");
    gv.Style.Add("top", "20px");
    gv.EnableViewState = false;
    form1.Controls.Add(gv);
    //get the table and display
    gv.DataSource = GetDataTable();
    gv.DataBind();
}
```

This rendered DataTable is shown in Figure 4-2.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1379/ADO%20and%20XML/DataTable%20Sample.aspx
Go Links
Get and Bind DataTable
Done
Local intranet

Eid	FirstName	LastName	Salary	LastName and FirstName
123456789A	Nancy	Davolio	10.00	Davolio, Nancy
987654321X	Janet	Leverling	20.00	Leverling, Janet

Figure 4-2 The employee *DataTable* object is bound to the *GridView* control.

If you are working with any controls that inherit from *ListControl*, such as the *ListBox*, you also need to set the *DataTextField* and *DataValueField* properties.

Using *DataRowState* with the *DataRow* Object The *DataRow* has a *RowState* property that can be viewed and filtered at any time and can be any of the following *DataRow-State* enumeration values:

- ***Detached*** *DataRow* is created but not added to a *DataTable*.
- ***Added*** *DataRow* is added to a *DataTable*.
- ***Unchanged*** *DataRow* has not changed since the last call to the *AcceptChanges* method. The *DataRow* changes to this state when the *AcceptChanges* method is called.
- ***Modified*** *DataRow* has been modified since the last time the *AcceptChanges* method was called.
- ***Deleted*** *DataRow* is deleted using the *Delete* method of the *DataRow*.

Figure 4-3 shows the *RowState* transitions at different times in the *DataRow* object's life.

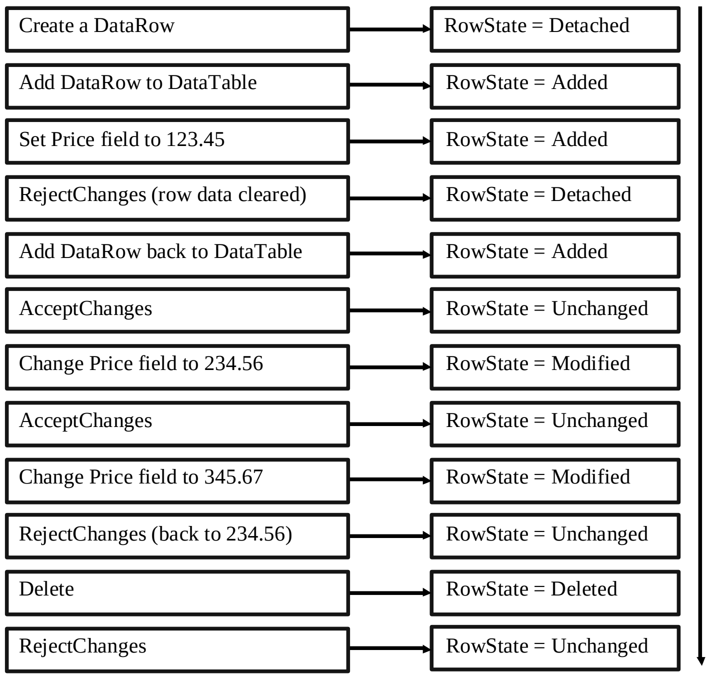


Figure 4-3 The *RowState* changes during the lifetime of a *DataRow* object.

Notice that, after the Price is assigned a value of 123.45, the *RowState* does not change to *Modified*. The *RowState* is still *Added* because *RowState* is an indicator of an action required to send an update of this data to the database. The fact that 123.45 was placed into the Price is not as important as the fact that a *DataRow* needs to be added to the database.

Holding Multiple Copies of Data with the *DataRowVersion* The *DataRow* can hold up to three versions, or copies, of the data: Original, Current, and Proposed. When the *DataRow* is created, it contains a single copy of the data, which is the Current version. When the *DataRow* is placed into edit mode by executing its *BeginEdit* method, changes to the data are placed in a second version of the data, called the Proposed ver sion. When the *EndEdit* method is executed, the Current version becomes the Origi nal version, the Proposed version becomes the Current version, and the Proposed version no longer exists. After *EndEdit* has completed its execution, there are two ver sions of the *DataRow* data: Original and Current. If the *BeginEdit* method is called again, the Current version of the data is copied to a third version of the data, which is the Proposed version. Calling *EndEdit* again causes the Proposed version to become the Current version and the Proposed version to no longer exist.

When you retrieve data from the *DataRow*, the *DataRowVersion* you want to retrieve can also be specified as follows:

- **Current** This is the current value of the *DataRow*, even after changes have been made. This version exists in all situations, except when the *RowState* property is *Deleted*. If you attempt to retrieve the Current version and the *RowState* is *Deleted*, an exception is thrown.
- **Default** If the *RowState* is *Added* or *Modified*, the default version is Current. If the *RowState* is *Deleted*, an exception is thrown. If the *BeginEdit* method has been executed, the default version is Proposed.
- **Original** This is the value at the time the last *AcceptChanges* method was exe cuted. If the *AcceptChanges* method was never executed, the Original version is the value that was originally loaded into the *DataRow*. Note that this version is not populated until the *RowState* becomes *Modified*, *Unchanged*, or *Deleted*. If the *RowState* is *Deleted*, this information is still retrievable. If the *RowState* is *Added*, a *VersionNotFoundException* is thrown.

- **Proposed** This is the value at the time of editing the *DataRow*. If the *RowState* is *Deleted*, an exception is thrown. If the *BeginEdit* method has not been explicitly executed, or if *BeginEdit* was implicitly executed via editing a detached *DataRow* (an orphaned *DataRow* object that has not been added to a *DataTable* object), a *VersionNotFoundException* is thrown.

You can also query the *HasVersion* method on the *DataRow* object to test for the exist ence of a particular *DataRowVersion*. You can use this method to test for the existence of a *DataRowVersion* before attempting to retrieve a version that does not exist. The fol lowing code snippet demonstrates how to retrieve a string using the *RowState* and the *DataRowVersion*:

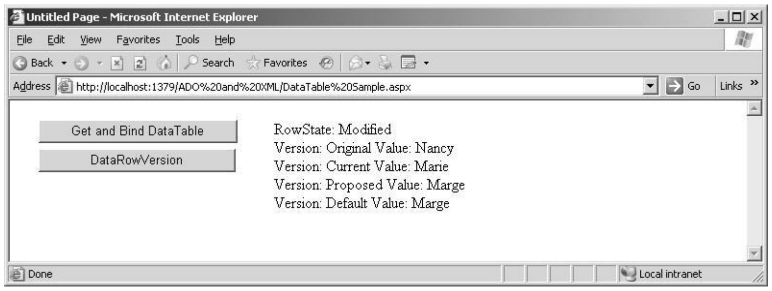
```
'VB
Private Function GetDataRowInfo( _
    ByVal row As DataRow, ByVal columnName As String) _
    As String

   Dim retVal As String = String.Format( _
    "RowState: {0} <br />", row.RowState)

   Dim versionString As String
   For Each versionString In [Enum].GetNames( _
        GetType(DataRowVersion))
    Dim version As DataRowVersion = _
        CType([Enum].Parse(GetType(DataRowVersion), _
        versionString), DataRowVersion)
    If (row.HasVersion(version)) Then
        retVal += String.Format( _
            "Version: {0} Value: {1} <br />", _
            version, row(columnName, version))
    Else
        retVal += String.Format( _
            "Version: {0} does not exist.<br />", _
            version)
    End If
   Next
   Return retVal
End Function

//C#
private string GetDataRowInfo(DataRow row, string columnName)
{
   string retVal = string.Format(
    "RowState: {0}<br />",
    row.RowState);

   foreach (string versionString in
    Enum.GetNames(typeof(DataRowVersion)))
   {
        DataRowVersion version = (
            DataRowVersion)Enum.Parse(
                typeof(DataRowVersion), versionString);

        if (row.HasVersion(version))
        {
            retVal += string.Format(
                "Version: {0} Value: {1}<br />",
                version, row[columnName, version]);
        }
        else
        {
            retVal += string.Format(
                "Version: {0} does not exist.<br />",
                version);
        }
    }
    return retVal;
}
```

Resetting the *RowState* with *AcceptChanges* and *RejectChanges* The *AcceptChanges* method is used to reset the *DataRow* state to *Unchanged*. This method exists on the *DataRow*, *DataTable*, and *DataSet* objects. (We cover *DataSet* later in this chapter.) After data has been loaded from the database, the *RowState* property of the loaded rows is set to *Added*. Calling *AcceptChanges* on the *DataTable* resets the *RowState* of all of the *DataRow* objects to *Unchanged*. If you modify the *DataRow* objects, their *Row-State* changes to *Modified*. When you are ready to save the data, you can easily query the *DataTable* object for its changes by using the *GetChanges* method on the *DataTable* object, which returns a *DataTable* that is populated only with the *DataRow* objects that have changed since the last time that *AcceptChanges* was executed. Only the changes need to be sent to the data store.

After the changes have been successfully sent to the data store, change the state of the *DataRow* objects to *Unchanged* by calling the *AcceptChanges* method, which indicates that the *DataRow* objects are synchronized with the data store. Note that executing the *AcceptChanges* method also causes the *DataRow* object's Current *DataRowVersion* to be copied to the *DataRow* object's Original version. Consider the following code snippet:

```
'VB
Protected Sub Button2_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button2.Click
    'add label to form
    Dim lbl As New Label()
    lbl.Style.Add("position", "absolute")
    lbl.Style.Add("left", "275px")
    lbl.Style.Add("top", "20px")
    lbl.EnableViewState = false
    form1.Controls.Add(lbl)
    'get the first row to play with
    Dim dr As DataRow = GetDataTable().Rows(0)
    'clear the rowstate
    dr.AcceptChanges()
    'make change in a single statement
    dr("FirstName") = "Marie"
    'start making changes that may span multiple statements
    dr.BeginEdit()
    dr("FirstName") = "Marge"
    lbl.Text = GetDataRowInfo(dr, "FirstName")
    dr.EndEdit()
End Sub

//C#
protected void Button2_Click(object sender, EventArgs e)
{
    //add label to form
    Label lbl = new Label();
    lbl.Style.Add("position", "absolute");
    lbl.Style.Add("left", "275px");
    lbl.Style.Add("top", "20px");
    lbl.EnableViewState = false;
    form1.Controls.Add(lbl);
    //get the first row to play with
    DataRow dr = GetDataTable().Rows[0];
    //clear the rowstate
    dr.AcceptChanges();
    //make change in a single statement
    dr["FirstName"] = "Marie";
    //start making changes that may span multiple statements
    dr.BeginEdit();
    dr["FirstName"] = "Marge";
    lbl.Text = GetDataRowInfo(dr, "FirstName");
    dr.EndEdit();
}
```

This code starts by adding a *Label* control to the Web page that holds the results of this test. Next, the first *DataRow* object in the employee *DataTable* is retrieved. The *DataRow* has an initial *RowState* of *Added*, and the *AcceptChanges* method clears the *RowState* to *Unchanged*. Next, the *FirstName* is modified in a single statement, which causes the *RowState* to become *Modified*. At this time, the Current version contains the modified data and the Original version contains the data values that exist after the *AcceptChanges* method is executed. Next, the *BeginEdit* method is executed to place the *DataRow* in an edit mode and the *FirstName* is changed again. At this time, the Proposed version contains the current data and executing the *GetDataRowInfo* method displays the results shown in Figure 4-4.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1379/ADO%20and%20XML/DataTable%20Sample.aspx
Go Links
Get and Bind DataTable
DataRowVersion
Done
Local intranet

```
RowState: Modified
Version: Original Value: Nancy
Version: Current Value: Marie
Version: Proposed Value: Marge
Version: Default Value: Marge
```

Figure 4-4 The *DataRow* information after making changes.

The *RejectChanges* method is used to roll back the *DataRow* to the point in time when you last called the *AcceptChanges* method. The *AcceptChanges* method overwrites the Original *DataRowVersion,* which means that you cannot roll back to a point in time that is earlier than the last time *AcceptChanges* was called.

Explicitly Changing *RowState* with the *SetAdded* and *SetModified* Methods The *SetAdded* and *SetModified* methods on the *DataRow* allow you to explicitly set the *RowState*. This is useful when you want to force a *DataRow* to be stored in a data store that is different from the data store from which the *DataRow* was originally loaded.

Deleting and Undeleting the *DataRow* The *Delete* method on the *DataRow* is used to set the *RowState* of the *DataRow* to *Deleted*. A *DataRow* object that has a *RowState* of *Deleted* indicates that the row needs to be deleted from the data store.

There are many scenarios where you need to undelete a *DataRow*. The *DataRow* object doesn't have an undelete method, but you can use the *RejectChanges* method to per form an undelete that may satisfy some scenarios. The problem is that executing the *RejectChanges* method copies the Original *DataRowVersion* to the Current *DataRowVersion*, which effectively restores the *DataRow* object to its state at the time the last *AcceptChanges* method was executed. This means that any changes that were made to the data prior to deleting are lost.

Copying and Cloning the *DataTable*

You often need to create a full copy of a *DataTable* in your application, possibly to pass it to another application, or to use as a scratch pad for operations that may be thrown out later. For example, you may want to assign a *DataTable* object to a *GridView* con trol to allow a user to edit the data, but you also may want to provide a cancel button that aborts all changes on the Web page. A simple way to implement this functionality is to create a copy of your *DataTable* object and use the copy for editing. If the user clicks the cancel button, the *DataTable* copy is thrown out. If the user decides to keep the changes, you can replace the original *DataTable* object with the edited copy.

To create a copy of a *DataTable* object, use the *Copy* method on the *DataTable*, which copies the *DataTable* object's schema and data. The following code snippet shows how to invoke the *Copy* method:

```
'VB
Dim copy as DataTable = employee.Copy( )

//C#
DataTable copy = employee.Copy( );
```

You often require a copy of the *DataTable* schema without the data. You can accom plish this by invoking the *Clone* method on the *DataTable*. Use this method when an empty copy of the *DataTable* is required and to which *DataRow* objects will be added at a later time. The following code shows the *Clone* method:

```
'VB
Dim clone as DataTable = employee.Clone( )

//C#
DataTable clone = employee.Clone( );
```

Importing *DataRow* Objects into a *DataTable*

The *ImportRow* method on the *DataTable* object copies a *DataRow* from a *DataTable* that has the same schema. The *ImportRow* method also imports Current and Original version data. If you attempt to import a *DataRow* that has a primary key value that already exists in the *DataTable* object, a *ConstraintException* is thrown. The following code snippet shows the process for cloning the *DataTable* and then copying a single *DataRow* to the cloned copy:

```
'VB
Dim clone as DataTable = employee.Clone( )
clone.ImportRow(employee.Rows(0))
```

```
//C#
DataTable clone = employee.Clone();
clone.ImportRow(employee.Rows[0]);
```

Using the *DataTable* with XML Data

You can use the *WriteXml* method of a *DataTable* to write the contents of the *DataTable* to an XML file or stream. This method should be used with the *Server.MapPath* method to convert a simple filename to the Web site path, as shown in the following code snippet:

```
'VB
Protected Sub Button5_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button5.Click
    Dim employee As DataTable = GetDataTable()
    employee.WriteXml(Server.MapPath("employee.xml"))
    Response.Redirect("employee.xml")
End Sub

//C#
protected void Button5_Click(object sender, EventArgs e)
{
    DataTable employee = GetDataTable();
    employee.WriteXml(Server.MapPath("employee.xml"));
    Response.Redirect("employee.xml");
}
```

MORE INFO Changes to the *DataTable*

The following Microsoft link provides more information about the changes to the *DataTable* in ADO.NET 2.0: *http://msdn.microsoft.com/msdnmag/issues/05/11/DataPoints*.

When this method is executed, the employee.xml file is produced, which looks like the following:

```
<?xml version="1.0" standalone="yes"?>
<DocumentElement>
 <Employee>
     <Eid>123456789A</Eid>
     <FirstName>Nancy</FirstName>
     <LastName>Davolio</LastName>
     <Salary>10</Salary>
     <LastName_x0020_and_x0020_FirstName>
            Davolio, Nancy
     </LastName_x0020_and_x0020_FirstName>
 </Employee>
 <Employee>
     <Eid>987654321X</Eid>
     <FirstName>Janet</FirstName>
     <LastName>Leverling</LastName>
```

```
    <Salary>20</Salary>
    <LastName_x0020_and_x0020_FirstName>
        Leverling, Janet
    </LastName_x0020_and_x0020_FirstName>
  </Employee>
</DocumentElement>
```

This example uses *DocumentElement* as the root element and uses repeating *Employee* elements for each *DataRow*. The data for each *DataRow* is nested as an ele ment within each *Employee* element. Also notice that an XML element name cannot have spaces, so *LastName* and *FirstName* are automatically encoded (converted) to *LastName_x0020_*and*_x0020_FirstName*.

You can fine-tune the XML output by providing an XML schema or by setting proper ties on the *DataTable* and its objects. To change the name of the repeating element for the *DataRow* objects from *Employee* to *Person*, you can change the *DataTable* object's *TableName*. The *DataColumn* has a *ColumnMapping* property you can use to configure the output of each column by assigning one of the following *MappingType* enumera tion values:

- ***Attribute*** Places the column data into an XML attribute.
- ***Element*** Is the default. Places the column data into an XML element.
- ***Hidden*** Is the column data that is not sent to the XML file.
- ***SimpleContent*** Is the column data that is stored as text within the row's element tags and does not include element tags for the column.

To change the *Eid*, *LastName*, *FirstName*, and *Salary* to XML attributes, you can set each *DataColumn* object's *ColumnMapping* property to *MappingType.Attribute*. The LastName and FirstName column is an expression column, so its data does not need to be stored. Therefore, its *ColumnMapping* property can be set to *MappingType.Hidden*. The follow ing snippets show the necessary code and the resulting XML file contents:

'VB

```
Protected Sub Button6_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button6.Click
    Dim employee As DataTable = GetDataTable()
    employee.TableName = "Person"
    employee.Columns("Eid").ColumnMapping = MappingType.Attribute
    employee.Columns("FirstName").ColumnMapping = MappingType.Attribute
    employee.Columns("LastName").ColumnMapping = MappingType.Attribute
    employee.Columns("Salary").ColumnMapping = MappingType.Attribute
    employee.Columns("LastName and FirstName").ColumnMapping = _
        MappingType.Hidden
    employee.WriteXml(Server.MapPath("Person.xml"))
    Response.Redirect("Person.xml")
End Sub
```

//C#

```
protected void Button6_Click(object sender, EventArgs e)
{
    DataTable employee = GetDataTable();
    employee.TableName = "Person";
    employee.Columns["Eid"].ColumnMapping = MappingType.Attribute;
    employee.Columns["FirstName"].ColumnMapping = MappingType.Attribute;
    employee.Columns["LastName"].ColumnMapping = MappingType.Attribute;
    employee.Columns["Salary"].ColumnMapping = MappingType.Attribute;
    employee.Columns["LastName and FirstName"].ColumnMapping =
        MappingType.Hidden;
    employee.WriteXml(Server.MapPath("Person.xml"));
    Response.Redirect("Person.xml");
}
```

XML

```
<?xml version="1.0" standalone="yes"?>
<DocumentElement>
<Person Eid="123456789A" FirstName="Nancy" LastName="Davolio" Salary="10" />
<Person Eid="987654321X" FirstName="Janet" LastName="Leverling" Salary="20" />
</DocumentElement>
```

Although the resulting XML file is compact, the data types aren’t saved, so all data is considered to be string data. You can use the *XmlWriteMode.WriteSchema* enumera tion value to store the XML schema with the data, as shown here:

'VB

```
Protected Sub Button7_Click(ByVal sender As Object, _
     ByVal e As System.EventArgs) Handles Button7.Click
    Dim employee As DataTable = GetDataTable()
    employee.TableName = "Person"
    employee.Columns("Eid").ColumnMapping = MappingType.Attribute
    employee.Columns("FirstName").ColumnMapping = MappingType.Attribute
    employee.Columns("LastName").ColumnMapping = MappingType.Attribute
    employee.Columns("Salary").ColumnMapping = MappingType.Attribute
    employee.Columns("LastName and FirstName").ColumnMapping = _
        MappingType.Hidden
    employee.WriteXml(Server.MapPath("PersonWithSchema.xml"), _
        XmlWriteMode.WriteSchema)
    Response.Redirect("PersonWithSchema.xml")
End Sub
```

//C#

```
protected void Button7_Click(object sender, EventArgs e)
{
    DataTable employee = GetDataTable();
    employee.TableName = "Person";
    employee.Columns["Eid"].ColumnMapping = MappingType.Attribute;
    employee.Columns["FirstName"].ColumnMapping = MappingType.Attribute;
    employee.Columns["LastName"].ColumnMapping = MappingType.Attribute;
    employee.Columns["Salary"].ColumnMapping = MappingType.Attribute;
    employee.Columns["LastName and FirstName"].ColumnMapping =
          MappingType.Hidden;
    employee.WriteXml(Server.MapPath("PersonWithSchema.xml"),
          XmlWriteMode.WriteSchema);    Response.Redirect("PersonWithSchema.xml");
}
```

XML

```
<?xml version="1.0" standalone="yes"?>
<NewDataSet>
  <xs:schema id="NewDataSet" xmlns="" xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:msdata="urn:schemas-microsoft-com:xml-msdata">
    <xs:element name="NewDataSet" msdata:IsDataSet="true"
                msdata:MainDataTable="Person" msdata:UseCurrentLocale="true">
      <xs:complexType>
        <xs:choice minOccurs="0" maxOccurs="unbounded">
          <xs:element name="Person">
            <xs:complexType>
              <xs:attribute name="Eid" msdata:Caption="EID" use="required">
                <xs:simpleType>
                  <xs:restriction base="xs:string">
                    <xs:maxLength value="10" />
                  </xs:restriction>
                </xs:simpleType>
              </xs:attribute>
              <xs:attribute name="FirstName" use="required">
                <xs:simpleType>
                  <xs:restriction base="xs:string">
                    <xs:maxLength value="35" />
                  </xs:restriction>
                </xs:simpleType>
              </xs:attribute>
              <xs:attribute name="LastName" type="xs:string" use="required" />
              <xs:attribute name="Salary" type="xs:decimal" default="0.00" />
              <xs:attribute name="LastName_x0020_and_x0020_FirstName"
                   msdata:ReadOnly="true"
                   msdata:Expression="lastName + ', ' + firstName"
                   use="prohibited">
                <xs:simpleType>
                  <xs:restriction base="xs:string">
                    <xs:maxLength value="70" />
                  </xs:restriction>
                </xs:simpleType>
              </xs:attribute>
            </xs:complexType>
          </xs:element>
        </xs:choice>
      </xs:complexType>
      <xs:unique name="Constraint1" msdata:PrimaryKey="true">
```

```
                <xs:selector xpath=".//Person" />
                <xs:field xpath="@Eid" />
            </xs:unique>
          </xs:element>
  </xs:schema>
  <Person Eid="123456789A" FirstName="Nancy" LastName="Davolio"
        Salary="10.00" />
  <Person Eid="987654321X" FirstName="Janet" LastName="Leverling"
        Salary="20.00" />
</NewDataSet>
```

With the XML Schema included in the file, the data types are defined. Notice that the XML schema also includes the maximum length settings for *Eid* and *FirstName*. A *DataTable* can be loaded with this XML file, and the resulting *DataTable* is the same as the *DataTable* that was saved to the file. The following code snippet reads the XML file into a new *DataTable* object:

```
'VB
Protected Sub Button8_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button8.Click
    'add grid to form
    Dim gv As New GridView()
    gv.Style.Add("position", "absolute")
    gv.Style.Add("left", "275px")
    gv.Style.Add("top", "20px")
    gv.EnableViewState = False
    form1.Controls.Add(gv)
    'get the table and display
    Dim xmlTable as New DataTable()
    xmlTable.ReadXml(Server.MapPath("PersonWithSchema.xml"))
    gv.DataSource = xmlTable
    gv.DataBind()
End Sub

//C#
protected void Button8_Click(object sender, EventArgs e)
{
    //add grid to form
    GridView gv = new GridView();
    gv.Style.Add("position", "absolute");
    gv.Style.Add("left", "275px");
    gv.Style.Add("top", "20px");
    gv.EnableViewState = false;
    form1.Controls.Add(gv);
    //get the table and display
    DataTable xmlTable = new DataTable();
    xmlTable.ReadXml(Server.MapPath("PersonWithSchema.xml"));
    gv.DataSource = xmlTable;
    gv.DataBind();
}
```

Although the data for the LastName and FirstName column was not saved, the col umn data is populated because this column is derived and the schema contains the expression to re-create this column data.

Opening a *DataView* Window in a *DataTable*

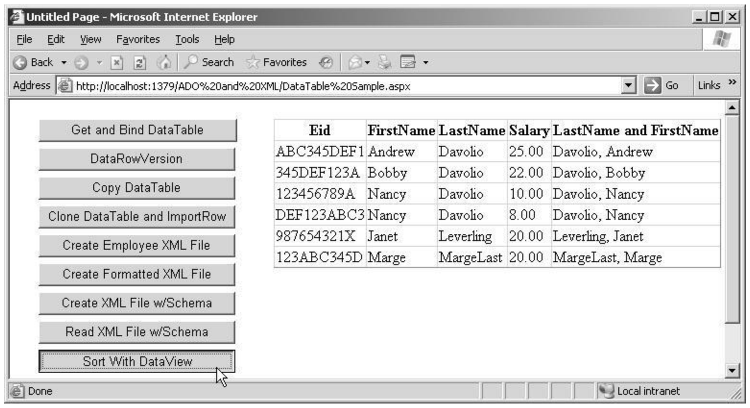
The *DataView* object provides a window into a *DataTable* that can be sorted and fil tered using the *Sort*, *RowFilter*, and *RowStateFilter* properties. A *DataTable* can have many *DataView* objects assigned to it, allowing the data to be viewed in many different ways without requiring the data to be reread from the database. The *DataView* object also contains the *AllowDelete*, *AllowEdit*, and *AllowNew* properties to constrain user input as needed.

If you look at the *DataView* object's internal structure, you will find that it is essen tially an index. You can provide a sort definition to sort the index in a certain order, and you can provide a filter to filter the index entries.

Ordering Data Using the *Sort* Property The *Sort* property requires a sort expression. The default order for the sort is ascending, but you can specify ASC or DESC with a comma-separated list of columns to be sorted. In the following code snippet, the employee *DataTable* is retrieved, additional rows are added, and a *DataView* is cre ated on the employee *DataTable* with a compound sort on the LastName column and the FirstName column in ascending order and on the Salary column in descending order.

'VB
```
Protected Sub Button9_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button9.Click
    'add grid to form
    Dim gv As New GridView()
    gv.Style.Add("position", "absolute")
    gv.Style.Add("left", "275px")
    gv.Style.Add("top", "20px")
    gv.EnableViewState = False
    form1.Controls.Add(gv)
    'get datatable
    Dim employee As DataTable = GetDataTable()
    'Add New DataRow by adding the values
    employee.Rows.Add("ABC345DEF1", "Thomas", "Andersen", 25.00)
    employee.Rows.Add("123ABC345D", "Sean", "Chai" , 20.00)
    employee.Rows.Add("345DEF123A", "Erik", "Andersen", 22.00)
    employee.Rows.Add("DEF123ABC3", "Nancy", "Andersen", 8.00)
    'sort and display
    Dim view As New DataView(employee)
    view.Sort = "LastName ASC, FirstName ASC, Salary  DESC"
    gv.DataSource = view
    gv.DataBind()
End Sub

//C#
protected void Button9_Click(object sender, EventArgs e)
{
    //add grid to form
    GridView gv = new GridView();
    gv.Style.Add("position", "absolute");
    gv.Style.Add("left", "275px");
    gv.Style.Add("top", "20px");
    gv.EnableViewState = false;
    form1.Controls.Add(gv);
    //get datatable
    DataTable employee = GetDataTable();
    //Add New DataRow by adding the values
    employee.Rows.Add("ABC345DEF1", "Thomas", "Andersen", 25.00m);
    employee.Rows.Add("123ABC345D", "Sean", "Chai" , 20.00m);
    employee.Rows.Add("345DEF123A", "Erik", "Andersen", 22.00m);
    employee.Rows.Add("DEF123ABC3", "Nancy", "Andersen", 8.00m);
    //sort and display
    DataView view = new DataView(employee);
    view.Sort = "LastName ASC, FirstName ASC, Salary  DESC";
    gv.DataSource = view;
    gv.DataBind();
}
```

Figure 4-5 shows the sorted *DataView* when the Web page is run.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1379/ADO%20and%20XML/DataTable%20Sample.aspx
Go Links
Get and Bind DataTable
DataRowVersion
Copy DataTable
Clone DataTable and ImportRow
Create Employee XML File
Create Formatted XML File
Create XML File w/Schema
Read XML File w/Schema
Sort With DataView
Done
Local intranet

Eid	FirstName	LastName	Salary	LastName and FirstName
ABC345DEF1	Andrew	Davolio	25.00	Davolio, Andrew
345DEF123A	Bobby	Davolio	22.00	Davolio, Bobby
123456789A	Nancy	Davolio	10.00	Davolio, Nancy
DEF123ABC3	Nancy	Davolio	8.00	Davolio, Nancy
987654321X	Janet	Leverling	20.00	Leverling, Janet
123ABC345D	Marge	MargeLast	20.00	MargeLast, Marge

Figure 4-5 The sorted employee *DataView* object.

Narrowing the Search with the *RowFilter* and *RowStateFilter* Properties The *DataView* filters comprise a *RowFilter* and a *RowStateFilter*. The *RowFilter* is set to a SQL *"WHERE"* clause without the word *"WHERE."* The following code shows a filter on the LastName column for employees whose names begin with the letter A and on the Salary column for employees whose salaries are greater than 15.

```
'VB
view.RowFilter = "LastName like 'A%' and Salary > 15"

//C#
view.RowFilter = "LastName like 'A%' and Salary > 15";
```

The *RowStateFilter* provides a filter based on the *DataRow* object's *RowState* property. This filter provides an extremely easy way to retrieve specific version information within the *DataTable* using one of the *DataViewRowState* enumeration values, which are as follows:

- ***Added*** Retrieves the Current *DataRowVersion* of *DataRow* objects that have a *RowState* of *Added*.
- ***CurrentRows*** Retrieves all *DataRow* objects that have a Current *DataRowVersion*.
- *Deleted* Retrieves the Original *DataRowVersion* of *DataRow* objects that have a *RowState* of *Deleted*.
- ***ModifiedCurrent*** Retrieves the Current *DataRowVersion* of *DataRow* objects that have a *RowState* of *Modified*.
- ***ModifiedOriginal*** Retrieves the Original *DataRowVersion* of *DataRow* objects that have a *RowState* of *Modified*.
- ***None*** Clears the *RowStateFilter* property.
- ***OriginalRows*** Retrieves the *DataRow* objects that have an Original *DataRow-Version*.
- ***Unchanged*** Retrieves *DataRow* objects that have a *RowState* of *Unchanged*.

Using a *DataSet* Object

The *DataSet* is a memory-based relational representation of data and is the primary dis connected data object. The *DataSet* contains a collection of *DataTable* and *DataRelation* objects, as shown in Figure 4-6. The *DataTable* objects can contain unique and for
eign key constraints to enforce data integrity. The *DataSet* also provides methods for

cloning the *DataSet* schema, copying the *DataSet*, merging with other *DataSet* objects, and retrieving changes from the *DataSet*.

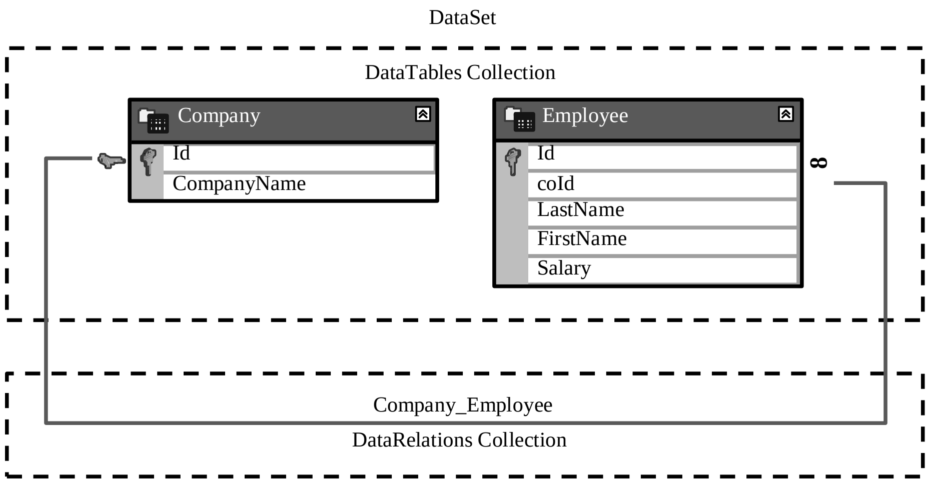


Figure 4-6 The *DataSet* object contains a collection of *DataTable* and *DataRelation* objects.

You can create the *DataSet* schema programmatically or by providing an XML schema definition. The following code demonstrates the creation of a simple *DataSet* contain ing a *DataTable* for companies and a *DataTable* for employees. The two *DataTable* objects are joined using a *DataRelation* named Company_Employee. (The *DataRela tion* is discussed in more detail in the next section of this chapter.)

'VB

```
Private Function GetDataSet() As DataSet

  Dim companyData As New DataSet("CompanyList")

  Dim company As DataTable = companyData.Tables.Add("company")
  company.Columns.Add("Id", GetType(Guid))
  company.Columns.Add("CompanyName", GetType(String))
  company.PrimaryKey = New DataColumn() {company.Columns("Id")}

  Dim employee As DataTable = companyData.Tables.Add("employee")
  employee.Columns.Add("Id", GetType(Guid))
  employee.Columns.Add("companyId", GetType(Guid))
  employee.Columns.Add("LastName", GetType(String))
  employee.Columns.Add("FirstName", GetType(String))
  employee.Columns.Add("Salary", GetType(Decimal))
  employee.PrimaryKey = New DataColumn() {employee.Columns("Id")}

  companyData.Relations.Add( _
      "Company_Employee", _
```

```
              company.Columns("Id"), _
              employee.Columns("CompanyId"))

       Return companyData
    End Function
```

//C#

```
private DataSet GetDataSet()
{
  DataSet companyData = new DataSet("CompanyList");

  DataTable company = companyData.Tables.Add("company");
  company.Columns.Add("Id", typeof(Guid));
  company.Columns.Add("CompanyName", typeof(string));
  company.PrimaryKey = new DataColumn[] { company.Columns["Id"] };

  DataTable employee = companyData.Tables.Add("employee");
  employee.Columns.Add("Id", typeof(Guid));
  employee.Columns.Add("companyId", typeof(Guid));
  employee.Columns.Add("LastName", typeof(string));
  employee.Columns.Add("FirstName", typeof(string));
  employee.Columns.Add("Salary", typeof(decimal));
  employee.PrimaryKey = new DataColumn[] { employee.Columns["Id"] };

  companyData.Relations.Add(
       "Company_Employee",
       company.Columns["Id"],
       employee.Columns["CompanyId"]);
  return companyData;
}
```

After the *DataSet* is created, the *DataTable* objects are populated with sample data, as shown in the following code sample. This code populates the Id columns by creating a new globally unique identifier. After a company is created and added to the com pany *DataTable*, the employee names for that company are created and added.

'VB

```
Public Sub PopulateDataSet(ByVal ds As DataSet)

  Dim company As DataTable = ds.Tables("Company")
  Dim employee As DataTable = ds.Tables("Employee")

  Dim coId, empId As Guid
  coId = Guid.NewGuid()
  company.Rows.Add(coId, "Northwind Traders")
  empId = Guid.NewGuid()
  employee.Rows.Add(empId, coId, "JoeLast", "JoeFirst", 40.00)
  empId = Guid.NewGuid()
  employee.Rows.Add(empId, coId, "MaryLast", "MaryFirst", 70.00)
  empId = Guid.NewGuid()
```

```
 employee.Rows.Add(empId, coId, "SamLast", "SamFirst", 12.00)

 coId = Guid.NewGuid()
 company.Rows.Add(coId, "Contoso")
 empId = Guid.NewGuid()
 employee.Rows.Add(empId, coId, "SueLast", "SueFirst", 20.00)
 empId = Guid.NewGuid()
 employee.Rows.Add(empId, coId, "TomLast", "TomFirst", 68.00)
 empId = Guid.NewGuid()
 employee.Rows.Add(empId, coId, "MikeLast", "MikeFirst", 18.99)

End Sub

//C#
private void PopulateDataSet(DataSet ds)
{
    DataTable company = ds.Tables["Company"];
    DataTable employee = ds.Tables["Employee"];

    Guid coId, empId;
    coId = Guid.NewGuid();
    company.Rows.Add(coId, "Northwind Traders");
    empId = Guid.NewGuid();
    employee.Rows.Add(empId, coId, "JoeLast", "JoeFirst", 40.00);
    empId = Guid.NewGuid();
    employee.Rows.Add(empId, coId, "MaryLast", "MaryFirst", 70.00);
    empId = Guid.NewGuid();
    employee.Rows.Add(empId, coId, "SamLast", "SamFirst", 12.00);

    coId = Guid.NewGuid();
    company.Rows.Add(coId, "Contoso");
    empId = Guid.NewGuid();
    employee.Rows.Add(empId, coId, "SueLast", "SueFirst", 20.00);
    empId = Guid.NewGuid();
    employee.Rows.Add(empId, coId, "TomLast", "TomFirst", 68.00);
    empId = Guid.NewGuid();
    employee.Rows.Add(empId, coId, "MikeLast", "MikeFirst", 18.99);
}
```

Using the Globally Unique Identifier (GUID) as a Primary Key

The previous code sample creates and populates a *DataSet*. Notice the use of the *Guid* data type for the Id columns. Although this option is not mandatory, you should con sider implementing this option, especially when working with disconnected data. This can help you deal with the following issues:

- If you use an auto-number Id column and if many people are creating new *DataRow* objects, it will be difficult for you to merge data later because there may be many duplicate keys.

- The *Guid* data type is a “surrogate” key, meaning that its only purpose is to define uniqueness of the row and aid in connecting multiple tables together via relationships. This means that there is no reason for a user to see and change this value, which simplifies maintenance of the *DataSet*. If you allow the user to change the primary key on a row, you have to propogate the change down to all of the related tables. For example, changing the CompanyId value requires the update of the Company Id value in the Employee table.
- The use of the *Guid* can simplify the joining of tables, which is better than the scenarios where you use compound keys that are based on the actual data. Com pound keys typically result in smaller data footprints because the key is based on actual data, whereas joining tables is usually more difficult because compound joins are required. Remember that if you are using compound keys that are based on the actual data, you inevitably need to deal with recursive updates.

GetLabel and *GetGridView* Methods

The sample code in this chapter makes calls to the *GetLabel* and *GetGridView* methods. Instead of placing a *GridView* or *Label* control on the form to display the sample code output, these methods are used to dynamically create the proper output control as needed, which simplifies the sample code. The code for these methods is as follows.

```
'VB
Private Function GetLabel(ByVal left As Integer, _
       ByVal top As Integer) As Label
    Dim lbl As New Label()
    lbl.Style.Add("position", "absolute")
    lbl.Style.Add("left", left.ToString() + "px")
    lbl.Style.Add("top", top.ToString() + "px")
    lbl.EnableViewState = False
    form1.Controls.Add(lbl)
    Return lbl
End Function

Private Function GetGridView(ByVal left As Integer, _
       ByVal top As Integer) As GridView
    Dim gv As New GridView()
    gv.Style.Add("position", "absolute")
    gv.Style.Add("left", left.ToString() + "px")
    gv.Style.Add("top", top.ToString() + "px")
    gv.EnableViewState = False
    form1.Controls.Add(gv)
    Return gv
End Function
```

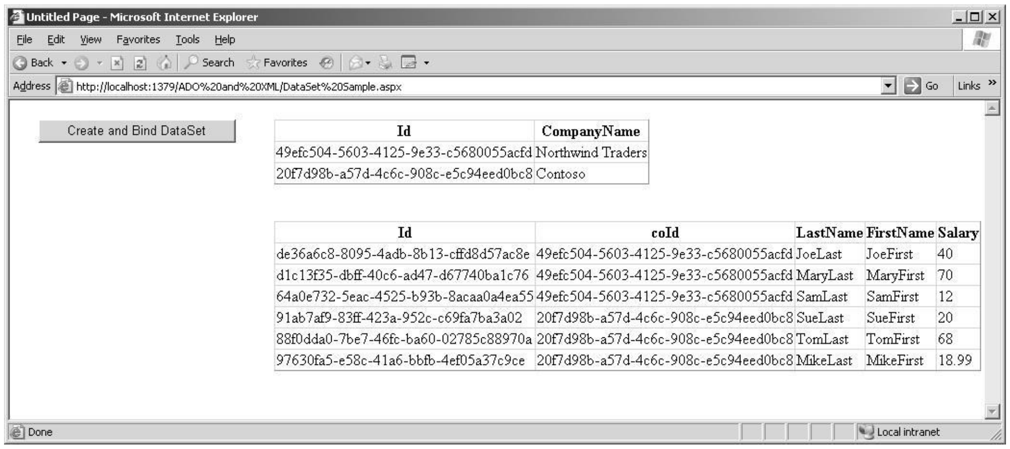
```
//C#
private Label GetLabel(int left, int top)
{
    Label lbl = new Label();
    lbl.Style.Add("position", "absolute");
    lbl.Style.Add("left", left.ToString() + "px");
    lbl.Style.Add("top", top.ToString() + "px");
    lbl.EnableViewState = false;
    form1.Controls.Add(lbl);
    return lbl;
}

private GridView GetGridView(int left, int top)
{
    GridView gv = new GridView();
    gv.Style.Add("position", "absolute");
    gv.Style.Add("left", left.ToString() + "px");
    gv.Style.Add("top", top.ToString() + "px");
    gv.EnableViewState = false;
    form1.Controls.Add(gv);
    return gv;
}
```

Binding to the *DataSet* Object

Assign the *DataSet* to the *DataSource* property of a data-bound control to display the contents of a *DataSet*. The first *DataTable* in the *DataSet* is rendered when you issue the *DataBind* method on the control, but you can be more specific about the *Data-Table* to use by assigning the name of the *DataTable* to the *DataMember* property of the data-bound control. The following code snippet uses the *GetGridView*, which dynamically creates a *GridView* and adds it to the form. This method is called to create a *GridView* for the Company table and another *GridView* for the Employee table. The code sample retrieves the populated *DataSet*, retrieves the populated *DataSet*, and binds the *DataSet* to the *GridView* controls:

```
' VB
Protected Sub Button1_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button1.Click
  'add grids to form
  Dim gvCompany As GridView = GetGridView(275, 20)
  Dim gvEmployee As GridView = GetGridView(275, 125)

  'get the dataset and display
  Dim companyList As DataSet = GetDataSet()
  PopulateDataSet(companyList)

  'display
  gvCompany.DataSource = companyList
  gvCompany.DataMember = "Company"
  gvEmployee.DataSource = companyList
  gvEmployee.DataMember = "Employee"
  gvCompany.DataBind()
  gvEmployee.DataBind()
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    //add grids to form
    GridView gvCompany = GetGridView(275, 20);
    GridView gvEmployee = GetGridView(275, 125);

    //get the dataset and populate
    DataSet companyList = GetDataSet();
    PopulateDataSet(companyList);

    //display
    gvCompany.DataSource = companyList;
    gvCompany.DataMember = "Company";
    gvEmployee.DataSource = companyList;
    gvEmployee.DataMember = "Employee";
    gvCompany.DataBind();
    gvEmployee.DataBind();
}
```

Figure 4-7 shows the result after the Web page is displayed and the button is clicked.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1379/ADO%20and%20XML/DataSet%20Sample.aspx
Go Links
Create and Bind DataSet
Done
Local intranet

Id	CompanyName
49efc504-5603-4125-9e33-c5680055acfd	Northwind Traders
20f7d98b-a57d-4c6c-908c-e5c94eed0bc8	Contoso

Id	coId	LastName	FirstName	Salary
de36a6c8-8095-4adb-8b13-cffd8d57ac8e	49efc504-5603-4125-9e33-c5680055acfd	JoeLast	JoeFirst	40
d1c13f35-dbff-40c6-ad47-d67740ba1c76	49efc504-5603-4125-9e33-c5680055acfd	MaryLast	MaryFirst	70
64a0e732-5eac-4525-b93b-8acaa0a4ea55	49efc504-5603-4125-9e33-c5680055acfd	SamLast	SamFirst	12
91ab7af9-83ff-423a-952c-c69fa7ba3a02	20f7d98b-a57d-4c6c-908c-e5c94eed0bc8	SueLast	SueFirst	20
88f0dda0-7be7-46fc-ba60-02785c88970a	20f7d98b-a57d-4c6c-908c-e5c94eed0bc8	TomLast	TomFirst	68
97630fa5-e58c-41a6-bbfb-4ef05a37c9ce	20f7d98b-a57d-4c6c-908c-e5c94eed0bc8	MikeLast	MikeFirst	18.99

Figure 4-7 The populated *DataSet*, bound to two *GridView* controls.

Using Typed *DataSets*

After the *DataSet* object's schema is created, you can access any of the *DataTable* objects by using the table name (as shown in the following example) that retrieves the *Company DataTable* from the *saleData DataSet* object:

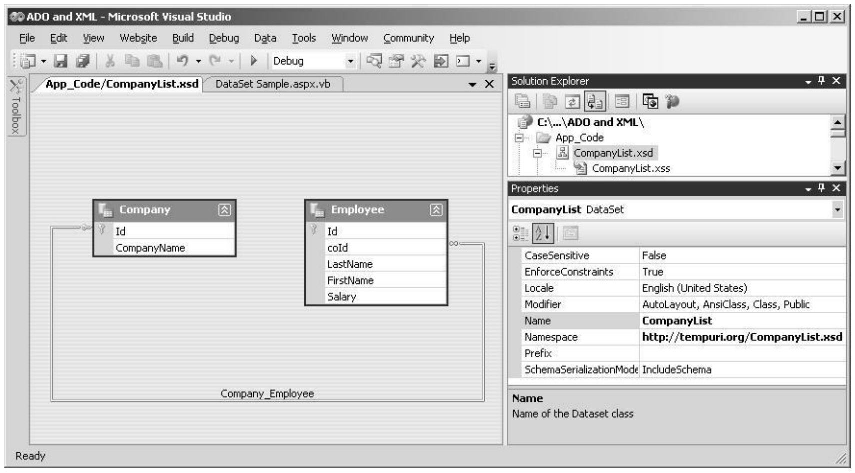
```
'VB
Dim companyTable as DataTable = salesData.Tables("Company")

//C#
DataTable companyTable = salesData.Tables["Company"];
```

If the name of the table is misspelled, an exception is thrown, but not until runtime. You can be notified of an error when you build your project by creating a new, special ized *DataSet* class that inherits from *DataSet,* and by adding a property for each of the tables. For example, a specialized *DataSet* class might contain a property called *Com pany* that can be accessed as follows:

```
'VB
Dim companyTable as DataTable = vendorData.Company

//C#
DataTable companyTable = vendorData.Company;
```

In this example, a compile error is generated if Company is not spelled correctly. (Keep in mind that you probably won't misspell the *Company* property because Visual Studio's IntelliSense displays the *Company* property for quick selection when the line of code is being typed.)

You can provide an XML Schema Definition (XSD) file to generate the typed *DataSet* class. You can use the DataSet Editor to graphically create and modify an XSD file, which, in turn, can be used to generate the typed *DataSet* class. Figure 4-8 shows the CompanyList *DataSet* that is loaded into the DataSet Editor.



CompanyList DataSet

CaseSensitive	False
EnforceConstraints	True
Locale	English (United States)
Modifier	AutoLayout, AnsiClass, Class, Public
Name	**CompanyList**
Namespace	**http://tempuri.org/CompanyList.xsd**
Prefix	
SchemaSerializationMode	IncludeSchema

Name
Name of the Dataset class

Figure 4-8 The DataSet template contains an XML schema definition and generates source code to create a typed *DataSet*.

Navigating *DataTable* Objects with *DataRelation* Objects

The *DataRelation* object is used to join two *DataTable* objects that are in the same *DataSet*, thus providing a navigable path between the two *DataTable* objects. The *DataRelation* can be traversed from parent *DataTable* to child *DataTable* or from child *DataTable* to parent *DataTable*. The following code example populates the Company and Employee *DataTable* objects and then performs *DataRelation* object navigation:

'VB

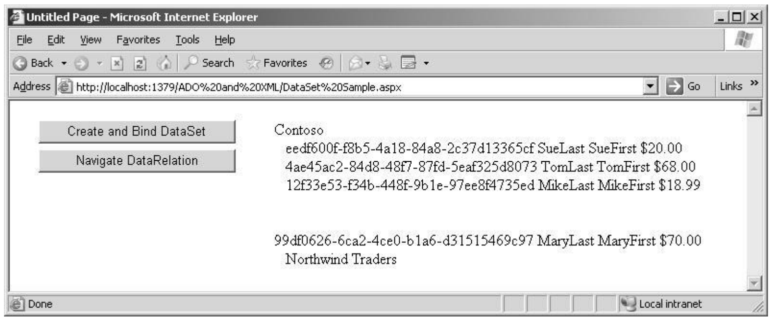
```
Protected Sub Button2_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button2.Click
    'add a label to the form
    Dim lbl As Label = GetLabel(275, 20)

    'get the dataset and populate
    Dim companyList As DataSet = GetDataSet()
    PopulateDataSet(companyList)

    'get the relationship
    Dim dr As DataRelation = companyList.Relations("Company_Employee")

    'display second company
    Dim companyParent As DataRow = companyList.Tables("company").Rows(1)
    lbl.Text = companyParent("CompanyName") + "<br />"

    'display employees
    For Each employeeChild As DataRow In companyParent.GetChildRows(dr)
        lbl.Text += "&nbsp;&nbsp;&nbsp;" + employeeChild("Id").ToString() + " " _
          + employeeChild("LastName") + " " _
```

```
                + employeeChild("FirstName") + " " _
                + String.Format("{0:C}", employeeChild("Salary")) + "<br />"
        Next

        lbl.Text += "<br /><br />"

        'display second employee
        Dim employeeParent As DataRow = companyList.Tables("employee").Rows(1)
        lbl.Text += employeeParent("Id").ToString() + " " _
          + employeeParent("LastName") + " " _
          + employeeParent("FirstName") + " " _
          + String.Format("{0:C}", employeeParent("Salary")) + "<br />"

        'display company
        Dim companyChild As DataRow = employeeParent.GetParentRow(dr)
        lbl.Text += "&nbsp;&nbsp;&nbsp;" + companyChild("CompanyName") + "<br />"
End Sub
```

//C#

```
protected void Button2_Click(object sender, EventArgs e)
{
        //add a label to the form
        Label lbl = GetLabel(275, 20);

        //get the dataset and populate
        DataSet companyList = GetDataSet();
        PopulateDataSet(companyList);

        //get the relationship
        DataRelation dr = companyList.Relations["Company_Employee"];

        //display second company
        DataRow companyParent = companyList.Tables["company"].Rows[1];
        lbl.Text = companyParent["CompanyName"] + "<br />";

        //display employees
        foreach (DataRow employeeChild in companyParent.GetChildRows(dr))
         {
                lbl.Text += "&nbsp;&nbsp;&nbsp;" + employeeChild["Id"] + " "
                  + employeeChild["LastName"] + " "
                  + employeeChild["FirstName"] + " "
                  + string.Format("{0:C}", employeeChild["Salary"]) + "<br />";
         }

        lbl.Text += "<br /><br />";

        //display second employee
        DataRow employeeParent = companyList.Tables["employee"].Rows[1];
        lbl.Text += employeeParent["Id"] + " "
          + employeeParent["LastName"] + " "
          + employeeParent["FirstName"] + " "
          + string.Format("{0:C}", employeeParent["Salary"]) + "<br />";
        //display company
        DataRow companyChild = employeeParent.GetParentRow(dr);
        lbl.Text += "&nbsp;&nbsp;&nbsp;" + companyChild["CompanyName"] + "<br />";
}
```

In this code example, the previously declared Company_Employee *DataRelation* navigates from parent to child and then from child to parent. The result is shown in Figure 4-9.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1379/ADO%20and%20XML/DataSet%20Sample.aspx
Go Links
Create and Bind DataSet
Navigate DataRelation
Done
Local intranet

```
Contoso
   eedf600f-f8b5-4a18-84a8-2c37d13365cf SueLast SueFirst $20.00
   4ae45ac2-84d8-48f7-87fd-5eaf325d8073 TomLast TomFirst $68.00
   12f33e53-f34b-448f-9b1e-97ee8f4735ed MikeLast MikeFirst $18.99


99df0626-6ca2-4ce0-b1a6-d31515469c97 MaryLast MaryFirst $70.00
   Northwind Traders
```

Figure 4-9 The *DataRelation* object is used to navigate the *DataTable* objects from parent to child or child to parent.

Primary and Foreign Key Constraint Creation When you create a *DataRelation* object without unique and foreign key constraints, its sole purpose is to navigate between parent and child *DataTable* objects. The *DataRelation* constructor allows for the cre ation of a unique constraint on the parent *DataTable* object and a foreign key con straint on the child *DataTable* object.

Cascading Updates and Deletes There are many scenarios where you want the dele tion of a parent *DataRow* object to force the deletion of child *DataRow* objects. You can accomplish this by setting the *DeleteRule* on the *ForeignKeyConstraint* to *Cascade* (default). The following is a list of the *Rule* enumeration members:

- ***Cascade*** Default. Deletes or updates the child *DataRow* objects when the *DataRow* object is deleted or its unique key is changed.
- ***None*** Throws an *InvalidConstraintException* if the parent *DataRow* object is deleted or its unique key is changed.
- ***SetDefault*** Sets the foreign key column(s) value to the default value of the *Data-Column* object(s) if the parent *DataRow* object is deleted or its unique key is changed.

- ***SetNull*** Sets the foreign key column(s) value to *DbNull* if the parent *DataRow* object is deleted or its unique key is changed.

As with deleting, on some occasions, you'll want to cascade changes to a unique key in the parent *DataRow* object to the child *DataRow* object's foreign key. You can set the *ChangeRule* to a member of the *Rule* enumeration to get the appropriate behavior.

Serializing and Deserializing *DataSet* Objects

A *DataSet* can be serialized as XML or as binary data to a stream or file. The *DataSet* can also be deserialized from XML or binary data from a stream or file. The serialized data can be transferred across a network via many protocols, including HTTP. This section looks at the various methods of transferring data.

Serializing the *DataSet* Object as XML You can serialize a *DataSet* to an XML file by executing the *DataSet* object's *WriteXml* method. The following code snippet uses the populated companyList *DataSet* that was created earlier in this chapter and writes the contents to an XML file. The resulting XML file contents are also shown.

```
'VB
Protected Sub Button4_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button4.Click
    'get dataset and populate
    'get the dataset and populate
     Dim companyList As DataSet = GetDataSet()
     PopulateDataSet(companyList)

     'write to xml file
     companyList.WriteXml(MapPath("CompanyList.xml"))

     'display file
     Response.Redirect("CompanyList.xml")
End Sub

//C#
protected void Button4_Click(object sender, EventArgs e)
{
     //get dataset and populate
     //get the dataset and populate
     DataSet companyList = GetDataSet();
     PopulateDataSet(companyList);

     //write to xml file
     companyList.WriteXml(MapPath("CompanyList.xml"));

     //display file
    Response.Redirect("CompanyList.xml");
}
```

XML

```
<?xml version="1.0" standalone="yes"?>
<CompanyList>
  <company>
      <Id>c2a464fb-bdce-498a-a216-fb844dfb05a5</Id>
      <CompanyName>Northwind Traders</CompanyName>
  </company>
  <company>
      <Id>aa40966c-18b7-451b-acea-237eaa5e08af</Id>
      <CompanyName>Contoso</CompanyName>
  </company>
  <employee>
      <Id>7ad2a59c-dd3a-483b-877c-b4fe0d0c9bbe</Id>
      <coId>c2a464fb-bdce-498a-a216-fb844dfb05a5</coId>
      <LastName>JoeLast</LastName>
      <FirstName>JoeFirst</FirstName>
      <Salary>40</Salary>
  </employee>
  <employee>
      <Id>343d98b0-e6aa-432d-9755-2c9501cd1ace</Id>
      <coId>c2a464fb-bdce-498a-a216-fb844dfb05a5</coId>
      <LastName>MaryLast</LastName>
      <FirstName>MaryFirst</FirstName>
      <Salary>70</Salary>
  </employee>
  <employee>
      <Id>d69af78c-8f2e-4d4f-9fd0-e0ebca6fccaa</Id>
      <coId>c2a464fb-bdce-498a-a216-fb844dfb05a5</coId>
      <LastName>SamLast</LastName>
      <FirstName>SamFirst</FirstName>
      <Salary>12</Salary>
  </employee>
  <employee>
      <Id>3cc2b9da-3087-47de-99eb-9f924f1edb0d</Id>
      <coId>aa40966c-18b7-451b-acea-237eaa5e08af</coId>
      <LastName>SueLast</LastName>
      <FirstName>SueFirst</FirstName>
      <Salary>20</Salary>
  </employee>
  <employee>
      <Id>c5804b95-c498-45ab-91b4-07fc50154f2a</Id>
      <coId>aa40966c-18b7-451b-acea-237eaa5e08af</coId>
      <LastName>TomLast</LastName>
      <FirstName>TomFirst</FirstName>
      <Salary>68</Salary>
  </employee>
  <employee>
      <Id>ad3ca5ac-eac9-4bec-88d2-5d32522abd41</Id>
      <coId>aa40966c-18b7-451b-acea-237eaa5e08af</coId>
      <LastName>MikeLast</LastName>
```

```
        <FirstName>MikeFirst</FirstName>
        <Salary>18.99</Salary>
  </employee>
</CompanyList>
```

The XML document is well formed and its root node is called *CompanyList*, which you can change by changing the *DataSetName* property.

Notice that the single *Company DataRow* object is represented in the XML file by the single *Company* element, while the *Employee DataRow* objects are represented in the XML file by the repeating *Employee* elements. The column data is represented as ele ments within the element for the *DataRow*, but you can change this by changing the *ColumnMapping* property of the *DataColumn* objects.

You can nest the *Employee* elements inside the *Company* object that has the employees by setting the *Nested* property of the *DataRelation* object to *true*. In the following code snippet, the XML format is changed substantially by nesting the data and setting all of the *DataColumn* objects to *Attribute*. The resulting XML file is also shown.

```
'VB
Protected Sub Button5_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button5.Click
    'get dataset and populate
    'get the dataset and populate
     Dim companyList As DataSet = GetDataSet()
     PopulateDataSet(companyList)

     'format xml
     companyList.Relations("Company_Employee").Nested = True
     For Each dt As DataTable In companyList.Tables
        For Each dc As DataColumn In dt.Columns
               dc.ColumnMapping = MappingType.Attribute
        Next
     Next

     'write to xml file
     companyList.WriteXml(MapPath("CompanyList.xml"))

     'display file
     Response.Redirect("CompanyList.xml")
End Sub

//C#
protected void Button5_Click(object sender, EventArgs e)
{
     //get dataset and populate
     //get the dataset and populate
     DataSet companyList = GetDataSet();
     PopulateDataSet(companyList);
    //format xml
    companyList.Relations["Company_Employee"].Nested = true;
    foreach (DataTable dt in companyList.Tables)
    {
        foreach (DataColumn dc in dt.Columns)
            {
                dc.ColumnMapping = MappingType.Attribute;
            }
    }

    //write to xml file
    companyList.WriteXml(MapPath("CompanyListNested.xml"));

    //display file
    Response.Redirect("CompanyListNested.xml");
}
```

XML

```
<?xml version="1.0" standalone="yes"?>
<CompanyList>
  <company Id="63cd2a1e-c578-4f21-a826-c5dfb50258b0"
        CompanyName="Northwind Traders">
      <employee Id="a2e7bbba-20ba-4b73-86b3-2d0cca4f1bbb"
            coId="63cd2a1e-c578-4f21-a826-c5dfb50258b0"
            LastName="JoeLast" FirstName="JoeFirst" Salary="40" />
      <employee Id="5cf475e8-1d97-4784-b72f-84bfbf4a8e14"
            coId="63cd2a1e-c578-4f21-a826-c5dfb50258b0"
            LastName="MaryLast" FirstName="MaryFirst" Salary="70" />
      <employee Id="55ff1a2b-8956-4ded-99a4-68610134b774"
            coId="63cd2a1e-c578-4f21-a826-c5dfb50258b0"
            LastName="SamLast" FirstName="SamFirst" Salary="12" />
  </company>
  <company Id="0adcf278-ccd3-4c3d-a78a-27aa35dc2756"
        CompanyName="Contoso">
      <employee Id="bc431c32-5397-47b6-9a16-0667be455f02"
            coId="0adcf278-ccd3-4c3d-a78a-27aa35dc2756"
            LastName="SueLast" FirstName="SueFirst" Salary="20" />
      <employee Id="5822bf9f-49c1-42dd-95e0-5bb728c5ac60"
            coId="0adcf278-ccd3-4c3d-a78a-27aa35dc2756"
            LastName="TomLast" FirstName="TomFirst" Salary="68" />
      <employee Id="1b2334a4-e339-4255-b826-c0453fda7e61"
            coId="0adcf278-ccd3-4c3d-a78a-27aa35dc2756"
            LastName="MikeLast" FirstName="MikeFirst" Salary="18.99" />
  </company>
</CompanyList>
```

In the example, the XML file is written, but the XML file contains no information that describes the data types of the data. When not specified, the default data type for all data is *string*. If the XML file is read into a new *DataSet*, all data, including *DateTime* data and numeric data, is loaded as string data. Use the *XmlWriteMode.WriteSchema* enumeration value when saving because it stores the data type information with the XML file, as shown in the following code snippet:

```
'VB
'write to xml file with schema
companyList.WriteXml( _
    MapPath("CompanyListNestedWithSchema.xml"), _
    XmlWriteMode.WriteSchema)

//C#
//write to xml file with schema
companyList.WriteXml(
    MapPath("CompanyListNestedWithSchema.xml"),
    XmlWriteMode.WriteSchema);
```

The XML file is substantially larger than what's presented here. Instead of embedding the schema in the XML file, you can create a separate XSD file to load before loading the data. You can use the *DataSet* object's *WriteXmlSchema* method to extract the XML schema definition to a separate file, as shown here:

```
'VB
'write to xsd file
companyList.WriteXmlSchema( _
    MapPath("CompanyListSchema.xsd"))

//C#
//write to xsd file
companyList.WriteXmlSchema(
    MapPath("CompanyListSchema.xsd"));
```

Serializing a Changed *DataSet* Object as a DiffGram A *DiffGram* is an XML document that contains all of the data from your *DataSet* object, including the original *DataRow* object information. To save as a DiffGram, use the *XmlWriteMode.DiffGram* enumera tion value when serializing a *DataSet* object. This snippet shows the creation of com pany rows with changes that make it so that one is inserted, one is updated, one is deleted, and one is unchanged. Then the *DataSet* is written as a DiffGram.

```
'VB
Protected Sub Button8_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button8.Click
     'get the dataset and populate
    Dim companyList As DataSet = GetDataSet()
    Dim company as DataTable = companyList.Tables("company")
    company.Rows.Add(Guid.NewGuid(), "UnchangedCompany")
    company.Rows.Add(Guid.NewGuid(), "ModifiedCompany")
    company.Rows.Add(Guid.NewGuid(), "DeletedCompany")
    companyList.AcceptChanges()
    company.Rows(1)("CompanyName") = "ModifiedCompany1"
    company.Rows(2).Delete()
    company.Rows.Add(Guid.NewGuid(), "AddedCompany")

    'format xml
    companyList.Relations("Company_Employee").Nested = True
    For Each dt As DataTable In companyList.Tables
        For Each dc As DataColumn In dt.Columns
            dc.ColumnMapping = MappingType.Attribute
        Next
    Next

    'write to xml diffgram file
    companyList.WriteXml( _
      MapPath("companyListDiffGram.xml"), XmlWriteMode.DiffGram)

    'display file
    Response.Redirect("companyListDiffGram.xml")
End Sub
```

//C#

```
protected void Button8_Click(object sender, EventArgs e)
{
    //get the dataset and populate
    DataSet companyList = GetDataSet();
    DataTable company = companyList.Tables["company"];
    company.Rows.Add(Guid.NewGuid(), "UnchangedCompany");
    company.Rows.Add(Guid.NewGuid(), "ModifiedCompany");
    company.Rows.Add(Guid.NewGuid(), "DeletedCompany");
    companyList.AcceptChanges();
    company.Rows[1]["CompanyName"] = "ModifiedCompany1";
    company.Rows[2].Delete();
    company.Rows.Add(Guid.NewGuid(), "AddedCompany");

    //format xml
    companyList.Relations["Company_Employee"].Nested = true;
    foreach (DataTable dt in companyList.Tables)
     {
        foreach (DataColumn dc in dt.Columns)
        {
            dc.ColumnMapping = MappingType.Attribute;
        }
     }

    //write to xml diffgram file
    companyList.WriteXml(
      MapPath("CompanyListDiffGram.xml"), XmlWriteMode.DiffGram);
    //display file
    Response.Redirect("CompanyListDiffGram.xml");
}
```

The DiffGram is mostly used in an environment where a user occasionally connects to a database to synchronize a disconnected *DataSet* object with the current information that is contained in the database. When the user is not connected to the database, the *DataSet* object is stored locally as a DiffGram to ensure that you still have the original data, because the original data is needed when it's time to send your changes back to the database.

The DiffGram contains all of the *DataRowVersion* information, as shown in the fol lowing XML document. Company1 has not been modified. Notice that Company2 has been modified, and its status is indicated as such. Also notice that the bottom of the XML document contains the original information for *DataRow* objects that have been modified or deleted. This XML document also shows Company3 as deleted because Company3 has "before" information but not current information. Company4 is an inserted *DataRow* object as indicated, so this *DataRow* object has no "before" information.

```
<?xml version="1.0" standalone="yes"?>
<diffgr:diffgram xmlns:msdata="urn:schemas-microsoft-com:xml-msdata"
     xmlns:diffgr="urn:schemas-microsoft-com:xml-diffgram-v1">
 <CompanyList>
    <company diffgr:id="company1" msdata:rowOrder="0"
          Id="09b8482c-e801-4c63-82f6-0f5527b3768b"
          CompanyName="UnchangedCompany" />
    <company diffgr:id="company2" msdata:rowOrder="1"
          diffgr:hasChanges="modified"
          Id="8f9eceb3-b6de-4da7-84dd-d99a278a23ee"
          CompanyName="ModifiedCompany1" />
    <company diffgr:id="company4" msdata:rowOrder="3"
          diffgr:hasChanges="inserted"
          Id="65d28892-b8af-4392-8b64-718a612f6aa7"
          CompanyName="AddedCompany" />
 </CompanyList>
 <diffgr:before>
    <company diffgr:id="company2" msdata:rowOrder="1"
          Id="8f9eceb3-b6de-4da7-84dd-d99a278a23ee"
          CompanyName="ModifiedCompany" />
    <company diffgr:id="company3" msdata:rowOrder="2"
          Id="89b576d2-60ae-4c36-ba96-c4a7a8966a6f"
          CompanyName="DeletedCompany" />
 </diffgr:before>
</diffgr:diffgram>
```

Deserializing a *DataSet* from XML You can deserialize an XML file or stream into a *DataSet* object by loading the schema and reading the stream. You can use the follow ing code to read the schema file and the load the XML file:

```
'VB
Protected Sub Button9_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button9.Click
    'add grids to form
    Dim gvCompany As GridView = GetGridView(275, 20)
    Dim gvEmployee As GridView = GetGridView(275, 125)

   'get the dataset and populate schema
    Dim companyList as new DataSet()
    companyList.ReadXmlSchema(MapPath("CompanyListSchema.xsd"))
    'populate from file
    companyList.ReadXml(MapPath("CompanyListNested.xml"))

    'display
    gvCompany.DataSource = companyList
    gvCompany.DataMember = "Company"
    gvEmployee.DataSource = companyList
    gvEmployee.DataMember = "Employee"
    gvCompany.DataBind()
    gvEmployee.DataBind()
End Sub

//C#
protected void Button9_Click(object sender, EventArgs e)
{
    //add grids to form
   GridView gvCompany = GetGridView(275, 20);
    GridView gvEmployee = GetGridView(275, 125);

    //get the dataset and populate schema
    DataSet companyList = new DataSet();
    companyList.ReadXmlSchema(MapPath("CompanyListSchema.xsd"));
    //populate from file
    companyList.ReadXml(MapPath("CompanyListNested.xml"));

    //display
    gvCompany.DataSource = companyList;
    gvCompany.DataMember = "Company";
    gvEmployee.DataSource = companyList;
    gvEmployee.DataMember = "Employee";
    gvCompany.DataBind();
    gvEmployee.DataBind();
}
```

When reading an XML file, you can optionally pass an *XmlReadMode* enumeration value. If this value is not passed, the default is *XmlReadMode.IgnoreSchema*. This means that if the XML data file contains an XML schema definition, it is ignored. Listed below are the other options of the *XmlReadMode* enumeration:

- ***Auto*** The XML source is examined by the *ReadXml* method and the appropriate mode is selected.
- ***DiffGram*** If the *XmlFile* contains a *DiffGram*, the changes are applied to the *DataSet* using the same semantics that the *Merge* method uses. (*Merge* is covered in more detail in the next section.)
- ***Fragment*** This option causes the XML to be read as a fragment. Fragments can contain multiple root elements. *FOR XML* in SQL Server is an example of some thing that produces fragments.
- ***IgnoreSchema*** This causes any schema that is defined within the XML data file to be ignored.
- ***InferSchema*** Using this option, the XML file is read, and the *DataTable* objects and *DataColumn* objects are created based on the data. If the *DataSet* currently has *DataTable* objects and *DataColumn* objects, they are used and extended to accommodate new tables and columns that exist in the XML document, but don't exist in the *DataSet* object. All data types of all *DataColumn* objects are a string.
- ***InferTypedSchema*** Using this option, the XML file is read, and the schema is cre ated based on the data. An attempt is made to identify the data type of each col umn, but if the data type cannot be identified, it is a string.
- ***ReadSchema*** Using this option, the XML file is read, and then embedded schema is searched for. If the *DataSet* already has *DataTable* objects with the same name, an exception is thrown. All other existing tables remain.

Inferring a schema simply means that the *DataSet* attempts to create a schema for the data based on looking for patterns of XML elements and attributes.

Serializing the *DataSet* Object as Binary Data The size of an XML file that is produced when serializing a *DataSet* object can cause problems with resources, such as memory and drive space or bandwidth, when you move this data across the network. If XML is not required and you want the best performance, the *DataSet* can be serialized as a binary file. The following code snippet writes the contents of the *vendorData DataSet* that we previously defined and populated to a binary file:

```
'VB
'Added the following Imports statements to the top of the file
Imports System.Runtime.Serialization.Formatters.Binary
Imports System.IO

Protected Sub Button10_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button10.Click
    'get dataset and populate
    'get the dataset and populate
     Dim companyList As DataSet = GetDataSet()
     PopulateDataSet(companyList)

     'set output to binary else this will be xml
     companyList.RemotingFormat = SerializationFormat.Binary

     'write to binary file
     Using fs As New FileStream( _
       MapPath("CompanyList.bin"), FileMode.Create)
     Dim fmt As New BinaryFormatter()
     fmt.Serialize(fs, companyList)
End Using

     'feedback
     Dim lbl As Label = GetLabel(275, 20)
     lbl.Text = "File Saved."

End Sub

//C#
//Added the following using statements to the top of the file
using System.Runtime.Serialization.Formatters.Binary;
using System.IO;

protected void Button10_Click(object sender, EventArgs e)
{
     //get dataset and populate
     //get the dataset and populate
     DataSet companyList = GetDataSet();
     PopulateDataSet(companyList);

     //set output to binary else this will be xml
     companyList.RemotingFormat = SerializationFormat.Binary;

     //write to binary file
     using (FileStream fs =
       new FileStream(MapPath("CompanyList.bin"), FileMode.Create))
     {
            BinaryFormatter fmt = new BinaryFormatter();
            fmt.Serialize(fs, companyList);
        }

        //feedback
        Label lbl = GetLabel(275, 20);
        lbl.Text = "File Saved.";
}
```

NOTE New in ADO.NET 2.0

The *RemotingFormat* property, which provides true binary serialization, is new in ADO.NET 2.0.

The *DataSet* object's *RemotingFormat* property must be set to ensure binary serializa tion. This property is also available on the *DataTable* object for scenarios where only a single *DataTable* is to be binary serialized. Be careful when making the choice to seri alize as XML or binary, because binary files contain more initial overhead (about 20 kilobytes) than XML files. For large *DataSet* objects, binary serialization always pro duces a smaller file, but for small *DataSet* objects, binary serialization may not pro duce the desired result.

Deserializing a *DataSet* from Binary Data You can easily deserialize the binary data file that we created in the previous example into a *DataSet* from a file or stream. The *BinaryFormatter* stores the schema automatically, so there is no need to load a schema first. The *BinaryFormatter* automatically identifies the file as having been saved as *BinaryXml*. You can use the following code to load the binary file and display the *com panyList*:

```
'VB
Protected Sub Button11_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button11.Click
    'add grids to form
    Dim gvCompany As GridView = GetGridView(275, 20)
    Dim gvEmployee As GridView = GetGridView(275, 125)

   'get the dataset from the file
    Dim companyList As DataSet
    Using fs As New FileStream( _
            MapPath("CompanyList.bin"), FileMode.Open)
        Dim fmt As New BinaryFormatter()
        companyList = CType(fmt.Deserialize(fs), DataSet)
    End Using

    'display
    gvCompany.DataSource = companyList
    gvCompany.DataMember = "Company"
    gvEmployee.DataSource = companyList
    gvEmployee.DataMember = "Employee"
    gvCompany.DataBind()
    gvEmployee.DataBind()
End Sub
```

//C#

```
protected void Button11_Click(object sender, EventArgs e)
{
    //add grids to form
   GridView gvCompany = GetGridView(275, 20);
    GridView gvEmployee = GetGridView(275, 125);

    //get the dataset from the file
    DataSet companyList;
    using (FileStream fs = new FileStream(
            MapPath("CompanyList.bin"), FileMode.Open))
    {
      BinaryFormatter fmt = new BinaryFormatter();
      companyList = (DataSet)fmt.Deserialize(fs);
    }

    //display
    gvCompany.DataSource = companyList;
    gvCompany.DataMember = "Company";
    gvEmployee.DataSource = companyList;
    gvEmployee.DataMember = "Employee";
    gvCompany.DataBind();
    gvEmployee.DataBind();
}
```

Using Merge to Combine DataSet Data

On many occasions, data available in one *DataSet* must be combined with another *DataSet*. For example, an expense application might need to combine serialized *DataSet* objects (expense reports) received by e-mail from a number of people. It's also common within an application and (based on the user clicking Update) can merge the modified version back to the original *DataSet*.

The *Merge* method on the *DataSet* is used to combine data from multiple *DataSet* objects. The *Merge* method has several overloads that allow data to be merged from *DataSet*, *DataTable*, or *DataRow* objects. The following code example demonstrates how to use the *Merge* method to combine changes from one *DataSet* into another *DataSet*:

'VB

```
Protected Sub Button12_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button12.Click
```

```
    'add grids to form
    Dim gvcompany As GridView = GetGridView(275, 20)
    Dim gvemployee As GridView = GetGridView(275, 125)

    'get the dataset
    Dim original As DataSet = GetDataSet()
    'add AdventureWorks
    original.Tables("Company").Rows.Add( _
      Guid.NewGuid(), "AdventureWorks")

    'copy the dataset
    Dim copy as DataSet = original.Copy()

    'modify the copy
    Dim aw as DataRow = copy.Tables("Company").Rows(0)
    aw("CompanyName") = "AdventureWorks Changed"
    Dim empId as Guid
    empId = Guid.NewGuid()
    copy.Tables("Employee").Rows.Add(empId, aw("Id"), _
           "MarkLast", "MarkFirst", 90.00)
    empId = Guid.NewGuid()
    copy.Tables("Employee").Rows.Add(empId, aw("Id"), _
      "SueLast", "SueFirst", 41.00)

    'merge changes back to the original
    original.Merge(copy, False, MissingSchemaAction.AddWithKey)

    'display
    gvcompany.DataSource = original
    gvcompany.DataMember = "company"
    gvemployee.DataSource = original
    gvemployee.DataMember = "employee"
    gvcompany.DataBind()
    gvemployee.DataBind()
End Sub
```

```
//C#
protected void Button12_Click(object sender, EventArgs e)
{
    //add grids to form
    GridView gvcompany = GetGridView(275, 20);
    GridView gvemployee = GetGridView(275, 125);

    //get the dataset
    DataSet original = GetDataSet();
    //add AdventureWorks
    original.Tables["Company"].Rows.Add(
      Guid.NewGuid(), "AdventureWorks");

    //copy the dataset
    DataSet copy = original.Copy();
    //modify the copy
    DataRow aw = copy.Tables["Company"].Rows[0];
    aw["CompanyName"] = "AdventureWorks Changed";
    Guid empId;
    empId = Guid.NewGuid();
    copy.Tables["Employee"].Rows.Add(empId, aw["Id"],
          "MarkLast", "MarkFirst", 90.00m);
    empId = Guid.NewGuid();
    copy.Tables["employee"].Rows.Add(empId, aw["Id"],
      "SueLast", "SueFirst", 41.00m);

    //merge changes back to the original
    original.Merge(copy, false, MissingSchemaAction.AddWithKey);

    //display
    gvcompany.DataSource = original;
    gvcompany.DataMember = "Company";
    gvemployee.DataSource = original;
    gvemployee.DataMember = "Employee";
    gvcompany.DataBind();
    gvemployee.DataBind();
}
```

The *Merge* method is always called on the *DataSet* that you will merge into; it takes three parameters, and is then called. The first parameter is the *Copy* object. The sec ond parameter is a Boolean called *preserveChanges*, which specifies whether updates from the copy *DataSet* should overwrite changes made in the original object. The last parameter is a *MissingSchemaAction* enumeration member. The *AddSchemaWithKey* is selected, which means that if a new *DataTable* is added to the copy *DataSet* object, the new *DataTable* and its data are added to the original *DataSet* object. The following is a list of the *MissingSchemaAction* enumeration members:

- ***Add*** Adds the necessary *DataTable* and *DataColumn* objects to complete the schema.
- ***AddWithPrimaryKey*** Adds the necessary *DataTable*, *DataColumn*, and *Prima ryKey* objects to complete the schema.
- ***Error*** Shows when an exception is thrown if a *DataColumn* does not exist in the *DataSet* that is being updated.
- ***Ignore*** Ignores data that resides in *DataColumns* that are not in the *DataSet* being updated.

When you use the *Merge* method, make sure each of the *DataTable* objects has a primary key. Failure to set the *PrimaryKey* property of the *DataTable* object results in a *DataRow* object being appended rather than an existing *DataRow* object being modified.

Quick Check

1. When working with disconnected data, what primary data object must you always have at least one of?
2. You have a *DataSet* with *Order* and *OrderDetail DataTable* objects. You want to be able to retrieve the *OrderDetail* rows for a specific *Order*. What data object can you use to navigate from the *Order* row to the *OrderDetail* rows?
3. You want to save a *DataSet* object to an XML file, but you are concerned that you may lose the original version of the *DataRow* object. How should you save the *DataSet* object?

Quick Check Answers

1. A *DataTable* object.
2. The *DataRelation* object.
3. Save it as a DiffGram.

Lab: Working with Disconnected Data

In this lab, you create and use a typed *DataSet* that you add graphically to your Web site. This *DataSet* populates a *GridView* control with *Customer* rows.

� **Exercise 1: Create the Web Site and the Typed *DataSet***

In this exercise, you create the Web site and add the controls to the site.

1. Open Visual Studio 2005 and create a new Web site called **WorkingWith DisconnectedData,** using your preferred programming language. The new Web site is created, and a Web page called Default.aspx is displayed.
2. In the Solution Explorer, add a typed *DataSet* graphically by right-clicking the Web site project and selecting Add New Item. Select *DataSet*, name the *DataSet* **Sales.xsd**, and click OK. When prompted to create the App_Code folder, click Yes. You will also be prompted to select a database connection; click Cancel.
3. Drag a *DataTable* from the ToolBox and drop it onto the DataSet Editor surface.
4. Select the *DataTable*. In the Properties window, set the name of the *DataTable* to **Customer**.

5. Add the following columns to the Customer Table by right-clicking the *Data-Table,* selecting Add, and selecting Column.

Column Name	Data Type
Id	*System.Guid*
CustomerName	*System.String*

6. Close and save the Sales type instance called *DataSet*.

� **Exercise 2: Add *GridView* and *DataSet***

In this exercise, you add a *GridView* control to the Default.aspx page. In the code-behind page, you instantiate the *Sales DataSet*, populate it, and bind it to the *GridView* control.

1. Open the Web site that you created in Exercise 1. Alternatively, you can open the completed Lesson 1, Exercise 1 project from the CD.
2. Add a *GridView* control to the Default.aspx Web page. Regardless of the language you choose, your .aspx source for the form element should look like the following:

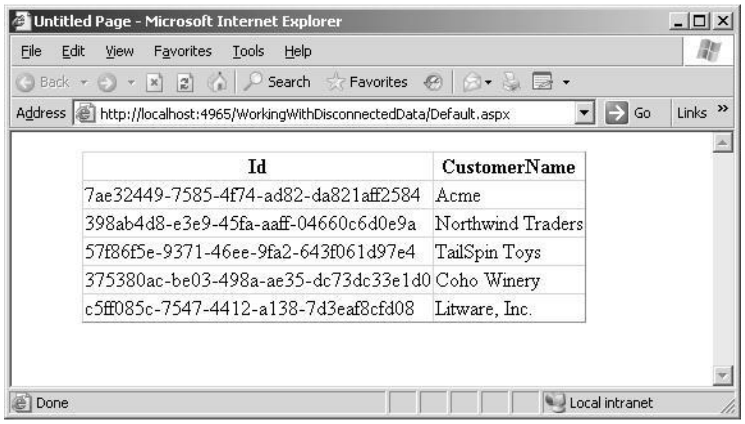
```
<form id="form1" runat="server">
    <div>
      <asp:GridView ID="GridView1" runat="server"
            Style="z-index: 100; left: 55px; position: absolute;top: 15px">
      </asp:GridView>
    </div>
</form>
```

3. Double-click an empty location on the Web page to go to the code-behind page. In the code-behind page, add code to create and populate an instance of the *Sales DataSet*, and assign the *DataSet* object to the *GridView*. This code only needs to exe cute when the page is not being posted back and should look like the following:

```
'VB
Partial Class _Default
    Inherits System.Web.UI.Page

    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      If Not IsPostBack Then
            Dim salesDataSet As New Sales()
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Acme")
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Northwind Traders")
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "TailSpin Toys")
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Coho Winery")
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Litware, Inc.")
            GridView1.DataSource = salesDataSet
            GridView1.DataMember = "Customer"
```

```
             DataBind()
          End If
        End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class _Default : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
      if (!IsPostBack)
        {
            Sales salesDataSet = new Sales();
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Acme");
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Northwind Traders");
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "TailSpin Toys");
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Coho Winery");
            salesDataSet.Customer.Rows.Add(Guid.NewGuid(), "Litware, Inc.");
            GridView1.DataSource = salesDataSet;
            GridView1.DataMember = "Customer";
            DataBind();
        }
    }
}
```

4. Run the Web page. Figure 4-10 shows the results.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4965/WorkingWithDisconnectedData/Default.aspx
Go Links
Done
Local intranet

Id	CustomerName
7ae32449-7585-4f74-ad82-da821aff2584	Acme
398ab4d8-e3e9-45fa-aaff-04660c6d0e9a	Northwind Traders
57f86f5e-9371-46ee-9fa2-643f061d97e4	TailSpin Toys
375380ac-be03-498a-ae35-dc73dc33e1d0	Coho Winery
c5ff085c-7547-4412-a138-7d3eaf8cfd08	Litware, Inc.

Figure 4-10 The typed *DataSet* is populated and bound to the *GridView* control.

Lesson 2: Using the ADO.NET Connected Classes

The ADO.NET libraries contain *provider classes*, which are classes that you can use to transfer data between a data store and the client application. There are many different kinds of data stores, meaning that there is a need for specialized code to provide the necessary bridge between the disconnected data access classes and a particular data store. The provider classes fulfill this need.

This lesson focuses on these specialized classes, starting with the most essential, such as *DbConnection* and *DbCommand*, and concludes with the more elaborate classes that have been added in ADO.NET 2.0, such as *DbProviderFactory* and *DbProviderFactories*.

After this lesson, you will be able to:

- Identify and use the following connected data classes in your Web application:
  - ❑ *DbConnection*
  - ❑ *DbCommand*
  - ❑ *DbDataAdapter*
  - ❑ *DbProviderFactory*
  - ❑ *DbProviderFactories*

Estimated lesson time: 60 minutes

Using Provider Classes to Move Data

The classes that are responsible for the movement of data between the disconnected data classes in the client application and the data store are referred to as connected classes or provider classes. The Microsoft .NET Framework contains the following providers:

- ***OleDb*** Contains classes that provide general-purpose data access to many data sources. You can use this provider to access SQL Server 6.5 (and earlier ver sions), SyBase, DB2/400, and Microsoft Access.
- ***Odbc*** Contains classes for general-purpose data access to many data sources. This provider is typically used when no newer provider is available.
- ***SQL Server*** Contains classes that provide functionality similar to the generic *OleDb* provider. The difference is that these classes are tuned for SQL Server 7.0 and later data access. SQL Server 6.5 and earlier must use the *OleDb* provider.

- ***Oracle*** Contains classes for accessing Oracle 8i and later servers. This provider is similar to the *OleDb* provider but provides better performance.

You can also use third-party providers, such as *DB2* and *MySql*, which you can down load from the Web.

Table 4-1 lists the primary provider classes and interfaces. The classes are subclassed by the provider, which replaces the *Db* prefix with a provider prefix, such as *Sql*, *Ora cle*, *Odbc*, or *OleDb*. You can use the base classes with factory classes to create client code that is not provider-specific. The following sections describe many of these classes.

Table 4-1 Primary Provider Classes and Interfaces in ADO.NET

Base Classes	*SqlClient* Classes	Generic Interface
DbConnection	*SqlConnection*	*IDbConnection*
DbCommand	*SqlCommand*	*IDbCommand*
DbDataReader	*SqlDataReader*	*IDataReader/IDataRecord*
DbTransaction	*SqlTransaction*	*IDbTransaction*
DbParameter	*SqlParameter*	*IDbDataParameter*
DbParameterCollection	*SqlParameterCollection*	*IDataParameterCollection*
DbDataAdapter	*SqlDataAdapter*	*IDbDataAdapter*
DbCommandBuilder	*SqlCommandBuilder*	
DbConnectionString-Builder	*SqlConnectionStringBuilder*	
DBDataPermission	*SqlPermission*	

Getting Started with the *DbConnection* Object

To access a data store, you need a valid, open connection object. The *DbConnection* class is an abstract class that the provider-specific connection classes inherit from. The connection class hierarchy is shown in Figure 4-11.

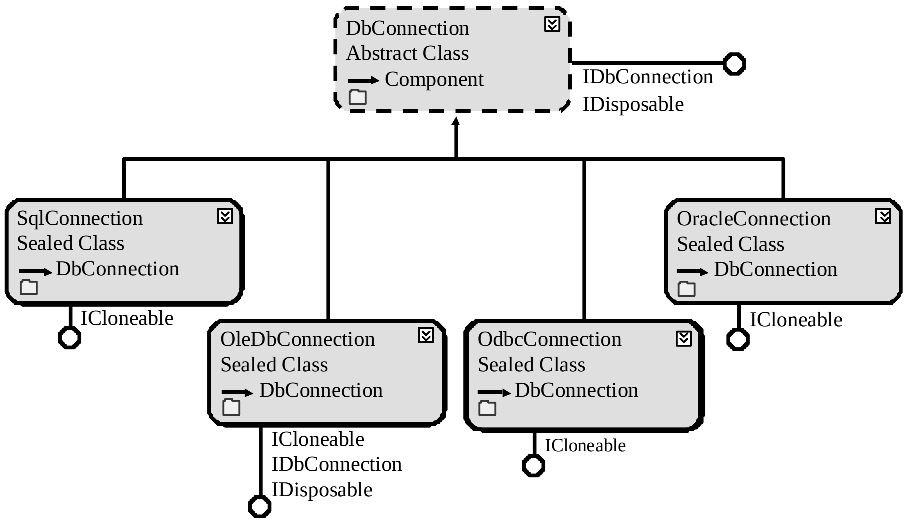


Figure 4-11 The *DbConnection* class hierarchy.

To create a connection, you must have a valid connection string. The following code snippet shows how to create the connection object and then assign the connection string. When you are finished working with the connection object, you must close the connection to free up the resources being held. The *pubs* sample database is used in this example. The *pubs* and *Northwind* sample databases are available from the Microsoft download site and are also included on the sample disc.

```
'VB
Dim connection as DbConnection = new SqlConnection()
connection.ConnectionString = _
    "Server=.;Database=pubs;Trusted_Connection=true"
connection.Open()
'Do lots of cool work here
connection.Close()

//C#
DbConnection connection = new SqlConnection();
connection.ConnectionString =
    "Server=.;Database=pubs;Trusted_Connection=true";
connection.Open();
    //Do lots of cool work here
connection.Close();
```

Creating an instance of the *SqlConnection* class using the SQL Server .NET provider creates the *DbConnection*. The *ConnectionString* property is initialized to use the local machine (".") and the database is set to *pubs*. Lastly, the connection uses a trusted con nection for authentication when connecting to SQL Server.

The connection must be opened before you can send commands to the data store, and you must always close the connection when you're done to prevent orphaned connections to the data store. You can close the connection by executing the *Close* method or by executing the *Dispose* method. It's common to create a "using" block to force the *Dispose* method to execute, as shown in the following code snippet.

NOTE New in ASP.NET 2.0

The using block is new to Visual Basic in 2.0 of the .NET Framework, but it has always been in C#.

```
'VB
using (connection)
    connection.Open()
    'cool commands here...
End Using

//C#
using (connection)
{
    connection.Open();
    //cool commands here...
}
```

You can place the using block inside a try/catch block to force the connection to be disposed, which typically provides a cleaner implementation than the try/catch/ finally block.

Regardless of the programming language used, the connection string is the same. The following sections explain how to configure a connection string using each of the .NET providers.

Configuring an ODBC Connection String Open Database Connectivity (ODBC) is one of the older technologies that the .NET Framework supports, primarily because there are still many scenarios where the .NET Framework is required to connect to older database products that have ODBC drivers. Table 4-2 describes the most com mon ODBC connection string settings.

Table 4-2 ODBC Connection String Keywords

Keyword	Description
Driver	The ODBC driver to use for the connection.

Table 4-2 ODBC Connection String Keywords

Keyword	Description
DSN	A data source name, which can be configured via Control Panel | Administrative Tools | Data Sources (ODBC).
Server	The name of the server to connect to.
Trusted_Connection	A description that specifies what security is based on using the domain account of the currently logged-on user.
Database	The database to connect to.
DBQ	Typically, the physical path to a data source.

Working with Sample ODBC Connection Strings The following connection string instructs the text driver to treat the files that are located in the C:\Sample\MySample-Folder subdirectory as tables in a database.

```
Driver={Microsoft Text Driver (*.txt; *.csv)};
    DBQ=C:\\Sample\\MySampleFolder;
```

The following connection string instructs the Access driver to open the *Northwind* database file that is located in the C:\Program Files\mySampleFolder folder.

```
Driver={Microsoft Access Driver (*.mdb)};
    DBQ=C:\\program files\\mySampleApp\\northwind.mdb
```

The following connection string uses the settings that have been configured as a data source name (DSN) on the current machine.

```
DSN=My Application DataSource
```

The following is a connection to an Oracle database on the ORACLE8i7 servers. The name and password are passed in as well.

```
Driver={Microsoft ODBC for Oracle};
    Server=ORACLE8i7;
    UID=john;
    PWD=s3$W%1Xz
```

The following connection string uses the Excel driver to open the MyBook.xls file.

```
Driver={Microsoft Excel Driver (*.xls)};
    DBQ=C:\\Samples\\MyBook.xls
```

The following connection string uses the SQL Server driver to open the *Northwind* database on MyServer using the passed-in user name and password.

```
DRIVER={SQL Server};
    SERVER=MyServer;
    UID=AppUserAccount;
    PWD=Zx%7$ha;
    DATABASE=northwind;
```

This connection string uses the SQL Server driver to open the *Northwind* database on MyServer using SQL Server's trusted security.

```
DRIVER={SQL Server};
    SERVER=MyServer;
    Trusted_Connection=yes
    DATABASE=northwind;
```

Configuring an OLEDB Connection String Another common, but older, technol ogy that is used to access databases is Object Linking and Embedding for Data bases (OLEDB). Table 4-3 describes the most common OLEDB connection string settings.

Table 4-3 OLEDB Connection String Keywords

Keyword	Description
Data Source	The name of the database or physical location of the database file.
File Name	The physical location of a file that contains the real connection string.
Persist Security Info	A setting which, if set to *true*, retrieves the con nection string and returns the complete con nection string that was originally provided. If set to *false*, the connection string contains the information that was originally provided, minus the security information.
Provider	The vendor-specific driver to use for connecting to the data store.

Working with Sample OLEDB Connection Strings This connection string uses the set tings stored in the MyAppData.udl file. (The .udl extension stands for universal data link.)

```
FILE NAME=C:\Program Files\MyApp\MyAppData.udl
```

This connection string uses the Jet driver, which is the Access driver, and opens the demo database file. Retrieving the connection string from the connection returns the connection that was originally passed in, minus the security information.

```
Provider=Microsoft.Jet.OLEDB.4.0;
   Data Source=C:\Program Files\myApp\demo.mdb;
   Persist Security Info=False
```

Configuring a SQL Server Connection String The SQL Server provider allows you to access SQL Server 7.0 and later. If you need to connect to SQL Server 6.5 and earlier, use the OLEDB provider. Table 4-4 describes the most common SQL Server connec tion string settings.

Table 4-4 SQL Server Connection String Keywords

Keyword	Description
Data Source, addr, address, network address, server	The name or IP address of the database server.
Failover Partner	A support provider for database mirroring in SQL Server 2005.
AttachDbFilename, extended properties, initial file name	The full or relative path and name of a file containing the database to be attached to. The path supports the keyword string |*DataDirectory*|, which points to the application's data directory. The database must reside on a local drive. The log file name must be in the format <database-File-Name>_log.ldf or it will not be found. If the log file is not found, a new log file is created.
Initial Catalog, database	The name of the database to use.

Table 4-4 SQL Server Connection String Keywords

Keyword	Description
Integrated Security, trusted_connection	A secure connection to SQL Server, in which authenti cation is via the user's domain account. Can be set to *true*, *false*, or *sspi*. The default is false.
Persist Security Info, persistsecurityinfo	A setting that, if set to *true*, causes a retrieval of the con nection string to return the complete connection string that was originally provided. If set to *false*, the connec tion string contains the information that was originally provided, minus the security information. The default is false.
User ID, uid, user	The user name to use to connect to the SQL Server when not using a trusted connection.
Password, pwd	The password to use to log onto SQL Server when not using a trusted connection.
Enlist	When set to *true*, this pooler automatically enlists the connection into the caller thread's ongoing transaction context.
Pooling	A setting that, when set to *true*, causes the request for a new connection to be drawn from the pool. If the pool does not exist, one is created.
Max Pool Size	A setting that specifies the maximum allowed connec tions in the connection pool. The default is 100.
Min Pool Size	A setting that specifies the minimum number of connec tions to keep in the pool. The default is 0.
Asynchronous Processing, async	A setting that, when set to *true*, enables execution of asynchronous commands on the connection. (Syn chronous commands should use a different connec tion to minimize resource usage.) The default is false.

Table 4-4 SQL Server Connection String Keywords

Keyword	Description
Connection Reset	A setting that, when set to *true*, indicates that the data base connection is reset when the connection is removed from the pool. The default is true. A setting of false results in fewer round-trips to the server when cre ating a connection, but the connection state is not updated.
MultipleActiveResultSets	A setting that, when set to *true*, allows for the retrieval of multiple forward-only, read-only result sets on the same connection. The default is false.
Replication	A setting that is used by SQL Server for replication.
Connect Timeout, connection timeout, timeout	The time in seconds to wait while an attempt is made to connect to the data store. The default is 15 seconds.
Encrypt	A setting in which, if *Encrypt* is set to *true* and SQL Server has a certificate installed, all communication between the client and server is SSL-encrypted.
Load Balance Timeout, connection lifetime	The maximum time in seconds that a pooled connec tion should live. The maximum time is checked only when the connection is returned to the pool. This set ting is useful in getting load-balanced cluster configura tions to force a balance between a server that is online and a server that has just started. The default is 0.
Network Library, net, network	The network library DLL to use when connecting to SQL Server. Allowed libraries include dbmssocn (TCP/IP), dbnmpntw (Named Pipes), dbmsrpcn (Multiprotocol), dbmsadsn (Apple Talk), dbmsgnet (VIA), dbmsipcn (Shared Memory), and dbmsspxn (IPX/SPX). The default is dbmssocn (TCP/IP), but if a network is not specified and either "." or "(local)" is specified for the server, shared memory is used as the default.

Table 4-4 SQL Server Connection String Keywords

Keyword	Description
Packet Size	The size in bytes for each packet that is sent to SQL Server. The default is 8192.
Application Name, app	The name of the application. If not set, this defaults to .NET SQL Client Data Provider.
Current Language, language	The SQL Server language record name.
Workstation ID, wsid	The name of the client computer that is connecting to SQL Server.

Working with Sample SQL Server Connection Strings The following connection string connects to the *northwind* database on the current computer (localhost) using integrated security. This connection must be made within 30 seconds or an exception is thrown. The security information is not persisted.

```
Persist Security Info=False;
    Integrated Security=SSPI;
    database=northwind;
    server=localhost;
    Connect Timeout=30
```

This next connection string uses the TCP sockets library (DBMSSOCN) and connects to the *MyDbName* database on the computer located at IP address 192.168.1.5, using port 1433. Authentication is based on using MyUsername as the user name and u$2hJq@1 as the password.

```
Network Library=DBMSSOCN;
    Data Source=192.168.1.5,1433;
    Initial Catalog=MyDbName;
    User ID=myUsername;
    Password= u$2hJq@1
```

Attaching to a Local SQL Database File with SQL Express Microsoft SQL Server 2005 Express Edition is installed as part of the default Visual Studio 2005 installa tion, which makes it an excellent database to use when you're developing applications that are destined to be used on SQL Server 2005 Express Edition or SQL Server 2005. When you're building small Web sites and single-user applications, SQL Server 2005

Express Edition is a natural choice due to its XCOPY deployment capabilities, reliabil ity, and high-performance engine. In addition, SQL Server 2005 Express Edition data bases can easily be attached to SQL Server 2005. To attach a local database file, you can use the following connection string.

```
Data Source=.\SQLEXPRESS;
    AttachDbFilename=C:\MyApplication\PUBS.MDF;
    Integrated Security=True;
    User Instance=True
```

In this example, the Data Source is set to an instance of SQL Express called .\SQLEX PRESS. The database file name is set to the database file located at C:\MyApplica tion\PUBS.MDF. Note that the log file (PUBS_LOG.LDF) must also exist. Integrated security is used to authenticate with SQL Server 2005 Express Edition; setting User Instance to *true* starts an instance of SQL Server 2005 Express Edition using the cur rent user's account.

Although you can use SQL Server to attach to a local file, SQL Server does not work with the User Instance=True setting. Also, SQL Server keeps the database attached when your application ends, so the next time you run SQL Server, an exception will be thrown because the data file is already attached.

AttachDBFilename can also understand the keyword |*DataDirectory*| to use the appli cation's data directory. Here is the revised connection string.

```
Data Source=.\SQLEXPRESS;
    AttachDbFilename=|DataDirectory|\PUBS.MDF;
    Integrated Security=True;
    User Instance=True
```

For a Web application, the *DataDirectory* keyword resolves to the App_Data folder.

Storing the Connection String in the Web Configuration File Connection strings should always be located outside your source code to simplify changes without requiring a recompile of your application. You can store connection strings in the machine or Web configuration file. You place the <*connectionStrings*> element under the <*configuration*> root element. This section supports the <add>, <remove>, and <clear> tags, as shown here:

```
<connectionStrings>
    <clear />
   <add name="PubsData"
      providerName="System.Data.SqlClient"
      connectionString=
      "Data Source=.\SQLEXPRESS;
```

```
            AttachDbFilename=|DataDirectory|PUBS.MDF;
            Integrated Security=True;
            User Instance=True"/>
</connectionStrings>
```

This example clears the list of *connectionStrings* that may have been defined in the machine configuration file, and then adds a new connection string setting called *PubsData*. The *connectionStrings* can be accessed in code by using the static *ConnectionStrings* collection on the *ConfigurationManager* class. In the following code sample, a *Label* control is dynamically created, the *PubsData* connection string is read from the Web.config file, and connection information is displayed in the *Label*:

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button1.Click
    Dim lbl As Label = GetLabel(275, 20)
    'Get the settings from the configuration file
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    'name = "PubsData"
    lbl.Text = "<p><b>Name:</b> " _
        + pubs.Name + "</p>"
    'provider = "System.Data.SqlClient"
    lbl.Text += "<p><b>Provider Name:</b> " _
        + pubs.ProviderName + "</p>"
    'cnString = "Data Source=.\SQLEXPRESS;
    '        AttachDbFilename=|DataDirectory|PUBS.MDF;
    '        Integrated Security=True;
    '        User Instance=True"
    lbl.Text += "<p><b>Connection String:</b> " _
        + pubs.ConnectionString + "</p>"
End Sub

Private Function GetLabel(ByVal left As Integer, _
        ByVal top As Integer) As Label
    Dim lbl As New Label()
    lbl.Style.Add("position", "absolute")
    lbl.Style.Add("left", left.ToString() + "px")
    lbl.Style.Add("top", top.ToString() + "px")
    lbl.EnableViewState = False
    form1.Controls.Add(lbl)
    Return lbl
End Function

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    Label lbl = GetLabel(275, 20);

    //Get the settings from the configuration file
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
   DbConnection connection = new SqlConnection(pubs.ConnectionString);
    //name = "PubsData"
    lbl.Text = "<p><b>Name:</b> "
          + pubs.Name + "</p>";
    //provider = "System.Data.SqlClient"
    lbl.Text += "<p><b>Provider Name:</b> "
          + pubs.ProviderName + "</p>";
    //cnString = "Data Source=.\SQLEXPRESS;
    //          AttachDbFilename=|DataDirectory|PUBS.MDF;
    //          Integrated Security=True;
    //          User Instance=True"
    lbl.Text += "<p><b>Connection String:</b> "
          + pubs.ConnectionString + "</p>";
}

private Label GetLabel(int left, int top)
{
    Label lbl = new Label();
    lbl.Style.Add("position", "absolute");
    lbl.Style.Add("left", left.ToString() + "px");
    lbl.Style.Add("top", top.ToString() + "px");
    lbl.EnableViewState = false;
    form1.Controls.Add(lbl);
    return lbl;
}
```

Working with Connection Pools Creating and opening a connection to a data store can be a time-consuming and resource-intensive proposition, especially on Web-based systems, if you require separate connections to the data store on a user-by-user basis. It's easy to get into a situation where every user has one or more open connec tions to the database and the database server is consuming too many resources just managing connections. Ideally, the data store should be spending most of its time delivering data and as little time as possible maintaining connections. This is where connection pooling can help.

Connection pooling is the process of reusing existing active connections instead of cre ating new connections when a request is made to the database. It involves the use of a connection manager that is responsible for maintaining a list, or pool, of available connections. When the connection manager receives a request for a new connection, it checks its pool for available connections. If a connection is available, it is returned. If no connections are available, and the maximum pool size has not been reached, a new connection is created and returned. If the maximum pool size has been reached, the connection request is added to the queue and the next available connection is returned, as long as the connection timeout has not been reached.

Connection pooling is controlled by parameters placed into the connection string. The following is a list of parameters that affect pooling:

- **Connection Timeout** The time in seconds to wait while a connection to the data store is attempted. The default is 15 seconds.
- **Min Pool Size** The minimum amount of pooled connections to keep in the pool. The default is 0. It's usually good to set this to a low number, such as 5, when your application requires consistent, fast response—even if the application is inactive for long periods of time.
- **Max Pool Size** The maximum allowed number of connections in the connection pool. The default is 100, which is usually more than enough for most Web site applications.
- **Pooling** A setting in which a value of *true* causes the request for a new connec tion to be drawn from the pool. If the pool does not exist, it is created. The default is true.
- **Connection Reset** An indicator that the database connection is reset when the connection is removed from the pool. The default is true. A value of *false* results in fewer round-trips to the server when creating a connection, but the connec tion state is not updated.
- **Load Balancing Timeout, Connection Lifetime** The maximum time in seconds that a pooled connection should live. The maximum time is checked only when the connection is returned to the pool. This setting is useful in load-balanced cluster configurations to force a balance between a server that is online and a server that has just started. The default is 0.
- **Enlist** When this value is *true*, the connection is automatically enlisted into the creation thread's current transaction context. The default is true.

To implement connection pooling, you must follow a few rules:

- The connection string must be exactly the same, character-by-character, for every user or service that participates in the pool. Remember that each character must match in terms of lowercase and uppercase as well.
- The user ID must be the same for every user or service that participates in the pool. Even if you specify integrated security=true, the Windows user account of the process is used to determine pool membership.
- The process ID must be the same. It has never been possible to share connec tions across processes, and this limitation extends to pooling.

Where Is the Pool Located? Connection pooling is a client-side technology, which means that the connection pool exists on the machine that initiates the *DbConnection* object's *Open* statement. The database server has no idea that there might be one or more connection pools involved in your application.

When Is the Pool Created? A connection pool group is an object that manages the connection pools for a specific ADO.NET provider. When the first connection is instantiated, a connection pool group is created, but the first connection pool is not created until the first connection is opened.

Do Connections Stay in the Pool? A connection is removed from the pool of avail able connections for use and then returned to the pool of available connections. When a connection is returned to the connection pool, it has a default idle lifetime of four to eight minutes, which is an intentionally random time span to ensure that idle connections are not held indefinitely. You can set the connection string's Min Pool Size to one or greater when you want to make sure that at least one connection is avail able when your application is idle for long periods.

Using the Load-Balancing Timeout The connection string has a setting called the Load Balancing Timeout, which is also known as the Connection Lifetime. Connec tion Lifetime still exists for backward compatibility, but the new name better describes this setting's intended use. Use this setting only in an environment with clustered servers, because it's meant to aid in load-balancing database connections. This setting is only examined on closed connections. If the connection stays open longer than its Load Balancing Timeout setting, the connection is destroyed. Other wise, the connection is added back into the pool.

The Load Balancing Timeout setting can be used to ensure that new connections are being created when you are using a database server cluster. If two database servers are clustered together and they appear heavily loaded, you may choose to add a third database server. After adding the third database server, you may notice that the origi nal databases still seem overloaded and the new server has few or no connections.

The problem is that connection pooling is doing its job by maintaining connections to the existing database servers. Specify a Load Balancing Timeout setting that throws out some of the good connections so the new connection can go to the newly added database server. You lose a bit of performance because you destroy good connections, but the new connections potentially go to a new database server, which improves per formance.

Using the Visual Studio 2005 GUI to Add a Connection If you need to perform data base-management tasks, you can add a connection to the database using the Server Explorer window and the Connection Wizard. A connection is automatically created for you for each database file that is added to your project, and you can also add con nections manually. Figure 4-12 shows the Server Explorer window after the Pubs.mdf and Northwind.mdf files were added to the project, and after a connection was man ually added to the *Northwind* database on the local copy of SQL Server 2005 by right-clicking the Connections node and selecting New Connection to start the Connection Wizard.

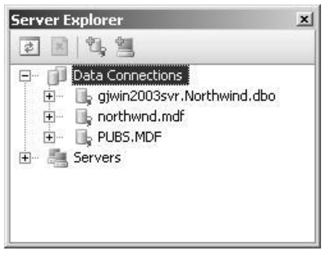


Figure 4-12 The Server Explorer window shows the connections that were added.

You can use the connection to perform maintenance, modify the database schema and data, and run queries. Also, controls such as the *SqlDataSource* allow you to select one of these connections when you add the control to the Web page.

Securing Connection Strings With Encryption You store connections strings in your configuration files to make it easy to change the connection string without requiring a recompile of the application. The problem is that connection strings may contain login information such as user names and passwords.

The solution is to encrypt the connection string section of your configuration file by using the aspnet_regiis.exe utility. You can use the /? option to get help on the utility.

You encrypt and decrypt the contents of a Web.config file by using the System.Con figuration.DPAPIProtectedConfigurationProvider, which uses the Windows Data Protection API (DPAPI) to encrypt and decrypt data, or the System.Configura tion.RSAProtectedConfigurationProvider, which uses the RSA encryption algorithm to encrypt and decrypt data.

When you need to use the same encrypted configuration file on many computers in a Web farm, you must use the System.Configuration.RSAProtectedConfigurationPro vider, which allows you to export the encryption keys used to encrypt the data. The encryption keys can be imported into another server. This is the default setting. A typ ical Web.config file might look like the following:

```
<?xml version="1.0"?>
<configuration xmlns="http://schemas.microsoft.com/.NetConfiguration/v2.0">
    <appSettings/>
    <connectionStrings>
        <add name="ConnectionString"
            connectionString="Data Source=.\SQLEXPRESS;
            AttachDbFilename=|DataDirectory|\northwnd.mdf;
            Integrated Security=True;User Instance=True"
            providerName="System.Data.SqlClient" />
    </connectionStrings>
    <system.web>
      …
    </system.web>
</configuration>
```

The *connectionStrings* element can be encrypted by running the Visual Studio 2005 Command Prompt, executing the following command, and specifying the full path to your Web site folder:

```
aspnet_regiis -pef "connectionStrings" "C:\...\EncryptWebSite"
```

Note that the *–pef* switch requires you to pass the physical Web site path, which is the last parameter. Be sure to verify the path to your Web.config file. The encrypted Web.config file will look like the following:

```
<?xml version="1.0"?>
<configuration xmlns="http://schemas.microsoft.com/.NetConfiguration/v2.0">
    <protectedData>
      <protectedDataSections>
          <add name="connectionStrings"
              provider="RsaProtectedConfigurationProvider"
              inheritedByChildren="false" />
      </protectedDataSections>
    </protectedData>
    <appSettings/>
    <connectionStrings>
      <EncryptedData Type="http://www.w3.org/2001/04/xmlenc#Element"
       xmlns="http://www.w3.org/2001/04/xmlenc#">
          <EncryptionMethod
              Algorithm="http://www.w3.org/2001/04/xmlenc#tripledes-cbc" />
          <KeyInfo xmlns="http://www.w3.org/2000/09/xmldsig#">
              <EncryptedKey Recipient=""
                xmlns="http://www.w3.org/2001/04/xmlenc#">
                <EncryptionMethod
                    Algorithm="http://www.w3.org/2001/04/xmlenc#rsa-1_5" />
                <KeyInfo xmlns="http://www.w3.org/2000/09/xmldsig#">
                    <KeyName>Rsa Key</KeyName>
                </KeyInfo>
                <CipherData>
<CipherValue>PPWA1TkWxs2i698Dj07iLUberpFYIj6wBhbmqfmNK/plarau4i1k+xq5bZzB4VJW8
OkhwzcIIdZIXff6INJ1wlZz76ZV1DIbRzbH71t6d/L/qJtuOexXxTi2LrepreK/q3svMLpsJycnDPa
t9xaGoaLq4Cg3P19Z1J6HquFILeo=</CipherValue>
                </CipherData>
               </EncryptedKey>
           </KeyInfo>
           <CipherData>
<CipherValue>Q1re8ntDDv7/dHsvWbnIKdZF6COA1y3S91hmnhUN3nxYfrjSc7FrjEVyJfJhl5EDX
4kXd8ukAjrqwuBNnQbsh1PAXNFDflzB4FF+jyPKP/jm1Q9mDnmiq+NCuo3KpKj8F4vcHbcj+f3GYqq
B4pYbblAvYnjPyPrrPmxLNT9KDtDr8pDbtGnKqAfcMnQPvA8l5w3BzPM4a73Vtt2kL/z9QJRu3Svd9
33taxOO/HufRJEnE2/hcBq30WcBmEuXx3LFNjV+xVmuebrInhhxQgM2froBKYxgjwWiWNjIIjIeTI2
FQ8nZ8V8kzAVohmDYkZpCj4NQGdrjD996h97phI6NnHZYZHJ7oPRz</CipherValue>
           </CipherData>
       </EncryptedData>
     </connectionStrings>
     <system.web>
         …
     </system.web>
</configuration>
```

If changes are made to the connectionStrings section using the GUI tools, the new connection is encrypted, which means that you won't have to run the aspnet_regiis utility again.

You can decrypt the *connectionStrings* section by using the following command:

```
aspnet_regiis -pdf "connectionStrings" "C:\...\EncryptWebSite"
```

After the *connectionStrings* section is decrypted, it looks just as it did before it was encrypted.

Using the *DbCommand* Object

The *DbCommand* object is used to send one or more Structured Query Language (SQL) statements to the data store. The *DbCommand* can be any of the following types:

- **Data Manipulation Language (DML)** Commands that retrieve, insert, update, or delete data.
- **Data Definition Language (DDL)** Commands that create tables or other database objects, or modify the database schema.
- **Data Control Language (DCL)** Commands that grant, deny, or revoke permissions.

The *DbCommand* object requires a valid open connection to issue the command to the data store. A *DbConnection* object can be passed into the *DbCommand* object's con structor or attached to the *DbCommand* object's *Connection* property after the *DbCom mand* is created, but you should always consider using the *CreateCommand* method on the *DbConnection* object to limit the amount of provider-specific code in your appli cation. The *DbConnection* automatically creates the appropriate provider-specific *DbCommand*.

The *DbCommand* also requires a valid value for its *CommandText* and *Command-Type* properties. The following code snippet shows how to create and initialize a *DbCommand*:

```
'VB
Protected Sub Button3_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button3.Click
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = New SqlConnection()
    connection.ConnectionString = pubs.ConnectionString
    Dim cmd As DbCommand = connection.CreateCommand()
    cmd.CommandType = CommandType.StoredProcedure
    cmd.CommandText = "uspGetCustomerById"
    Dim lbl as Label = GetLabel(275,20)
    lbl.Text = "Command Created"
End Sub

//C#
protected void Button3_Click(object sender, EventArgs e)
{
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
    DbConnection connection =
     new SqlConnection(pubs.ConnectionString);
    DbCommand cmd = connection.CreateCommand();
    cmd.CommandType = CommandType.StoredProcedure;
    cmd.CommandText = "uspGetCustomerById";
    Label lbl = GetLabel(275, 20);
    lbl.Text = "Command Created";
}
```

This code creates a *SqlConnection* object and assigns it to the connection variable that has the data type of *DbConnection*. The *DbConnection* object is then used to create a *SqlCommand*, which is assigned to the *cmd* variable. The *DbConnection* must be opened before the command can be executed. To execute a stored procedure as shown, the *CommandText* property contains the name of the stored procedure, while the *CommandType* indicates that this is a call to a stored procedure.

Using *DbParameter* Objects to Pass Data When you need to pass data to a stored procedure, you should use *DbParameter* objects. For example, a user-defined stored procedure called *uspGetCustomerById* might require a customer identification to retrieve the appropriate customer. You can create *DbParameter* objects by using the *Parameters.Add* method of the *Command* object, as shown here:

```
'VB
Protected Sub Button4_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button4.Click
  Dim pubs As ConnectionStringSettings
  pubs = ConfigurationManager.ConnectionStrings("PubsData")
  Dim connection As DbConnection = New SqlConnection()
  connection.ConnectionString = pubs.ConnectionString
  Dim cmd As DbCommand = connection.CreateCommand()
  cmd.CommandType = CommandType.StoredProcedure
  cmd.CommandText = "uspGetCustomerById"
  Dim parm As DbParameter = cmd.CreateParameter()
  parm.ParameterName = "@Id"
  parm.Value = "AROUT"
  cmd.Parameters.Add(parm)
  Dim lbl As Label = GetLabel(275, 20)
  lbl.Text = "Command and Parmaters Created"
End Sub

//C#
protected void Button4_Click(object sender, EventArgs e)
{
  ConnectionStringSettings pubs =
    ConfigurationManager.ConnectionStrings["PubsData"];
  DbConnection connection =
    new SqlConnection(pubs.ConnectionString);
  DbCommand cmd = connection.CreateCommand();
  cmd.CommandType = CommandType.StoredProcedure;
  cmd.CommandText = "uspGetCustomerById";
  DbParameter parm = cmd.CreateParameter();
  parm.ParameterName = "@Id";
  parm.Value = "AROUT";
  cmd.Parameters.Add(parm);
  Label lbl = GetLabel(275, 20);
  lbl.Text = "Command and Parmaters Created";
}
```

This code creates and configures a *DbConnection* object and a *DbCommand* object. A single parameter called *@Id* is created and assigned the value *AROUT*.

NOTE Be careful with parameter names and parameter order

The SQL provider requires that the parameter names match the parameter names defined in the stored procedure. The creation of the parameters is, therefore, not order-dependent.

The *OleDb* provider, on the other hand, requires the parameters to be defined in the same order that they are defined in the stored procedure. This means the name assigned to the parameter need not match the name defined in the stored procedure.

Use the name assigned to the *DbParameter* object to access the parameter through code. For example, to retrieve the value that is currently in the *SqlParameter* called *@Id*, use the following code:

```
'VB
Dim id as String = cmd.Parameters("@Id").Value

//C#
string id = (string)((DbParameter)cmd.Parameters["@Id"]).Value;
```

Building SQL Commands Using Server Explorer The Server Explorer window can be used to create SQL Commands by right-clicking a connection and selecting New Query. This opens a four-pane window and prompts you to select tables, views, func tion, and synonyms to be added to the query. The four-paned window provides win dows for the following:

- **Diagram Pane** Visually shows the tables and views that have been selected, and also shows the relationships between them.
- **Criteria Pane** Is a tabular pane that allows you to select the columns and specify attributes for each column, such as alias, sort, and filters.
- **SQL Pane** Is a textual pane that shows the actual SQL statement that is being built.
- **Results Pane** Is a tabular pane that shows the results after the query has been executed.

Using the *ExecuteNonQuery* Method When you want to execute a *DbCommand* object and you don't expect a tabular result to be returned, you should use the *ExecuteNon-Query* method. Examples of SQL statements that don't return any rows are an insert, an update, or a delete query. This method returns an integer that represents the number of rows affected by the operation. The following example executes a SQL statement to increment the *qty* field in the sales table for sales with *qty* greater than 50; it returns the number of rows that were updated.

```
'VB
Protected Sub Button5_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button5.Click
     Dim pubs As ConnectionStringSettings
     pubs = ConfigurationManager.ConnectionStrings("PubsData")
     Dim connection As DbConnection = New SqlConnection()
     connection.ConnectionString = pubs.ConnectionString
     Dim cmd As DbCommand = connection.CreateCommand()
     cmd.CommandType = CommandType.Text
     cmd.CommandText = _
       "UPDATE SALES SET qty = qty + 1 WHERE qty > 50"
     connection.Open()
     Dim count As Integer = cmd.ExecuteNonQuery()
     connection.Close()
     Dim lbl As Label = GetLabel(275, 20)
     lbl.Text = "Count = " + count.ToString()
End Sub

//C#
protected void Button5_Click(object sender, EventArgs e)
{
     ConnectionStringSettings pubs =
       ConfigurationManager.ConnectionStrings["PubsData"];
    DbConnection connection = new SqlConnection(pubs.ConnectionString);
     DbCommand cmd = connection.CreateCommand();
     cmd.CommandType = CommandType.Text;
     cmd.CommandText = "UPDATE SALES SET qty = qty + 1 WHERE qty > 50";
     connection.Open();
     int count = cmd.ExecuteNonQuery();
     connection.Close();
     Label lbl = GetLabel(275, 20);
     lbl.Text = "Count = " + count.ToString();
}
```

Using the *ExecuteScalar* Method You may execute a query that is expected to return a tabular result containing a single row and column, such as a query that retrieves the total sales for the day. In situations such as this, the results can be treated as a single return value. For example, the following SQL returns a result that consists of a single row with a single column:

```
SELECT COUNT(*) FROM Sales
```

If you use the *ExecuteScalar* method, the .NET runtime does not create an instance of a *DataTable* to hold the result, which means less resource usage and better performance.

The following code shows how to use the *ExecuteScalar* method to easily retrieve the number of rows in the Sales table into a variable called *count*:

```
'VB
Protected Sub Button6_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button6.Click
     Dim pubs As ConnectionStringSettings
     pubs = ConfigurationManager.ConnectionStrings("PubsData")
     Dim connection As DbConnection = New SqlConnection()
     connection.ConnectionString = pubs.ConnectionString
     Dim cmd As DbCommand = connection.CreateCommand()
     cmd.CommandType = CommandType.Text
     cmd.CommandText = "SELECT COUNT(*) FROM Sales"
     connection.Open()
     Dim count As Integer = cmd.ExecuteScalar()
     connection.Close()
     Dim lbl As Label = GetLabel(275, 20)
     lbl.Text = "Count = " + count.ToString()
End Sub

//C#
protected void Button6_Click(object sender, EventArgs e)
{
     ConnectionStringSettings pubs =
       ConfigurationManager.ConnectionStrings["PubsData"];
    DbConnection connection = new SqlConnection(pubs.ConnectionString);
     DbCommand cmd = connection.CreateCommand();
     cmd.CommandType = CommandType.Text;
     cmd.CommandText = "SELECT COUNT(*) FROM Sales";
     connection.Open();
     int count = (int)cmd.ExecuteScalar();
     connection.Close();
     Label lbl = GetLabel(275, 20);
     lbl.Text = "Count = " + count.ToString();
}
```

Using the *ExecuteReader* Method The *ExecuteReader* method returns a *DbDataReader* instance that represents a forward-only, read-only, server-side cursor. *DbDataReader* objects can be created only by executing one of the *ExecuteReader* methods on the *DbCommand* object. (See the next section for more information on the *DbDataReader*.) The following example uses the *ExecuteReader* method to create a *DbDataReader* object with the query results and continuously loops through the results until the end of data has been reached (when the *Read* method returns *false*).

```
'VB
Protected Sub Button8_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button8.Click
```

```
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = New SqlConnection()
    connection.ConnectionString = pubs.ConnectionString
    Dim cmd As DbCommand = connection.CreateCommand()
    cmd.CommandType = CommandType.Text
    cmd.CommandText = "SELECT stor_id, ord_num FROM Sales"
    connection.Open()
    Dim rdr As DbDataReader = cmd.ExecuteReader()
    Dim lbl As Label = GetLabel(275, 20)
    While (rdr.Read())
      lbl.Text += rdr("stor_id") + ": " + rdr("ord_num") + "<br />"
    End While
    connection.Close()
End Sub

//C#
protected void Button8_Click(object sender, EventArgs e)
{
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
   DbConnection connection = new SqlConnection(pubs.ConnectionString);
    DbCommand cmd = connection.CreateCommand();
    cmd.CommandType = CommandType.Text;
    cmd.CommandText = "SELECT stor_id, ord_num FROM Sales";
    connection.Open();
   DbDataReader rdr = cmd.ExecuteReader();
    Label lbl = GetLabel(275, 20);
    while (rdr.Read())
    {
      lbl.Text += rdr["stor_id"] + ": " + rdr["ord_num"] + "<br />";
    }
    connection.Close();
}
```

Using the *DbDataReader* Object

A *DbDataReader* object provides a high-performance method of retrieving data from the data store. It delivers a forward-only, read-only, server-side cursor. This makes the *DbDataReader* object an ideal choice for populating *ListBox* controls, *DropDownList* controls, and even *GridView* controls that display read-only data. When you run reports, you can use the *DbDataReader* object to retrieve the data from the data store. The *DbDataReader* might not be a good choice when you are coding an operation that modifies data and needs to send the changes back to the database. For data modifica tions, the *DbDataAdapter* object, which is discussed in the next section, might be a better choice.

The *DbDataReader* contains a *Read* method that retrieves data into its buffer. Only one row of data is ever available at a time, which means that the data does not need to be completely read into the application before it is processed. The following code popu lates a new *DataTable* directly with the list of publishers from the *pubs* database:

```
'VB
Protected Sub Button9_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button9.Click
     Dim pubs As ConnectionStringSettings
     pubs = ConfigurationManager.ConnectionStrings("PubsData")
     Dim connection As DbConnection = New SqlConnection()
     connection.ConnectionString = pubs.ConnectionString
     Dim cmd As DbCommand = connection.CreateCommand()
     cmd.CommandType = CommandType.Text
     cmd.CommandText = "SELECT pub_id, pub_name FROM publishers"
     connection.Open()
     Dim rdr As DbDataReader = cmd.ExecuteReader()
     Dim publishers As New DataTable()
     publishers.Load(rdr, LoadOption.Upsert)
     connection.Close()
     Dim gv as GridView = GetGridView(275,20)
     gv.DataSource = publishers
     gv.DataBind()
End Sub

//C#
protected void Button9_Click(object sender, EventArgs e)
{
     ConnectionStringSettings pubs =
       ConfigurationManager.ConnectionStrings["PubsData"];
    DbConnection connection = new SqlConnection(pubs.ConnectionString);
     DbCommand cmd = connection.CreateCommand();
     cmd.CommandType = CommandType.Text;
     cmd.CommandText = "SELECT pub_id, pub_name FROM Publishers";
     connection.Open();
    DbDataReader rdr = cmd.ExecuteReader();
     DataTable publishers = new DataTable();
     publishers.Load(rdr, LoadOption.Upsert);
     connection.Close();
     GridView gv = GetGridView(275, 20);
     gv.DataSource = publishers;
     gv.DataBind();
}
```

Notice that the *DataTable* object’s *Load* method contains a *LoadOption* parameter. The *LoadOption* gives you the option of deciding which *DataRowVersion* should get the incoming data. For example, if you load a *DataTable* object, modify the data, and then save the changes back to the database, you might encounter concurrency errors if someone else has modified the data between the time you got the data and the time you attempted to save the data. One option is to load the *DataTable* object again, using the default *PreserveCurrentValues* enumeration value, which loads the original *DataRowVersion* with the data from the database while leaving the current *DataRow-Version* untouched. Next, you can simply execute the *Update* method again and the update will succeed.

For this to work properly, the *DataTable* must have a *PrimaryKey* defined. Failure to define a *PrimaryKey* results in duplicate *DataRow* objects being added to the *Data-Table* object. The *LoadOption* enumeration members are as follows:

- ***OverwriteChanges*** Overwrites the original *DataRowVersion* and the current *DataRowVersion* and changes the *RowState* to *Unchanged*. New rows have a *Row-State* of *Unchanged* as well.
- ***PreserveChanges* (default)** Overwrites the original *DataRowVersion*, but does not modify the current *DataRowVersion*. New rows have a *RowState* of *Unchanged* as well.
- ***Upsert*** Overwrites the current *DataRowVersion*, but does not modify the orig inal *DataRowVersion*. New rows have a *RowState* of *Added*. Rows that had a *RowState* of *Unchanged* have a *RowState* of *Unchanged* if the current *DataRow-Version* is the same as the original *DataRowVersion*, but if they are different, the *RowState* is *Modified*.

NOTE New in ASP.NET 2.0

Multiple Active Result Sets (MARS) is new in version 2.0 of the .NET Framework.

Using Multiple Active Result Sets (MARS) to Execute Multiple Commands on a Connection One of the problems with the *DbDataReader* is that it keeps an open server-side cursor while you are looping through the results of your query. If you try to execute another command while the first command is still executing, you receive an *InvalidOperationException* stating that "There is already an open DataReader asso ciated with this Connection which must be closed first." You can avoid this exception by setting the *MultipleActiveResultSets* connection string option to *true* when connect ing to MARS-enabled hosts, such as SQL Server 2005. For example, the following con nection string shows how this setting is added into a new connection string called *PubsDataMars*:

```
<connectionStrings>
    <clear />
   <add name="PubsData"
      providerName="System.Data.SqlClient"
      connectionString=
      "Data Source=.\SQLEXPRESS;
              AttachDbFilename=|DataDirectory|PUBS.MDF;
              Integrated Security=True;
              User Instance=True"/>
    <add name="PubsDataMars"
      providerName="System.Data.SqlClient"
      connectionString=
      "Data Source=.\SQLEXPRESS;
              AttachDbFilename=|DataDirectory|PUBS.MDF;
              Integrated Security=True;
              User Instance=True;
              MultipleActiveResultSets=True"/>
</connectionStrings>
```

NOTE MARS performance

MARS does not provide any performance gains, but it does simplify your coding efforts. As a mat ter of fact, setting *MultipleActiveResultSets=True* in the connection string has a negative performance impact, so you should not turn on MARS arbitrarily.

MARS is something that you can live without. MARS simply makes your program ming easier. Think of a scenario in which you execute a query to get a list of authors and, while you are looping through a list of the authors that are returned, you want to execute a second query to get the total royalties for each author.

On a database server without MARS, you could first collect the list of authors into a collection and close the connection. After that, you could loop through the collection to get each author's ID and execute a query to get the total royalties for the author. This means that you would loop through the authors twice: once to populate the col lection, and again to get each author's ID and execute a query to get the author's total of the royalties. A MARS solution is to simply create two connections: one for the author list and one for the total of royalties query.

Another benefit that MARS provides is for a situation in which you have purchased database client licenses that are based on the quantity of connections to the database. Without MARS, you would have to open a separate connection to the database for each command that needs to run at the same time, which means that you might need to purchase more client licenses.

The following code snippet shows how MARS can be used to perform the nested que ries for the author list and the total of the royalties:

```
'VB
Protected Sub Button10_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button10.Click
  Dim lbl As Label = GetLabel(275, 20)
  Dim pubs As ConnectionStringSettings
  pubs = ConfigurationManager.ConnectionStrings("PubsDataMars")
  Dim connection As DbConnection = New SqlConnection()
  connection.ConnectionString = pubs.ConnectionString
  Dim cmd As DbCommand = connection.CreateCommand()
  cmd.CommandType = CommandType.Text
  cmd.CommandText = "SELECT au_id, au_lname, au_fname FROM Authors"
  connection.Open()
  Dim rdr As DbDataReader = cmd.ExecuteReader()
  While rdr.Read()
        Dim salesCmd As DbCommand = connection.CreateCommand()
        salesCmd.CommandType = CommandType.Text
        salesCmd.CommandText = _
                "SELECT SUM(royaltyper) FROM TitleAuthor WHERE (au_id = @auId)"
        Dim parm As DbParameter = salesCmd.CreateParameter()
        parm.ParameterName = "@auId"
        parm.Value = rdr("au_id")
        salesCmd.Parameters.Add(parm)
        Dim qtySales As Object = salesCmd.ExecuteScalar()
        lbl.Text += rdr("au_lname").ToString() + ", " + rdr("au_fname").ToString() _
                + ": " + string.Format("{0:C}",qtySales) + "<br />"
  End While
  connection.Close()
End Sub

//C#
protected void Button10_Click(object sender, EventArgs e)
{
  Label lbl = GetLabel(275, 20);
  ConnectionStringSettings pubs =
        ConfigurationManager.ConnectionStrings["PubsDataMars"];
  DbConnection connection = new SqlConnection(pubs.ConnectionString);
  DbCommand cmd = connection.CreateCommand();
  cmd.CommandType = CommandType.Text;
  cmd.CommandText = "SELECT au_id, au_lname, au_fname FROM Authors";
  connection.Open();
  DbDataReader rdr = cmd.ExecuteReader();
  while (rdr.Read())
    {
        DbCommand salesCmd = connection.CreateCommand();
        salesCmd.CommandType = CommandType.Text;
        salesCmd.CommandText =
                "SELECT SUM(royaltyper) FROM titleauthor WHERE (au_id = @auId)";
        DbParameter parm = salesCmd.CreateParameter();
        parm.ParameterName = "@auId";
        parm.Value = (string)rdr["au_id"];
        salesCmd.Parameters.Add(parm);
        object qtyRoyalties = salesCmd.ExecuteScalar();
        lbl.Text += (string)rdr["au_lname"] + ", " + (string)rdr["au_fname"]
                + ": " + string.Format("{0:C}",qtyRoyalties) + "<br />";
    }
  connection.Close();
}
```

Performing Bulk Copy Operations with the *SqlBulkCopy* Object

The *SqlBulkCopy* class provides a high-performance method for copying data to a table in a SQL Server database. The source of the copy is constrained to the overloads of the *WriteToServer* method, which can accept an array of *DataRow* objects, an object that implements the *IDbDataReader* interface, a *DataTable* object, or a *DataTable* and *DataRowState,* as shown in Figure 4-13. This variety of parameters means that you can retrieve data from most locations.

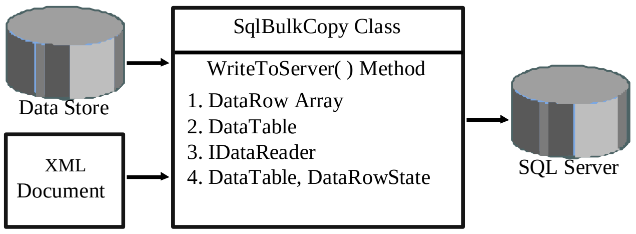


Figure 4-13 The *SqlBulkCopy* object can copy from a variety of sources to a SQL Server table.

NOTE New in ASP.NET 2.0

The *SqlBulkCopy* object is new in version 2.0 of the .NET Framework.

The following code shows how you can use a *SqlBulkCopy* object to copy data from the Store table in the *pubs* database to the StoreList table:

```
'VB
Protected Sub Button11_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button11.Click
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = New SqlConnection()
    connection.ConnectionString = pubs.ConnectionString
    Dim bulkCopy As ConnectionStringSettings
    bulkCopy = ConfigurationManager.ConnectionStrings("PubsData")
    Dim bulkCopyConnection As DbConnection = New SqlConnection()
    bulkCopyConnection.ConnectionString = bulkCopy.ConnectionString
    Dim cmd As DbCommand = connection.CreateCommand()
    cmd.CommandType = CommandType.Text
    cmd.CommandText = "SELECT stor_name FROM Stores"
    connection.Open()
    bulkCopyConnection.Open()

    'make sure that table exists and is empty
    'in case button is clicked more that once
    Dim cleanup as SqlCommand = bulkCopyConnection.CreateCommand()
    cleanup.CommandText = _
      "IF EXISTS ( SELECT * FROM sys.objects " _
         + " WHERE object_id = OBJECT_ID('dbo.StoreList')  " _
         + " AND type in ('U')) " _
         + "DROP TABLE dbo.StoreList " _
        + "CREATE TABLE dbo.StoreList(stor_name varchar(40) NOT NULL )"
    cleanup.ExecuteNonQuery()

    'do the bulkcopy
    Dim rdr As DbDataReader = cmd.ExecuteReader()
    Dim bc As New SqlBulkCopy(bulkCopyConnection)
    bc.DestinationTableName = "StoreList"
    bc.WriteToServer(rdr)
    connection.Close()
    bulkCopyConnection.Close()
    Dim lbl as Label = GetLabel(275,20)
    lbl.Text = "Done with bulk copy"
End Sub
```

//C#

```
protected void Button11_Click(object sender, EventArgs e)
{
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
    DbConnection connection =
      new SqlConnection(pubs.ConnectionString);
    ConnectionStringSettings bulkCopy =
      ConfigurationManager.ConnectionStrings["PubsData"];
    SqlConnection bulkCopyConnection =
      new SqlConnection(bulkCopy.ConnectionString);
    DbCommand cmd = connection.CreateCommand();
    cmd.CommandType = CommandType.Text;
    cmd.CommandText = "SELECT stor_name FROM Stores";
    connection.Open();
    bulkCopyConnection.Open();

    //make sure that table exists and is empty
    //in case button is clicked more that once
    SqlCommand cleanup = bulkCopyConnection.CreateCommand();
    cleanup.CommandText =
      "IF EXISTS ( SELECT * FROM sys.objects "
         + " WHERE object_id = OBJECT_ID('dbo.StoreList')  "
         + " AND type in ('U')) "
         + "DROP TABLE dbo.StoreList "
         + "CREATE TABLE dbo.StoreList(stor_name varchar(40) NOT NULL )";
    cleanup.ExecuteNonQuery();
    //do the bulkcopy
    DbDataReader rdr = cmd.ExecuteReader();
     SqlBulkCopy bc = new SqlBulkCopy(bulkCopyConnection);
     bc.DestinationTableName = "StoreList";
     bc.WriteToServer(rdr);
     connection.Close();
     bulkCopyConnection.Close();
     Label lbl = GetLabel(275, 20);
     lbl.Text = "Done with bulk copy";
}
```

You should consider using the *IDbDataReader* parameter whenever possible to get the best performance with the least resources used. You can decide how much data should be copied based on the query that you use. For example, the preceding code sample retrieved only the store names and could have had a WHERE clause to further limit the data.

Using the *DbDataAdapter* Object

The *DbDataAdapter* object is used to retrieve and update data between a *DataTable* and a data store. The *DbDataAdapter* is derived from the *DataAdapter* class and is the base class of the provider-specific *DbDataAdapter* classes, as shown in Figure 4-14.

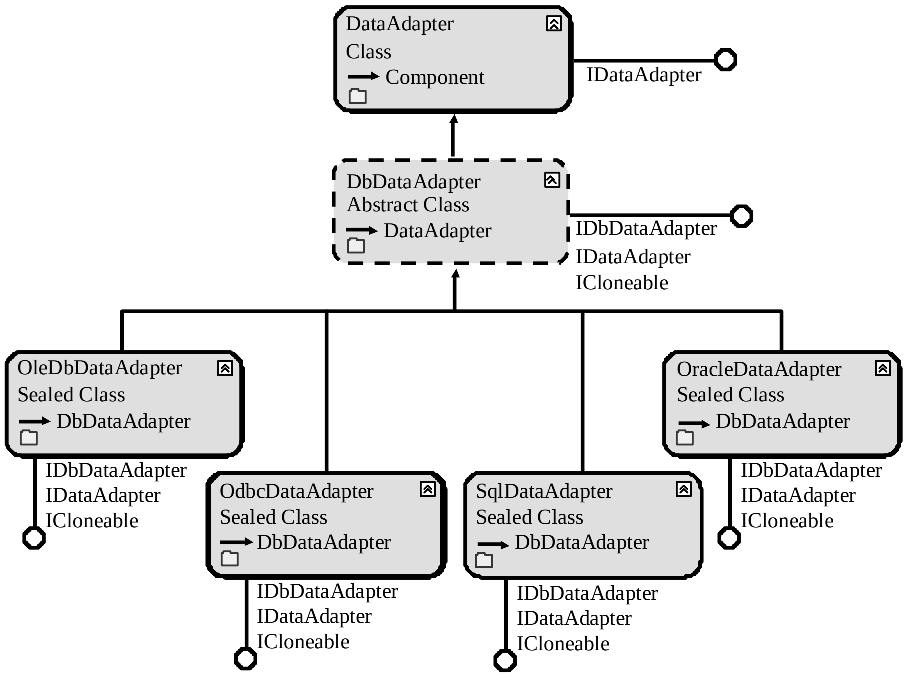


Figure 4-14 The *DbDataAdapter* hierarchy, showing the *DataAdapter* base class and the provider-specific derived classes

The *DbDataAdapter* has a *SelectCommand* property that you use when retrieving the data. The *SelectCommand* must contain a valid *DbCommand* object, which must have a valid connection.

The *DbDataAdapter* also has *InsertCommand*, *UpdateCommand*, and *DeleteCommand* properties, which can optionally contain *DbCommand* objects to send *DataTable* changes to the data store. You don't need to create these command objects if you only need to read data from the data store, but if you create one of these latter three com mands, you must create all four of them.

Using the *Fill* Method The *Fill* method moves data from the data store to the *Data-Table* object that you pass into this method. The *Fill* method has several overloads, some of which accept only a *DataSet* as a parameter. When a *DataSet* is passed to the *Fill* method, a new *DataTable* object is created in the *DataSet* if a source *DataTable* object is not specified.

The following code snippet shows how a *DataTable* can be loaded using the *Fill* method:

```
'VB
Protected Sub Button12_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button12.Click
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = New SqlConnection()
    connection.ConnectionString = pubs.ConnectionString
    Dim cmd As SqlCommand = CType(connection.CreateCommand(), SqlCommand)
    cmd.CommandType = CommandType.Text
    cmd.CommandText = "SELECT pub_id, pub_name FROM publishers"
    Dim pubsDataSet As New DataSet("Pubs")
    Dim da As New SqlDataAdapter(cmd)
    da.Fill(pubsDataSet, "publishers")
    Dim gv as GridView = GetGridView(275,20)
    gv.DataSource = pubsDataSet
    gv.DataMember = "publishers"
    gv.DataBind()
End Sub

//C#
protected void Button12_Click(object sender, EventArgs e)
{
    ConnectionStringSettings pubs =
        ConfigurationManager.ConnectionStrings["PubsData"];
   DbConnection connection = new SqlConnection(pubs.ConnectionString);
    SqlCommand cmd = (SqlCommand)connection.CreateCommand();
    cmd.CommandType = CommandType.Text;
    cmd.CommandText = "SELECT pub_id, pub_name FROM Publishers";
    SqlDataAdapter da = new SqlDataAdapter(cmd);
    DataSet pubsDataSet = new DataSet("Pubs");
    da.Fill(pubsDataSet, "publishers");
    GridView gv = GetGridView(275, 20);
    gv.DataSource = pubsDataSet;
    gv.DataMember = "publishers";
    gv.DataBind();
}
```

Saving Changes to the Database Using the *Update* Method The *Update* method retrieves the changes from a *DataTable* object and executes the appropriate *InsertCom mand*, *UpdateCommand*, or *DeleteCommand* to send each change to the data store on a row-by-row basis. The *Update* method retrieves the *DataRow* objects that have been changed by looking at the *RowState* property of each row. If the *RowState* is anything but *Unchanged*, the *Update* method sends the change to the database.

For the *Update* method to work, all four commands must be assigned to the *DbData-Adapter*. Normally, this means creating individual *DbCommand* objects for each com mand. You can easily create the commands by using the *DbDataAdapter* configuration wizard, which starts when a *DbDataAdapter* is dropped onto the form. The wizard can generate stored procedures for all four commands.

Another way to populate the *DbDataAdapter* object's commands is to use the *DbCom mandBuilder* object. This object creates the *InsertCommand*, *UpdateCommand*, and *DeleteCommand* as long as a valid *SelectCommand* exists. The *DbCommandBuilder* is great for specific changes and demos, but it's generally better to use stored procedures for all database access to eliminate security risk from SQL injection attacks. The fol lowing code demonstrates a simple update to the database using the *SqlDataAdapter*, which is the SQL Server–specific version of the *DbDataAdapter*:

```
'VB
Protected Sub Button13_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button13.Click
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = New SqlConnection()
    connection.ConnectionString = pubs.ConnectionString
    Dim cmd As SqlCommand = _
      CType(connection.CreateCommand(), SqlCommand)
    cmd.CommandType = CommandType.Text
    cmd.CommandText = "SELECT * FROM publishers"
    Dim pubsDataSet As New DataSet("Pubs")
    Dim da As New SqlDataAdapter(cmd)
    Dim bldr As New SqlCommandBuilder(da)
    da.Fill(pubsDataSet, "publishers")
    'Modify data here - added time to assure change
    pubsDataSet.Tables("publishers").Rows(0)("pub_name") _
      = "Hello" + DateTime.Now.ToLongTimeString()
    'Add a row - use minutes and seconds for id
    pubsDataSet.Tables("publishers").Rows.Add( _
      "99" + DateTime.Now.Second.ToString(), _
      "Tailspin Toys", "Paris", Nothing, "France")
    da.Update(pubsDataSet, "publishers")
    Dim lbl As Label = GetLabel(275, 20)
    lbl.Text = "Update Complete"
End Sub

//C#
protected void Button13_Click(object sender, EventArgs e)
{
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
   DbConnection connection = new SqlConnection(pubs.ConnectionString);
    SqlCommand cmd = (SqlCommand)connection.CreateCommand();
    cmd.CommandType = CommandType.Text;
    cmd.CommandText = "SELECT * FROM Publishers";
    SqlDataAdapter da = new SqlDataAdapter(cmd);
    DataSet pubsDataSet = new DataSet("Pubs");
    SqlCommandBuilder bldr = new SqlCommandBuilder(da);
    da.Fill(pubsDataSet, "publishers");
    //Modify data here - added time to assure change
    pubsDataSet.Tables["publishers"].Rows[0]["pub_name"]
      = "Hello" + DateTime.Now.ToLongTimeString();
    //Add a row - use seconds in id
    pubsDataSet.Tables["publishers"].Rows.Add(
      "99" + DateTime.Now.Second.ToString(),
      "Tailspin Toys", "Paris", null, "France");
    da.Update(pubsDataSet, "publishers");
    Label lbl = GetLabel(275, 20);
    lbl.Text = "Update Complete";
}
```

Saving Changes to the Database in Batches One way to increase update performance is to send the changes to the database server in batches instead of sending changes on a row-by-row basis. You can do this by assigning a value to the *DbDataAdapter* object's *UpdateBatchSize* property. This property defaults to 1, which causes each change to be sent to the server on a row-by-row basis. Setting the value to 0 instructs the *DbData-Adapter* object to create the largest possible batch size for changes, or you can set the value to the number of changes you want to send to the server in each batch. Setting the *UpdateBatchSize* to a number greater than the number of changes that need to be sent is equivalent to setting it to 0.

NOTE New in ASP.NET 2.0

The *UpdateBatchSize* property is new in version 2.0 of the .NET Framework.

You can confirm that the changes are being sent to the database server in batches by adding a *RowUpdated* event to the *DbDataAdapter* object. The event handler method exposes the number of rows affected in the last batch. When the *UpdateBatchSize* is set to 1, the *RecordsAffected* property is always 1. In the following code snippet, the publishers' table contains eight rows. The *pubsDataSet* is filled, and then the *pub_name* field is modified on all eight rows. Before the *Update* method is executed, the *UpdateBatchSize* is changed to 3. When the *Update* method is executed, the changes are sent to the database as a batch of three changes, another batch of three changes, and finally, a batch of two changes. This code contains a *RowUpdated* event handler to collect batch information, which is displayed after the *Update* method is executed.

```
'VB
Public WithEvents da As New SqlDataAdapter()
Public sb As New System.Text.StringBuilder()

Private Sub rowUpdated(ByVal sender As Object, _
        ByVal e As SqlRowUpdatedEventArgs) Handles da.RowUpdated
    sb.Append("Rows: " & e.RecordsAffected.ToString() & vbCrLf)
End Sub

Protected Sub Button14_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button14.Click
    Dim pubs As ConnectionStringSettings
    pubs = ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = New SqlConnection()
    connection.ConnectionString = pubs.ConnectionString
    Dim cmd As SqlCommand = _
      CType(connection.CreateCommand(), SqlCommand)
    cmd.CommandType = CommandType.Text
    cmd.CommandText = "SELECT * FROM publishers"
    Dim pubsDataSet As New DataSet("Pubs")
    da.SelectCommand = cmd
    Dim bldr As New SqlCommandBuilder(da)
    da.Fill(pubsDataSet, "publishers")
    'Modify data here
    For Each dr As DataRow In pubsDataSet.Tables("publishers").Rows
      dr("pub_name") = "Updated Toys " _
            + DateTime.Now.Minute.ToString() _
            + DateTime.Now.Second.ToString()
    Next
    da.UpdateBatchSize = 3
    da.Update(pubsDataSet, "publishers")
    Dim lbl As Label = GetLabel(275, 20)
    lbl.Text = sb.ToString()
End Sub

//C#
public SqlDataAdapter da = new SqlDataAdapter();
public System.Text.StringBuilder sb = new System.Text.StringBuilder();

private void rowUpdated(object sender, SqlRowUpdatedEventArgs e)
{
    sb.Append("Rows: " + e.RecordsAffected.ToString() + "\r\n");
}

protected void Button14_Click(object sender, EventArgs e)
{
    //event subscription is normally placed in constructor but is here
   //to encapsulate the sample
    da.RowUpdated += new SqlRowUpdatedEventHandler(rowUpdated);
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
   DbConnection connection = new SqlConnection(pubs.ConnectionString);
    SqlCommand cmd = (SqlCommand)connection.CreateCommand();
    cmd.CommandType = CommandType.Text;
    cmd.CommandText = "SELECT * FROM Publishers";
    da.SelectCommand = cmd;
    DataSet pubsDataSet = new DataSet("Pubs");
    SqlCommandBuilder bldr = new SqlCommandBuilder(da);
    da.Fill(pubsDataSet, "publishers");
    //Modify data here
    foreach (DataRow dr in pubsDataSet.Tables["publishers"].Rows)
    {
      dr["pub_name"] = "Updated Toys "
            + DateTime.Now.Minute.ToString()
            + DateTime.Now.Second.ToString();
    }
    da.UpdateBatchSize = 3;
    da.Update(pubsDataSet, "publishers");
    //if event subscription is in the contructor, no need to
    //remove it here....
    da.RowUpdated -= new SqlRowUpdatedEventHandler(rowUpdated);
    Label lbl = GetLabel(275, 20);
    lbl.Text = sb.ToString();
}
```

Using the *OleDbDataAdapter* Object to Access ADO Recordset or Record The *OleDbDataAdapter* is similar to the *SqlDataAdapter*; however, the *OleDbDataAdapter* provides a unique feature: the ability to read a legacy ADO Recordset or Record into a *DataSet*. Consider the following code snippet:

```
'VB
Protected Sub Button7_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button7.Click
      Dim da as  new OleDbDataAdapter()
      Dim ds as new DataSet()
      ' set reference to adodb.dll and
      ' add using ADODB
      Dim adoCn as new ADODB.Connection()
      Dim adoRs as new ADODB.Recordset()
      adoCn.Open( _
         "Provider=Microsoft.Jet.OLEDB.4.0;" _
            + "Data Source=" _
           + MapPath("App_Data/Northwind.mdb") + ";" _
            + "Persist Security Info=False", "", "", -1)
     adoRs.Open("SELECT * FROM Customers", _
         adoCn, ADODB.CursorTypeEnum.adOpenForwardOnly, _
         ADODB.LockTypeEnum.adLockReadOnly, 1)
      da.Fill(ds, adoRs, "Customers")
      adoCn.Close()
      Dim gv as GridView = GetGridView(275, 20)
      gv.DataSource = ds
      gv.DataMember = "Customers"
      gv.DataBind()
End Sub

//C#
protected void Button7_Click(object sender, EventArgs e)
{
      OleDbDataAdapter da = new OleDbDataAdapter();
      DataSet ds = new DataSet();
      // set reference to adodb.dll and
      // add using ADODB
      ADODB.Connection adoCn = new ADODB.Connection();
      ADODB.Recordset adoRs = new ADODB.Recordset();
      adoCn.Open(
         "Provider=Microsoft.Jet.OLEDB.4.0;"
           + "Data Source="
            + MapPath("App_Data/Northwind.mdb") + ";"
            + "Persist Security Info=False", "", "", -1);
     adoRs.Open("SELECT * FROM Customers",
         adoCn, ADODB.CursorTypeEnum.adOpenForwardOnly,
         ADODB.LockTypeEnum.adLockReadOnly, 1);
      da.Fill(ds, adoRs, "Customers");
      adoCn.Close();
      GridView gv = GetGridView(275, 20);
      gv.DataSource = ds;
      gv.DataMember = "Customers";
      gv.DataBind();
}
```

This code sample is opening a connection to a Microsoft Access database called northwind.mdb and retrieving the Customers table into an ADODB.Recordset. The recordset is passed to the *Fill* method on the *OleDbDataAdapter*, which uses the recordset as the source when filling the *DataSet* object.

The primary purpose of this feature is to support legacy data, which can be useful in situations where you have a legacy ADODB.Recordset and you want to display it using one of the .NET GUI controls, or if you want to save the data to a data store using one of the .NET providers.

Using the *DbProviderFactory* Classes

There are many reasons for writing an application that does not require database provider-specific code. A company might want the flexibility to upgrade from one database product to another, such as moving from Microsoft Access to SQL Server. A company might have a retail application that must allow connectivity to any data source.

ADO.NET provides base classes that the provider-specific classes inherit from, as shown earlier in Table 4-1. The .NET Framework supports only single inheritance, so this approach has limitations if you want to create your own base class, but for classes that will expand, providing base class inheritance is better than providing interface implementation. Note that interfaces are still provided for backward compatibility.

NOTE New in ASP.NET 2.0

The provider factory objects are new in version 2.0 of the .NET Framework.

The *DbProviderFactory* lets you create a factory object that is responsible for creating the appropriate provider objects. Each provider must supply a subclass of *DbProviderFactory* that can be used to create instances of its provider classes. For example, you can use the *SqlClientFactory* to create instances of any of the SQL Server classes. Figure 4-15 shows the *DbProviderFactory* class hierarchy.

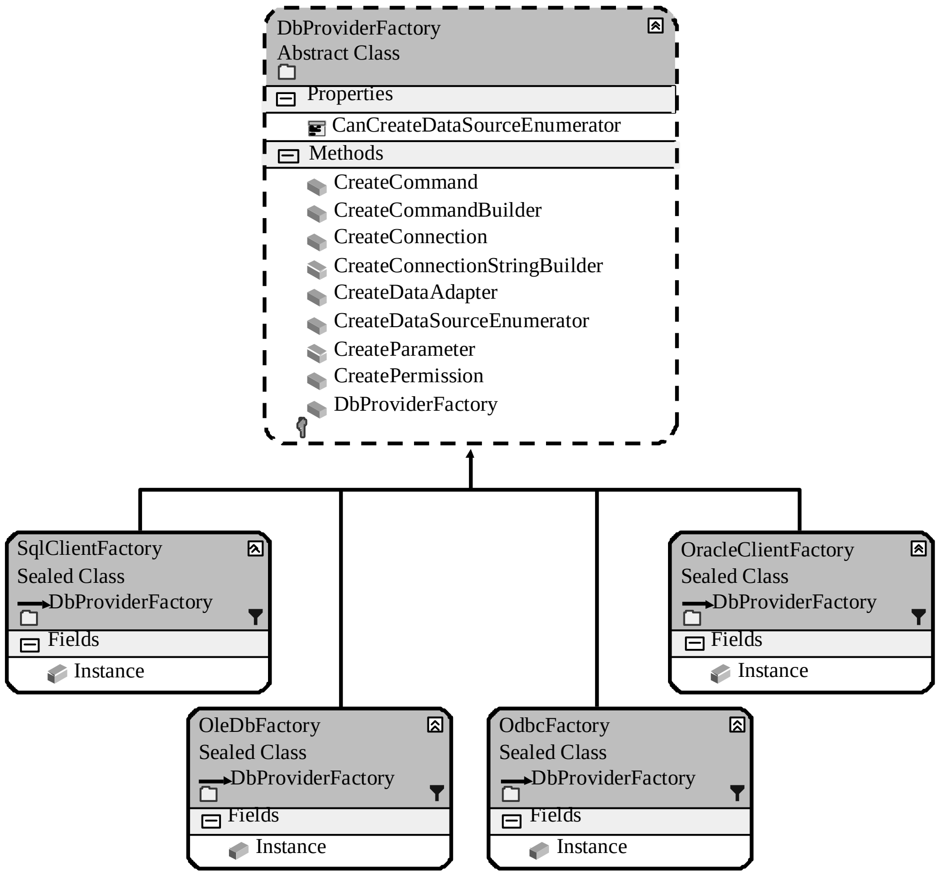


Figure 4-15 The *DbProviderFactory* and the *SqlClientFactory* classes.

The provider factory classes are implemented as singletons, where each class provides an *Instance* property that is used to access the methods and properties shown in Figure 4-15. For example, you can use the following code to create a new connection using the *SqlClientFactory*:

```
'VB
'Get the singleton instance
Dim factory As DbProviderFactory = SqlClientFactory.Instance

Public Function GetProviderConnection() As DbConnection
    Dim connection As DbConnection = factory.CreateConnection()
    connection.ConnectionString = "Data Source=.\SQLEXPRESS;" _
      & "AttachDbFilename=|DataDirectory|PUBS.MDF;" _
      & "Integrated Security=True;User Instance=True"
    Return connection
End Function
```

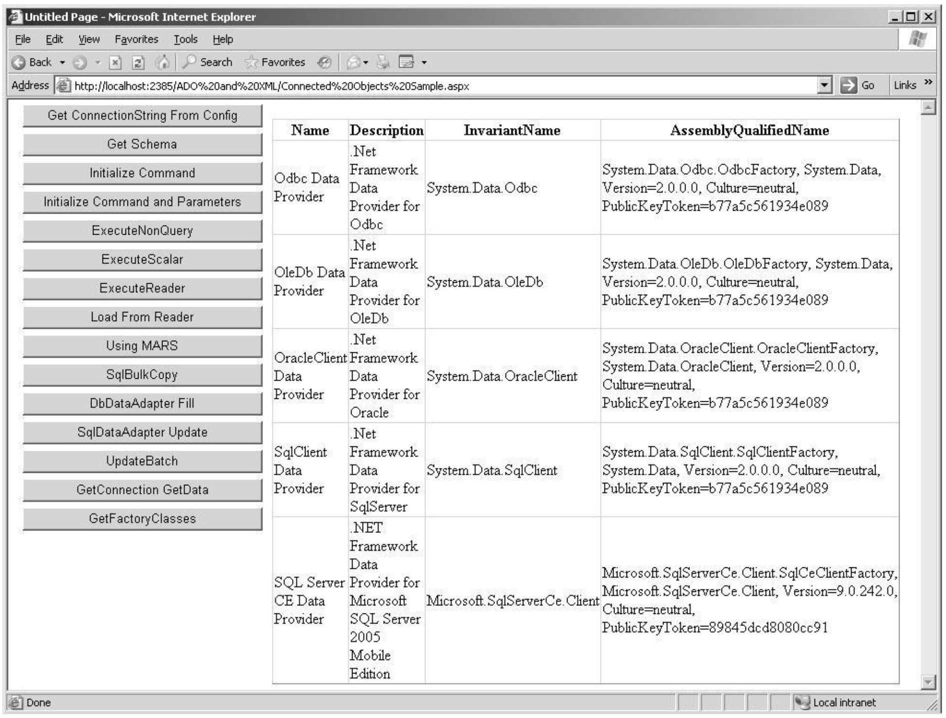
```
//C#
//Get the singleton instance
DbProviderFactory factory = SqlClientFactory.Instance;

public DbConnection GetProviderConnection()
{
    DbConnection connection = factory.CreateConnection();
    connection.ConnectionString = @"Data Source=.\SQLEXPRESS;"
        + "AttachDbFilename=|DataDirectory|PUBS.MDF;"
        + "Integrated Security=True;User Instance=True";
    return connection;
}
```

Using the *DbProviderFactories* Class

To query for the list of available factories, you can use the *DbProviderFactories* class. This class is a factory for obtaining factories. It contains a method called *GetFactory-Classes* that returns a *DataTable* that is populated with information describing all available providers. Retrieving the list of providers can be easily demonstrated by using the following code snippet:

```
'VB
Dim providersList As DataTable = Nothing

Protected Sub Button16_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button16.Click
    providersList = DbProviderFactories.GetFactoryClasses()
    Dim gv As GridView = GetGridView(275, 20)
    gv.Width = 400
    gv.DataSource = providersList
    gv.DataBind()
End Sub

//C#
DataTable providersList = null;

protected void Button16_Click(object sender, EventArgs e)
{
    providersList = DbProviderFactories.GetFactoryClasses();
    GridView gv = GetGridView(275, 20);
    gv.Width = 400;
    gv.DataSource = providersList;
    gv.DataBind();
}
```

When the Web page is run and the button is clicked, the screen shown in Figure 4-16 is displayed.



Name	Description	InvariantName	AssemblyQualifiedName
Odbc Data Provider	.Net Framework Data Provider for Odbc	System.Data.Odbc	System.Data.Odbc.OdbcFactory, System.Data, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089
OleDb Data Provider	.Net Framework Data Provider for OleDb	System.Data.OleDb	System.Data.OleDb.OleDbFactory, System.Data, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089
OracleClient Data Provider	.Net Framework Data Provider for Oracle	System.Data.OracleClient	System.Data.OracleClient.OracleClientFactory, System.Data.OracleClient, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089
SqlClient Data Provider	.Net Framework Data Provider for SqlServer	System.Data.SqlClient	System.Data.SqlClient.SqlClientFactory, System.Data, Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089
SQL Server CE Data Provider	.NET Framework Data Provider for Microsoft SQL Server 2005 Mobile Edition	Microsoft.SqlServerCe.Client	Microsoft.SqlServerCe.Client.SqlCeClientFactory, Microsoft.SqlServerCe.Client, Version=9.0.242.0, Culture=neutral, PublicKeyToken=89845dcd8080cc91

Figure 4-16 The available provider factory classes on an example computer.

The invariant column contains a string that you can use to retrieve a specific provider. The name and description provide information that you can use to display a friendly provider list to an application user. The listed assembly names are fully qualified. Any provider on the list must be located within the application's probing path. This means that the .NET runtime must be able to locate the provider. In most situations, the pro vider library is installed in the GAC or the application folder.

The provider list shown in Figure 4-16 is from the Machine.config file, which, by default, contains the following provider information within the <*configuration*> root element:

```
<system.data>
 <DbProviderFactories>
    <add name="Odbc Data Provider"
     invariant="System.Data.Odbc"
     description=".Net Framework Data Provider for Odbc"
     type="System.Data.Odbc.OdbcFactory, System.Data,
          Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" />
    <add name="OleDb Data Provider"
     invariant="System.Data.OleDb"
     description=".Net Framework Data Provider for OleDb"
     type="System.Data.OleDb.OleDbFactory, System.Data,
          Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" />
    <add name="OracleClient Data Provider"
     invariant="System.Data.OracleClient"
     description=".Net Framework Data Provider for Oracle"
          type="System.Data.OracleClient.OracleClientFactory,
           System.Data.OracleClient, Version=2.0.0.0, Culture=neutral,
           PublicKeyToken=b77a5c561934e089" />
    <add name="SqlClient Data Provider"
     invariant="System.Data.SqlClient"
     description=".Net Framework Data Provider for SqlServer"
     type="System.Data.SqlClient.SqlClientFactory, System.Data,
          Version=2.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089" />
    <add name="SQL Server CE Data Provider"
     invariant="Microsoft.SqlServerCe.Client"
     description=".NET Framework Data Provider for
          Microsoft SQL Server 2005 Mobile Edition"
     type="Microsoft.SqlServerCe.Client.SqlCeClientFactory,
          Microsoft.SqlServerCe.Client, Version=9.0.242.0,
          Culture=neutral, PublicKeyToken=89845dcd8080cc91" />
 </DbProviderFactories>
</system.data>
```

Notice that *DbDatabaseProviderFactories* uses the <*add*> element. By using the <*add*> element, you can add more providers to the Machine.config file or the application's configuration file. You can also use the <*remove*> tag to remove providers from the default machine.config list. For example, the following is a sample App.config file that removes the ODBC provider from the defaults defined in Machine.config:

```
<configuration>
 <system.data>
    <DbProviderFactories>
          <remove invariant="System.Data.Odbc" />
    </DbProviderFactories>
 </system.data>
</configuration>
```

If very few specific providers (such as SQL Server and Oracle) are required, you can use the <*clear*> element to remove all of the providers in the Machine.config file and then use the <*add*> element to add the desired providers back into the list. The follow ing example clears the provider list and adds the SQL Server provider back into the list:

```
<configuration>
 <system.data>
    <DbProviderFactories>
          <clear/>
          <add name="SqlClient Data Provider"
```

```
               invariant="System.Data.SqlClient"
               description=".Net Framework Data Provider for SqlServer"
               type="System.Data.SqlClient.SqlClientFactory, System.Data,
               Version=2.0.0.0, Culture=neutral,
               PublicKeyToken=b77a5c561934e089" />
      </DbProviderFactories>
   </system.data>
</configuration>
```

Enumerating Data Sources

Sometimes you want to display a list of the available data sources for a given provider. For example, if an application allows data to be read from one SQL Server and written to a different SQL Server, it might require a dialog box for selecting from a list of avail able SQL Servers for the source and destination servers. The following code snippet shows how to enumerate the data sources:

```
'VB
Protected Sub Button17_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button17.Click
    Dim factory as DbProviderFactory  = _
      DbProviderFactories.GetFactory("System.Data.SqlClient")
   'get SQL Server instances
    Dim sources as DataTable = _
      factory.CreateDataSourceEnumerator().GetDataSources()
    Dim gv As GridView = GetGridView(275, 20)
    gv.DataSource = sources
    gv.DataBind()
End Sub

//C#
protected void Button17_Click(object sender, EventArgs e)
{
    DbProviderFactory factory =
      DbProviderFactories.GetFactory("System.Data.SqlClient");
    //get SQL Server instances
    DataTable sources =
      factory.CreateDataSourceEnumerator().GetDataSources();
    GridView gv = GetGridView(275, 20);
    gv.DataSource = sources;
    gv.DataBind();
}
```

Catching Provider Exceptions

All provider specific exceptions inherit from a common base class called *DbException*. When working with a provider-neutral coding model, your *try/catch* block can simply catch *DbException* generically instead of trying to catch each provider-specific exception.

The *DbException* object contains a *Data* collection property that contains information about the error; you can also use the *Message* property to retrieve information about the error. In the following example, a loop is created to show how you might want to retry a command on error. This code also demonstrates the use of the *try/catch* block and the *using* block.

```
'VB
Protected Sub Button19_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button19.Click
  Dim lbl As Label = GetLabel(275, 20)
  Dim maxTries As Integer = 3
  For i As Integer = 1 To maxTries
    Dim pubs As ConnectionStringSettings = _
        ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As DbConnection = _
        New SqlConnection(pubs.ConnectionString)
    Dim cmd As DbCommand = connection.CreateCommand()

    Try
        Using (connection)
            Using (cmd)
              cmd.CommandType = CommandType.Text
              'choose the SQL statement; one causes error, other does not.
              cmd.CommandText = "RaisError('Custom Error',19,1) With Log"
              'cmd.CommandText = "Select @@Version"
              connection.Open()
              cmd.ExecuteNonQuery()
            End Using
        End Using
        lbl.Text += "Command Executed Successfully<br />"
        Return
    Catch xcp As DbException
        lbl.Text += xcp.Message + "<br />"
        for each item as DictionaryEntry in  xcp.Data
            lbl.Text += "&nbsp;&nbsp;" + item.Key.ToString()
            lbl.Text += " = " + item.Value.ToString()
            lbl.Text += "<br />"
        Next
    End Try
  Next
  lbl.Text += "Max Tries Exceeded<br />"
End Sub

//C#
protected void Button19_Click(object sender, EventArgs e)
{
  Label lbl = GetLabel(275, 20);
  int maxTries = 3;
  for (int i = 0; i < maxTries; i++)
  {
    ConnectionStringSettings pubs =
            ConfigurationManager.ConnectionStrings["PubsData"];
        DbConnection connection =
            new SqlConnection(pubs.ConnectionString);
        DbCommand cmd = connection.CreateCommand();

        try
          {
            using (connection)
             {
                using (cmd)
                {
                  cmd.CommandType = CommandType.Text;
                  //choose the SQL statement; one causes error, other does not.
                  cmd.CommandText = "RaisError('Custom Error',19,1) With Log";
                  //cmd.CommandText = "Select @@Version";
                  connection.Open();
                  cmd.ExecuteNonQuery();
                }
             }
            lbl.Text += "Command Executed Successfully<br />";
            return;
          }
        catch (DbException xcp)
          {
            lbl.Text += xcp.Message + "<br />";
            foreach (DictionaryEntry item in xcp.Data)
             {
                lbl.Text += "&nbsp;&nbsp;" + item.Key.ToString();
                lbl.Text += " = " + item.Value.ToString();
                lbl.Text += "<br />";
             }
          }
      }
      lbl.Text += "Max Tries Exceeded<br />";
}
```

Detecting Information with the *Connection* Event The connection classes contain an event called *InfoMessage* that can be used to retrieve general and error information from the database. You can use the *InfoMessage* event to view the results of SQL Print statements and any messages that are available as a result of the SQL RaiseError state ment, regardless of the error level.

The following code snippet shows how this can be used to display information in a *Label* and a *GridView* by subscribing to the *InfoMessage* event when running a query that has informational messages:

```
'VB
Protected Sub Button18_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button18.Click
```

```
    Dim errLabel As Label = GetLabel(275, 20)
    Dim errGrid As GridView = GetGridView(275, 100)
    Dim pubs As ConnectionStringSettings = _
      ConfigurationManager.ConnectionStrings("PubsData")
    Dim connection As New SqlConnection(pubs.ConnectionString)
    AddHandler connection.InfoMessage, AddressOf connection_InfoMessage
    Dim cmd As DbCommand = connection.CreateCommand()
    cmd.CommandType = CommandType.Text
    cmd.CommandText = "SELECT job_id, job_desc FROM Jobs;" _
          + "Print 'Hello Everyone';" _
          + "Raiserror('Info Error Occured', 10,1 )" _
          + "Print GetDate()"
    connection.Open()
    Dim rdr As DbDataReader = cmd.ExecuteReader()
    Dim publishers As New DataTable()
    publishers.Load(rdr, LoadOption.Upsert)
    connection.Close()
    Dim gv As GridView = GetGridView(275, 200)
    gv.DataSource = publishers
    gv.DataBind()
    errLabel.Text = errMessage
    errGrid.DataSource = errCollection
    errGrid.DataBind()
End Sub

Private errMessage As String = String.Empty
Private errCollection As New List(Of SqlError)

Private Sub connection_InfoMessage(ByVal sender As Object, _
      ByVal e As SqlInfoMessageEventArgs)
    errMessage += "Message: " + e.Message + "<br />"
    For Each err As SqlError In e.Errors
      errCollection.Add(err)
    Next
End Sub

//C#
protected void Button18_Click(object sender, EventArgs e)
{
    Label errLabel = GetLabel(275, 20);
    GridView errGrid = GetGridView(275, 100);
    ConnectionStringSettings pubs =
      ConfigurationManager.ConnectionStrings["PubsData"];
    SqlConnection connection = new SqlConnection(pubs.ConnectionString);
    connection.InfoMessage +=
      new SqlInfoMessageEventHandler(connection_InfoMessage);
    DbCommand cmd = connection.CreateCommand();
    cmd.CommandType = CommandType.Text;
    cmd.CommandText = "SELECT job_id, job_desc FROM Jobs;"
      + "Print 'Hello Everyone';"
      + "Raiserror('Info Error Occured', 10,1 )"
      + "Print GetDate()";
    connection.Open();
    DbDataReader rdr = cmd.ExecuteReader();
    DataTable publishers = new DataTable();
    publishers.Load(rdr, LoadOption.Upsert);
    connection.Close();
    GridView gv = GetGridView(275, 200);
    gv.DataSource = publishers;
    gv.DataBind();
    errLabel.Text = errMessage;
    errGrid.DataSource = errCollection;
    errGrid.DataBind();
}

private string errMessage = string.Empty;
private List<SqlError> errCollection = new List<SqlError>();

void connection_InfoMessage(object sender, SqlInfoMessageEventArgs e)
{
    errMessage += "Message: " + e.Message + "<br />";
    foreach(SqlError err in e.Errors) errCollection.Add(err);
}
```

Using the ADO.NET *Transaction* Object

A *transaction* is an atomic unit of work that must be completed in its entirety. The transaction succeeds if it is committed and fails if it is aborted. Transactions have four essential properties: atomicity, consistency, isolation, and durability (known as the *ACID properties*).

- **Atomicity** The work cannot be broken into smaller parts. Although a transac tion might contain many SQL statements, it must be run as an all-or-nothing proposition, which means that, if a transaction is only partially complete when an error occurs, the work reverts to its state prior to the start of the transaction.
- **Consistency** A transaction must operate on a consistent view of the data and must also leave the data in a consistent state. Any work in progress must not be visible to other transactions until the transaction has been committed.
- **Isolation** A transaction should appear to be running by itself, the effects of other ongoing transactions must be invisible to this transaction, and the effects of this transaction must be invisible to other ongoing transactions.
- **Durability** When a transaction is committed, it must be persisted so it is not lost in the event of a power failure or other system failure. Only committed transac tions are recovered during power-up and crash recovery; uncommitted work is rolled back.

You can use the *DbConnection* object with the *BeginTransaction* method, which creates a *DbTransaction* object. The following code snippet shows how this is done:

```
'VB
Protected Sub Button20_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button20.Click
    Dim lbl As Label = GetLabel(275, 20)
    Dim cnSetting As ConnectionStringSettings = _
      ConfigurationManager.ConnectionStrings("PubsData")
    Using cn As New SqlConnection()
      cn.ConnectionString = cnSetting.ConnectionString
      cn.Open()
      Using tran As SqlTransaction = cn.BeginTransaction()
              Try
                  'work code here
                  Using cmd As SqlCommand = cn.CreateCommand()
                    cmd.Transaction = tran
                    cmd.CommandText = "UPDATE jobs SET min_lvl=min_lvl * 1.1"
                    Dim count As Integer = CInt(cmd.ExecuteNonQuery())
                  lbl.Text = "Count = " + count.ToString()
                  End Using
                  'if we made it this far, commit
                  tran.Commit()
             Catch xcp As Exception
                  tran.Rollback()
                  'cleanup code
                  lbl.Text = xcp.Message
             End Try
      End Using
    End Using
End Sub

//C#
protected void Button20_Click(object sender, EventArgs e)
{
    Label lbl = GetLabel(275, 20);
    ConnectionStringSettings cnSetting =
      ConfigurationManager.ConnectionStrings["PubsData"];
    using (SqlConnection cn = new SqlConnection())
    {
      cn.ConnectionString = cnSetting.ConnectionString;
      cn.Open();
      using (SqlTransaction tran = cn.BeginTransaction())
         {
              try
              {
                  //work code here
                  using (SqlCommand cmd = cn.CreateCommand())
                  {
                    cmd.Transaction = tran;
                    cmd.CommandText = "UPDATE jobs SET min_lvl=min_lvl * 1.1";
                    int count = (int)cmd.ExecuteNonQuery();
                    lbl.Text = "Count = " + count.ToString();
                  }
                  //if we made it this far, commit
                  tran.Commit();
              }
             catch (Exception xcp)
              {
                  tran.Rollback();
                  //cleanup code
                  lbl.Text = xcp.Message;
              }
          }
      }
}
```

In this code, a *SqlConnection* object is created and opened, and the connection object is used to create a transaction object by executing the *BeginTransaction* method. The *try* block does the work and commits the transaction. If an exception is thrown, the *catch* block rolls back the transaction. Also, notice that the *SqlCommand* object must have its *Transaction* property assigned to the connection's transaction.

The scope of the transaction is limited to the code within the *try* block, but the trans action was created by a specific connection object, so the transaction cannot span to a different *Connection* object.

Asynchronous Data Access

Asynchronous access to data can greatly improve the performance or perceived per formance (responsiveness) of your application. With asynchronous access, multiple commands can be executed simultaneously and notification of command completion can be accomplished by either polling, using *WaitHandles*, or delegating.

Synchronous vs. Asynchronous Access

Commands are normally executed synchronously, which causes the command to "block" program execution until the command has completed. Blocking execution keeps the program from continuing until the command has finished executing. This simplifies the writing of the code because the developer simply thinks about code exe cution in a rather procedural, step-by-step fashion, as shown in Figure 4-17. The prob lem arises with long-running commands, because blocking inhibits the program's ability to do other work such as performing additional commands or, more impor tantly, allowing the user to abort the command.

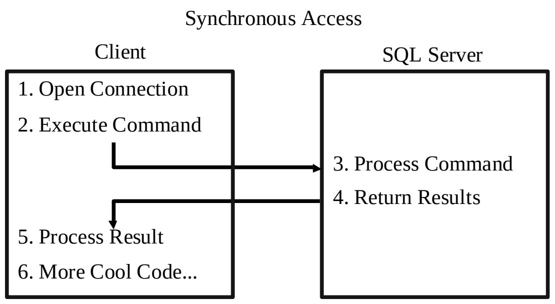


Figure 4-17 Synchronous data access.

Asynchronous command execution does not block program execution because it takes place on a new thread, which is another path of execution for your code. This means the original thread can continue executing while the new thread is waiting for its command to complete, as shown in Figure 4-18. The original thread is free to repaint the screen or listen for other events, such as button clicks.

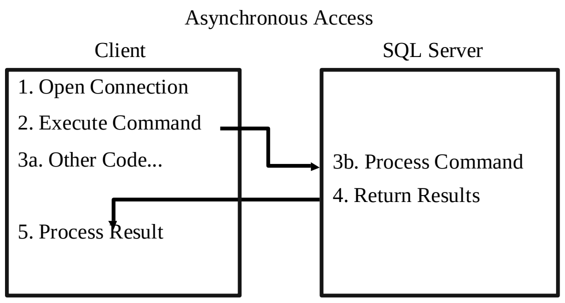


Figure 4-18 Asynchronous data access.

To demonstrate the difference between synchronous and asynchronous data access, the following code uses synchronous data access. This code simulates three long-run ning queries and then places a message in a label on the form.

'VB

```
Protected Sub Button21_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button21.Click
   Dim lbl As Label = GetLabel(275, 20)
   Dim dtStart as DateTime = DateTime.Now
   Dim ver As String = string.Empty
   Dim cnSettings As SqlConnectionStringBuilder
   cnSettings = New SqlConnectionStringBuilder( _
     "Data Source=.;" _
          + "Database=PUBS;" _
          + "Integrated Security=True;" _
```

```
            + "Max Pool Size=5")
    Using cn1 As SqlConnection = _
            New SqlConnection(cnSettings.ConnectionString)
    Using cn2 As SqlConnection = _
            New SqlConnection(cnSettings.ConnectionString)
    Using cn3 As SqlConnection = _
            New SqlConnection(cnSettings.ConnectionString)
      Using cmd1 As SqlCommand = cn1.CreateCommand()
      Using cmd2 As SqlCommand = cn2.CreateCommand()
      Using cmd3 As SqlCommand = cn3.CreateCommand()
            cmd1.CommandText = _
                "WaitFor Delay '00:00:10' Select '1st Query<br />'"
            cmd2.CommandText = _
                "WaitFor Delay '00:00:10' Select '2nd Query<br />'"
            cmd3.CommandText = _
                "WaitFor Delay '00:00:10' Select '3rd Query<br />'"

            cn1.Open()
            Dim dr1 as SqlDataReader = cmd1.ExecuteReader()
            While dr1.Read()
                ver += dr1(0).ToString()
            End While
            dr1.Close()

            cn2.Open()
            Dim dr2 as SqlDataReader = cmd2.ExecuteReader()
            While dr2.Read()
                ver += dr2(0).ToString()
            End While
            dr2.Close()

            cn3.Open()
            Dim dr3 as SqlDataReader = cmd3.ExecuteReader()
            While dr3.Read()
                ver += dr3(0).ToString()
            End While
            dr3.Close()

      End Using
      End Using
      End Using
    End Using
    End Using
    End Using

    Dim dtEnd as DateTime = DateTime.Now
    ver += "Running Time: " _
         + (dtEnd - dtStart).ToString() + " Seconds<br />"
    lbl.Text = ver
End Sub
```

//C#

```
protected void Button21_Click(object sender, EventArgs e)
{
     Label lbl = GetLabel(275, 20);
    DateTime dtStart = DateTime.Now;
     string ver = string.Empty;
     SqlConnectionStringBuilder cnSettings =
       new SqlConnectionStringBuilder(
     "Data Source=.;"
          + "Database=PUBS;"
         + "Integrated Security=True;"
          + "Max Pool Size=5");
     using( SqlConnection cn1 =
               new SqlConnection(cnSettings.ConnectionString))
     {
     using( SqlConnection cn2 =
               new SqlConnection(cnSettings.ConnectionString))
     {
     using( SqlConnection cn3 =
               new SqlConnection(cnSettings.ConnectionString))
     {
       using(SqlCommand cmd1 = cn1.CreateCommand())
          {
       using(SqlCommand cmd2 = cn2.CreateCommand())
          {
       using(SqlCommand cmd3 = cn3.CreateCommand())
          {
               cmd1.CommandText =
                      "WaitFor Delay '00:00:10' Select '1st Query<br />'";
               cmd2.CommandText =
                      "WaitFor Delay '00:00:10' Select '2nd Query<br />'";
               cmd3.CommandText =
                      "WaitFor Delay '00:00:10' Select '3rd Query<br />'";

               cn1.Open();
               SqlDataReader dr1 = cmd1.ExecuteReader();
               while( dr1.Read())
                 {
                      ver += dr1[0].ToString();
                 }
               dr1.Close();

               cn2.Open();
               SqlDataReader dr2 = cmd2.ExecuteReader();
               while( dr2.Read())
                 {
                      ver += dr2[0].ToString();
                 }
               dr2.Close();

               cn3.Open();
               SqlDataReader dr3 = cmd3.ExecuteReader();
               while( dr3.Read())
```

```
                {
                      ver += dr3[0].ToString();
                 }
                dr3.Close();

            }
            }
            }
     }
     }
     }

     DateTime dtEnd = DateTime.Now;
     ver += "Running Time: "
          + (dtEnd - dtStart).ToString() + " Seconds<br />";
     lbl.Text = ver;
}
```

In this code, each of the three queries is run, one at a time. The running time dis played is approximately 30 seconds.

NOTE New in ASP.NET 2.0

The *Asynchronous Processing* and *async* connection string keys are new in version 2.0 of the .NET Framework.

To use asynchronous code to run these queries, you must set the connection string to have *Asynchronous Processing=true* and *async=true*, or an exception is thrown. Next, one of the command object's *Begin* methods must be executed. The *SqlCommand* object provides the *BeginExecuteNoQuery*, *BeginExecuteReader*, and *BeginExecuteXml-Reader* methods. The following code shows the asynchronous implementation:

```
'VB
Protected Sub Button22_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button22.Click
      Dim lbl As Label = GetLabel(275, 20)
     Dim dtStart as DateTime = DateTime.Now
     Dim ver As String = string.Empty
     Dim cnSettings As SqlConnectionStringBuilder
     cnSettings = New SqlConnectionStringBuilder( _
       "Data Source=.;" _
                + "Database=PUBS;" _
                + "Asynchronous Processing=true;" _
                 + "Integrated Security=True;" _
                 + "Max Pool Size=5")
     Using cn1 As SqlConnection = _
                New SqlConnection(cnSettings.ConnectionString)
     Using cn2 As SqlConnection = _
                New SqlConnection(cnSettings.ConnectionString)
```

```
    Using cn3 As SqlConnection = _
            New SqlConnection(cnSettings.ConnectionString)
      Using cmd1 As SqlCommand = cn1.CreateCommand()
      Using cmd2 As SqlCommand = cn2.CreateCommand()
      Using cmd3 As SqlCommand = cn3.CreateCommand()
            cmd1.CommandText = _
                  "WaitFor Delay '00:00:10' Select '1st Query<br />'"
            cmd2.CommandText = _
                  "WaitFor Delay '00:00:10' Select '2nd Query<br />'"
            cmd3.CommandText = _
                  "WaitFor Delay '00:00:10' Select '3rd Query<br />'"

            cn1.Open()
            cn2.Open()
            cn3.Open()
            Dim ar1 as IAsyncResult = cmd1.BeginExecuteReader()
            Dim ar2 as IAsyncResult = cmd2.BeginExecuteReader()
            Dim ar3 as IAsyncResult = cmd3.BeginExecuteReader()

            ar1.AsyncWaitHandle.WaitOne()
            Dim dr1 as SqlDataReader = cmd1.EndExecuteReader(ar1)
            While dr1.Read()
                  ver += dr1(0).ToString()
            End While
            dr1.Close()

            ar2.AsyncWaitHandle.WaitOne()
            Dim dr2 as SqlDataReader = cmd2.EndExecuteReader(ar2)
            While dr2.Read()
                  ver += dr2(0).ToString()
            End While
            dr2.Close()

            ar3.AsyncWaitHandle.WaitOne()
            Dim dr3 as SqlDataReader = cmd3.EndExecuteReader(ar3)
            While dr3.Read()
                  ver += dr3(0).ToString()
            End While
            dr3.Close()

      End Using
      End Using
      End Using
    End Using
    End Using
    End Using

    Dim dtEnd as DateTime = DateTime.Now
    ver += "Running Time: " _
          + (dtEnd - dtStart).ToString() + " Seconds<br />"
    lbl.Text = ver
End Sub
```

```
//C#
protected void Button22_Click(object sender, EventArgs e)
{
     Label lbl = GetLabel(275, 20);
    DateTime dtStart = DateTime.Now;
     string ver = string.Empty;
     SqlConnectionStringBuilder cnSettings =
       new SqlConnectionStringBuilder(
     "Data Source=.;"
          + "Database=PUBS;"
         + "Asynchronous Processing=true;"
          + "Integrated Security=True;"
          + "Max Pool Size=5");
     using (SqlConnection cn1 =
               new SqlConnection(cnSettings.ConnectionString))
     {
     using (SqlConnection cn2 =
               new SqlConnection(cnSettings.ConnectionString))
     {
     using (SqlConnection cn3 =
               new SqlConnection(cnSettings.ConnectionString))
     {
       using (SqlCommand cmd1 = cn1.CreateCommand())
          {
       using (SqlCommand cmd2 = cn2.CreateCommand())
          {
       using (SqlCommand cmd3 = cn3.CreateCommand())
          {
               cmd1.CommandText =
                     "WaitFor Delay '00:00:10' Select '1st Query<br />'";
               cmd2.CommandText =
                     "WaitFor Delay '00:00:10' Select '2nd Query<br />'";
               cmd3.CommandText =
                     "WaitFor Delay '00:00:10' Select '3rd Query<br />'";

               cn1.Open();
               cn2.Open();
               cn3.Open();
               IAsyncResult ar1 = cmd1.BeginExecuteReader();
               IAsyncResult ar2 = cmd2.BeginExecuteReader();
               IAsyncResult ar3 = cmd3.BeginExecuteReader();

               ar1.AsyncWaitHandle.WaitOne();
               SqlDataReader dr1 = cmd1.EndExecuteReader(ar1);
               while (dr1.Read())
                {
                     ver += dr1[0].ToString();
                }
               dr1.Close();

               ar2.AsyncWaitHandle.WaitOne();
               SqlDataReader dr2 = cmd2.EndExecuteReader(ar2);
               while (dr2.Read())
```

```
                {
                    ver += dr2[0].ToString();
                }
                dr2.Close();

                ar3.AsyncWaitHandle.WaitOne();
                SqlDataReader dr3 = cmd3.EndExecuteReader(ar3);
                while (dr3.Read())
                {
                    ver += dr3[0].ToString();
                }
                dr3.Close();

            }
            }
            }
        }
        }
        }

        DateTime dtEnd = DateTime.Now;
        ver += "Running Time: "
            + (dtEnd - dtStart).ToString() + " Seconds<br />";
        lbl.Text = ver;
}
```

MORE INFO Asynchronous command execution

The following Microsoft link provides more information about asynchronous command execution in ADO.NET 2.0:

http://msdn.microsoft.com/data/ref/adonet/default.aspx?pull=/library/en-us/dnvs05/html/async2.asp.

As you can see, the label is populated with the result of the queries, and the running time is only about 10 seconds. The *BeginExecuteReader* method was used to spawn each of the new threads. After the threads were spawned, the *IAsyncResult* object's *AsyncWaitHandle* property was used to wait until the command finished executing.

Storing and Retrieving Binary Large Object (BLOB) Data

When working with data, one challenge is to move large objects between the client application and the database server. In some scenarios, you might be able to treat large-object data just like any other data, but in many cases, you might be forced to look at alternative approaches.

In ADO.NET you can work with BLOBs by using a *SqlDataReader* object to return a result set, by using a *SqlDataAdapter* object to fill a *DataTable* object, or by using a *Sql-Parameter* configured as an output parameter. If an object is so large that you can't load it without running out of memory, you must deal with it by reading and process ing it a chunk at a time.

Reading BLOB Data The normal operation of the *DataReader* object is to read one row at a time. When the row is available, all of the columns are buffered and available for you to access in any order.

To access the *DataReader* object in a stream fashion, you can change the *DbCommand* object's behavior to a sequential stream when you execute the *ExecuteReader* method. In this mode, you must get the bytes from the stream in the order of each column that is being returned, and you can't retrieve the data more than once. You essentially have access to the underlying *DataReader* object's stream.

To work with chunks of data, you should understand the operation of a stream object. When you read from a stream, you pass a byte array buffer that the stream populates. The stream does not have an obligation to populate the buffer, however. The stream's only obligation is to populate the buffer with at least one byte if the stream is not at its end. If the end has been reached, no bytes are read. When you use slow streams, such as a slow Internet network stream, data might not be avail able when you attempt to read the stream. In this case, the stream is not at its end, but no bytes are available, and the thread will block (wait) until one byte has been received. Based on the stream operation described, you should always perform stream reading in a loop that continues until no more bytes are read.

The following code sample reads all of the logos from the pub_info table in the *pubs* database and stores the logos to a GIF file:

```
'VB
Protected Sub Button23_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button23.Click
    Const pubIdColumn As Integer = 0
    Const pubLogoColumn As Integer = 1
    'bufferSize must be bigger than oleOffset
    Const bufferSize As Integer = 100
    Dim buffer(bufferSize) As Byte
    Dim byteCountRead As Integer
    Dim currentIndex As Long = 0

    Dim pubSetting As ConnectionStringSettings = _
      ConfigurationManager.ConnectionStrings("PubsData")
    Using cn As New SqlConnection()
      cn.ConnectionString = pubSetting.ConnectionString
```

```
        cn.Open()

        Using cmd As SqlCommand = cn.CreateCommand()
            cmd.CommandText = _
                "SELECT pub_id, logo FROM pub_info"
            Dim rdr As SqlDataReader = cmd.ExecuteReader( _
                CommandBehavior.SequentialAccess)
            While (rdr.Read())

                Dim pubId As String = _
                    rdr.GetString(pubIdColumn)
                Dim fileName As String = MapPath(pubId + ".gif")

                ' Create a file to hold the output.
                Using fs As New FileStream( _
                  fileName, FileMode.OpenOrCreate, _
                  FileAccess.Write)
                  currentIndex = 0
                  byteCountRead = _
                      CInt(rdr.GetBytes(pubLogoColumn, _
                      currentIndex, buffer, 0, bufferSize))
                  While (byteCountRead <> 0)
                      fs.Write(buffer, 0, byteCountRead)
                      currentIndex += byteCountRead
                      byteCountRead = _
                       CInt(rdr.GetBytes(pubLogoColumn, _
                       currentIndex, buffer, 0, bufferSize))
                  End While
                End Using
            End While
        End Using
      End Using
      Dim lbl as Label = GetLabel(275,20)
      lbl.Text = "Done Writing Logos To Disk"
End Sub
```

//C#

```
protected void Button23_Click(object sender, EventArgs e)
{
      const int pubIdColumn = 0;
      const int pubLogoColumn = 1;
      //bufferSize must be bigger than oleOffset
      const int bufferSize = 100;
      byte[] buffer = new byte[bufferSize];
      int byteCountRead;
      long currentIndex = 0;

      ConnectionStringSettings pubSetting =
        ConfigurationManager.ConnectionStrings["PubsData"];
      using (SqlConnection cn = new SqlConnection())
      {
        cn.ConnectionString = pubSetting.ConnectionString;
        cn.Open();

        using (SqlCommand cmd = cn.CreateCommand())
           {
                 cmd.CommandText =
                       "SELECT pub_id, logo FROM pub_info";
                 SqlDataReader rdr = cmd.ExecuteReader(
                       CommandBehavior.SequentialAccess);
                 while (rdr.Read())
                  {
                       string pubId =
                             rdr.GetString(pubIdColumn);
                       string fileName = MapPath(pubId + ".gif");

                       //Create a file to hold the output.
                       using (FileStream fs = new FileStream(
                          fileName, FileMode.OpenOrCreate,
                          FileAccess.Write))
                       {
                          currentIndex = 0;
                          byteCountRead =
                                (int)rdr.GetBytes(pubLogoColumn,
                                currentIndex, buffer, 0, bufferSize);
                          while (byteCountRead != 0)
                             {
                                fs.Write(buffer, 0, byteCountRead);
                                currentIndex += byteCountRead;
                                byteCountRead =
                                 (int)rdr.GetBytes(pubLogoColumn,
                                 currentIndex, buffer, 0, bufferSize);
                             }
                       }
                  }
           }
      }
      Label lbl = GetLabel(275, 20);
      lbl.Text = "Done Writing Logos To Disk";
}
```

This code gives you the pattern for reading the BLOB and writing it to a file. The *Exe cuteReader* method is executed with the *CommandBehavior.SequentialAccess* parame ter. Next, a loop runs to read row data, and within the loop and for each row, the pub_id is read to create the file name. A new *FileStream* object is created, which opens the file for writing.

Next, a loop reads bytes into a byte array buffer, and then writes the bytes to the file. The buffer size is set to 100 bytes, which keeps the amount of data in memory to a minimum.

Writing BLOB Data You can write BLOB data to a database by issuing the appropriate INSERT or UPDATE statement and passing the BLOB value as an input parameter. You can use the SQL Server *UPDATETEXT* function to write the BLOB data in chunks of a specified size. The *UPDATETEXT* function requires a pointer to the BLOB field being updated, so the SQL Server *TEXTPTR* function is first called to get a pointer to the field of the record to be updated.

The following code example updates the pub_info table, replacing the logo for pub_id 9999 with a new logo from a file:

```
'VB
Protected Sub Button24_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button24.Click
     Const bufferSize As Integer = 100
     Dim buffer(bufferSize) As Byte
     Dim currentIndex As Long = 0
     Dim logoPtr() As Byte

     Dim pubString As ConnectionStringSettings = _
       ConfigurationManager.ConnectionStrings("PubsData")
     Using cn As New SqlConnection()
       cn.ConnectionString = pubString.ConnectionString
       cn.Open()

       Using cmd As SqlCommand = cn.CreateCommand()
              cmd.CommandText = _
 "SELECT TEXTPTR(Logo) FROM pub_info WHERE pub_id = '9999'"
              logoPtr = CType(cmd.ExecuteScalar(), Byte())
       End Using
       Using cmd As SqlCommand = cn.CreateCommand()
              cmd.CommandText = _
 "UPDATETEXT pub_info.Logo @Pointer @Offset null @Data"
              Dim ptrParm As SqlParameter = _
                     cmd.Parameters.Add("@Pointer", SqlDbType.Binary, 16)
              ptrParm.Value = logoPtr
              Dim logoParm As SqlParameter = _
                     cmd.Parameters.Add("@Data", SqlDbType.Image)
              Dim offsetParm As SqlParameter = _
                     cmd.Parameters.Add("@Offset", SqlDbType.Int)
              offsetParm.Value = 0
              Using fs As New FileStream(MapPath("Logo.gif"), _
                       FileMode.Open, FileAccess.Read)
                     Dim count As Integer = fs.Read(buffer, 0, bufferSize)
                     While (count <> 0)
                       logoParm.Value = buffer
                       logoParm.Size = count
                       cmd.ExecuteNonQuery()
                       currentIndex += count
```

```
                    offsetParm.Value = currentIndex
                    count = fs.Read(buffer, 0, bufferSize)
                  End While
            End Using
      End Using
    End Using
    Dim lbl As Label = GetLabel(275, 20)
    lbl.Text = "Done Writing Logos To DB"
End Sub
```

//C#

```
protected void Button24_Click(object sender, EventArgs e)
{
    const int bufferSize = 100;
    byte[] buffer = new byte[bufferSize];
    long currentIndex = 0;
    byte[] logoPtr;

    ConnectionStringSettings pubString =
      ConfigurationManager.ConnectionStrings["PubsData"];
    using (SqlConnection cn = new SqlConnection())
    {
      cn.ConnectionString = pubString.ConnectionString;
      cn.Open();

      using (SqlCommand cmd = cn.CreateCommand())
         {
            cmd.CommandText =
 "SELECT TEXTPTR(Logo) FROM pub_info WHERE pub_id = '9999'";
            logoPtr = (byte[])cmd.ExecuteScalar();
         }
      using (SqlCommand cmd = cn.CreateCommand())
         {
            cmd.CommandText =
 "UPDATETEXT pub_info.Logo @Pointer @Offset null @Data";
            SqlParameter ptrParm =
                  cmd.Parameters.Add("@Pointer", SqlDbType.Binary, 16);
            ptrParm.Value = logoPtr;
            SqlParameter logoParm =
                  cmd.Parameters.Add("@Data", SqlDbType.Image);
            SqlParameter offsetParm =
                  cmd.Parameters.Add("@Offset", SqlDbType.Int);
            offsetParm.Value = 0;
            using (FileStream fs = new FileStream(MapPath("Logo.gif"),
                    FileMode.Open, FileAccess.Read))
             {
                  int count = fs.Read(buffer, 0, bufferSize);
                  while (count != 0)
                  {
                    logoParm.Value = buffer;
                    logoParm.Size = count;
                    cmd.ExecuteNonQuery();
                    currentIndex += count;
                    offsetParm.Value = currentIndex;
                    count = fs.Read(buffer, 0, bufferSize);
                }
            }
        }
    }
    Label lbl = GetLabel(275, 20);
    lbl.Text = "Done Writing Logos To DB";
}
```

This code opens a connection and retrieves a pointer to the logo that is to be updated by calling the *TEXTPTR* function using a *SqlCommand* object. Then, a new *SqlCom mand* object is created, and its *CommandText* property is set to the following:

```
"UPDATETEXT pub_info.logo @Pointer @Offset null @Data "
```

Note that the *null* parameter defines the quantity of bytes to delete. Passing *null* indi cates that all existing data should be deleted. Passing a *0* (zero) indicates that no data should be deleted; the new data simply overwrites the existing data. (You pass a num ber if you want to delete some of the data.) The other parameters represent the pointer to the start of the logo, the current offset to insert data, and the data being sent to the database.

After the file is opened, a loop starts that reads chunks of the file into the buffer and then sends the chunks to the database.

Quick Check

1. What two objects are required to send instructions to a SQL Server data base?
2. What connected object is used to obtain the fastest access to SQL Server data?
3. When you need to copy large amonts of data to SQL Server, what object should you use?

Quick Check Answers

1. *SqlConnection* and *SqlCommand* objects
2. The *SqlDataReader* object
3. The *SqlBulkCopy* object

Lab: Working with Connected Data

In this lab, you will work with the Visual Studio 2005 GUI to create a Web page that displays the shippers in the *Northwind* database and supports inserts, updates, and deletes.

� Exercise 1: Create the Web Site and the Typed *DataSet*

In this exercise, you will create the Web site and add the controls to the site.

1. Open Visual Studio 2005 and create a new Web site called **WorkingWithCon nectedData** using your preferred programming language. The new Web site will be created and a Web page called Default.aspx is displayed.
2. In the Solution Explorer, right-click the App_Data folder and select Add Existing Item. Navigate to the Northwind.mdf file and select it.
3. Drag a *DetailsView* control onto the Web page and size it wide enough to display a company name.
4. Click the symbol in the upper-right corner of the *DetailsView* control to display the DetailsView Tasks window.
5. Click the Auto Format link and select Professional.
6. Click the Choose Data Source drop-down list and select New Data Source to start the Data Source Configuration Wizard. For the data source type, select Database and click OK.
7. On the Choose Your Data Connection screen, click New Connection. The Data-Source is set to Microsoft SQL Server (SqlClient). Click the Change button and select the Microsoft SQL Server Database File (SqlClient). In the Database File Name property, select the Northwind.mdf file that you just added to the App_Data folder and click Open. Click OK to accept the changes and go back to the Choose Your Data Connection screen. Click Next to go to the Save the Con nection String to the Application Configuration File screen.
8. In the Save the Connection String to the Application Configuration File screen, change the connection string name to **nwConnection** and click Next.
9. In the Configure Select Statement screen, select the Shippers table from the Name drop-down list box and click the asterisk (*) to select all rows and columns.
10. While still in the Configure Select Statement screen, click Advanced and select the options for both Generate Insert, Update, And Delete statements and Use Optimistic Concurrency. Click OK.

11. In the Test Query screen, click the Test Query button to see the data. Click Finish to return to the DetailsView Tasks window.
12. Once you select the Enable Paging, Enable Inserting, Enable Editing, and Enable Deleting options, configuration of the *DetailsView* is complete.
13. Run the Web page. Notice that the data was retrieved and displayed.
14. Add a new shipper. Notice that the CompanyName and the Phone fields are dis played, but the ShipperID field is an autonumber field, so it's not displayed.

Lesson 3: Working with XML Data

The .NET Framework provides vast support for XML. The implementation of XML is focused on performance, reliability, and scalability. The integration of XML with ADO.NET offers the ability to use XML documents as a data source. This lesson will cover many of the XML objects that are included in the .NET Framework.

After this lesson, you will be able to:

- Use the Document Object Model to manage XML data.
- Use the *XmlNamedNodeMap* object.
- Use the *XmlNodeList* object.
- Use the *XmlReader* and *XmlWriter* objects.
- Use the *XmlNodeReader* to read node trees.
- Validate Data with the *XmlValidatingReader*.

Estimated lesson time: 60 minutes

Real World

Glenn Johnson

The world has big plans for XML and its supporting technologies, with many companies already embracing XML, and many companies planning implemen tations of XML technologies in new applications. The World Wide Web Consor tium (W3C) envisions the future Web as being completely based on XML technologies. XML is often the preferred format for data being stored to a file and for data being sent across the Internet because XML can represent hierarchi cal data, is text-based, and is not platform dependent.

The XML Document Object Model

The W3C has provided standards that define the structure and provide a standard programming interface that can be used in a wide variety of environments and appli cations for XML documents. This is called the *Document Object Model* (DOM). Classes that support the DOM are typically capable of random access navigation and modifi cation of the XML document.

XML Namespace

The XML classes are accessible by setting a reference to the System.Xml.dll file and adding the Imports *System.Xml* (C# using *System.Xml;*) directive to the code.

The System.Data.dll file also extends the *System.Xml* namespace. This is the location of the *XmlDataDocument* class. If this class is required, a reference must be set to the System.Data.dll file.

XML Objects

This section covers the primary XML classes in the .NET Framework. Each of these classes offers varying degrees of functionality. It's important to look at each of the classes in detail in order to make the correct decision on which classes should be used. Figure 4-19 shows a high-level view of the objects that are covered.

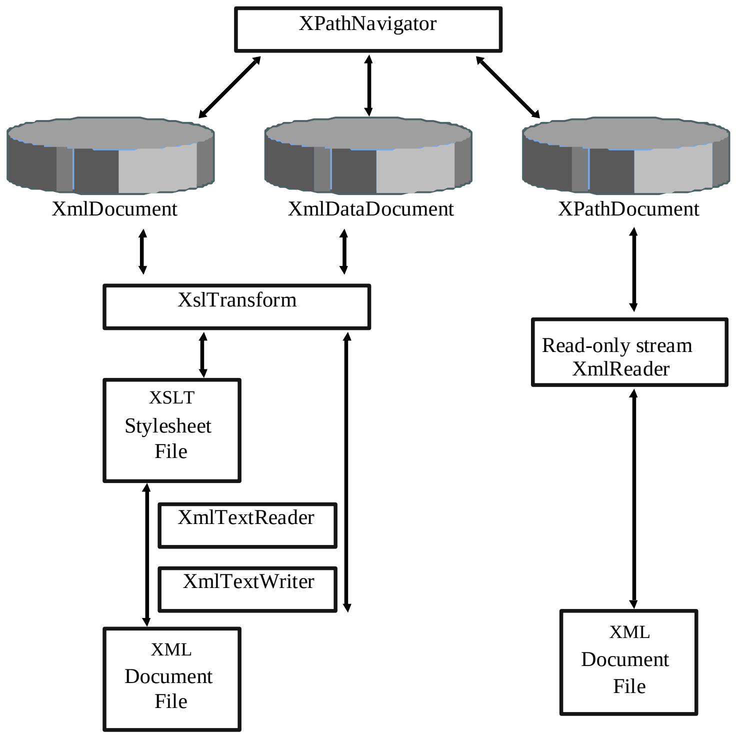


Figure 4-19 The primary XML objects that are covered in this lesson.

XmlDocument* and *XmlDataDocument The *XmlDocument* and *XmlDataDocument* objects are in-memory representations of XML that use the Document Object Model (DOM) Level 1 and Level 2. These classes can be used to navigate and edit the XML nodes.

The *XmlDataDocument* inherits from the *XmlDocument* and also represents relational data. The *XmlDataDocument* can expose its data as a *DataSet* to provide relational and nonrelational views of the data. The *XmlDataDocument* is in the *System.Data.dll* assembly.

These classes provide many methods to implement the Level 2 specifications, and also contain methods to facilitate common operations. The methods are summarized in Table 4-5. The *XmlDocument* contains all of the methods for creating *XmlElements* and *XmlAttributes*.

Table 4-5 *XmlDocument* and *XmlDataDocument* Methods

Method	Description
CreateNodeType	Creates an XML node in the document. There are *Create* methods for each node type.
CloneNode	Creates a duplicate of an XML node. This method takes a Boolean argument called deep. If deep is *false*, only the node is copied. If deep is *true*, all child nodes are recursively copied as well.
GetElementByID	Locates and returns a single node based on its *ID* attribute. Note that this requires a Document Type Definition (DTD) that identifies an attribute as being an *ID* type. An attribute that has the name of *ID* is not an *ID* type by default.
GetElementsByTagName	Locates and returns an *XmlNodeList* containing all of the descendant elements based on the element name.

Table 4-5 *XmlDocument* and *XmlDataDocument* Methods

Method	Description
ImportNode	Imports a node from a different *XmlDocument* into this document. The source node remains unmodi fied in the original *XmlDocument*. This method takes a Boolean argument called deep. If deep is *false*, only the node is copied. If deep is *true*, all child nodes are recursively copied as well.
InsertBefore	Inserts an *XmlNode* immediately before the refer enced node. If the referenced node is nothing, then the new node is inserted at the end of the child list. If the node already exists in the tree, the original node is removed when the new node is inserted.
InsertAfter	Inserts an XmlNode immediately after the referenced node. If the referenced node is nothing, then the new node is inserted at the beginning of the child list. If the node already exists in the tree, the original node is removed when the new node is inserted.
Load	Loads an XML document from a disk file, Uniform Resource Locator (URL), or stream.
LoadXml	Loads an XML document from a string.
Normalize	Assures that there are no adjacent text nodes in the document. This is like saving the document and reloading it. This method may be desirable when text nodes are being programmatically added to an *XmlDocument*, and the text nodes are side by side. Normalizing combines the adjacent text nodes to produce a single text node.

Table 4-5 *XmlDocument* and *XmlDataDocument* Methods

Method	Description
PrependChild	Inserts a node at the beginning of the child node list. If the new node is already in the tree, it is removed before it is inserted. If the node is an *XmlDocument-Fragment*, the complete fragment is added.
ReadNode	Loads a node from an XML document using an *XmlTextReader* or *XmlNodeReader* object. The reader must be on a valid node before executing this method. The reader reads the opening tag, all child nodes, and the closing tag of the current ele ment. This repositions the reader to the next node.
RemoveAll	Removes all children and attributes from the current node.
RemoveChild	Removes the referenced child.
ReplaceChild	Replaces the referenced child with a new node. If the new node is already in the tree, it is removed first.
Save	Saves the XML document to a disk file, URL, or stream.
SelectNodes	Selects a list of nodes that match the XPath expression.
SelectSingleNode	Selects the first node that matches the XPath expression.
WriteTo	Writes a node to another XML document using an *XmlTextWriter*.
WriteContentsTo	Writes a node and all of its descendants to another XML document using an *XmlTextWriter*.

XPathDocument The *XPathDocument* provides a cached read-only *XmlDocument* that can be used for performing quick XPath queries. This constructor for this class requires a stream object in order to create an instance of this object. The only useful method that this class exposes is the *CreateNavigator* method.

XmlConvert The *XmlConvert* class has many static methods for converting between XSD data types and common language runtime (CLR) data types. This class is especially important when working with data sources that allow names that are not valid XML names. If a column in a database table is called List Price, trying to create an element or attribute with a space character throws an exception. Using *XmlConvert* to encode the name converts the space to *_0x0020_*, so the XML element name becomes *List_x0020_Price*. Later, this name can be decoded using the *XmlConvert.DecodeName* method.

The *XmlConvert* also provides many static methods for converting strings to numeric values.

XPathNavigator The *DocumentNavigator* provides efficient navigation of an *XmlDoc ument* by providing XPath support for navigation. The *XPathNavigator* uses a cursor model and XPath queries to provide read-only random access to the data. The *XPath-Navigator* supports XML Stylesheet Language Transforms (XSLT) and can be used as the input to a transform.

XmlNodeReader The *XmlNodeReader* provides forward-only access to data in an *Xml-Document* or *XmlDataDocument*. It provides the ability to start at a given node in the *XmlDocument* and sequentially read each node.

XmlTextReader The *XmlTextWrite* provides non-cached, forward-only access to XML data. It parses XML tokens but makes no attempt to represent the XML doc ument as a Document Object Model (DOM). The *XmlTextReader* does not perform document validation, but it checks the XML data to ensure that it is well formed.

XmlTextWriter The *XmlTextWriter* provides non-cached, forward-only writing of XML data to a stream of files, ensuring that the data conforms to the W3C XML 1.0 standard. The *XmlTextWriter* contains logic for working with namespaces and resolving namespace conflicts.

XmlValidatingReader Obsolete; replaced by *XmlReader*.

XmlReader The *XmlReader* provides an object for reading and validating against DTD, XML Schema Reduced (XDR), or Xml Schema Definition (XSD). The construc tor expects a Reader or a string as the source of the XML to be validated.

XslTransform The *XslTransform* can transform an XML document using an XSL stylesheet. The *XslTransform* supports XSLT 1.0 syntax and provides two methods: *Load* and *Transform*.

The *Load* method is used to load an XSLT stylesheet from a file or a stream. The *Transform* method is used to perform the transformation. The *Transform* method has several overloads but essentially expects a *XmlDocument* or *XmlNode* as the first argument, an *XsltArgumentList*, and an output stream.

Working with XML Documents

There are certainly many ways of working with XML data in the .NET Framework. This section covers some of the methods, such as creating a new XML file from scratch, reading and writing XML files, searching XML data, and transforming XML data.

Creating a New *XmlDocument* from Scratch To create a new *XmlDocument*, start by creating an *XmlDocument* object. The *XmlDocument* object contains *CreateEle ment* and *CreateAttribute* methods that are used to add nodes to the *XmlDocument* object. The *XmlElement* contains the *Attributes* property, which is an *XmlAttribute-Collection*. The *XmlAttributeCollection* inherits from the *XmlNamedNodeMap* class, which is a collection of names with corresponding values.

The following code shows how an *XmlDocument* can be created from scratch and saved to a file, and also uses the *GetLabel* method that was defined earlier in this chapter.

'VB

```
Protected Sub Button1_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button1.Click
    'Declare and create new XmlDocument
    Dim xmlDoc As New XmlDocument()

    Dim el As XmlElement
    Dim childCounter As Integer
    Dim grandChildCounter As Integer

    'Create the xml declaration first
    xmlDoc.AppendChild( _
     xmlDoc.CreateXmlDeclaration("1.0", "utf-8", Nothing))

    'Create the root node and append into doc
    el = xmlDoc.CreateElement("myRoot")
    xmlDoc.AppendChild(el)

    'Child Loop
    For childCounter = 1 To 4
      Dim childelmt As XmlElement
      Dim childattr As XmlAttribute

      'Create child with ID attribute
      childelmt = xmlDoc.CreateElement("myChild")
      childattr = xmlDoc.CreateAttribute("ID")
      childattr.Value = childCounter.ToString()
      childelmt.Attributes.Append(childattr)

      'Append element into the root element
      el.AppendChild(childelmt)
      For grandChildCounter = 1 To 3
             'Create grandchildren
             childelmt.AppendChild(xmlDoc.CreateElement("GrandChild"))
      Next
    Next

    'Save to file
    xmlDoc.Save(MapPath("XmlDocumentTest.xml"))
    Dim lbl as Label = GetLabel(275, 20)
    lbl.Text = "XmlDocumentTest.xml Created"
End Sub
```

//C#

```
protected void Button1_Click(object sender, EventArgs e)
{
    //Declare and create new XmlDocument
    XmlDocument xmlDoc = new XmlDocument();

    XmlElement el;
    int childCounter;
    int grandChildCounter;

   //Create the xml declaration first
    xmlDoc.AppendChild(
     xmlDoc.CreateXmlDeclaration("1.0", "utf-8", null));

    //Create the root node and append into doc
    el = xmlDoc.CreateElement("myRoot");
    xmlDoc.AppendChild(el);

    //Child Loop
    for (childCounter = 1; childCounter <= 4; childCounter++)
    {
      XmlElement childelmt;
      XmlAttribute childattr;

      //Create child with ID attribute
      childelmt = xmlDoc.CreateElement("myChild");
      childattr = xmlDoc.CreateAttribute("ID");
      childattr.Value = childCounter.ToString();
      childelmt.Attributes.Append(childattr);

      //Append element into the root element
      el.AppendChild(childelmt);
      for (grandChildCounter = 1; grandChildCounter <= 3; grandChildCounter++)
        {
          //Create grandchildren
          childelmt.AppendChild(xmlDoc.CreateElement("GrandChild"));
        }
    }

    //Save to file
    xmlDoc.Save(MapPath("XmlDocumentTest.xml"));
    Label lbl = GetLabel(275, 20);
    lbl.Text = "XmlDocumentTest.xml Created";
}
```

This code started by creating an instance of an *XmlDocument*. Next, the XML declara tion is created and placed inside the child collection. An exception is thrown if this is not the first child of the *XmlDocument*. The following is the XML file that was pro duced by running the code sample:

```
<?xml version="1.0" encoding="utf-8"?>
<myRoot>
 <myChild ID="1">
    <GrandChild />
    <GrandChild />
    <GrandChild />
 </myChild>
 <myChild ID="2">
    <GrandChild />
    <GrandChild />
    <GrandChild />
 </myChild>
 <myChild ID="3">
    <GrandChild />
    <GrandChild />
    <GrandChild />
 </myChild>
 <myChild ID="4">
    <GrandChild />
```

```
      <GrandChild />
      <GrandChild />
  </myChild>
</myRoot>
```

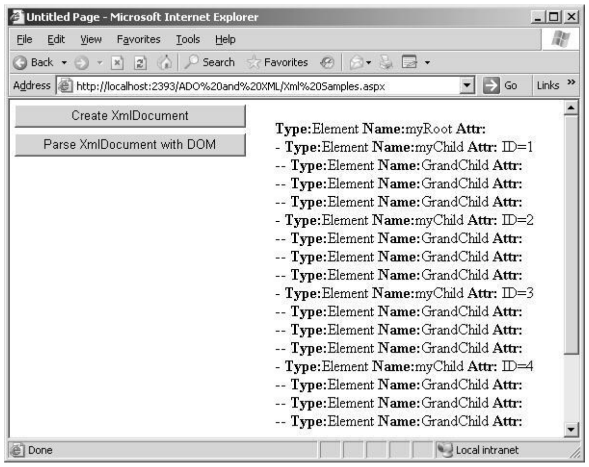
The previous code also works with the *XmlDataDocument*, but the *XmlDataDocument* has more features for working relational data. These features will be explored later in this lesson.

Parsing *XmlDocuments* Using the DOM An *XmlDocument* can be parsed by using a recursive routine to loop through all elements. The following code is an example of parsing an *XmlDocument*:

```
'VB
Protected Sub Button2_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button2.Click
  lbl = GetLabel(275, 20)
  Dim xmlDoc As New XmlDocument()
  xmlDoc.Load(MapPath("XmlDocumentTest.xml"))
  RecurseNodes(xmlDoc.DocumentElement)
End Sub

Public Sub RecurseNodes(ByVal node As XmlNode)
  'start recursive loop with level 0
  RecurseNodes(node, 0)
End Sub

Public Sub RecurseNodes(ByVal node As XmlNode, ByVal level As Integer)
  Dim s As String
  Dim n As XmlNode
  Dim attr As XmlAttribute

  s = String.Format("{0} <b>Type:</b>{1} <b>Name:</b>{2} <b>Attr:</b> ", _
    New String("-", level), node.NodeType, node.Name)
  For Each attr In node.Attributes
    s &= String.Format("{0}={1} ", attr.Name, attr.Value)
  Next
  lbl.Text += s & "<br>"
  For Each n In node.ChildNodes
    RecurseNodes(n, level + 1)
  Next
End Sub

//C#
protected void Button2_Click(object sender, EventArgs e)
{
  lbl = GetLabel(275, 20);
  XmlDocument xmlDoc = new XmlDocument();
  xmlDoc.Load(MapPath("XmlDocumentTest.xml"));
  RecurseNodes(xmlDoc.DocumentElement);
}
```

```
public void RecurseNodes(XmlNode node)
{
     //start recursive loop with level 0
     RecurseNodes(node, 0);
}

public void RecurseNodes(XmlNode node, int level)
{
     string s;
     s = string.Format("{0} <b>Type:</b>{1} <b>Name:</b>{2} <b>Attr:</b> ",
       new string('-', level), node.NodeType, node.Name);
     foreach (XmlAttribute attr in node.Attributes)
     {
       s += string.Format("{0}={1} ", attr.Name, attr.Value);
     }
     lbl.Text += s + "<br>";
     foreach (XmlNode n in node.ChildNodes)
     {
       RecurseNodes(n, level + 1);
     }
}
```

The output of this code is shown in Figure 4-20. This code starts by loading an XML file and then calling a procedure called *RecurseNodes*. The *RecurseNodes* procedure is overloaded. The first call simply passes the xmlDoc's root node. The recursive calls pass the recursion level. Each time the *RecurseNodes* procedure executes, the node information is printed, and for each child that the node has, a recursive call is made.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2393/ADO%20and%20XML/Xml%20Samples.aspx
Go Links
Create XmlDocument
Parse XmlDocument with DOM
Done
Local intranet

```
Type:Element Name:myRoot Attr:
- Type:Element Name:myChild Attr: ID=1
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
- Type:Element Name:myChild Attr: ID=2
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
- Type:Element Name:myChild Attr: ID=3
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
- Type:Element Name:myChild Attr: ID=4
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
-- Type:Element Name:GrandChild Attr:
```

Figure 4-20 Parsing the XmlDocument.

Parsing XmlDocuments Using the *XPathNavigator* The *XPathNavigator* provides an alternate method of walking the XML document recursively. This object does not use the methods that are defined in the DOM. Instead, it uses XPath queries to navigate the data and is in the *System.Xml.XPath* namespace. It offers many methods and prop erties that can be used, as shown in the following code example:

'VB

```
Protected Sub Button3_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button3.Click

    lbl = GetLabel(275, 20)
    Dim xmlDoc As New XmlDocument()
    xmlDoc.Load(MapPath("XmlDocumentTest.xml"))

    Dim xpathNav As XPathNavigator = xmlDoc.CreateNavigator()
    xpathNav.MoveToRoot()
    RecurseNavNodes(xpathNav)

End Sub

Public Sub RecurseNavNodes(ByVal node As XPathNavigator)
    'start recursive loop with level 0
    RecurseNavNodes(node, 0)
End Sub

Public Sub RecurseNavNodes(ByVal node As XPathNavigator, _
 ByVal level As Integer)
    Dim s As String

    s = string.Format("{0} <b>Type:</b>{1} <b>Name:</b>{2} <b>Attr:</b> ", _
       New String("-", level), node.NodeType, node.Name)

    If node.HasAttributes Then
      node.MoveToFirstAttribute()
         Do
            s += string.Format("{0}={1} ", node.Name, node.Value)
      Loop While node.MoveToNextAttribute()
      node.MoveToParent()
    End If

    lbl.Text += s + "<br>"

    If node.HasChildren Then
      node.MoveToFirstChild()
         Do
            RecurseNavNodes(node, level + 1)
      Loop While node.MoveToNext()
      node.MoveToParent()
    End If
End Sub
```

//C#

```
protected void Button3_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);
    XmlDocument xmlDoc = new XmlDocument();
    xmlDoc.Load(MapPath("XmlDocumentTest.xml"));

    XPathNavigator xpathNav = xmlDoc.CreateNavigator();
    xpathNav.MoveToRoot();
    RecurseNavNodes(xpathNav);
}

public void RecurseNavNodes(XPathNavigator node)
{
    //start recursive loop with level 0
    RecurseNavNodes(node, 0);
}

public void RecurseNavNodes(XPathNavigator node, int level)
{
    string s = null;

    s = string.Format("{0} <b>Type:</b>{1} <b>Name:</b>{2} <b>Attr:</b> ",
       new string('-', level), node.NodeType, node.Name);

    if (node.HasAttributes)
    {
      node.MoveToFirstAttribute();
          do
        {
            s += string.Format("{0}={1} ", node.Name, node.Value);
      } while (node.MoveToNextAttribute());
      node.MoveToParent();
    }

    lbl.Text += s + "<br>";

    if (node.HasChildren)
    {
      node.MoveToFirstChild();
          do
        {
            RecurseNavNodes(node, level + 1);
      } while (node.MoveToNext());
      node.MoveToParent();
    }
}
```

This is recursive code that works in a similar fashion to the DOM example that was previously covered. The difference is in the methods that are used to get access to each node.

To get access to the attributes, there is a *HasAttributes* property that is *true* if the cur rent node has attributes. The *MoveToFirstAttribute* and *MoveToNextAttribute* methods are used to navigate the attributes. After the attribute list has been navigated, the *MoveToParent* method moves back to the element.

The *HasChildren* property returns *true* if the current node has child nodes. The *MoveToFirstChild* and *MoveToNext* are used to navigate the child nodes. After the children have been navigated, the *MoveToParent* method moves back to the parent element.

Depending on the task at hand, it may be more preferable to use the *XPathNavigator* instead of the DOM. In this example, other than syntax, there is little difference between the two methods.

Searching the *XmlDocument* Using the DOM The DOM provides *GetElementByID* and the *GetElementsByTagName* methods for searching an *XmlDocument*. The *GetElementByID* method locates an element based on its ID. The ID refers to an ID type that has been defined in a DTD document. To demonstrate this, the following XML is used in many of the examples:

XML File – XmlSample.xml

```
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE myRoot [
<!ELEMENT myRoot ANY>
<!ELEMENT myChild ANY>
<!ELEMENT myGrandChild EMPTY>
<!ATTLIST myChild
ChildID ID #REQUIRED
>
]>
<myRoot>
<myChild ChildID="ref-1">
<myGrandChild/>
<myGrandChild/>
<myGrandChild/>
</myChild>
<myChild ChildID="ref-2">
<myGrandChild/>
<myGrandChild/>
<myGrandChild/>
</myChild>
```

```
<myChild ChildID="ref-3">
<myGrandChild/>
<myGrandChild/>
<myGrandChild/>
</myChild>
<myChild ChildID="ref-4">
<myGrandChild/>
<myGrandChild/>
<myGrandChild/>
</myChild>
</myRoot>
```

The *ChildID* has been defined as an *ID* data type, and an ID is required to begin with a character, underscore, or colon. The following code performs a lookup of the ele ment with an *ID* of *ref-3*:

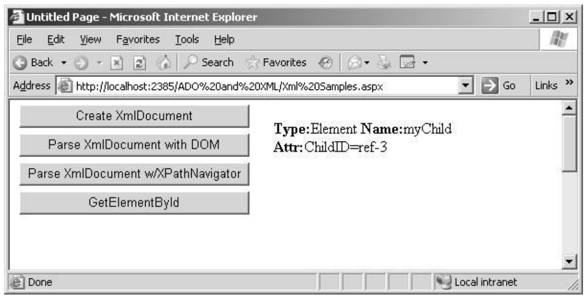
'VB

```
Protected Sub Button4_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button4.Click
    lbl = GetLabel(275, 20)
    Dim s As String
    'Declare and create new XmlDocument
    Dim xmlDoc As New XmlDocument()
    xmlDoc.Load(MapPath("XmlSample.xml"))

    Dim node As XmlNode
    node = xmlDoc.GetElementById("ref-3")

    s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1} <b>Attr:</b>", _
     node.NodeType, node.Name)

    Dim a As XmlAttribute
    For Each a In node.Attributes
       s += string.Format("{0}={1} ", a.Name, a.Value)
    Next
 lbl.Text = s + "<br>"
End Sub
```

//C#

```
protected void Button4_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);
    string s;
    //Declare and create new XmlDocument
    XmlDocument xmlDoc = new XmlDocument();
    xmlDoc.Load(MapPath("XmlSample.xml"));

    XmlNode node;
    node = xmlDoc.GetElementById("ref-3");

    s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1} <b>Attr:</b>",
     node.NodeType, node.Name);

    foreach (XmlAttribute a in node.Attributes)
    {
      s += string.Format("{0}={1} ", a.Name, a.Value);
    }
    lbl.Text = s + "<br>";
}
```

The browser output is shown in Figure 4-21. When an *ID* data type is defined, the ID must be unique. This code locates *ref-3* and displays the node and attributes information.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2385/ADO%20and%20XML/Xml%20Samples.aspx
Go Links
Create XmlDocument
Parse XmlDocument with DOM
Parse XmlDocument w/XPathNavigator
GetElementById
Done
Local intranet

```
Type:Element Name:myChild
Attr:ChildID=ref-3
```

Figure 4-21 The browser output when the code is run to locate *ref-3* using the *GetElementById* method.

The *SelectSingleNode* method can also be used to locate an element. The *SelectSingle-Node* method requires an XPath query to be passed into the method. The previous code sample has been modified to call the *SelectSingleNode* method to achieve the same result using an XPath query. The sample code is as follows:

'VB

```
Protected Sub Button5_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button5.Click
    lbl = GetLabel(275, 20)
    Dim s As String
    'Declare and create new XmlDocument
    Dim xmlDoc As New XmlDocument()
    xmlDoc.Load(MapPath("XmlSample.xml"))

    Dim node As XmlNode
    node = xmlDoc.SelectSingleNode("//myChild[@ChildID='ref-3']")

    s = String.Format("<b>Type:</b>{0} <b>Name:</b>{1} <b>Attr:</b>", _
     node.NodeType, node.Name)

    Dim a As XmlAttribute
    For Each a In node.Attributes
      s += String.Format("{0}={1} ", a.Name, a.Value)
    Next
    lbl.Text = s + "<br>"
End Sub
```

```
//C#
protected void Button5_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);
    string s;
    //Declare and create new XmlDocument
    XmlDocument xmlDoc = new XmlDocument();
    xmlDoc.Load(MapPath("XmlSample.xml"));

    XmlNode node;
    node = xmlDoc.SelectSingleNode("//myChild[@ChildID='ref-3']");

    s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1} <b>Attr:</b>",
     node.NodeType, node.Name);

    foreach (XmlAttribute a in node.Attributes)
    {
      s += string.Format("{0}={1} ", a.Name, a.Value);
    }
    lbl.Text = s + "<br>";
}
```

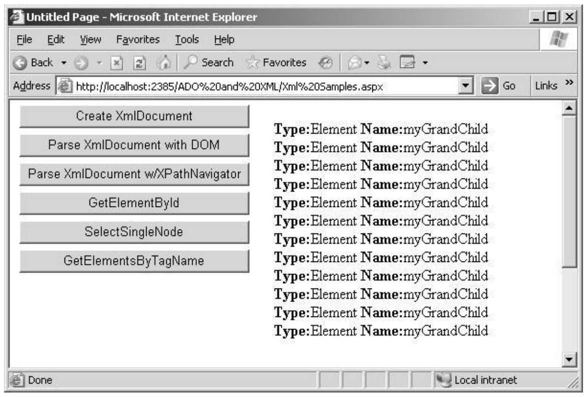
The *SelectSingleNode* method does not require a DTD to be provided and can perform an XPath lookup on any element or attribute where the *SelectSingleNode* requires an *ID* data type and a DTD.

The *GetElementsByTagName* method returns an *XmlNodeList* containing all matched elements. This following code returns a list of nodes which have the tag name of *myGrandChild*.

```
'VB
Protected Sub Button6_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button6.Click

    lbl = GetLabel(275, 20)
    Dim s As String

    'Declare and create new XmlDocument
    Dim xmlDoc As New XmlDocument()
    xmlDoc.Load(MapPath("XmlSample.xml"))

    Dim elmts As XmlNodeList
    elmts = xmlDoc.GetElementsByTagName("myGrandChild")

    For Each node as XmlNode In elmts
      s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1}", _
       node.NodeType, node.Name)
```

```
        lbl.Text += s + "<br>"
      Next
End Sub

//C#
protected void Button6_Click(object sender, EventArgs e)
{
      lbl = GetLabel(275, 20);
      string s;

      //Declare and create new XmlDocument
      XmlDocument xmlDoc = new XmlDocument();
      xmlDoc.Load(MapPath("XmlSample.xml"));

      XmlNodeList elmts;
      elmts = xmlDoc.GetElementsByTagName("myGrandChild");

      foreach (XmlNode node in elmts)
      {
        s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1}",
         node.NodeType, node.Name);
        lbl.Text += s + "<br>";
      }
}
```

This code retrieves the list of elements that have the tag names of *myGrandChild*. The browser output is shown in Figure 4-22. This method does not require a DTD to be included, which makes this method a preference, even for a single node lookup when searching by tag name.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2385/ADO%20and%20XML/Xml%20Samples.aspx
Go Links
Create XmlDocument
Parse XmlDocument with DOM
Parse XmlDocument w/XPathNavigator
GetElementById
SelectSingleNode
GetElementsByTagName
Done
Local intranet

```
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
Type:Element Name:myGrandChild
```

Figure 4-22 The browser output when performing a search for *myGrandChild* elements using the *GetElementsByTagName* method.

The *SelectNodes* method can also be used to locate an *XmlNodeList*. The *SelectNodes* method requires an XPath query to be passed into the method. The previous code sample has been modified to call the *SelectNodes* method to achieve the same result. The code is as follows:

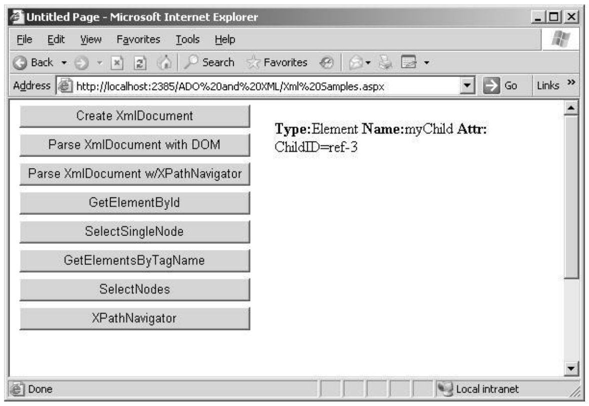
```
'VB
Protected Sub Button7_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button7.Click

              lbl = GetLabel(275, 20)
     Dim s As String

     'Declare and create new XmlDocument
     Dim xmlDoc As New XmlDocument()
     xmlDoc.Load(MapPath("XmlSample.xml"))

     Dim elmts As XmlNodeList
     elmts = xmlDoc.SelectNodes("//myGrandChild")
     For Each node As XmlNode In elmts
       s = String.Format("<b>Type:</b>{0} <b>Name:</b>{1}", _
        node.NodeType, node.Name)
       lbl.Text += s + "<br>"
     Next
End Sub

//C#
protected void Button7_Click(object sender, EventArgs e)
{
     lbl = GetLabel(275, 20);
     string s;

     //Declare and create new XmlDocument
     XmlDocument xmlDoc = new XmlDocument();
     xmlDoc.Load(MapPath("XmlSample.xml"));

     XmlNodeList elmts;
     elmts = xmlDoc.SelectNodes("//myGrandChild");
     foreach (XmlNode node in elmts)
     {
       s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1}",
        node.NodeType, node.Name);
       lbl.Text += s + "<br>";
     }
}
```

Note that this method can perform an XPath lookup on any element or attribute, with much more querying flexibility; whereas, the *SelectElementsByTagName* is limited to a tag name.

Using the *XPathNavigator* to Search XPathDocuments The *XPathNavigator* offers much more flexibility for performing searches than what is available through the DOM. The *XPathNavigator* has many methods that are focused around XPath que ries using a cursor model. The *XPathNavigator* works with the *XmlDocument*, but the *XPathDocument* object is tuned for the *XPathNavigator* and uses fewer resources than the *XmlDocument*. If the DOM is not required, use the *XPathDocument* instead of the *XmlDocument*. The following code example performs a search for the *myChild* element, where the *ChildID* attribute is equal to *ref-3*:

```
'VB
Protected Sub Button8_Click(ByVal sender As Object, _
       ByVal e As System.EventArgs) Handles Button8.Click
     lbl = GetLabel(275, 20)
     Dim s As String
     Dim xmlDoc As New XPathDocument(MapPath("XmlSample.xml"))
     Dim nav As XPathNavigator = xmlDoc.CreateNavigator()

     Dim expr As String = "//myChild[@ChildID='ref-3']"

    'Display the selection.
     Dim iterator As XPathNodeIterator = nav.Select(expr)
     Dim navResult As XPathNavigator = iterator.Current
     While (iterator.MoveNext())

       s = string.Format("<b>Type:</b>{0} <b>Name:</b>{1} ", _
        navResult.NodeType, navResult.Name)

       If navResult.HasAttributes Then
              navResult.MoveToFirstAttribute()
              s += "<b>Attr:</b> "
                Do
                     s += string.Format("{0}={1} ", _
                      navResult.Name, navResult.Value)
              Loop While navResult.MoveToNextAttribute()
       End If

       lbl.Text += s + "<br>"
     End While
End Sub

//C#
protected void Button8_Click(object sender, EventArgs e)
{
     lbl = GetLabel(275, 20);
     string s;
     XPathDocument xmlDoc = new XPathDocument(MapPath("XmlSample.xml"));
     XPathNavigator nav = xmlDoc.CreateNavigator();

     string expr = "//myChild[@ChildID='ref-3']";

     //Display the selection.
    XPathNodeIterator iterator = nav.Select(expr);
    XPathNavigator navResult = iterator.Current;
    while (iterator.MoveNext())
    {
      s = String.Format("<b>Type:</b>{0} <b>Name:</b>{1} ",
       navResult.NodeType, navResult.Name);

      if (navResult.HasAttributes)
        {
            navResult.MoveToFirstAttribute();
            s += "<b>Attr:</b> ";
             do
             {
                  s += String.Format("{0}={1} ",
                   navResult.Name, navResult.Value);
            } while (navResult.MoveToNextAttribute());
        }

      lbl.Text += s + "<br>";
    }
}
```

Figure 4-23 shows the browser output. This code uses an XPath query to locate the *myChild* element for which the *ChildID* attribute is equal to *ref-3*. The *Select* method is called with the query string. The *Select* method returns an *XPathNodeIterator* object, which allows navigation over the node or nodes that are returned. The *XPathNode-Iterator* has a property called *Current*, which represents the current node, and is in itself an *XPathNavigator* data type. Rather than use *iterator.Current* throughout the code, a variable called *navResult* is created and assigned a reference to *iterator.Current.* Note that the call to *MoveToParent* is not required when finishing the loop through the attributes. This is because the *iterator.MoveNext* doesn't care what the current location is, because it is simply going to the next node in its list.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2385/ADO%20and%20XML/Xml%20Samples.aspx Go Links
Create XmlDocument
Parse XmlDocument with DOM
Parse XmlDocument w/XPathNavigator
GetElementById
SelectSingleNode
GetElementsByTagName
SelectNodes
XPathNavigator
Done
Local intranet

Type: Element **Name:**myChild **Attr:** ChildID=ref-3

Figure 4-23 Using the XPathNavigator to search for a node.

Some of the real power of the *XPathNavigator* starts to show when the requirement is to retrieve a list of nodes and sort the output. Sorting involves compiling an XPath query string to an *XPathExpression* object, and then adding a sort to the compiled expressions. The following is an example of compiling and sorting:

'VB

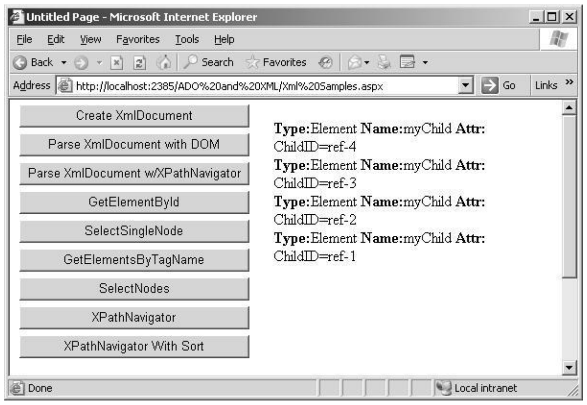
```
Protected Sub Button9_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button9.Click
    lbl = GetLabel(275, 20)
    Dim s As String
    Dim xmlDoc As New XPathDocument(MapPath("XmlSample.xml"))
    Dim nav As XPathNavigator = xmlDoc.CreateNavigator()

    'Select all myChild elements
    Dim expr As XPathExpression
    expr = nav.Compile("//myChild")

    'Sort the selected books by title.
    expr.AddSort("@ChildID", _
     XmlSortOrder.Descending, _
     XmlCaseOrder.None, "", _
     XmlDataType.Text)

   'Display the selection.
    Dim iterator As XPathNodeIterator = nav.Select(expr)
    Dim navResult As XPathNavigator = iterator.Current
    While (iterator.MoveNext())

      s = String.Format("<b>Type:</b>{0} <b>Name:</b>{1} ", _
       navResult.NodeType, navResult.Name)

      If navResult.HasAttributes Then
            navResult.MoveToFirstAttribute()
            s += "<b>Attr:</b> "
             Do
                  s += String.Format("{0}={1} ", _
                   navResult.Name, navResult.Value)
            Loop While navResult.MoveToNextAttribute()
      End If

      lbl.Text += s + "<br>"
    End While
End Sub
```

//C#

```
protected void Button9_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);
    string s;
    XPathDocument xmlDoc = new XPathDocument(MapPath("XmlSample.xml"));
    XPathNavigator nav = xmlDoc.CreateNavigator();

   //Select all myChild elements
    XPathExpression expr;
    expr = nav.Compile("//myChild");

    //Sort the selected books by title.
    expr.AddSort("@ChildID",
     XmlSortOrder.Descending,
     XmlCaseOrder.None, "",
     XmlDataType.Text);

    //Display the selection.
    XPathNodeIterator iterator = nav.Select(expr);
    XPathNavigator navResult = iterator.Current;
    while (iterator.MoveNext())
    {
      s = String.Format("<b>Type:</b>{0} <b>Name:</b>{1} ",
       navResult.NodeType, navResult.Name);

      if (navResult.HasAttributes)
         {
            navResult.MoveToFirstAttribute();
            s += "<b>Attr:</b> ";
             do
             {
                   s += String.Format("{0}={1} ",
                    navResult.Name, navResult.Value);
            } while (navResult.MoveToNextAttribute());
         }
      lbl.Text += s + "<br>";
    }
}
```

Figure 4-24 shows the browser output. This code is similar to the previous example, with the exception of the creation of the *expr* variable. The *expr* variable is created by compiling the query string to an *XPathExpression*. After that, the *AddSort* method is used to sort the output in descending order, based on the *ChildID* attribute.

When working with XML, it may seem easier to use the *DOM* methods to access data, but there are limits to the search capabilities that could require walking the tree to get the desired output. On the surface, the *XPathNavigator* may appear to be more diffi cult to use, but having the ability to perform XPath queries and sorting make this the object of choice for more complex XML problem solving.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2385/ADO%20and%20XML/Xml%20Samples.aspx Go Links
Create XmlDocument
Parse XmlDocument with DOM
Parse XmlDocument w/XPathNavigator
GetElementById
SelectSingleNode
GetElementsByTagName
SelectNodes
XPathNavigator
XPathNavigator With Sort
Done
Local intranet

```
Type:Element Name:myChild Attr:
ChildID=ref-4
Type:Element Name:myChild Attr:
ChildID=ref-3
Type:Element Name:myChild Attr:
ChildID=ref-2
Type:Element Name:myChild Attr:
ChildID=ref-1
```

Figure 4-24 The browser output when the XPath query is compiled to an *XPathExpression* and sorted.

Writing a File Using the *XmlTextWriter* The *XmlTextWriter* can be used to create an XML file from scratch. This class has many properties that aid in the creation of XML nodes. The following sample creates an XML file called EmployeeList.xml and writes two employees to the file:

'VB

```
Protected Sub Button10_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button10.Click
  Dim xmlWriter As New _
    XmlTextWriter(MapPath("EmployeeList.xml"), _
    System.Text.Encoding.UTF8)

  With xmlWriter
    .Formatting = Formatting.Indented
    .Indentation = 5

    .WriteStartDocument()
    .WriteComment("XmlTextWriter Test Date: " & _
     DateTime.Now.ToShortDateString())

    .WriteStartElement("EmployeeList")

    'New Employee
    .WriteStartElement("Employee")
    .WriteAttributeString("EmpID", "1")
    .WriteAttributeString("LastName", "JoeLast")
    .WriteAttributeString("FirstName", "Joe")
    .WriteAttributeString("Salary", XmlConvert.ToString(50000))

    .WriteElementString("HireDate", _
                    XmlConvert.ToString(#1/1/2003#, _
                    XmlDateTimeSerializationMode.Unspecified))

            .WriteStartElement("Address")
            .WriteElementString("Street1", "123 MyStreet")
            .WriteElementString("Street2", "")
            .WriteElementString("City", "MyCity")
            .WriteElementString("State", "OH")
            .WriteElementString("ZipCode", "12345")

            'Address
            .WriteEndElement()
            'Employee
            .WriteEndElement()

            'New Employee
            .WriteStartElement("Employee")
            .WriteAttributeString("EmpID", "2")
            .WriteAttributeString("LastName", "MaryLast")
            .WriteAttributeString("FirstName", "Mary")
            .WriteAttributeString("Salary", XmlConvert.ToString(40000))

            .WriteElementString("HireDate", _
                    XmlConvert.ToString(#1/2/2003#, _
                    XmlDateTimeSerializationMode.Unspecified))

            .WriteStartElement("Address")
            .WriteElementString("Street1", "234 MyStreet")
            .WriteElementString("Street2", "")
            .WriteElementString("City", "MyCity")
            .WriteElementString("State", "OH")
            .WriteElementString("ZipCode", "23456")

            'Address
            .WriteEndElement()
            'Employee
            .WriteEndElement()

            'EmployeeList
            .WriteEndElement()
            .Close()
        End With
        Response.Redirect("EmployeeList.xml")
End Sub
```

//C#

```
protected void Button10_Click(object sender, EventArgs e)
{
    XmlTextWriter xmlWriter  = new
    XmlTextWriter(MapPath("EmployeeList.xml"),
    System.Text.Encoding.UTF8);

    xmlWriter.Formatting = Formatting.Indented;
xmlWriter.Indentation = 5;

xmlWriter.WriteStartDocument();
xmlWriter.WriteComment("XmlTextWriter Test Date: " +
  DateTime.Now.ToShortDateString());

xmlWriter.WriteStartElement("EmployeeList");

//New Employee
xmlWriter.WriteStartElement("Employee");
xmlWriter.WriteAttributeString("EmpID", "1");
xmlWriter.WriteAttributeString("LastName", "JoeLast");
xmlWriter.WriteAttributeString("FirstName", "Joe");
xmlWriter.WriteAttributeString("Salary", XmlConvert.ToString(50000));

xmlWriter.WriteElementString("HireDate",
  XmlConvert.ToString(DateTime.Parse("1/1/2003"),
  XmlDateTimeSerializationMode.Unspecified));

xmlWriter.WriteStartElement("Address");
xmlWriter.WriteElementString("Street1", "123 MyStreet");
xmlWriter.WriteElementString("Street2", "");
xmlWriter.WriteElementString("City", "MyCity");
xmlWriter.WriteElementString("State", "OH");
xmlWriter.WriteElementString("ZipCode", "12345");

//Address
xmlWriter.WriteEndElement();
//Employee
xmlWriter.WriteEndElement();

//New Employee
xmlWriter.WriteStartElement("Employee");
xmlWriter.WriteAttributeString("EmpID", "2");
xmlWriter.WriteAttributeString("LastName", "MaryLast");
xmlWriter.WriteAttributeString("FirstName", "Mary");
xmlWriter.WriteAttributeString("Salary", XmlConvert.ToString(40000));

xmlWriter.WriteElementString("HireDate",
  XmlConvert.ToString(DateTime.Parse("1/2/2003"),
  XmlDateTimeSerializationMode.Unspecified));

xmlWriter.WriteStartElement("Address");
xmlWriter.WriteElementString("Street1", "234 MyStreet");
xmlWriter.WriteElementString("Street2", "");
xmlWriter.WriteElementString("City", "MyCity");
xmlWriter.WriteElementString("State", "OH");
xmlWriter.WriteElementString("ZipCode", "23456");

//Address
xmlWriter.WriteEndElement();
//Employee
```

```
    xmlWriter.WriteEndElement();

    //EmployeeList
    xmlWriter.WriteEndElement();
    xmlWriter.Close();

    Response.Redirect("EmployeeList.xml");
}
```

This code starts by opening the file as part of the constructor for the *XmlTextWriter*. The constructor also expects an encoding type. Since an argument is required, pass ing *Nothing* causes the encoding type to be UTF-8, which is the same as the value that is explicitly being passed. The following is the EmployeeList.xml that is created.

The XmlTextWriter was used to produce this XML file

```
<?xml version="1.0" encoding="utf-8"?>
<!--XmlTextWriter Test Date: 8/16/2006-->
<EmployeeList>
    <Employee EmpID="1" LastName="JoeLast" FirstName="Joe" Salary="50000">
        <HireDate>2003-01-01T00:00:00</HireDate>
        <Address>
            <Street1>123 MyStreet</Street1>
            <Street2 />
            <City>MyCity</City>
            <State>OH</State>
            <ZipCode>12345</ZipCode>
        </Address>
    </Employee>
    <Employee EmpID="2" LastName="MaryLast" FirstName="Mary" Salary="40000">
        <HireDate>2003-01-02T00:00:00</HireDate>
        <Address>
            <Street1>234 MyStreet</Street1>
            <Street2 />
            <City>MyCity</City>
            <State>OH</State>
            <ZipCode>23456</ZipCode>
        </Address>
    </Employee>
</EmployeeList>
```

There are many statements that are doing nothing more than writing to the *xmlWriter*. Typing time is saved in the VB code by the use of *With xmlWriter* statement, which allows a simple dot to be typed to represent the *xmlWriter* object.

The *XmlTextWriter* handles the formatting of the document by setting the *Formatting* and *Indentation* properties.

The *WriteStartDocument* method writes the XML declaration to the file. The *WriteComment* writes a comment to the file.

When writing elements, you can use either the *WriteStartElement* method or the *WriteElementString* method. The *WriteStartElement* method only writes the starting element but keeps track of the nesting level and adds new elements inside this element. The element is completed when a call is made to the *WriteEndElement* method. The *WriteElementString* method simply writes a closed element to the file.

The *WriteAttribute* method takes a name and value pair and writes the attribute into the current open element.

When writing is complete, the *Close* method must be called to avoid losing data. The file is then saved.

Reading a File Using the *XmlTextReader* The *XmlTextReader* is used to read an XML file, node by node. The reader provides forward-only, non-caching access to an XML data stream. The reader is ideal for use when there is a possibility that the information that is desired is near the top of the XML file, and the file is large. If random access is required, use the *XPathNavigator* class or the *XmlDocument* class. The following code reads the XML file that was created in the previous example and displays information about each node:

```
'VB
Protected Sub Button11_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button11.Click
  lbl = GetLabel(275, 20)
  Dim xmlReader As New _
    XmlTextReader(MapPath("EmployeeList.xml"))

  Do While xmlReader.Read()

    Select Case xmlReader.NodeType
        Case XmlNodeType.XmlDeclaration, _
         XmlNodeType.Element, _
         XmlNodeType.Comment
            Dim s As String
            s = String.Format("{0}: {1} = {2}<br>", _
              xmlReader.NodeType, _
              xmlReader.Name, _
              xmlReader.Value)
            lbl.Text += s
        Case XmlNodeType.Text
            Dim s As String
            s = String.Format(" - Value: {0}<br>", _
             xmlReader.Value)
            lbl.Text += s
    End Select
```

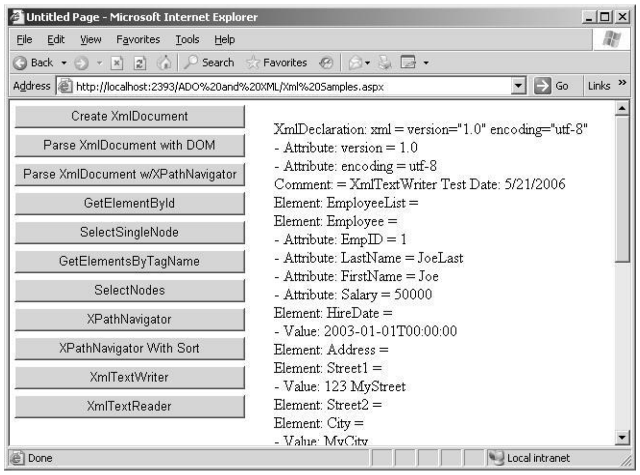
```
          If xmlReader.HasAttributes Then
                Do While xmlReader.MoveToNextAttribute()
                      Dim s As String
                      s = String.Format(" - Attribute: {0} = {1}<br>", _
                       xmlReader.Name, xmlReader.Value)
                      lbl.Text += s
                Loop
          End If
      Loop
      xmlReader.Close()
End Sub
```

//C#

```
protected void Button11_Click(object sender, EventArgs e)
{
      lbl = GetLabel(275, 20);
      XmlTextReader xmlReader = new
        XmlTextReader(MapPath("EmployeeList.xml"));

      while( xmlReader.Read())
      {
        switch( xmlReader.NodeType)
           {
                case XmlNodeType.XmlDeclaration:
                case XmlNodeType.Element:
                case XmlNodeType.Comment:
                 {
                      string s;
                      s = String.Format("{0}: {1} = {2}<br>",
                        xmlReader.NodeType,
                        xmlReader.Name,
                        xmlReader.Value);
                      lbl.Text += s;
                      break;
                 }
                case XmlNodeType.Text:
                 {
                      string s;
                      s = String.Format(" - Value: {0}<br>",
                       xmlReader.Value);
                      lbl.Text += s;
                      break;
                 }
           }

        if( xmlReader.HasAttributes)
           {
                while (xmlReader.MoveToNextAttribute())
                 {
                      string s;
                      s = String.Format(" - Attribute: {0} = {1}<br>",
                       xmlReader.Name, xmlReader.Value);
                      lbl.Text += s;
```

```
            }
        }
    }
    xmlReader.Close();
}
```

Figure 4-25 shows the browser output. This code opens the EmployeeList file, and then performs a simple loop, reading one element at a time until finished. For each node that is read, a check is made on the *NodeType*, and the node information is printed.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:2393/ADO%20and%20XML/Xml%20Samples.aspx Go Links
Create XmlDocument
Parse XmlDocument with DOM
Parse XmlDocument w/XPathNavigator
GetElementById
SelectSingleNode
GetElementsByTagName
SelectNodes
XPathNavigator
XPathNavigator With Sort
XmlTextWriter
XmlTextReader
Done
Local intranet

```
XmlDeclaration: xml = version="1.0" encoding="utf-8"
- Attribute: version = 1.0
- Attribute: encoding = utf-8
Comment: = XmlTextWriter Test Date: 5/21/2006
Element: EmployeeList =
Element: Employee =
- Attribute: EmpID = 1
- Attribute: LastName = JoeLast
- Attribute: FirstName = Joe
- Attribute: Salary = 50000
Element: HireDate =
- Value: 2003-01-01T00:00:00
Element: Address =
Element: Street1 =
- Value: 123 MyStreet
Element: Street2 =
Element: City =
- Value: MyCity
```

Figure 4-25 Using the *XmlTextReader* object to read an XML file and display each node's information.

When a node is read, its corresponding attributes are read as well. A check is made to see if the node has attributes, and they are displayed.

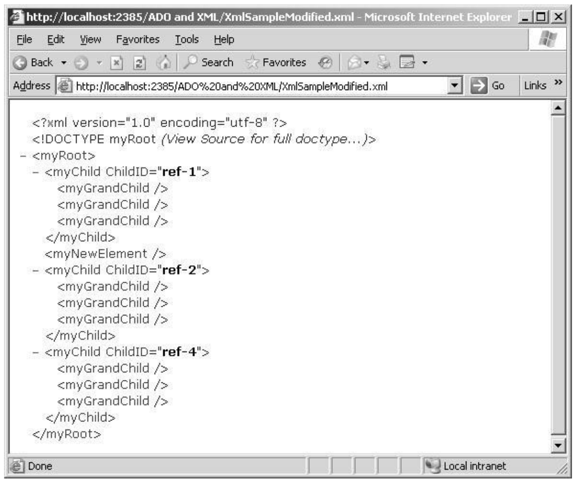
Modifying an XML Document

When the *XmlDocument* object is loaded, you can easily add and remove nodes. When removing a node, you simply need to locate the node and delete it from its parent. When adding a node, you need to create the node, search for the appropriate location to insert the node into, and insert the node. The following code snippet deletes an existing node and adds a new node:

```
'VB
Protected Sub Button12_Click(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Button12.Click

    lbl = GetLabel(275, 20)
    'Declare and load new XmlDocument
    Dim xmlDoc As New XmlDocument()
    xmlDoc.Load(MapPath("XmlSample.xml"))

    'delete a mode
    Dim node As XmlNode
    node = xmlDoc.SelectSingleNode("//myChild[@ChildID='ref-3']")
    node.ParentNode.RemoveChild(node)

    'create a node and add it
    Dim newElement as XmlElement = _
      xmlDoc.CreateElement("myNewElement")
    node = xmlDoc.SelectSingleNode("//myChild[@ChildID='ref-1']")
    node.ParentNode.InsertAfter(newElement, node)
    xmlDoc.Save(MapPath("XmlSampleModified.xml"))
    Response.Redirect("XmlSampleModified.xml")
End Sub

//C#
protected void Button12_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);

    //Declare and load new XmlDocument
    XmlDocument xmlDoc = new XmlDocument();
    xmlDoc.Load(MapPath("XmlSample.xml"));

    //delete a mode
    XmlNode node;
    node = xmlDoc.SelectSingleNode("//myChild[@ChildID='ref-3']");
    node.ParentNode.RemoveChild(node);

    //create a node and add it
    XmlElement newElement =
      xmlDoc.CreateElement("myNewElement");
    node = xmlDoc.SelectSingleNode("//myChild[@ChildID='ref-1']");
    node.ParentNode.InsertAfter(newElement, node);
    xmlDoc.Save(MapPath("XmlSampleModified.xml"));
    Response.Redirect("XmlSampleModified.xml");
}
```

To delete a node, use the *SelectSingleNode* method to locate the node to delete. After the node is located, the node can be removed from its parent by using the *ParentNode* property's *RemoveChild* method.

To add a node, execute the *CreateElement* method on the *XmlDocument* object. Next, the insert location is searched and the *ParentNode* property's *InsertAfter* method is used to insert the new node. Figure 4-26 shows the resulting XML document.



```
<?xml version="1.0" encoding="utf-8" ?>
<!DOCTYPE myRoot (View Source for full doctype...)>
- <myRoot>
  - <myChild ChildID="ref-1">
      <myGrandChild />
      <myGrandChild />
      <myGrandChild />
    </myChild>
    <myNewElement />
  - <myChild ChildID="ref-2">
      <myGrandChild />
      <myGrandChild />
      <myGrandChild />
    </myChild>
  - <myChild ChildID="ref-4">
      <myGrandChild />
      <myGrandChild />
      <myGrandChild />
    </myChild>
  </myRoot>
```

Figure 4-26 The result of deleting a node and adding a node.

Validating XML Documents

An important element to exchanging documents between disparate systems is the ability to define the structure of an XML document and then validate the XML docu ment against its defined structure. The .NET Framework offers the ability to perform validation against a document type definition (DTD) or schema. Earlier versions of the .NET Framework used the *XmlValidatingReader* object to perform validation, but this object is now obsolete. Instead, this section explores XML document validation using the *XmlReader* class.

The *XmlReader* class performs forward-only reading and validation of a stream of XML. The *XmlReader* class contains a *Create* method that can be passed as a string or a stream, as well as an *XmlReaderSettings* object. To perform validation, the *XmlReader-Settings* object must be created and its properties set to perform validation. In the next example, the files XmlSample.xml and XmlBadSample.xml are validated using the fol lowing code:

```
'VB
Protected Sub Button13_Click(ByVal sender As Object, _
      ByVal e As System.EventArgs) Handles Button13.Click
   lbl = GetLabel(275, 20)
   If ValidateDocument(MapPath("XmlSample.xml")) Then
      lbl.Text += "Valid Document<br />"
   Else
      lbl.Text += "Invalid Document<br />"
```

```
    End If
End Sub

Protected Sub Button14_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button14.Click
    lbl = GetLabel(275, 20)
    If ValidateDocument(MapPath("XmlBadSample.xml")) Then
        lbl.Text += "Valid Document<br />"
    Else
        lbl.Text += "Invalid Document<br />"
    End If
End Sub

Public Function ValidateDocument(ByVal fileName As String) _
        As Boolean
    Dim xmlSet As New XmlReaderSettings()
    xmlSet.ValidationType = ValidationType.DTD
    xmlSet.ProhibitDtd = False
    Dim vr As XmlReader = XmlReader.Create( _
            fileName, xmlSet)

    Dim xd As New XmlDocument()
    Try
        xd.Load(vr)
        Return True
    Catch ex As Exception
        lbl.Text += ex.Message + "<br />"
        Return False
    Finally
        vr.Close()
    End Try
End Function
```

//C#

```
protected void Button13_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);
    if (ValidateDocument(MapPath("XmlSample.xml")))
    {
        lbl.Text += "Valid Document<br />";
    }
    else
    {
        lbl.Text += "Invalid Document<br />";
    }
}

protected void Button14_Click(object sender, EventArgs e)
{
    lbl = GetLabel(275, 20);
    if (ValidateDocument(MapPath("XmlBadSample.xml")))
    {
      lbl.Text += "Valid Document<br />";
    }
    else
    {
      lbl.Text += "Invalid Document<br />";
    }
}

private bool ValidateDocument(string fileName)
{
    XmlReaderSettings xmlSet = new XmlReaderSettings();
    xmlSet.ValidationType = ValidationType.DTD;
    xmlSet.ProhibitDtd = false;
    XmlReader vr = XmlReader.Create(fileName, xmlSet);
    XmlDocument xd = new XmlDocument();
    try
    {
      xd.Load(vr);
      return true;
    }
    catch (Exception ex)
    {
      lbl.Text += ex.Message + "<br />";
      return false;
    }
    finally
    {
      vr.Close();
    }
}
```

The XmlBadSample.xml file is as follows:

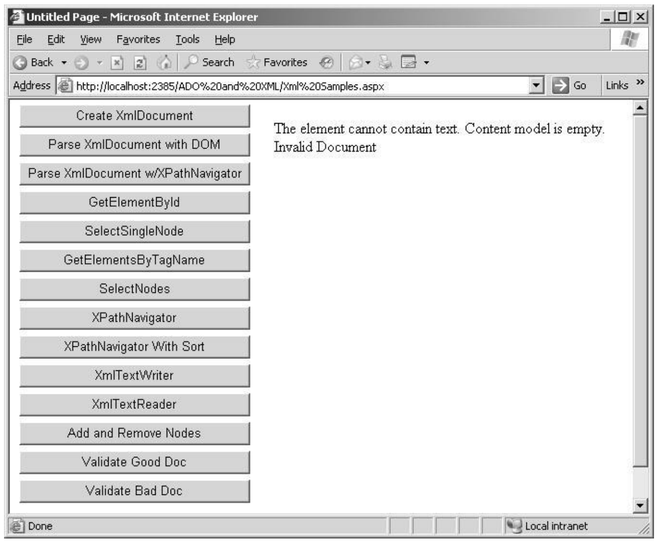
XML File – XmlBadSample.xml

```
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE myRoot [
    <!ELEMENT myRoot ANY>
    <!ELEMENT myChild ANY>
    <!ELEMENT myGrandChild EMPTY>
    <!ATTLIST myChild
ChildID ID #REQUIRED
>
]>
<myRoot>
    <myChild ChildID="ref-1">
      <myGrandChild/>
      <myGrandChild/>
      <myGrandChild/>
    </myChild>
    <myChild ChildID="ref-2">
```

```
        <myGrandChild/>
        <myGrandChild/>
        <myGrandChild>this test</myGrandChild>
    </myChild>
    <myChild ChildID="ref-3">
        <myGrandChild/>
        <myGrandChild/>
        <myGrandChild/>
    </myChild>
    <myChild ChildID="ref-4">
        <myGrandChild/>
        <myGrandChild/>
        <myGrandChild/>
    </myChild>
</myRoot>
```

This code simply opens the XML file with an *XmlReader*, and, while the *XmlDocument* is being read, the document is being validated. Since this code has an embedded DTD, the document is validated.

The DTD states that the *myGrandChild* element must be empty, but one of the *myGrandChild* elements of *myChild ref-1* has a *myGrandChild* element containing the word *Hi*. This causes an error, as shown in Figure 4-27. Attempts to read from the *Xml-Reader* when valid should always be within a *try/catch* block to catch possible valida tion exceptions.



The element cannot contain text. Content model is empty.
Invalid Document

Figure 4-27 The *XmlReader* throws an exception when the document is not valid.

Quick Check

1. What method can you execute to locate a single XML node by its tag name?
2. What method can you use to search for all elements that have a specific tag name and retrieve the results as an *XmlNodeList*?
3. What object should you use to perform XPath queries on large XML documents?

Quick Check Answers

1. *SelectSingleNode*
2. *GetElementsByTagName* or *SelectNodes*
3. *XPathNavigator*

Lab: Working with XML Data

In this lab, you work with XML data to display a subset of an XML file in a *GridView* control, using the XmlDataSource and an XSL Transform file.

� **Exercise 1: Create the Web Site and the XML Files**

In this exercise, you create the Web site and XML file.

1. Open Visual Studio 2005; create a new Web site called **WorkingWithXmlData** using your preferred programming language. The new Web site will be created and a Web page called Default.aspx is displayed.
2. In the Solution Explorer, right-click the App_Data folder and select Add New Item. Select XML file, name the file **CarList.xml**, and click Add.
3. In the XML file, add the following:

XML File – CarList.xml

```xml
<?xml version="1.0" encoding="utf-8" ?>
<CarList>
   <Car Vin="1A59B" Make="Chevrolet" Model="Impala" Year="1963" Price="1125.00" />
    <Car Vin="9B25T" Make="Ford" Model="F-250" Year="1970" Price="1595.00" />
    <Car Vin="3H13R" Make="BMW" Model="Z-4" Year="2006" Price="55123.00" />
    <Car Vin="7D67A" Make="Mazda" Model="Miata" Year="2003" Price="28250.00" />
    <Car Vin="4T21N" Make="VW" Model="Bug" Year="1956" Price="500.00" />
</CarList>
```

4. Drag a *DetailsView* control onto the Web page and size it wide enough to display the car information.
5. Click the symbol in the upper-right corner of the *DetailsView* control to display the DetailsView Tasks window.
6. Click the Auto Format link and select Professional.
7. Click the Choose Data Source drop-down list and select New Data Source to start the Data Source Configuration Wizard. For the data source type, select XML file and click OK.
8. On the Configure Data Source page, click the browse button for the *Data* prop erty and browse to the CarList.xml file in the App_Data folder.
9. Click OK.
10. Select the Enable Paging option. Configuration of the *DetailsView* is complete.
11. Run the Web page. Notice that the data is retrieved and displayed.

Chapter 5

Creating Custom Web Controls

There are many controls in Microsoft Visual Studio 2005 that certainly save you lots of development time, but there are always opportunities for you to build your own controls to save even more development time. Many business problems require cus tom controls to simplify the development solution. Custom controls are typically required to obtain different functionality, new functionality, or the combined func tionality of several controls. This chapter covers the types of custom controls that you can create in ASP.NET 2.0.

Exam objectives in this chapter:

- Create a composite Web application control.
  - Create a user control.
  - Convert a Web Forms page to a user control.
  - Include a user control in a Web Forms page.
  - Manipulate user control properties.
  - Handle user control events within the user control code-declaration block or code-behind file.
  - Create instances of user controls programmatically.
  - Develop user controls in a code-behind file.
  - Create a templated user control.
- Create a custom Web control that inherits from the *WebControl* class.
  - Create a custom Web control.
  - Add a custom Web control to the Toolbox.
  - Individualize a custom Web control.
  - Create a custom designer for a custom Web control.

- Create a composite server control.
  - Create a base class for composite controls.
  - Create a composite control.
- Develop a templated control.
  - Create a templated control.
  - Develop a templated data-bound control.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic or C# and be comfortable with the following tasks:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed on your computer with Microsoft SQL Server 2005 Express Edition.
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.

Real World

Glenn Johnson

Although we use the controls that are built-in to save time, we commonly don't see the opportunities to save more time by implementing custom controls to solve business problems. Custom controls not only save you time, but they also provide a consistent interface for your Web site.

Custom Web Control Types

There are three primary custom control types that will be covered in this chapter: user controls, custom Web controls, and composite controls. The following is a descrip tion of these controls:

- **user control** A *user control* is a *template control* that provides extra behavior to allow constituent (individual) controls to be added to the user control in the Graphical User Interface (GUI) designer. These controls are added to the user control's template file, the .ascx file. The .ascx file is similar to the Web page's .aspx file and can have a code-behind page. To enable reuse, the .ascx and code-behind files must be included in each project that requires the user control.
- **custom Web control** A *custom Web control* is a control that inherits from a Web control, where you either write all of the code to render the control, or inherit it from an existing Web control and provide extra behavior as necessary. The class file can be compiled to a .dll that can be shared among applications and can optionally be installed in the global assembly cache (GAC).
- **composite control** A *composite control* is a custom Web control that can contain constituent controls; the constituent controls are added to the composite con trol via code to the class file that defines the control. The class file can be com piled to a .dll that can be shared among applications and can optionally be installed in the GAC.

Lesson 1: Working with User Controls

In this lesson, you learn how to create user controls and templated user controls. You also learn to make use of these controls in your Web page development efforts. This lesson starts by covering user controls, because they are the easiest to use. After that, the lesson covers templated user controls.

After this lesson, you will be able to:

- Create a user control.
- Add user controls to a Web page.
- Handle user control events within the user control code-declaration block or code-behind file.
- Create a templated user control.

Estimated lesson time: 60 minutes

Employing User Controls

A user control provides the easiest way to combine several controls onto a single con trol that can simply be dragged onto a Web page without writing much code.

Many times, pages contain similar controls. For example, when prompting a user for a billing address and a shipping address, the controls to retrieve the name, address, city, state, and zip code are duplicated. This is where user controls can be very handy. You can create a user control containing the name, address, city, state, and zip code and drop it onto a Web page where needed.

User controls are built using similar procedures to those that are required to build a standard Web page. Web pages can even be converted to user controls with little effort.

User controls inherit from the *UserControl* class, which inherits from the *Template-Control* class, which inherits from the *Control* class, as shown in Figure 5-1.

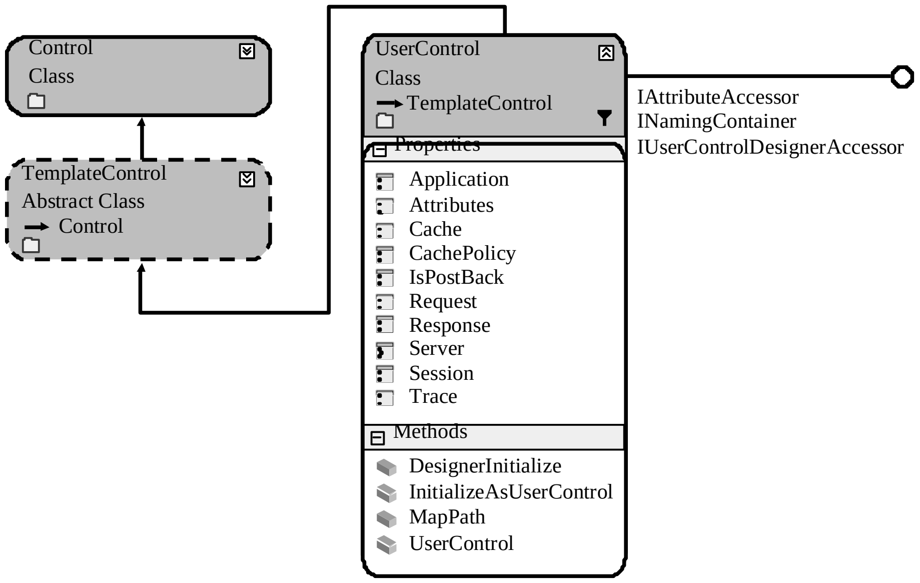


Figure 5-1 The *UserControl* class hierarchy.

MORE INFO **User Controls**

For more information on the User Controls, visit *http://msdn2.microsoft.com/en-us/library/fb3w5b53.aspx*.

Creating a User Control

User controls have a standard naming convention, which uses an .ascx extension to ensure that the control is not executed in a stand-alone fashion. You can create a user control in Visual Studio 2005 by choosing Website, Add New Item, Web User Con trol. On the surface, it appears that a new Web page was added. However, a quick glance at the HTML reveals a *Control* directive instead of a *Page* directive, as follows:

```
'VB
<%@ Control Language="VB"
    AutoEventWireup="false"
    CodeFile="MyControl.ascx.vb"
    Inherits="MyControl" %>

//C#
<%@ Control Language="C#"
    AutoEventWireup="true"
    CodeFile="MyControl.ascx.cs"
    Inherits="MyControl" %>
```

All text and controls that are added to this user control are rendered on the page that the control is added to. For example, a *Label* called *lblName* and a *TextBox* called *txt-Name* are placed on the user control, as shown below, and the user control can be added to any Web page where required.

```
'VB
<%@ Control Language="VB" AutoEventWireup="false"
       CodeFile="MyControl.ascx.vb" Inherits="MyControl" %>
<asp:Label ID="lblName" runat="server" Text="Label">
</asp:Label>
<asp:TextBox ID="txtName" runat="server" ></asp:TextBox>

//C#
<%@ Control Language="C#" AutoEventWireup="true"
       CodeFile="MyControl.ascx.cs" Inherits="MyControl" %>
<asp:Label ID="lblName" runat="server" Text="Label">
</asp:Label>
<asp:TextBox ID="txtName" runat="server"></asp:TextBox>
```

Creating a User Control from a Web Page

In addition to explicitly creating a user control, you can also convert a Web page to a user control. The primary benefit is that you can do your prototyping and testing without having to deal with placing the control on a Web page.

The procedure for converting a Web page to a user control is as follows:

1. Remove the *<html>*, *<body>*, and *<form>* begin and end tags.
2. Change the *@Page* directive at the top of the file to an *@Control* directive.
3. Change the file extension of your Web page from .aspx to.ascx.
4. In the *@Control* directive, change Inherits="System.Web.UI.Page" to Inher its="System.Web.UI.UserControl".

Adding a User Control to a Page

You can add a user control to a Web page by simply dragging it from the Solution Explorer and dropping it on a Web page. When you add the user control to the page, a look at the HTML reveals the following additions to the page:

```
<%@ Page Language="language" AutoEventWireup="false"
       CodeFile="Default.aspx.language" Inherits="_Default" %>
<%@ Register Src="MyControl.ascx" TagName="MyControl" TagPrefix="uc1" %>
<!DOCTYPE html
     PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
     Error! Hyperlink reference not valid.
```

```
<html xmlns="http://www.w3.org/1999/xhtml">
<head runat="server">
    <title>Untitled Page</title>
</head>
<body>
    <form id="form1" runat="server">
      <div>
            <uc1:MyControl ID="MyControl1" runat="server" />
      </div>
    </form>
</body>
</html>
```

Notice the *@Register* directive at the top of the page. This is a requirement to place the controls on the page. The *TagPrefix* attribute is a namespace identifier for the control. The default *TagPrefix* is *uc1* (as in User Control 1) and is changeable. The *TagName* attribute is the name of the control to use. The *Src* attribute is the location of the user control. The instance of *MyControl* is in the form tag. Notice that the ID is automati cally created as *MyControl1*, the next instance will be called *MyControl2*, and so on.

Accessing Data from the User Control

If this user control is placed on a Web page, the *TextBox* and *Label* are visible to the user, but how can the name be retrieved? The *TextBox* and *Label* controls are declared as protected members on the Web page, which means that they are accessible only to the *MyControl* class and to classes that inherit from the control. To access the data for the *Label* and *TextBox*, you could expose the properties that are required, such as the *Text* property of the *txtName* TextBox and the *Text* property of the *lblName* Label. The user control is a class and can contain properties and methods. You can add proper ties to the user controls called *UserName* and *UserCaption*, as follows:

```
'VB
Partial Class MyControl
    Inherits System.Web.UI.UserControl

    Public Property UserCaption() As String
      Get
            Return lblName.Text
      End Get
      Set(ByVal value As String)
            lblName.Text = value
      End Set
    End Property

    Public Property UserName() As String
      Get
            Return txtName.Text
```

```
        End Get
        Set(ByVal value As String)
            txtName.Text = value
        End Set
    End Property

End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class MyControl : System.Web.UI.UserControl
{
    public string UserCaption
    {
      get { return lblName.Text; }
      set { lblName.Text = value;  }
    }

    public string UserName
    {
      get { return txtName.Text; }
      set { txtName.Text = value; }
    }
}
```

To demonstrate the new properties, the *MyControl* user control, a *Button* control, and a *Label* control are added to the Web page, and code is added to the code-behind page of the Web page to retrieve the *UserName*, as follows:

ASPX File

'VB

```
<%@ Page Language="VB" AutoEventWireup="true"
        CodeFile="MyControlPropertyTest.aspx.vb
        Inherits="MyControlPropertyTest" %>

<%@ Register Src="MyControl.ascx" TagName="MyControl" TagPrefix="uc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
```

Error! Hyperlink reference not valid.

```
<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
```

```
        <title>Untitled Page</title>
</head>
<body>
        <form id="form1" runat="server">
        <div>
           <br />
           <asp:Button ID="Button1" runat="server" Text="Get Name"
                             OnClick="Button1_Click" />
           <br />
           <br />
           <uc1:MyControl ID="MyControl1" runat="server" />
           <br />
           <br />
           <asp:Label ID="Label1" runat="server" ></asp:Label>
           </div>
        </form>
</body>
</html>
```

//C#

```
<%@ Page Language="C#" AutoEventWireup="true"
       CodeFile="MyControlPropertyTest.aspx.cs"
       Inherits="MyControlPropertyTest" %>
<%@ Register Src="MyControl.ascx" TagName="MyControl" TagPrefix="uc1" %>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
       Error! Hyperlink reference not valid.

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
        <title>Untitled Page</title>
</head>
<body>
        <form id="form1" runat="server">
          <div>
                   <br />
                   <asp:Button ID="Button1" runat="server" Text="Get Name"
                              OnClick="Button1_Click" />&nbsp;<br />
                   <br />
                   <uc1:MyControl ID="MyControl1" runat="server" />
                   <br />
                   <br />
                   <asp:Label ID="Label1" runat="server"></asp:Label>
                   <br />
                   <br />
          </div>
        </form>
</body>
</html>
```

Code-Behind

'VB

```
Partial Class MyControlPropertyTest
        Inherits System.Web.UI.Page
```

```
    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
      MyControl1.UserCaption = "Enter User Name:"
    End Sub

    Protected Sub Button1_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Button1.Click
      Label1.Text = MyControl1.UserName
    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class MyControlPropertyTest : System.Web.UI.Page
{
     protected void Page_Load(object sender, EventArgs e)
      {
       MyControl1.UserCaption = "Enter User Name:";
      }
    protected void Button1_Click(object sender, EventArgs e)
    {
      Label1.Text = MyControl1.UserName;
    }
}
```

Positioning User Controls

When a user control is dropped onto a Web page, you always position it using some of the same techniques as you would use to position other controls using Flow Lay out, such as placing the user control in an HTML table.

You'll soon find that you cannot position the user control using Dynamic Hypertext Markup Language (DHTML) to set the absolute positioning using the *Style* property because the user control does not automatically add an outer tag for the contents of the control that could be assigned a *Style*. You can set the positioning using DHTML if you add a *Panel* control to the Web page and place the user control into the *Panel*. This allows the *Panel* and its contents to be positioned.

User Control Events

User controls can have their own events and cause a postback of the Web page's form data. It's interesting to note that user controls do not contain form server controls, since there can only be one form server control on a Web page. User controls are aware of the life cycle of the page, and the user control has many of the same events that the page has, such as the *Init* and *Load* events.

A user control can also handle its own events. In the following example, a user control called HiControl.ascx is created containing a *TextBox* control, a *Button* control, and a *Label* control. When the *Button* control is clicked, the user control handles the *Button* control's *Click* event to populate the *Label* control with a hello message.

ASCX File

```
'VB
<%@ Control Language="VB" AutoEventWireup="true"
    CodeFile="HiControl.ascx.vb" Inherits="HiControl" %>
<asp:TextBox ID="TextBox1" runat="server" ></asp:TextBox>
<asp:Button ID="Button1" runat="server" Text="Say Hi" />
<br />
<asp:Label ID="Label1" runat="server" Text="Label"></asp:Label>

//C#
<%@ Control Language="C#" AutoEventWireup="true"
    CodeFile="HiControl.ascx.cs" Inherits="HiControl" %>
<asp:TextBox ID="TextBox1" runat="server"></asp:TextBox>
<asp:Button ID="Button1" runat="server" Text="Say Hi"
    OnClick="Button1_Click" />
<br />
<asp:Label ID="Label1" runat="server" Text="Label"></asp:Label>
```

Code-Behind

```
'VB
Partial Class HiControl
    Inherits System.Web.UI.UserControl

   Protected Sub Button1_Click(ByVal sender As Object, _
         ByVal e As System.EventArgs) Handles Button1.Click
    Label1.Text = "Hi " + TextBox1.Text
   End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class HiControl : System.Web.UI.UserControl
{
    protected void Button1_Click(object sender, EventArgs e)
    {
      Label1.Text = "Hi " + TextBox1.Text;
    }

}
```

It's interesting to note that the code for *Button* control's *Click* event has been encapsu lated into the user control. Figure 5-2 shows the user control and the rendered output after the control was placed onto a simple Web page. Encapsulation of the user con trol's event code can help to simplify the page.

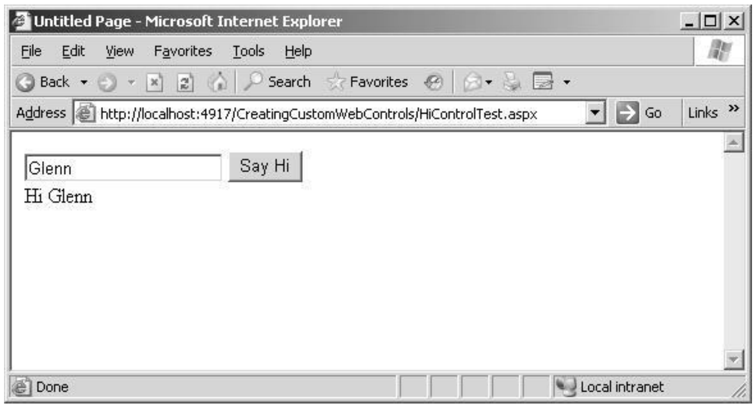

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4917/CreatingCustomWebControls/HiControlTest.aspx
Go Links
Glenn
Say Hi
Hi Glenn
Done
Local intranet

Figure 5-2 This user control contains encapsulated code to process the *Button* control's *Click* event.

Dynamically Loading Controls

Like other server controls, user controls can be loaded dynamically. Loading controls dynamically can be useful in situations where a variable quantity of user controls is displayed on the page. In the following example, the Web page loads two instances of *MyControl* onto the page. The *UserName* of the first instance is initialized.

'VB

```
Partial Class HiControlDynamicLoad
    Inherits System.Web.UI.Page
    Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load

      'Populate the form.
      Dim c1 As MyControl = _
            CType(LoadControl("MyControl.ascx"), MyControl)
      c1.UserName = "Glenn"
      form1.Controls.Add(c1)
      Dim c2 As MyControl = _
            CType(LoadControl("MyControl.ascx"), MyControl)
      form1.Controls.Add(c2)

    End Sub
End Class

//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class HiControlDynamicLoad : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
      //Populate the form.
      MyControl c1 =
            (MyControl)LoadControl("MyControl.ascx");
      c1.UserName = "Glenn";
      form1.Controls.Add(c1);
      MyControl c2 =
            (MyControl)LoadControl("MyControl.ascx");
      form1.Controls.Add(c2);
    }
}
```

The *LoadControl* method loads the control into memory, but this method returns a *System.Web.UI.Control*. To see the properties of *MyControl*, the returned *Control* object must be cast as a *MyControl* object. This is done using the *CType* function in Microsoft Visual Basic (VB) or the casting syntax in C#. The user control contains server con trols, so it must be loaded into the controls collection of the form as shown.

Raising Events to the Page

A common requirement is to be able to place a control, such as a *Button* control, in the user control, but it's not known how the control will be implemented when the devel oper is creating the user control. This problem can be solved by raising the event to the Web page. For example, you may have a *Button* in the user control that raises an event when the *Button* is clicked and passes the contents of the *TextBox*. The following code shows a user control with a button called *btnMessage* that raises an event called *SendMessage*. The *SendMessage* event passes the name that was typed into the *TextBox*.

ASCX File

```
'VB
<%@ Control Language="VB" AutoEventWireup="false"
       CodeFile="MessageControl.ascx.vb" Inherits="MessageControl" %>
<asp:Label ID="lblName" runat="server"  Text="Enter Name: "></asp:Label>
<asp:TextBox ID="txtName" runat="server" ></asp:TextBox>
<asp:Button ID="btnMessage" runat="server" Text="Send Message" />

//C#
<%@ Control Language="C#" AutoEventWireup="true"
       CodeFile="MessageControl.ascx.cs" Inherits="MessageControl" %>
<asp:Label ID="lblName" runat="server"  Text="Enter Name: "></asp:Label>
<asp:TextBox ID="txtName" runat="server" ></asp:TextBox>
<asp:Button ID="btnMessage" runat="server" Text="Send Message"
       OnClick="btnMessage_Click" />
```

Code-Behind

```
'VB
Partial Class MessageControl
    Inherits System.Web.UI.UserControl

    Public Event SendMessage(ByVal UserName As String)

    Public Property UserName() As String
      Get
            Return txtName.Text
      End Get
      Set(ByVal Value As String)
            txtName.Text = Value
      End Set
    End Property

    Private Sub btnMessage_Click(ByVal sender As System.Object, _
            ByVal e As System.EventArgs) Handles btnMessage.Click
      RaiseEvent SendMessage(txtName.Text)
    End Sub

End Class
```

```
//C#
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public delegate void SendMessageHandler(string message);

public partial class MessageControl : System.Web.UI.UserControl
{
    public event SendMessageHandler SendMessage;
    protected void btnMessage_Click(object sender, EventArgs e)
    {
      if (SendMessage != null) SendMessage(txtName.Text);
    }
}
```

The event must always be declared as public at the top of the user control class. The *btnMessage* control's *Click* event handler has been programmed to raise the event, passing the contents of *txtName.Text*. The user control can be added to a Web page, and code can be added to subscribe to the *SendMessage* event, as shown in the follow ing code sample:

ASPX File

```
'VB
<%@ Page Language="VB" AutoEventWireup="false"
     CodeFile="MessageControlTest.aspx.vb" Inherits="MessageControlTest" %>

<%@ Register Src="MessageControl.ascx"
     TagName="MessageControl" TagPrefix="uc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    Error! Hyperlink reference not valid.

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
    <title>Untitled Page</title>
</head>
<body>
    <form id="form1" runat="server">
    <div>
      <uc1:MessageControl ID="MessageControl1" runat="server" />
      <br />
      <br />
      <asp:Label ID="lblResult" runat="server" Text=""></asp:Label>
    </div>
    </form>
</body>
</html>
```

//C#

```
<%@ Page Language="C#" AutoEventWireup="true"
     CodeFile="MessageControlTest.aspx.cs" Inherits="MessageControlTest" %>

<%@ Register Src="MessageControl.ascx"
     TagName="MessageControl" TagPrefix="uc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    Error! Hyperlink reference not valid.

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
    <title>Untitled Page</title>
</head>
<body>
    <form id="form1" runat="server">
    <div>
      <uc1:MessageControl ID="MessageControl1" runat="server" />
      <br />
      <br />
      <asp:Label ID="lblResult" runat="server" Text=""></asp:Label>
    </div>
    </form>
</body>
</html>
```

Code-Behind

'VB

```
Partial Class MessageControlTest
    Inherits System.Web.UI.Page

   Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
     AddHandler  MessageControl1.SendMessage, addressof MessageReceived
   End Sub

   private Sub MessageReceived(message as String)
     lblResult.Text = message
   End Sub
End Class
```

//C#

```
using System;
using System.Data;
using System.Configuration;
using System.Collections;
using System.Web;
using System.Web.Security;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Web.UI.WebControls.WebParts;
using System.Web.UI.HtmlControls;

public partial class MessageControlTest : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
     {
      MessageControl1.SendMessage +=
            delegate(string message){ lblResult.Text = message;                              };
     }

}
```

Figure 5-3 shows the completed Web page after a name was entered into the TextBox and the Button was clicked.

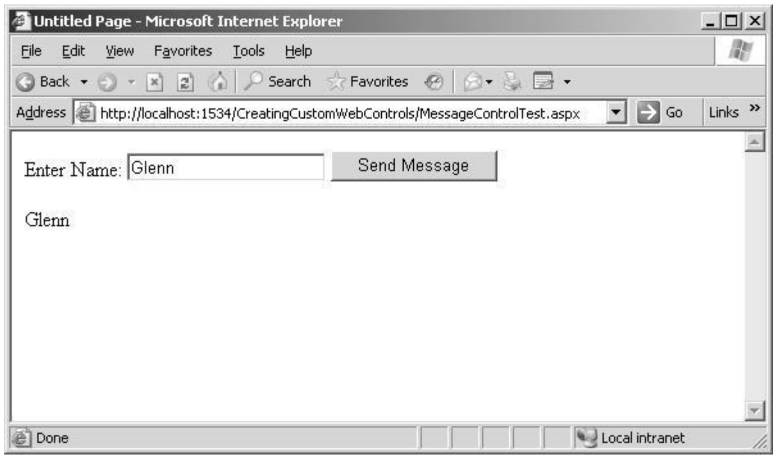

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1534/CreatingCustomWebControls/MessageControlTest.aspx
Go Links
Enter Name: Glenn
Send Message
Glenn
Done
Local intranet

Figure 5-3 The user control raises the *SendMessage* event that can be handled by the Web page.

It's interesting to note the differences in implementation based on the programming language. In VB, the event was easy to create because the creation of an event causes the VB compiler to automatically create a delegate to handle the event, whereas C# requires you to create the delegate. When it's time to implement the user control and its *SendMessage* event, VB requires you to create an event handler method to populate the *Label* control with the message, whereas C# lets you implement an anonymous method to handle the event.

Creating a Templated User Control

A templated user control provides separation of control data from its presentation, meaning that a templated user control does not provide a default user interface. For example, if you know that you need to display your shipper's information, such as the shipper ID, the shipper name, and the shipper phone number, but you don't know how the page designer wants to format this information, you could create a templated user control called *ShipperControl* that allows the page designer to supply the format for the shipper data using a template.

Like user controls, the templated user control is only reusable in the same Web site. If you want reusability across multiple sites, consider implementing the templated control that's described near the end of this chapter.

The templated user control must provide a container class that is a naming container and has properties that are accessible to the host page. The template contains the user interface for the templated user control and is supplied by the page developer at design time. A template can contain controls and markup. You can create a templated user control by following these steps:

1. Add a user control file to your Web application.
2. In the .ascx file, place an ASP.NET *Placeholder* control where you want the tem plate to appear.
3. In the code-behind file, implement a property of type *ITemplate*.
4. Add a new class to the App_Code folder in your Web site that contains the tem plate's naming container class. This class inherits from *Control*, implements the *INamingContainer*, and contains a public property for each data element that is visible to the template. The container control contains an instance of the tem plate when it is rendered.
5. Apply the *TemplateContainerAttribute* to the *ITemplate* property and pass the type of the template's naming container class as the argument to the constructor of the attribute.
6. Also, apply the *PersistenceModeAttribute* to the *ITemplate* property and pass the enumeration value of *PersistenceMode.InnerProperty* into its constructor.
7. In the user control's code-behind page, add public properties that let you pass your data to the template's naming container class so the data is available in the template.

8. In the *Page_Init* method of the user control, test for the *ITemplate* property being set. If the *ITemplate* property is set, create an instance of the naming con tainer class and create an instance of the template in the naming container. Add the naming container instance to the *Controls* property of the *PlaceHolder* server control.

The following code sample defines a templated user control called *ShipperControl.ascx* that allows you to set a ShipperID, ShipperName, and ShipperPhone and allows the Web page developer to create a template to define the output.

ASCX File

```
'VB
<%@ Control Language="VB" CodeFile="ShipperControl.ascx.vb"
       Inherits="ShipperControl" %>
<asp:PlaceHolder ID="ShipperHolder" runat="server" />

//C#
<%@ Control Language="C#" CodeFile="ShipperControl.ascx.cs"
       Inherits="ShipperControl"   %>
<asp:PlaceHolder ID="ShipperHolder" runat="server" />
```

Code-Behind

```
'VB
Partial Class ShipperControl
     Inherits System.Web.UI.UserControl

     <PersistenceMode(PersistenceMode.InnerProperty)> _
     <TemplateContainer(GetType(ShipperContainer))> _
     Public Property ShipperTemplate() As ITemplate
       Get
             Return _shipperTemplate
       End Get
       Set(ByVal value As ITemplate)
             _shipperTemplate = value
       End Set
     End Property
     Private _shipperTemplate As ITemplate

     Public Property ShipperId() As Integer
       Get
             Return _shipperId
       End Get
       Set(ByVal value As Integer)
             _shipperId = value
       End Set
     End Property
     Private _shipperId As Integer

     Public Property ShipperName() As String
       Get
```

```
            Return _shipperName
        End Get
        Set(ByVal value As String)
            _shipperName = value
        End Set
    End Property
    Private _shipperName As String

    Public Property ShipperPhone() As String
        Get
            Return _shipperPhone
        End Get
        Set(ByVal value As String)
            _shipperPhone = value
        End Set
    End Property
    Private _shipperPhone As String

    Public Sub Page_Init(ByVal sender As Object, _
            ByVal e As EventArgs) Handles Me.Init

        ShipperHolder.Controls.Clear()
        If ShipperTemplate Is Nothing Then
            ShipperHolder.Controls.Add( _
                New LiteralControl("No Template Defined"))
            Return
        End If
        Dim s As New ShipperContainer( _
            ShipperId, ShipperName, ShipperPhone)
        ShipperTemplate.InstantiateIn(s)
        ShipperHolder.Controls.Add(s)
    End Sub

End Class
```

//C#

```
using System;
using System.Web.UI;

public partial class ShipperControl : System.Web.UI.UserControl
{

    [PersistenceMode(PersistenceMode.InnerProperty)]
    [TemplateContainer(typeof(ShipperContainer))]
    public ITemplate ShipperTemplate
    {
        get { return _shipperTemplate; }
        set { _shipperTemplate = value; }
    }
    private ITemplate _shipperTemplate;

    public int ShipperId
    {
        get { return _shipperId; }
        set { _shipperId = value; }
    }
    private int _shipperId;

    public string ShipperName
    {
        get { return _shipperName; }
        set { _shipperName = value; }
    }
    private string _shipperName;


    public string ShipperPhone
    {
        get { return _shipperPhone; }
        set { _shipperPhone = value; }
    }
    private string _shipperPhone;

    public void Page_Init()
    {
        ShipperHolder.Controls.Clear();
        if (ShipperTemplate == null)
            {
                ShipperHolder.Controls.Add(
                    new LiteralControl("No Template Defined"));
                return;
            }
        ShipperContainer s = new ShipperContainer(
                ShipperId, ShipperName, ShipperPhone);
        ShipperTemplate.InstantiateIn(s);
        ShipperHolder.Controls.Add(s);
    }

}
```

Notice that this code requires a template-naming container called *ShipperContainer*. This code is placed in its own class file in the App_Code folder. The following is the contents of the *ShipperContainer* class:

```
'VB
Imports Microsoft.VisualBasic

Public Class ShipperContainer
    Inherits Control
    Implements INamingContainer

    Public Sub New(ByVal _shipperId As Integer, _
        ByVal _shipperName As String, ByVal _shipperPhone As String)
        Me._shipperId = _shipperId
        Me._shipperName = _shipperName
```

```
      Me._shipperPhone = _shipperPhone
    End Sub

    Public ReadOnly Property ShipperId() As Integer
      Get
            Return _shipperId
      End Get
    End Property
    Private _shipperId As Integer

    Public ReadOnly Property ShipperName() As String
      Get
            Return _shipperName
      End Get
    End Property
    Private _shipperName As String

    Public ReadOnly Property ShipperPhone() As String
      Get
            Return _shipperPhone
      End Get
    End Property
    Private _shipperPhone As String

End Class
```

```
//C#
using System;
using System.Web.UI;

public class ShipperContainer : Control, INamingContainer
{
    public ShipperContainer(int _shipperId,
      string _shipperName, string _shipperPhone)
    {
      ShipperId = _shipperId;
      ShipperName = _shipperName;
      ShipperPhone = _shipperPhone;
    }

    public int ShipperId
    {
      get { return _shipperId; }
      set { _shipperId = value; }
    }
    private int _shipperId;

    public string ShipperName
    {
      get { return _shipperName; }
      set { _shipperName = value; }
    }
    private string _shipperName;
    public string ShipperPhone
    {
      get { return _shipperPhone; }
      set { _shipperPhone = value; }
    }
    private string _shipperPhone;
}
```

Using the Templated User Control

Like the user control, the templated user must be used within the same project and can be used by dragging and dropping the templated user control from the Solution Explorer to a Web page. After the templated user control is added, you can set its properties and add a template. The following is a Web page that contains the *Shipper-Control* with a template to format the shipper data:

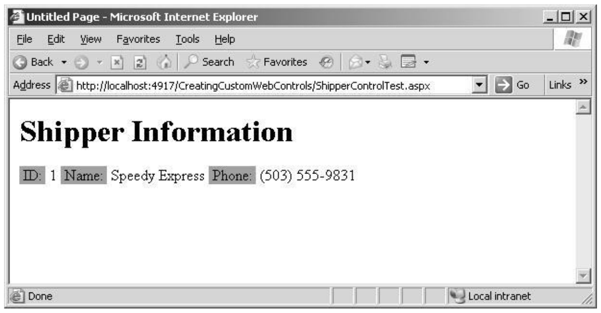
'VB

```
<%@ Page Language="VB" Debug="true"  AutoEventWireup="true"%>

<%@ Register TagPrefix="uc1" TagName="ShipperControl"
    Src="~/ShipperControl.ascx" %>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    Error! Hyperlink reference not valid.
<html xmlns="http://www.w3.org/1999/xhtml">

<script runat="server">
    Sub Page_Load()
      DataBind()
    End Sub 'Page_Load
</script>

<head runat="server">
    <title>ShipperControl Test</title>
</head>
<body>
    <form id="form1" runat="server">
      <uc1:ShipperControl ID="ShipperControl1" runat="server"
              ShipperId="1" ShipperName="Speedy Express"
              ShipperPhone="(503) 555-9831">
          <ShipperTemplate>
              <h1>Shipper Information</h1>
              <span style="background-color:Lime">&nbsp;ID:&nbsp;</span>
              <%# Container.ShipperId %>
              <span style="background-color:Lime">&nbsp;Name:&nbsp;</span>
              <%# Container.ShipperName %>
              <span style="background-color:Lime">&nbsp;Phone:&nbsp;</span>
              <%# Container.ShipperPhone %>
              </ShipperTemplate>
          </uc1:ShipperControl>

     </form>
</body>
</html>
```

//C#

```
<%@ Page Language="C#" AutoEventWireup="true"                  %>

<%@ Register Src="ShipperControl.ascx" TagName="ShipperControl"
     TagPrefix="uc1" %>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
     Error! Hyperlink reference not valid.

<script runat="server">
     public void Page_Load()
     {
       DataBind();
     }
</script>

<html xmlns="http://www.w3.org/1999/xhtml" >

<head runat="server">
      <title>Untitled Page</title>
</head>
<body>
     <form id="form1" runat="server">
       <uc1:ShipperControl ID="ShipperControl1" runat="server"
                  ShipperId="1" ShipperName="Speedy Express"
                  ShipperPhone="(503) 555-9831">
              <ShipperTemplate>
                  <h1>Shipper Information</h1>
                  <span style="background-color:Lime">&nbsp;ID:&nbsp;</span>
                  <%# Container.ShipperId %>
                  <span style="background-color:Lime">&nbsp;Name:&nbsp;</span>
                  <%# Container.ShipperName %>
                  <span style="background-color:Lime">&nbsp;Phone:&nbsp;</span>
                  <%# Container.ShipperPhone %>
              </ShipperTemplate>
       </uc1:ShipperControl>
     </form>
</body>
</html>
```

Note that the templated user control does not display in Design view, but if you run the Web page, it displays properly, as shown in Figure 5-4.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4917/CreatingCustomWebControls/ShipperControlTest.aspx
Go Links
Done
Local intranet

Shipper Information

ID: 1 Name: Speedy Express Phone: (503) 555-9831

Figure 5-4 The templated user control is rendered to display the supplier data.

Quick Check

1. What is the easiest way to combine several TextBoxes and Labels onto a sin gle control that can be simply dragged onto a Web page without writing much code?
2. What type of control can be used to provide data that is to be rendered but allows the Web page designer to specify the format of the data?

Quick Check Answers

1. Create a *UserControl*.
2. A templated user control.

Lab: Working With User Controls

In this lab, you create a user control for collecting address information and implement the control to collect bill-to and ship-to information.

� **Exercise 1: Create the Web Site and the User Control**

In this exercise, you create the Web site and create the user control.

1. Open Visual Studio 2005; create a new Web site called **WorkingWithUserControls** using your preferred programming language. The new Web site is created, and a Web page called Default.aspx is displayed.
2. Add a Web User Control called AddressControl.ascx to the Web site by right-clicking the Web site in the Solution Explorer window, selecting Add New Item, and then selecting Web User Control; assign **AddressControl.ascx** as the name. An empty window is displayed for the new user control.

3. In the Source view of the user control, add the following markup to create an HTML table for the address information, and add controls to the table to collect the address information.

AddressControl.ascx File

```
'VB
<%@ Control Language="VB" AutoEventWireup="false"
    CodeFile="AddressControl.ascx.vb" Inherits="AddressControl" %>

<table>
    <tr>
      <td colspan="2">
            <asp:Label ID="lblTitle" runat="server" Text=""
            style="font-weight: bold; font-size: large;" >
            </asp:Label>
      </td>
    </tr>
    <tr>
      <td>
      Name:
      </td>
      <td>
            <asp:TextBox ID="txtName" width="300px"  runat="server">
            </asp:TextBox>
      </td>
    </tr>
    <tr>
      <td>
      Address:
      </td>
      <td >
            <asp:TextBox ID="txtAddress1" width="300px"  runat="server">
            </asp:TextBox>
      </td>
    </tr>
    <tr>
      <td>
      &nbsp;
      </td>
      <td >
            <asp:TextBox ID="txtAddress2" width="300px"  runat="server">
            </asp:TextBox>
      </td>
    </tr>
    <tr>
      <td colspan="2">
            City: <asp:TextBox ID="txtCity" width="150px" runat="server">
                  </asp:TextBox>&nbsp;
            State:
                  <asp:DropDownList ID="ddlState" width="50px" runat="server">
                        <asp:ListItem Value="AK">AK</asp:ListItem>
                        <asp:ListItem Value="AZ">AZ</asp:ListItem>
                        <asp:ListItem Value="OH" Selected="True">OH</asp:ListItem>
                        <asp:ListItem Value="MA">MA</asp:ListItem>
                        <asp:ListItem Value="NH">NH</asp:ListItem>
                        <asp:ListItem Value="WA">WA</asp:ListItem>
                    </asp:DropDownList>&nbsp;
            Zip:  <asp:TextBox ID="txtZip" width="80px" runat="server">
                    </asp:TextBox>&nbsp;
      </td>
    </tr>
</table>

//C#
<%@ Control Language="C#" AutoEventWireup="true"
CodeFile="AddressControl.ascx.cs" Inherits="AddressControl" %>

<table>
    <tr>
      <td colspan="2">
            <asp:Label ID="lblTitle" runat="server" Text=""
            style="font-weight: bold; font-size: large;" >
            </asp:Label>
      </td>
    </tr>
    <tr>
      <td>
      Name:
      </td>
      <td>
            <asp:TextBox ID="txtName" width="300px"  runat="server">
            </asp:TextBox>
      </td>
    </tr>
    <tr>
      <td>
      Address:
      </td>
      <td >
            <asp:TextBox ID="txtAddress1" width="300px"  runat="server">
            </asp:TextBox>
      </td>
    </tr>
    <tr>
      <td>
      &nbsp;
      </td>
      <td >
            <asp:TextBox ID="txtAddress2" width="300px"  runat="server">
            </asp:TextBox>
      </td>
    </tr>
    <tr>
```

```
            <td colspan="2">
                City: <asp:TextBox ID="txtCity" width="150px" runat="server">
                    </asp:TextBox>&nbsp;
                State:
                    <asp:DropDownList ID="ddlState" width="50px" runat="server">
                        <asp:ListItem Value="AK">AK</asp:ListItem>
                        <asp:ListItem Value="AZ">AZ</asp:ListItem>
                        <asp:ListItem Value="OH" Selected="True">OH</asp:ListItem>
                        <asp:ListItem Value="MA">MA</asp:ListItem>
                        <asp:ListItem Value="NH">NH</asp:ListItem>
                        <asp:ListItem Value="WA">WA</asp:ListItem>
                    </asp:DropDownList>&nbsp;
                Zip:  <asp:TextBox ID="txtZip" width="80px" runat="server">
                    </asp:TextBox>&nbsp;
            </td>
        </tr>
    </table>
```

4. Figure 5-5 shows what the UI of your user control should look like in Design view.

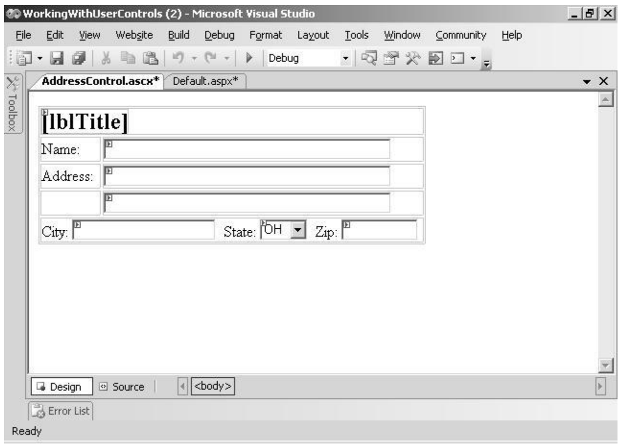

WorkingWithUserControls (2) - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window Community Help
Debug
Toolbox
AddressControl.ascx*
Default.aspx*
[lblTitle]
Name:
Address:
City:
State:
OH
Zip:
Design
Source
<body>
Error List
Ready

Figure 5-5 The UI of the AddressControl.ascx file in Design view.

5. In the code-behind for the user control, add public properties to allow the values of the Title, Name, Address1, Address2, City, State, and Zip to be read and set. Your code-behind page should look like the following:

```
'VB
Partial Class AddressControl
    Inherits System.Web.UI.UserControl

    Public Property Title() As String
      Get
```

```
            Return lblTitle.Text
    End Get
    Set(ByVal value As String)
            lblTitle.Text = value
    End Set
End Property

Public Property Name() As String
    Get
            Return txtName.Text
    End Get
    Set(ByVal value As String)
            txtName.Text = value
    End Set
End Property

Public Property Address1() As String
    Get
            Return txtAddress1.Text
    End Get
    Set(ByVal value As String)
            txtAddress1.Text = value
    End Set
End Property

Public Property Address2() As String
    Get
            Return txtAddress2.Text
    End Get
    Set(ByVal value As String)
            txtAddress2.Text = value
    End Set
End Property

Public Property City() As String
    Get
            Return txtCity.Text
    End Get
    Set(ByVal value As String)
            txtCity.Text = value
    End Set
End Property

Public Property State() As String
    Get
            Return ddlState.SelectedValue
    End Get
    Set(ByVal value As String)
            ddlState.SelectedValue = value
    End Set
End Property
```

```
    Public Property Zip() As String
      Get
            Return txtZip.Text
      End Get
      Set(ByVal value As String)
            txtZip.Text = value
      End Set
    End Property

End Class
```

//C#

```
using System;
using System.Web.UI;

public partial class AddressControl : System.Web.UI.UserControl
{
    public string Title
    {
      get { return lblTitle.Text; }
      set { lblTitle.Text = value; }
    }

    public string Name
    {
      get { return txtName.Text; }
      set { txtName.Text = value; }
    }

    public string Address1
    {
      get { return txtAddress1.Text; }
      set { txtAddress1.Text = value; }
    }

    public string Address2
    {
      get { return txtAddress2.Text; }
      set { txtAddress2.Text = value; }
    }

    public string City
    {
      get { return txtCity.Text; }
      set { txtCity.Text = value; }
    }

    public string State
    {
      get { return ddlState.SelectedValue; }
      set { ddlState.SelectedValue = value; }
```

```
        }

        public string Zip
        {
            get { return txtZip.Text; }
            set { txtZip.Text = value; }
        }

    }
```

� **Exercise 2: Employ the User Control**

In this exercise, you add multiple instances of AddressControl.ascx to the Default.aspx Web page and access their properties.

1. Open the Default.aspx Web page.
2. From the Solution Explorer window, drag the AddressControl.ascx file onto the Web page, change its *ID* property to **addBillTo**, and change the *Title* property to **Bill To Address**.
3. Add a *Button* control to the Web page and set its *Text* property to **Copy Bill To Address -> Ship To Address**.
4. From the Solution Explorer window, drag another AddressControl.ascx file onto the Web page, change its *ID* property to **addShipTo**, and change the *Title* property to **Ship To Address**. Figure 5-6 shows what your Web page should look like.

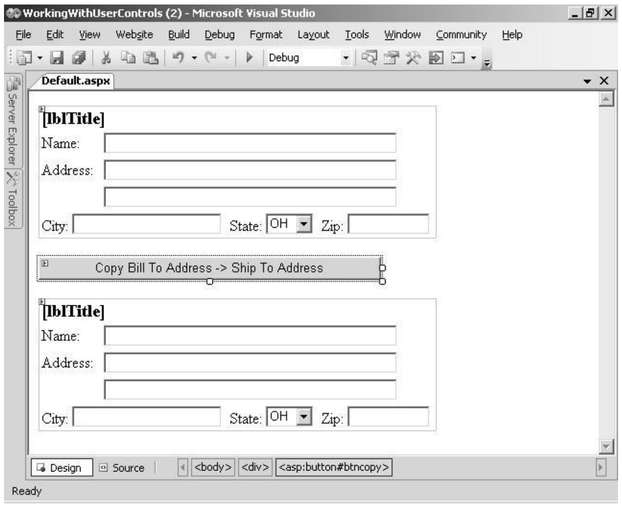

WorkingWithUserControls (2) - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window Community Help
Debug
Default.aspx
Server Explorer
Toolbox
[lblTitle]
Name:
Address:
City:
State:
OH
Zip:
Copy Bill To Address -> Ship To Address
[lblTitle]
Name:
Address:
City:
State:
OH
Zip:
Design
Source
<body>
<div>
<asp:button#btncopy>
Ready

Figure 5-6 The Default.aspx page contains two instances of the AddressControl.ascx file.

5. Add code to the *Button* control's *Click* event handler that copies the address properties from the *addBillTo* control to *addShipTo* control. Your code-behind page should look like the following:

```
'VB
Partial Class _Default
    Inherits System.Web.UI.Page

    Protected Sub btnCopy_Click(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles btnCopy.Click
      addShipTo.Name = addBillTo.Name
      addShipTo.Address1 = addBillTo.Address1
      addShipTo.Address2 = addBillTo.Address2
      addShipTo.City = addBillTo.City
      addShipTo.State = addBillTo.State
      addShipTo.Zip = addBillTo.Zip
    End Sub
End Class

//C#
using System;
using System.Web.UI;

public partial class _Default : System.Web.UI.Page
{
    protected void btnCopy_Click(object sender, EventArgs e)
    {
      addShipTo.Name = addBillTo.Name;
      addShipTo.Address1 = addBillTo.Address1;
      addShipTo.Address2 = addBillTo.Address2;
      addShipTo.City = addBillTo.City;
      addShipTo.State = addBillTo.State;
      addShipTo.Zip = addBillTo.Zip;
    }
}
```

6. View the Web page. Notice that the proper titles are displayed.

7. Try typing a bill-to address and clicking the *Button* control to copy the informa tion to the ship-to address. This shows that the properties can be read and set.

Lesson 2: Working with Custom Web Server Controls

In this lesson, you learn how to create custom controls that inherit from the *WebControl* class. These controls include composite controls and templated controls. You also learn to make use of these controls in your Web page development efforts.

After this lesson, you will be able to:

- Create a custom Web server control.
- Add custom Web server controls to a Web page.
- Individualize a custom Web server control.
- Create a custom designer for a custom Web server control.

Estimated lesson time: 60 minutes

Employing Custom Web Server Controls

A custom Web server control is a control that inherits from the *WebServer* control. This book has already covered many of the built-in Web server controls, so you should be familiar with the behaviors that they provide. Although you could specify that your custom control inherits from the *WebServer* class's parent class, the *Control* class, you should explore the class hierarchy and inherit from the class that provides the most useable benefits without going so far as to inherit from a class that provides many fea tures that won't be used by your class. The primary benefit that the *WebControl* class provides is styles, which include UI-related properties such as *BackColor*, *ForeColor, Font, Height,* and *Width*.

An ASP.NET Web server control renders markup as well as client-side JavaScript. You can override the *Control* class' *Render* method to provide the markup via the Html-TextWriter parameter that is passed to the method.

Creating a Custom Web Server Control

The two common approaches to creating a custom Web server control are to inherit from an existing control or to create a Web server control that inherits directly from *WebControl*. Regardless of the approach that you take, you should consider the reus ability of the control. If you want to use your custom Web server control in multiple Web sites, you should place the new custom Web server control class in a Class Library project to create a .dll that you can share. If you only need to use the custom Web server control in the current Web site, you can simply add the class to the Web site.

Inheriting from Existing Web Server Controls

You can easily inherit from an existing control to add more properties, methods, and events. You can also override existing methods and properties to provide different behaviors. For example, maybe you want to create a labeled text box that exposes *LabelText* and *LabelWidth* properties and renders the *LabelText* in a span tag that has the width set before the performing the usual text box rendering. This can help min imize the use of tables for formatting because setting the width of the span tag assures that the *TextBox* controls line up vertically regardless of the text that is placed into the *LabelText* property. The following code shows how you can inherit from the *TextBox* control and add new properties called *LabelText* and *LabelWidth*. The *Render* method is overridden to add the span tag to the HTML output with the proper settings to call the *TextBox* control's *Render* method.

```
'VB
Imports Microsoft.VisualBasic

Public Class LabeledTextBox
    Inherits TextBox

    Public Property LabelText() As String
      Get
          Return _labelText
      End Get
      Set(ByVal value As String)
          _labelText = value
      End Set
    End Property
    Private _labelText As String

    Public Property LabelWidth() As Integer
      Get
          Return _labelWidth
      End Get
      Set(ByVal value As Integer)
          _labelWidth = value
      End Set
    End Property
    Private _labelWidth As Integer

    Protected Overrides Sub Render(ByVal writer As HtmlTextWriter)
      writer.Write( _
          "<span style=""display:inline-block;width:{0}px"">{1}&nbsp;</span>" _
          , LabelWidth, LabelText)
      MyBase.Render(writer)
    End Sub

End Class
```

```
//C#
using System;
using System.Web.UI;
using System.Web.UI.WebControls;

public class LabeledTextBox : TextBox
{
    public string LabelText
    {
      get { return _labelText; }
      set { _labelText = value; }
    }
    private string _labelText;

    public int LabelWidth
    {
      get { return _labelWidth; }
      set { _labelWidth = value; }
    }
    private int _labelWidth;

    protected override void Render(HtmlTextWriter writer)
    {
      writer.Write(
            @"<span style=""display:inline-block;width:{0}px"">{1}&nbsp;</span>"
            ,LabelWidth, LabelText);
      base.Render(writer);
    }

}
```

If this class is in the current Web site application, you can dynamically create instances of the control as shown in the following code sample for the LabeledText-BoxTest.aspx file:

```
'VB
Partial Class LabeledTextBoxTest
    Inherits System.Web.UI.Page

    Protected Sub Page_Init(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Init
      Dim width As Integer = 150
      Dim prompt1 As New LabeledTextBox()
      prompt1.LabelText = "Enter Name:"
      prompt1.LabelWidth = width
      form1.Controls.Add(prompt1)
      Dim brk As New LiteralControl("<br />")
      form1.Controls.Add(brk)
      Dim prompt2 As New LabeledTextBox()
      prompt2.LabelText = "Enter Address:"
```

```
        prompt2.LabelWidth = width
        form1.Controls.Add(prompt2)
    End Sub
End Class

//C#
using System;
using System.Web.UI;
using System.Web.UI.WebControls;

public partial class LabeledTextBoxTest : System.Web.UI.Page
{
    protected void Page_Init(object sender, EventArgs e)
    {
        int width = 150;
        LabeledTextBox prompt1 = new LabeledTextBox();
        prompt1.LabelText = "Enter Name:";
        prompt1.LabelWidth = width;
        form1.Controls.Add(prompt1);
        LiteralControl brk = new LiteralControl("<br />");
        form1.Controls.Add(brk);
        LabeledTextBox prompt2 = new LabeledTextBox();
        prompt2.LabelText = "Enter Address:";
        prompt2.LabelWidth = width;
        form1.Controls.Add(prompt2);
    }
}
```

Figure 5-7 shows the rendered Web page. When this Web page is run, the two *LabeledTextBox* controls have their *TextBox* controls lined up vertically because the *LabelWidth* property is set for these controls.

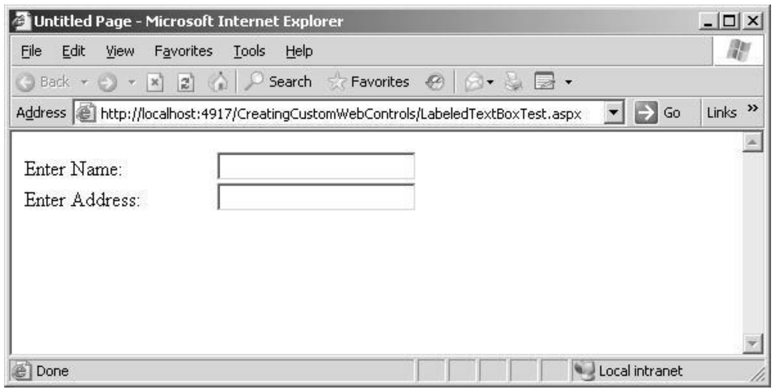

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4917/CreatingCustomWebControls/LabeledTextBoxTest.aspx
Go Links
Enter Name:
Enter Address:
Done
Local intranet

Figure 5-7 The rendered *LabeledTextBox* controls have *TextBox* controls that line up vertically.

Inheriting Directly from the *WebControl* Class

In addition to inheriting from an existing Web control, you can inherit directly from the *WebControl* class, which may be desirable when there is no control that currently provides behavior like the control that you want to implement.

When inheriting from the *WebControl* class, you must override the *Render* method to provide the desired output. The following is a code sample of *LogoControl* that con tains a property for the *LogoUrl* and the *CompanyName*:

```
'VB
Imports Microsoft.VisualBasic

Public Class LogoControl
    Inherits WebControl

    Public Property LogoUrl() As String
      Get
            Return _logoUrl
      End Get
      Set(ByVal value As String)
            _logoUrl = value
      End Set
    End Property
    Private _logoUrl As String

    Public Property CompanyName() As String
      Get
            Return _companyName
      End Get
      Set(ByVal value As String)
            _companyName = value
      End Set
    End Property
    Private _companyName As String

    Protected Overrides Sub Render( _
            ByVal writer As System.Web.UI.HtmlTextWriter)
      writer.WriteFullBeginTag("div")
      writer.Write("<img src=""{0}"" /><br />", LogoUrl)
      writer.Write(CompanyName + "<br />")
      writer.WriteEndTag("div")
    End Sub

End Class

//C#
using System;
using System.Web.UI;
using System.Web.UI.WebControls;
```

```
public class LogoControl : WebControl
{
    public LogoControl()
    {
    }

    public string LogoUrl
    {
      get { return _logoUrl; }
      set { _logoUrl = value; }
    }
    private string _logoUrl;

    public string CompanyName
    {
      get { return _companyName; }
      set { _companyName = value; }
    }
    private string _companyName;

    protected override void Render(HtmlTextWriter writer)
    {
      writer.WriteFullBeginTag("div");
      writer.Write(@"<img src=""{0}"" /><br />", LogoUrl);
      writer.Write(CompanyName + "<br />");
      writer.WriteEndTag("div");
    }
}
```

When this control is rendered, a *<div>* tag is output to the browser; the div tag con tains a nested img tag with the src set to the *LogoUrl*. Also in the div tag is the Com panyName as text on the line that follows the image. Finally, the end tag is written for the div tag.

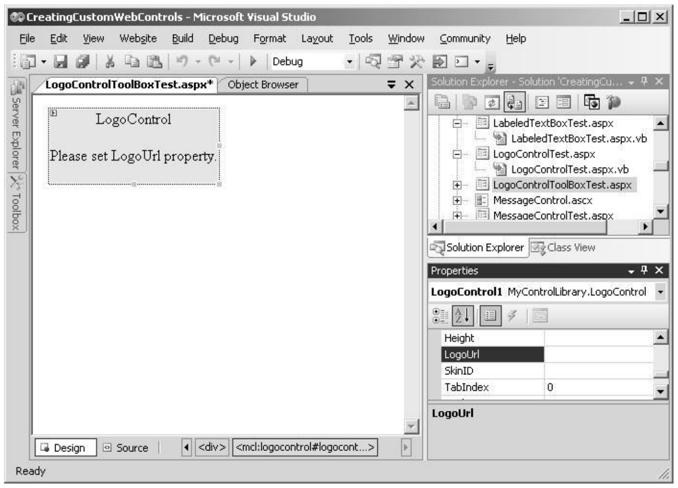
If this class is in the current Web site application, you can dynamically create instances of the control as shown in the following code sample for the LogoControl-Test.aspx file:

'VB

```
Partial Class LogoControlTest
     Inherits System.Web.UI.Page

    Protected Sub Page_Init(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Init
      Dim logo As New LogoControl()
       logo.CompanyName = "Northwind Traders"
      logo.LogoUrl = "NorthwindTraders.gif"
      form1.Controls.Add(logo)
    End Sub
End Class
```

```
//C#
using System;
using System.Web.UI;
using System.Web.UI.WebControls;

public partial class LogoControlTest : System.Web.UI.Page
{
    protected void Page_Init(object sender, EventArgs e)
    {
      LogoControl logo = new LogoControl();
      logo.CompanyName = "Northwind Traders";
      logo.LogoUrl = "NorthwindTraders.gif";
      form1.Controls.Add(logo);
    }
}
```

This code creates an instance of the *LogoControl*, sets its properties, and adds the *LogoControl* to the *form1* controls collection. The output is shown in Figure 5-8.


CreatingCustomWebControls - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window Community Help
Debug
LogoControlToolBoxTest.aspx*
Object Browser
Server Explorer
Toolbox
Design
Source
<div>
<mcl:logocontrol#logocont...>
Ready
Solution Explorer - Solution 'CreatingCu...
Solution Explorer
Class View
Properties
LogoUrl

LogoControl

Please set LogoUrl property.

```
LabeledTextBoxTest.aspx
  LabeledTextBoxTest.aspx.vb
LogoControlTest.aspx
  LogoControlTest.aspx.vb
LogoControlToolBoxTest.aspx
MessageControl.ascx
MessageControlTest.aspx
```

LogoControl1 MyControlLibrary.LogoControl

Height	
LogoUrl	
SkinID	
TabIndex	0

Figure 5-8 The rendered *LogoControl* inherits directly from *WebControl* and overrides the *Render* method.

Adding a Custom Web Server Control to the Toolbox

In the previous example, the control was added to the Web page dynamically by plac ing code in the code-behind page to instantiate and set the properties of the control. If you choose this method, you may also want to drag and drop your custom control from the Toolbox onto a Web page.

This basic requirement to having your Web control in the Toolbox is that the Web control be placed into a .dll file. In the case of the previous *LogoControl* example, the

LogoControl class has been added to a Class Library project called MyControlLibrary and placed into the default namespace of MyClassLibrary. You right-click the Tool box, select Choose Items, and browse for the MyClassLibrary.dll file to add the con trols that are contained in this .dll file to the Toolbox.

When the custom Web server control is added to the Toolbox, it uses the default icon. Add an attribute called *ToolboxBitmap* to specify the icon bitmap to use in the Tool box. The bitmap must be 16 by 16 pixels in size. The path to the icon must be an abso lute path with a drive letter specified. The bitmap path can also point to a .bmp file that is an embedded resource, as long as the name of the .bmp file has the same name as the fully qualified name of the class (classname.bmp). This means that you can add a .bmp file to the MyControlLibrary project called LogoControl.bmp, and, in the properties window, set the *Build Action* property to *Embedded Resource*.

The *ToolboxBitmapAttribute* class is located in the *System.Drawing* namespace in the *System.Drawing.dll* assembly. The following code snippet shows the *ToolboxBitmap* being set to a .bmp file that is configured to be an embedded resource. (When you use the *ToolBoxBitmapAttribute*, the *Attribute* suffix is optional.)

```
'VB
<ToolboxBitmap(GetType(LogoControl), "MyControlLibrary.LogoControl.bmp")> _
Public Class LogoControl
    Inherits WebControl

//C#
[ToolboxBitmap(typeof(LogoControl), "MyControlLibrary.LogoControl.bmp")]
public class LogoControl : WebControl
```

The *DefaultProperty* attribute specifies the default property of the component (as the name implies). This is the property that is active in the Properties window when you drop a control onto the Web page.

Individualizing a Custom Web Server Control

You can further change the way your custom server control behaves when it is dropped onto the Web page by setting the *ToolboxDataAttribute* in your control class. This attribute is used to change the markup that is generated. The following code snippet shows the *ToolboxDataAttribute* implementation:

```
'VB
<ToolboxData( _
    "<{0}:LogoControl runat=""server"" CompanyName="" "" LogoUrl="" ""  />")> _
Public Class LogoControl
    Inherits WebControl
```

```
//C#
[ToolboxData(
    @"<{0}:LogoControl runat=""server"" CompanyName="" "" LogoUrl="" "" />")]
public class LogoControl : WebControl
```

The placeholder {0} contains the namespace prefix as defined by the Web page designer. Notice that the *CompanyName* and *LogoUrl* attributes are inserted automat ically and assigned spaces.

You can also change the namespace prefix that is assigned by the Web page designer by assigning the *TagPrefixAttribute* to the assembly that contains your custom control. The following snippet shows the namespace prefix being changed to "mcl" for the controls in the MyControlLibrary project:

```
'VB
<Assembly: TagPrefix("MyControlLibrary", "mcl")>

//C#
[assembly: TagPrefix("MyControlLibrary", "mcl")]
```

With the previous changes to the *LogoControl*, dragging and dropping it on a Web page generates the following markup:

```
<mcl:LogoControl ID="LogoControl1" runat="server"
    CompanyName=" " LogoUrl=" " />
```

Creating a Custom Designer for a Custom Control

You can also specify a custom designer for your control that is used to render the con trol when in design mode by adding a reference to the *System.Design.dll* assembly and creating a class that inherits from the *ControlDesigner* class. This can be beneficial when the normal rendering of the control may not be visible due to code that needs to run to populate specific properties. For example, you may want to provide a custom designer for the *LogoControl* that provides a default rendering when the *LogoUrl* prop erty has not been set, as shown in the following code sample:

```
'VB
imports System.ComponentModel

public class LogoControlDesigner
    Inherits System.Web.UI.Design.ControlDesigner

      private _logoControl as LogoControl

      public overrides function  GetDesignTimeHtml() as String
            _logoControl = Ctype(component, LogoControl)
            if (_logoControl.LogoUrl.Trim().Length = 0) then
```

```
                return "<div id='mcl1' " _
                  + "style='background-color:yellow;border-width:2px;' >" _
                  + "<center>LogoControl</center><br />" _
                  + "<center>Please set LogoUrl property.</center><br />" _
                  + "</div>"
            else
                return mybase.GetDesignTimeHtml()
            End If
    end function

End Class

//C#
using System;
using System.ComponentModel;
using System.Collections.Generic;
using System.Text;

namespace MyControlLibrary
{
    class LogoControlDesigner : System.Web.UI.Design.ControlDesigner
    {
      private LogoControl _logoControl;

      public override string GetDesignTimeHtml()
        {
            if (_logoControl.LogoUrl.Trim().Length == 0)
             {
                return "<div id=\'mcl1\' "
                  + "style=\'background-color:yellow;border-width:2px;\' >"
                  + "<center>LogoControl</center><br />"
                  + "<center>Please set LogoUrl property.</center><br />"
                  + "</div>";
             }
            else
             {
                return base.GetDesignTimeHtml();
             }
        }

      public override void Initialize(IComponent component)
        {
            _logoControl = (LogoControl)component;
            base.Initialize(component);
            return;
        }
    }
}
```

After the class is created, you can assign the *DesignerAttribute* to the *LogoControl* class, as shown in the following code snippet:

```
'VB
<Designer("MyControlLibrary.LogoControlDesigner, MyControlLibrary")> _
Public Class LogoControl
    Inherits WebControl

//C#
[Designer("MyControlLibrary.LogoControlDesigner, MyControlLibrary")]
public class LogoControl : WebControl
```

When the *LogoControl* is dragged and dropped onto the Web page, the *LogoUrl* prop erty is not set and the alternate rendering is provided. After the *LogoUrl* has been set, the default rendering is provided.

Creating a Composite Control

A composite control is a custom Web control that contains other controls. This sounds like a user control, but the composite control doesn't provide the designer screen and .ascx file that lets you drag and drop controls on it at design time. Instead, you inherit from the *CompositeControl* class and add constituent controls to the *Controls* collection of your class. The *CompositeControl* class hierarchy is shown in Figure 5-9. A composite control can fire, handle, and bubble up events raised by child controls.

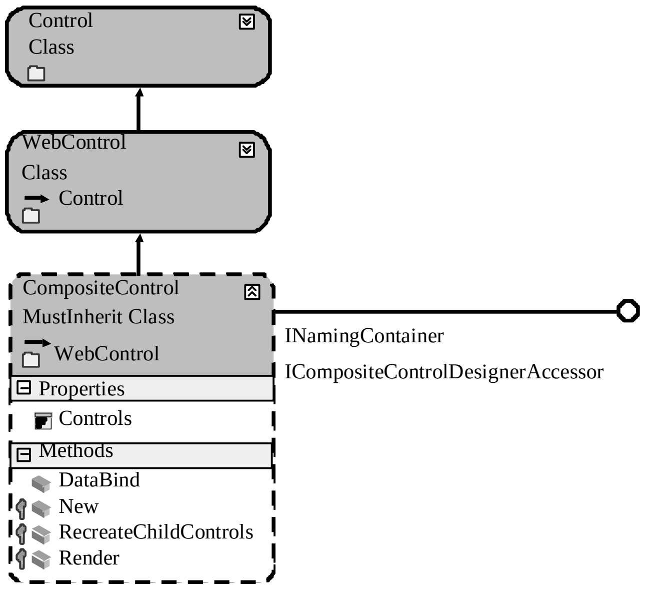


Figure 5-9 The *CompositeControl* class hierarchy.

A composite control is rendered out as a tree of constituent controls, each having its own life cycle and, together, forming a brand-new API. Because each of the child con trols knows how to handle its own *ViewState* and *PostBack* data, you don't need to write extra code to deal with this.

To create a composite control, create a class that inherits from the *CompositeControl* class and overrides the *CreateChildControls* method. The *CreateChildControls* method needs to contain the code to instantiate the child controls and set their properties. If you want to be able to assign styles to the composite control, you should create an instance of the *Panel* class to provide a container that can have attributes assigned to it, add it to the *Controls* collection of your composite control, and then add your con trols to the *Panel* control.

If you need to create many composite controls that have similar methods or proper ties, consider creating a base class for your composite controls that has the common code.

The following code sample shows a *UserPasswordControl* class that was added to the App_Code of the existing Web site. This control is used to prompt for a user name and password and also contains a submit button that can be subscribed to.

```
'VB
Imports System.Web.UI
Imports System.Web.UI.WebControls

Public Class UserPasswordControl
    Inherits CompositeControl
    Implements INamingContainer

    Public Event Submitted As System.EventHandler

    Public Property UserName() As String
      Get
            Dim txt As TextBox
            txt = CType(Me.FindControl("UserName"), TextBox)
            Return txt.Text
      End Get
      Set(ByVal Value As String)
            Dim txt As TextBox
            txt = CType(Me.FindControl("UserName"), TextBox)
            txt.Text = Value
      End Set
    End Property

    Public Property Password() As String
      Get
            Dim txt As TextBox
```

```
        txt = CType(Me.FindControl("Password"), TextBox)
        Return txt.Text
  End Get
  Set(ByVal Value As String)
        Dim txt As TextBox
        txt = CType(Me.FindControl("Password"), TextBox)
        txt.Text = Value
  End Set
End Property

Protected Overrides Sub CreateChildControls()
  Dim pnl As New Panel()
  Dim txtUserName As New TextBox()
  Dim txtPassword As New TextBox()
  Dim btnSubmit As New Button()
  AddHandler btnSubmit.Click, Addressof btnSubmit_Click

  'start control buildup
  Controls.Add(pnl)
  'add user name row
  pnl.Controls.Add(New LiteralControl("<table><tr><td>"))
  pnl.Controls.Add(New LiteralControl("User Name:"))
  pnl.Controls.Add(New LiteralControl("</td><td>"))
  pnl.Controls.Add(txtUserName)
  pnl.Controls.Add(New LiteralControl("</td></tr>"))
  'add password row
  pnl.Controls.Add(New LiteralControl("<tr><td>"))
  pnl.Controls.Add(New LiteralControl("Password:"))
  pnl.Controls.Add(New LiteralControl("</td><td>"))
  pnl.Controls.Add(txtPassword)
  pnl.Controls.Add(New LiteralControl("</td></tr>"))
  'add submit button row
  pnl.Controls.Add(New LiteralControl( _
 "<tr><td colspan=""2"" align=""center"" >"))
  pnl.Controls.Add(btnSubmit)
  pnl.Controls.Add(New LiteralControl("</td></tr></table>"))

  'setup control properties
  pnl.Style.Add("background-color", "silver")
  pnl.Style.Add("width", "275px")
  txtUserName.ID = "UserName"
  txtUserName.Style.Add("width", "170px")
  txtPassword.ID = "Password"
  txtPassword.TextMode = TextBoxMode.Password
  txtPassword.Style.Add("width", "170px")
  btnSubmit.Text = "Submit"

End Sub

Public Sub btnSubmit_Click(ByVal sender As Object, ByVal e As EventArgs)
  RaiseEvent Submitted(Me, e)
```

```
    End Sub
End Class

//C#
using System;
using System.ComponentModel;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Drawing;

public class UserPasswordControl : CompositeControl
{

    public event System.EventHandler Submitted;

    public string UserName
    {
      get
         {
              TextBox txt = (TextBox)FindControl("UserName");
              return txt.Text;
         }
      set
         {
              TextBox txt = (TextBox)FindControl("UserName");
              txt.Text = value;
         }
    }

    public string Password
    {
      get
         {
              TextBox pwd = (TextBox)FindControl("Password");
              return pwd.Text;
         }
      set
         {
              TextBox pwd = (TextBox)FindControl("Password");
              pwd.Text = value;
         }
    }

    protected override void CreateChildControls()
    {
      Panel pnl = new Panel();
      TextBox txtUserName = new TextBox();
      TextBox txtPassword = new TextBox();
      Button btnSubmit = new Button();
      btnSubmit.Click += new EventHandler(btnSubmit_Click);
```

```
        //start control buildup
        Controls.Add(pnl);
        //add user name row
        pnl.Controls.Add(new LiteralControl("<table><tr><td>"));
        pnl.Controls.Add(new LiteralControl("User Name:"));
        pnl.Controls.Add(new LiteralControl("</td><td>"));
        pnl.Controls.Add(txtUserName);
        pnl.Controls.Add(new LiteralControl("</td></tr>"));
        //add password row
        pnl.Controls.Add(new LiteralControl("<tr><td>"));
        pnl.Controls.Add(new LiteralControl("Password:"));
        pnl.Controls.Add(new LiteralControl("</td><td>"));
        pnl.Controls.Add(txtPassword);
        pnl.Controls.Add(new LiteralControl("</td></tr>"));
        //add submit button row
        pnl.Controls.Add(new LiteralControl(
            @"<tr><td colspan=""2"" align=""center"" >"));
        pnl.Controls.Add(btnSubmit);
        pnl.Controls.Add(new LiteralControl("</td></tr></table>"));

        //setup control properties
        pnl.Style.Add("background-color", "silver");
        pnl.Style.Add("width", "275px");
        txtUserName.ID = "UserName";
        txtUserName.Style.Add("width", "170px");
        txtPassword.ID = "Password";
        txtPassword.TextMode = TextBoxMode.Password;
        txtPassword.Style.Add("width", "170px");
        btnSubmit.Text = "Submit";
    }

    void btnSubmit_Click(object sender, EventArgs e)
    {
        if (Submitted != null) Submitted(this, e);
    }
}
```

In this code, the *UserName* and *Password* properties are exposed to give you access to this data. An event called *Submitted* is also created so you can subscribe to the Submit button’s *Click* event. The *CreateChildControls* method performs the work to instantiate the child controls for this composite control.

This control can be tested by adding it to a Web page using the same techniques described for custom Web controls. In the following code example, code is added in the code-behind page of the UserPassControlTest.aspx page to create a *UserPassword-Control* dynamically and set its properties. The *Submitted* event is used to simply dis play the user name and password.

```
'VB
Partial Class UserPasswordControlTest
    Inherits System.Web.UI.Page

    Protected Sub Page_Init(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Init
      Dim p As New UserPasswordControl()
      p.Style.Add("position", "absolute")
      p.Style.Add("left", "25px")
      p.Style.Add("top", "50px")
      form1.Controls.Add(p)
      AddHandler p.Submitted, AddressOf p_Submitted
    End Sub

    Public Sub p_Submitted(ByVal sender As Object, ByVal e As EventArgs)
      Dim p As UserPasswordControl = CType(sender, UserPasswordControl)
      Response.Write("User: " + p.UserName + "  Pass: " + p.Password)
    End Sub
End Class

//C#
using System;
using System.Web.UI;
using System.Web.UI.WebControls;

public partial class UserPasswordControlTest : System.Web.UI.Page
{
    protected void Page_Init(object sender, EventArgs e)
    {
      UserPasswordControl p = new UserPasswordControl();
      p.Style.Add("position", "absolute");
      p.Style.Add("left", "25px");
      p.Style.Add("top", "50px");
      form1.Controls.Add(p);
      p.Submitted += new EventHandler(p_Submitted);
    }

    void p_Submitted(object sender, EventArgs e)
    {
      UserPasswordControl p = (UserPasswordControl)sender;
      Response.Write("User: " + p.UserName + "  Pass: " + p.Password);
    }
}
```

When this Web page is run, the *UserPasswordControl* displayed at the location is deter mined by the *Style* property. After typing a user name and password, click the Submit button to display that user name and password, as shown in Figure 5-10.

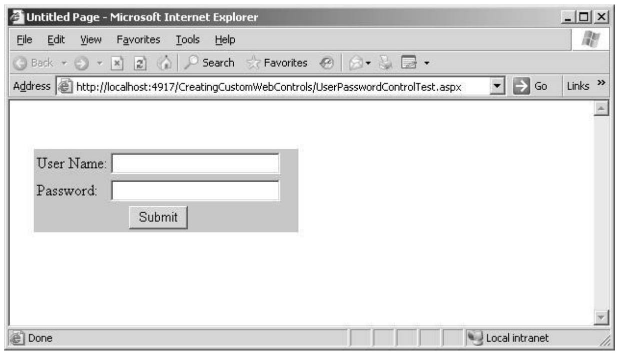

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4917/CreatingCustomWebControls/UserPasswordControlTest.aspx
Go Links
User Name:
Password:
Submit
Done
Local intranet

Figure 5-10 The *UserPasswordControl* collects the user name and password and exposes the *Sub mitted* event for processing of the data.

Creating a Templated Control

A templated control provides separation of control data from its presentation, which means that a templated control does not provide a default user interface. For example, if you know that you need to display product data, but you don't know how the page designer wants to format the product data, you could create a templated control called *ProductControl* that allows the page designer to supply the format for the prod uct data as a template.

The templated control must provide a naming container and a class whose properties and methods are accessible to the host page. The template contains the user interface for the templated user control and is supplied by the page developer at design time. The templates can contain controls and markup. You can create a templated control using the following steps:

1. Create a ClassLibrary (.dll) project for your templated control.
2. Add a reference to the System.Web.dll library.
3. To your project, add a container class that has public properties for the data that you wish to be able to access via the *Container* object in your template.
4. In the container class file, import the System.Web.UI namespace (the C# syntax is "using").
5. Code your container class to inherit from the *System.Web.UI.Control* class and implement the *INamingContainer* interface.
6. Add a class to the project for your templated control.

7. In the class file, import the System.Web.UI namespace (the C# syntax is "using").
8. Code your templated control to inherit from the *System.Web.UI.Control* class and implement the *INamingContainer* interface.
9. Add the *ParseChildren(true)* attribute to the class. This attribute provides direc tion to the page parser to indicate that the nested content contained within the server control is parsed as a control and not used to set properties of the tem- plated control.
10. Create one or more properties in the templated control class with the data type of *ITemplate* and that contain(s) a template as defined by the page designer. These properties need to have the *TemplateContainer* attribute set to the data type of the container, which might be the templated control, or, you could create a sub-container if you have repeating items to display in the template. Also, these properties have to have the *PersistenceMode* attribute set to *PersistenceMode.Inner-Property*, which allows page designers to add inner HTML elements to the HTML source of the templated control.
11. Add the desired properties to the template container that are to be accessible by the template.
12. The *DataBind* method must be overridden to call the *EnsureChildControls* method on the base *Control* class.
13. The *CreateChildControls* method must be overridden to provide the code to instantiate the template using the *InstantiateIn* method of the *ITemplate* inter face. Code should also be provided for a default implementation if no template is provided.

The following code is placed in a *ClassLibrary* project called *MyControlLibrary*, which defines a templated control class called *ProductControl*. This control contains properties called *ProductId*, *ProductName*, *QtyPerUnit*, and *UnitPrice*. The values can be assigned at design time or at run time. The *ProductControl* class also contains a *ProductTemplate* property that allows the page designer to assign a template.

```
'VB
Imports System.Web.UI

<ParseChildren(True)> _
Public Class ProductControl
    Inherits Control
    Implements INamingContainer
```

```
Public Property ProductId() As Integer
  Get
        Return _productId
  End Get
  Set(ByVal value As Integer)
        _productId = value
  End Set
End Property
Private _productId As Integer

Public Property ProductName() As String
  Get
        Return _productName
  End Get
  Set(ByVal value As String)
        _productName = value
  End Set
End Property
Private _productName As String

Public Property QtyPerUnit() As String
  Get
        Return _qtyPerUnit
  End Get
  Set(ByVal value As String)
        _qtyPerUnit = value
  End Set
End Property
Private _qtyPerUnit As String

Public Property UnitPrice() As Decimal
  Get
        Return _unitPrice
  End Get
  Set(ByVal value As Decimal)
        _unitPrice = value
  End Set
End Property
Private _unitPrice As Decimal


<PersistenceMode(PersistenceMode.InnerProperty)> _
<TemplateContainer(GetType(ProductContainer))> _
Public Property ProductTemplate() As ITemplate
  Get
        Return _productTemplate
  End Get
  Set(ByVal value As ITemplate)
        _productTemplate = value
  End Set
End Property
Private _productTemplate As ITemplate
```

```
    Public Overrides Sub DataBind()
      EnsureChildControls()
      MyBase.DataBind()
    End Sub

    Protected Overrides Sub CreateChildControls()
      Controls.Clear()
      ' If there is a template, use it to create children.
      ' else just show the message.
      If Not (ProductTemplate Is Nothing) Then
            Dim p As New ProductContainer( _
              ProductId, ProductName, QtyPerUnit, UnitPrice)
            ProductTemplate.InstantiateIn(p)
            Controls.Add(p)
      Else
            Me.Controls.Add(New LiteralControl( _
                  "No VB ProductTemplate Defined"))
      End If
    End Sub

End Class
```

//C#

```
using System;
using System.Web;
using System.Web.UI;

namespace MyControlLibrary
{
    [ParseChildren(true)]
    public class ProductControl : Control, INamingContainer
    {

      public int ProductId
         {
            get { return _productId; }
            set { _productId = value; }
         }
      private int _productId;

      public String ProductName
         {
            get { return _productName; }
            set { _productName = value; }
         }
      private String _productName;

      public String QtyPerUnit
         {
            get { return _qtyPerUnit; }
            set { _qtyPerUnit = value; }
         }
```

```
        private String _qtyPerUnit;

        public decimal UnitPrice
          {
              get { return _unitPrice; }
              set { _unitPrice = value; }
          }
        private decimal _unitPrice;

        [PersistenceMode(PersistenceMode.InnerProperty)]
        [TemplateContainer(typeof(ProductContainer))]
        public ITemplate ProductTemplate
          {
              get { return _productTemplate; }
              set { _productTemplate = value; }
          }
        private ITemplate _productTemplate;

        public override void DataBind()
          {
              EnsureChildControls();
              base.DataBind();
          }

        protected override void CreateChildControls()
          {
              Controls.Clear();
              // If there is a template, use it to create children.
              // else just show the message.
              if (ProductTemplate != null)
                {
                      ProductContainer p = new ProductContainer(
                        ProductId, ProductName, QtyPerUnit, UnitPrice);
                      ProductTemplate.InstantiateIn(p);
                      Controls.Add(p);
                }
              else
                {
                      this.Controls.Add(new LiteralControl(
                        "No ProductTemplate Defined"));
                }
          }
      }//end class
}//end ns
```

Notice that the *ProductControl* creates a *ProductContainer* in the *CreateChildControls* method. This is the container class that exposes the data that is available to the tem plate via the *Container* object. The code for the *ProductContainer* class is as follows:

'VB

```
Imports System.Web.UI
```

```
Public Class ProductContainer
    Inherits Control
    Implements INamingContainer

    Public Sub New()
    End Sub

    Public Sub New(ByVal _productId As Integer, ByVal _productName As String, _
    ByVal _qtyPerUnit As String, ByVal _unitPrice As Decimal)
      ProductId = _productId : ProductName = _productName
      QtyPerUnit = _qtyPerUnit : UnitPrice = _unitPrice
    End Sub


    Public Property ProductId() As Integer
      Get
            Return _productId
      End Get
      Set(ByVal value As Integer)
            _productId = value
      End Set
    End Property
    Private _productId As Integer

    Public Property ProductName() As String
      Get
            Return _productName
      End Get
      Set(ByVal value As String)
            _productName = value
      End Set
    End Property
    Private _productName As String

    Public Property QtyPerUnit() As String
      Get
            Return _qtyPerUnit
      End Get
      Set(ByVal value As String)
            _qtyPerUnit = value
      End Set
    End Property
    Private _qtyPerUnit As String

    Public Property UnitPrice() As Decimal
      Get
            Return _unitPrice
      End Get
      Set(ByVal value As Decimal)
            _unitPrice = value
      End Set
    End Property
    Private _unitPrice As Decimal
```

```
End Class

//C#
using System;
using System.Web;
using System.Web.UI;

namespace MyControlLibrary
{
    public class ProductContainer : Control, INamingContainer
    {
      public ProductContainer() { }

      public ProductContainer(int productId, string productName,
              string qtyPerUnit, decimal unitPrice)
         {
            ProductId = productId; ProductName = productName;
            QtyPerUnit = qtyPerUnit; UnitPrice = unitPrice;
         }

      public int ProductId
         {
            get { return _productId; }
            set { _productId = value; }
         }
      private int _productId;

      public String ProductName
         {
            get { return _productName; }
            set { _productName = value; }
         }
      private String _productName;

      public String QtyPerUnit
         {
            get { return _qtyPerUnit; }
            set { _qtyPerUnit = value; }
         }
      private String _qtyPerUnit;

      public decimal UnitPrice
         {
            get { return _unitPrice; }
            set { _unitPrice = value; }
         }
      private decimal _unitPrice;


    }//end class
}//end ns
```

Using the Templated Control

This class library project is compiled to a .dll, and the *ProductControl* can be added to the ToolBox by right-clicking the ToolBox and selecting the Choose Items option. Simply browse to and select the .dll file to add the *ProductControl* to your ToolBox.

In the following code example, a Web page is created called ProductControlTest.aspx and a *ProductControl* is added. After the *ProductControl* is added, the product's prop erties are set, and the *ProductTemplate* is defined in the HTML source of the page.

APSX File

```
'VB
<%@ Page Language="VB" AutoEventWireup="false" CodeFile="ProductControlTest.aspx.vb"
Inherits="ProductControlTest" %>

<%@ Register Assembly="MyControlLibrary" Namespace="MyControlLibrary" TagPrefix="cc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"Error! Hyperlink reference not valid.
DTD/xhtml1-transitional.dtd">

<script runat="Server">
    Public Sub Page_Load()
      DataBind()
    End Sub
</script>

<html xmlns="http://www.w3.org/1999/xhtml" >

<head runat="server">
     <title>Untitled Page</title>
</head>
<body>
     <form id="form1" runat="server">
     <div>
       <cc1:ProductControl ID="ProductControl1"
             runat="server" ProductId="925" ProductName="MyProduct"
             QtyPerUnit="12 per carton" UnitPrice="123.45">
             <ProductTemplate>
                  <h1>Product ID: <%# Container.ProductId %></h1>
                  <table border="1">
                    <tr>
                         <td>Name:</td>
                         <td><%# Container.ProductName %></td>
                    </tr>
                    <tr>
                         <td>Qty per Unit:</td>
                         <td><%# Container.QtyPerUnit %></td>
                    </tr>
                    <tr>
                         <td>Unit Price:</td>
```

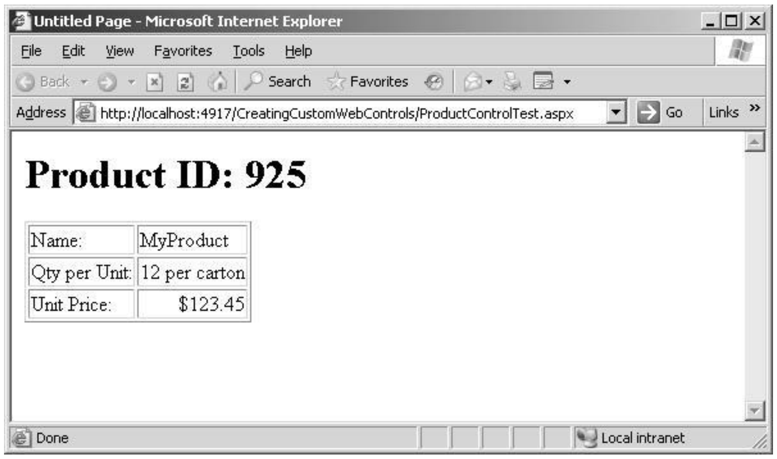
```
                              <td align="right">
                                    <%# Container.UnitPrice.ToString("C") %>
                              </td>
                        </tr>
                      </table>
                  </ProductTemplate>
          </cc1:ProductControl>
        </div>
        </form>
</body>
</html>
```

//C#

```
<%@ Page Language="C#" AutoEventWireup="true" CodeFile="ProductControlTest.aspx.cs"
Inherits="ProductControlTest" %>

<%@ Register Assembly="MyControlLibrary" Namespace="MyControlLibrary" TagPrefix="cc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"Error! Hyperlink reference not valid.
DTD/xhtml1-transitional.dtd">

<script runat="server">
      public void Page_Load()
      {
        DataBind();
      }
</script>

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
      <title>Untitled Page</title>
</head>
<body>
      <form id="form1" runat="server">
      <div>
        <cc1:ProductControl ID="ProductControl1"
                runat="server" ProductId="925" ProductName="MyProduct"
                QtyPerUnit="12 per carton" UnitPrice="123.45">
                <ProductTemplate>
                      <h1>Product ID: <%#Container.ProductId %></h1>
                      <table border="1">
                        <tr>
                              <td>Name:</td>
                              <td><%#Container.ProductName %></td>
                        </tr>
                        <tr>
                              <td>Qty per Unit:</td>
                              <td><%#Container.QtyPerUnit %></td>
                        </tr>
                        <tr>
                              <td>Unit Price:</td>
                              <td align="right">
                                    <%#Container.UnitPrice.ToString("C") %>
```

```
                    </td>
                  </tr>
                 </table>
              </ProductTemplate>
        </cc1:ProductControl>
       </div>
     </form>
</body>
</html>
```

Notice that the top of the .aspx file contains a script with the *DataBind* call, which forces the rendering of the *ProductControl* with the product data. When the page is run, the product data is displayed using the *ProductTemplate* that was defined in the HTML source, as shown in Figure 5-11.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4917/CreatingCustomWebControls/ProductControlTest.aspx Go Links
Done Local intranet

Product ID: 925

Name:	MyProduct
Qty per Unit:	12 per carton
Unit Price:	$123.45

Figure 5-11 The rendered templated control shows the product data formatted using the *Product-Template*.

Quick Check

- You want to create a control that can be distributed as a .dll. The control contains several *TextBox*, *Label*, and *Button* controls and you want to be able to add the control to the ToolBox. What is the best choice of control to create?

Quick Check Answer

- Create a composite control.

Lab: Working With Custom Web Server Controls

In this lab, you create a custom Web server control called *StateControl* that displays a list of the states. This control is compiled into a .dll file and added to the ToolBox so it is available to all of your projects.

� **Exercise 1: Create the Class Library Project and the Control**

In this exercise, you create the *CustomControls* class library project. You also add the *StateControl* class to the project and add code to populate the *Items* collection with the list of states.

1. Open Visual Studio 2005; create a new class library project called **CustomControls** using your preferred programming language.
2. The new project creates a class called Class1. Delete this class.
3. Add a new class called **StateControl** to your project.
4. Add a reference to the *System.Web.dll* and the *System.Drawing.dll* assemblies.
5. Add the following statements to import namespaces into your project:

```
'VB
Imports System.Web.UI.WebControls
Imports System.Drawing

//C#
using System.Web.UI.WebControls;
using System.Drawing;
```

6. Add the StateControl.bmp file to the project and set its Build Action to Embed ded Resource. This is a 16-by-6-pixel bitmap file showing the U.S. flag.
7. Add the *ToolboxBitmap* attribute above the *StateControl* to assign the StateCon trol.bmp file as the icon for the *StateControl* class.
8. In the constructor of the *StateControl*, add code to create an empty *ListItem* and a *ListItem* for each state, and add the *ListItems* to the *Items* collection of the *State-Control*. The *ListItem* for each state displays the full name of the state, but the posted value is the two-character state abbreviation. Your completed *StateControl* class should look like the following:

```
'VB
Imports System.Web.UI.WebControls
Imports System.Drawing

<ToolboxBitmap(GetType(StateControl), "StateControl.bmp")> _
```

```
Public Class StateControl
     Inherits DropDownList

     Public Sub New()
       Items.Add(New ListItem("", ""))
       Items.Add(New ListItem("Alabama", "AL"))
       Items.Add(New ListItem("Alaska", "AK"))
       Items.Add(New ListItem("Arizona", "AZ"))
       Items.Add(New ListItem("Arkansas", "AR"))
       Items.Add(New ListItem("California", "CA"))
       Items.Add(New ListItem("Colorado", "CO"))
       Items.Add(New ListItem("Connecticut", "CT"))
       Items.Add(New ListItem("Delaware", "DE"))
       Items.Add(New ListItem("District of Columbia", "DC"))
       Items.Add(New ListItem("Florida", "FL"))
       Items.Add(New ListItem("Georgia", "GA"))
       Items.Add(New ListItem("Hawaii", "HI"))
       Items.Add(New ListItem("Idaho", "ID"))
       Items.Add(New ListItem("Illinois", "IL"))
       Items.Add(New ListItem("Indiana", "IN"))
       Items.Add(New ListItem("Iowa", "IA"))
       Items.Add(New ListItem("Kansas", "KS"))
       Items.Add(New ListItem("Kentucky", "KY"))
       Items.Add(New ListItem("Louisiana", "LA"))
       Items.Add(New ListItem("Maine", "ME"))
       Items.Add(New ListItem("Maryland", "MD"))
       Items.Add(New ListItem("Massachusetts", "MA"))
       Items.Add(New ListItem("Michigan", "MI"))
       Items.Add(New ListItem("Minnesota", "MN"))
       Items.Add(New ListItem("Mississippi", "MS"))
       Items.Add(New ListItem("Missouri", "MO"))
       Items.Add(New ListItem("Montana", "MT"))
       Items.Add(New ListItem("Nebraska", "NE"))
       Items.Add(New ListItem("Nevada", "NV"))
       Items.Add(New ListItem("New Hampshire", "NH"))
       Items.Add(New ListItem("New Jersey", "NJ"))
       Items.Add(New ListItem("New Mexico", "NM"))
       Items.Add(New ListItem("New York", "NY"))
       Items.Add(New ListItem("North Carolina", "NC"))
       Items.Add(New ListItem("North Dakota", "ND"))
       Items.Add(New ListItem("Ohio", "OH"))
       Items.Add(New ListItem("Oklahoma", "OK"))
       Items.Add(New ListItem("Oregon", "OR"))
       Items.Add(New ListItem("Pennsylvania", "PA"))
       Items.Add(New ListItem("Rhode Island", "RI"))
       Items.Add(New ListItem("South Carolina", "SC"))
       Items.Add(New ListItem("South Dakota", "SD"))
       Items.Add(New ListItem("Tennessee", "TN"))
       Items.Add(New ListItem("Texas", "TX"))
       Items.Add(New ListItem("Utah", "UT"))
       Items.Add(New ListItem("Vermont", "VT"))
       Items.Add(New ListItem("Virginia", "VA"))
       Items.Add(New ListItem("Washington", "WA"))
```

```
          Items.Add(New ListItem("West Virginia", "WV"))
          Items.Add(New ListItem("Wisconsin", "WI"))
          Items.Add(New ListItem("Wyoming", "WY"))
          SelectedIndex = 0
       End Sub

End Class

//C#
using System;
using System.Web.UI;
using System.Web.UI.WebControls;
using System.Drawing;

namespace CustomControls
{
       [ToolboxBitmap(typeof(StateControl),"StateControl.bmp")]
       class StateControl : DropDownList
       {
          public StateControl()
              {
                    Items.Add(new ListItem("", ""));
                    Items.Add(new ListItem("Alabama", "AL"));
                    Items.Add(new ListItem("Alaska", "AK"));
                    Items.Add(new ListItem("Arizona", "AZ"));
                    Items.Add(new ListItem("Arkansas", "AR"));
                    Items.Add(new ListItem("California", "CA"));
                    Items.Add(new ListItem("Colorado", "CO"));
                    Items.Add(new ListItem("Connecticut", "CT"));
                    Items.Add(new ListItem("Delaware", "DE"));
                    Items.Add(new ListItem("District of Columbia", "DC"));
                    Items.Add(new ListItem("Florida", "FL"));
                    Items.Add(new ListItem("Georgia", "GA"));
                    Items.Add(new ListItem("Hawaii", "HI"));
                    Items.Add(new ListItem("Idaho", "ID"));
                    Items.Add(new ListItem("Illinois", "IL"));
                    Items.Add(new ListItem("Indiana", "IN"));
                    Items.Add(new ListItem("Iowa", "IA"));
                    Items.Add(new ListItem("Kansas", "KS"));
                    Items.Add(new ListItem("Kentucky", "KY"));
                    Items.Add(new ListItem("Louisiana", "LA"));
                    Items.Add(new ListItem("Maine", "ME"));
                    Items.Add(new ListItem("Maryland", "MD"));
                    Items.Add(new ListItem("Massachusetts", "MA"));
                    Items.Add(new ListItem("Michigan", "MI"));
                    Items.Add(new ListItem("Minnesota", "MN"));
                    Items.Add(new ListItem("Mississippi", "MS"));
                    Items.Add(new ListItem("Missouri", "MO"));
                    Items.Add(new ListItem("Montana", "MT"));
                    Items.Add(new ListItem("Nebraska", "NE"));
                    Items.Add(new ListItem("Nevada", "NV"));
                    Items.Add(new ListItem("New Hampshire", "NH"));
                    Items.Add(new ListItem("New Jersey", "NJ"));
```

```
                Items.Add(new ListItem("New Mexico", "NM"));
                Items.Add(new ListItem("New York", "NY"));
                Items.Add(new ListItem("North Carolina", "NC"));
                Items.Add(new ListItem("North Dakota", "ND"));
                Items.Add(new ListItem("Ohio", "OH"));
                Items.Add(new ListItem("Oklahoma", "OK"));
                Items.Add(new ListItem("Oregon", "OR"));
                Items.Add(new ListItem("Pennsylvania", "PA"));
                Items.Add(new ListItem("Rhode Island", "RI"));
                Items.Add(new ListItem("South Carolina", "SC"));
                Items.Add(new ListItem("South Dakota", "SD"));
                Items.Add(new ListItem("Tennessee", "TN"));
                Items.Add(new ListItem("Texas", "TX"));
                Items.Add(new ListItem("Utah", "UT"));
                Items.Add(new ListItem("Vermont", "VT"));
                Items.Add(new ListItem("Virginia", "VA"));
                Items.Add(new ListItem("Washington", "WA"));
                Items.Add(new ListItem("West Virginia", "WV"));
                Items.Add(new ListItem("Wisconsin", "WI"));
                Items.Add(new ListItem("Wyoming", "WY"));
                SelectedIndex = 0;
            }
        }
    }
```

9. Build the CustomControls project.

� Exercise 2: Create the Class Library Project and the Control

In this exercise, you create a Web site to test your *StateControl*.

1. Open Visual Studio 2005 and create a new ASP.NET Web site called **Working-WithCustomWebServerControls** using your preferred programming language.
   The new Web site is created and a Web page called Default.aspx is displayed.
2. Add the *StateControl* to the Toolbox by right-clicking the Toolbox and selecting Choose Items. Click the Browse button and locate the *CustomControls.dll* assem bly. Select the *CustomControls.dll* assembly, and the *StateControl* is displayed in the Toolbox.
3. Drag the *StateControl*, and drop it onto the Default.aspx Web page.
4. Set the *Style* property of the *StateControl* to set the location of the *StateControl*, as shown in the following code sample:

```
'VB
<%@ Page Language="C#" AutoEventWireup="true"
    CodeFile="Default.aspx.cs" Inherits="_Default" %>

<%@ Register Assembly="CustomControls"
    Namespace="CustomControls" TagPrefix="cc1" %>
```

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    Error! Hyperlink reference not valid.

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
    <title>Untitled Page</title>
</head>
<body>
    <form id="form1" runat="server">
    <div>
      <cc1:StateControl ID="StateControl1" runat="server"
            Style="z-index: 100; left: 80px; position: absolute; top: 30px">
      </cc1:StateControl>

    </div>
    </form>
</body>
</html>

//C#
<%@ Page Language="VB" AutoEventWireup="false"
     CodeFile="Default.aspx.vb" Inherits="_Default" %>

<%@ Register Assembly="CustomControls"
     Namespace="CustomControls" TagPrefix="cc1" %>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
    Error! Hyperlink reference not valid.

<html xmlns="http://www.w3.org/1999/xhtml" >
<head runat="server">
    <title>Untitled Page</title>
</head>
<body>
    <form id="form1" runat="server">
    <div>
      <cc1:StateControl ID="StateControl1" runat="server"
            Style="z-index: 100; left: 80px; position: absolute; top: 30px">
      </cc1:StateControl>
    </div>
    </form>
</body>
</html>
```

5. Test the Web page by pressing F5 to display the page. You should see the *State-Control* in the location that was set with the *Style* property. The drop-down list box contains the list of states shown in Figure 5-12.

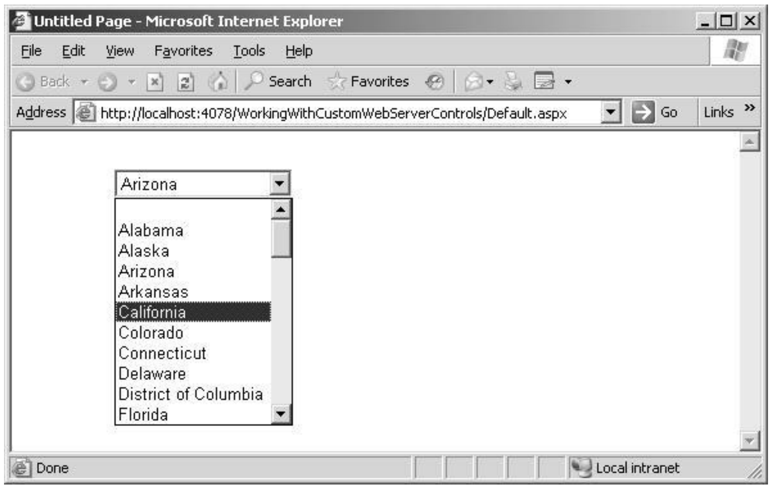

Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:4078/WorkingWithCustomWebServerControls/Default.aspx Go Links
Arizona
Alabama
Alaska
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
District of Columbia
Florida
Done
Local intranet

Figure 5-12 The *StateControl* with its drop down list of states.

Chapter 6

Input Validation and Site Navigation

The previous chapters covered many Web server control and custom Web server con trols. Those topics relate to building a Web page, and this chapter continues the Web page building process by covering input validation, which should be a mandatory requirement for all data that is collected from the user.

After the user input is validated and processed, you may want to navigate to a different Web page. This chapter covers the various means of navigating a Web site.

Exam objectives in this chapter:

- Program a Web application.
  - ❑ Redirect users to another page by using a server-side method.
  - ❑ Implement cross-page postbacks.
  - ❑ Assign focus to a control on a page when the page is displayed.
  - ❑ Avoid unnecessary client-side redirection by using the *HttpServerUtility .Transfer* method.
  - ❑ Avoid round trips by using client-side scripts.
- Implement site navigation and input validation.
  - ❑ Use the *SiteMap* Web server control to display a representation of a Web site's navigation structure.
  - ❑ Use validation controls to perform Web Forms validation.
  - ❑ Validate against values in a database for server controls by using a *Custom-Validator* control.
  - ❑ Create a *CustomValidator* control and tie it to a custom function.
  - ❑ Test programmatically whether a user's input passes validation before run ning code.
  - ❑ Specify the location of a validation error message for server controls.
  - ❑ Format validation error messages for server controls.

  - ❑ Specify the layout for in-place messages on server controls.
  - ❑ Disable validation for server controls.
  - ❑ Display custom error messages for server controls.
  - ❑ Validate server controls programmatically.
- Add and configure Web server controls.
  - ❑ Create and manipulate links on a Web Form by using the *HyperLink* Web server control.
  - ❑ Implement pagination for controls on a page by using the *Pager* Web server control.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic or C# and be comfortable with the following tasks:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed with Microsoft SQL Server 2005 Express Edition.
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.
- Know how to create a new Web site.
- Be able to add Web server controls to a Web page.

Real World

Glenn Johnson

Recently, I was searching the Web for information on a couple of personal water crafts. I performed my search and found three dealers that were nearby. I went to the first site; on their "Contact Us" page, I entered my e-mail address and the fol lowing message:

"Hi, I'm looking for two personal watercraft with a trailer. Please contact me."

I submitted my message and received a message stating that someone would get back to me.

I went to the second site and did the same thing. This time, when I submitted my message, I received a SQL syntax error. The problem is that my message has an apostrophe (single quote) in it. I changed my message to "…I am looking…" and re-submitted the message. The response was that someone would get back to me, so I decided that I would let them know about the problem when a salesper son contacted me. No one ever contacted me. This site probably still has this vul nerability.

You may be wondering what the big deal is. The problem is that this error is a blatant indicator that this Web site has a SQL injection vulnerability because the apostrophe is the string delimiter in a SQL statement. If an error is generated when the apostrophe is entered, it means that the developer did not take the necessary steps to escape the apostrophe. This means that the apostrophe that was entered by the user terminated the SQL string and SQL Server didn't know what to do with the characters that follow, so SQL Server threw a syntax error. A dishonest person could take advantage of this vulnerability to cause damage to the Web site or even to steal data from the Web site. Remember that it's impor tant to perform input validation to ensure proper user input.

Lesson 1: Performing Input Validation

In this lesson, you will learn how the validation framework operates and how you can use the validation controls that are included in ASP.NET 2.0 to perform input validation.

After this lesson, you will be able to:

- Understand the validation framework.
- Add validation controls to a Web page.
- Configure validation controls.
- Implement the *CustomValidator* control.
- Test for valid user input.

Estimated lesson time: 60 minutes

Understanding the Validation Framework

We are often faced with the challenge of ensuring that the user has input the neces sary data into all required fields and ensuring that the data is valid. The data-valida tion framework provides a simple way to accomplish this task with minimum coding. The validation controls that are built into ASP.NET 2.0 provide both client-side and server-side validation.

Client-side validation is a convenience to the user because it improves performance by checking the data at the browser before sending the data to the server. This avoids unnecessary round trips to the server, but client-side validation can be easily defeated by hackers.

Server-side validation provides a more secure means of validating the data that is posted back to the server. Using both client-side and server-side validation provides a better experience to the user and secure validation for the Web site.

To perform validation, the developer can simply attach one or more validator controls to each control that accepts user input. ASP.NET 2.0 provides several validation con trols that automatically provide server-side and client-side validation. Figure 6-1 shows the validation control hierarchy.

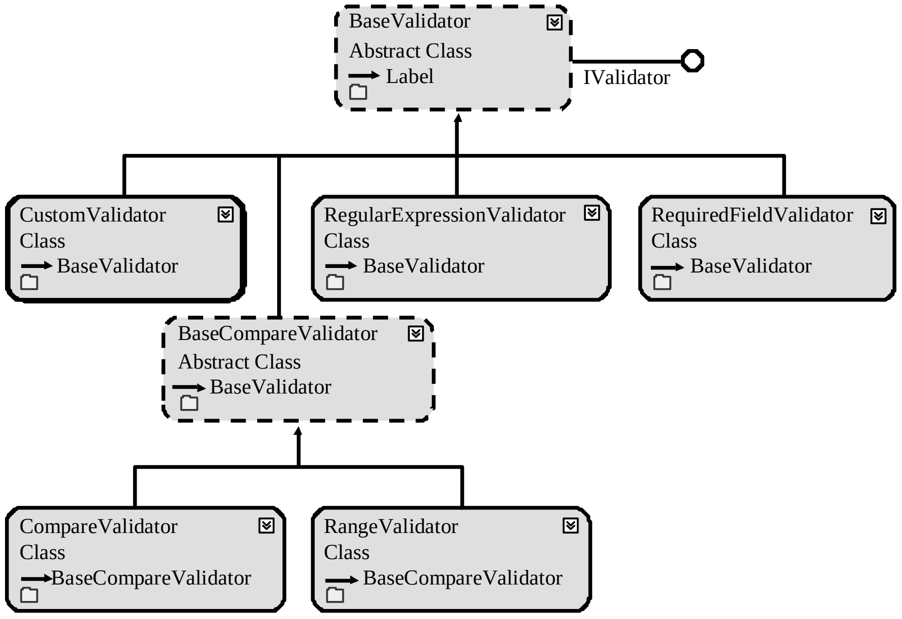


Figure 6-1 The validation control hierarchy.

You typically add a validation control to a Web page using the following steps:

1. Drag and drop the desired validator next to the control that is to be validated.
2. Name the validator control.
3. Set the *ControlToValidate* property to attach the validator to the control that will be validated.
4. Set the *ErrorMessage* property to a descriptive error message that the user will understand.
5. Copy the *ErrorMessage* property and paste it into the *ToolTip* property to display the error when the user hovers the pointer over the validator.
6. Set the *Text* property of the validator to a very short string, usually an asterisk (*), to minimize the space that is required by the validator when the control is not valid.

The validation framework contains the *ValidationSummary* control, which can be placed on the Web page to display all the validation error messages in one location. This is use ful in scenarios where the Web page is crowded with other controls and displaying the validation error next to the invalid control is difficult. The *ValidationSummary* control can also be configured to display a pop-up message with the validation errors in lieu of, or in addition to, displaying the validation errors on the Web page.

The *Page* object has a *Validators* property that contains a collection of all validation controls. The Web page also has a *Validate* method that you can call to check all of the validator controls in the page. By default, the *Validate* method is called automatically, but this call takes place after the *Load* event handler method executes. The Web page has a property called *IsValid* that is set after the *Validate* method is executed. Although the *IsValid* property is set automatically for you, you need to check the *IsValid* property in every event handler to determine whether the code that you should run is based on the *IsValid* state.

NOTE New in ASP.NET 2.0

The *Focus* and *SetFocusOnError* methods are new in ASP.NET 2.0.

The *Control* class has a method called *Focus* that can be called to set the focus to a spe cific control when the page is loaded. This method adds client-side JavaScript code that executes at the browser to set focus to the appropriate control. In addition to the new *Focus* method, a validation control has a similar method called *SetFocusOnError* that can be set to *true* to cause the invalid control to automatically receive focus.

Understanding the *BaseValidator* Class

The validation controls inherit from the *BaseValidator* abstract class. This class con tains most of the validation functionality. Table 6-1 contains a list of the properties that the *BaseValidator* provides.

Table 6-1 *BaseValidator* Properties

***BaseValidator* Property**	**Description**
ControlToValidate	Set this to the control that is to be validated.
Display	Set this to display the behavior of the validation mes sage; it can be set to None (doesn't display the valida tion message), Static (displays the validation message and consumes the same space on the Web page even when the message does not display), or Dynamic (dis plays the validation message, but takes up no space if no message needs to be displayed).

Table 6-1 ***BaseValidator* Properties**

***BaseValidator* Property**	**Description**
EnableClientSideScript	Set to *false* to disable client-side validation. Default is *true*.
ErrorMessage	Set to the text that displays when validation fails. If the *Text* property is set, the validation control displays the contents of the *Text* property, while the *ValidationSum mary* control displays the *ErrorMessage* contents.
IsValid	The valid status of a control.

Set the *Enabled* property to *false* to completely disable the control. If a validation con trol is to supply information to the *ValidationSummary* control and not display its own information beside the invalid control, set the *Display* property of the control to *None*.

Understanding the *RequiredFieldValidator* Control

The *RequiredFieldValidator* is used to ensure that the user has placed non–white space data into a control. The other controls do not attempt to validate an empty field, so you frequently need to use the *RequiredFieldValidator* with one of the other controls to achieve the desired validation.

The *RequiredFieldValidator* provides an additional property called *InitialValue* that is used when the control that you are validating defaults to a value and you want to ensure that the user changes this value. For example, if you normally display a zero (0) value in a control for the age and you want to ensure that the user changes the age, set the *InitialValue* to zero so a validation error occurs if the user leaves the default value of the control set to zero.

Understanding the *BaseCompareValidator* Class

The *RangeValidator* and *CompareValidator* inherit from the *BaseCompareValidator* con trol, which contains common comparison behavior that is used by these controls.

The *BaseCompareValidator* contains the *Type* property, which you can set to the data type that the text is converted to before a comparison is made. The data types that are available are as follows:

- ***Currency*** The data is validated as *System.Decimal*, but currency symbols and grouping characters also can be entered.

- ***Date*** The data is validated as a numeric date.
- ***Double*** The data is validated as *System.Double*.
- ***Integer*** The data is validated as *System.Int32*.
- ***String*** The data is validated as *System.String*.

Using the *CompareValidator* Control

The *CompareValidator* control performs its validation by using comparison operators such as greater than and less than to compare the data with a constant or a value in a different control. In addition, the *CompareValidator* can verify that the data is of a cer tain type, such as a date.

The *ValueToCompare* property can be set to a constant that is used to perform the com parison.

The *Operator* property defines how to perform the comparison and can be set to *Equal*, *NotEqual*, *GreaterThan*, *GreaterThanEqual*, *LessThan*, *LessThanEqual*, or *DataTypeCheck*.

The *ControlToCompare* property can be set to a control that is used to perform the comparison. This property takes precedence if this property and the *ValueToCompare* properties are both set.

Using the *RangeValidator* Control

The *RangeValidator* control is used to verify that the data to be validated is within a specified range of values. To use this control effectively, you must set the *Minimum-Value*, *MaximumValue*, and the *Type* properties.

The *Type* property causes the data to be converted to the proper data type prior to checking the range. The *Type* property defaults to *String*, so you must set the *Type* property to achieve proper range validation. For example, if you don't set the *Type* property, it defaults to *String*, and if a numeric range is being checked from 3 to 30, only strings that begin with the string letter 3 are considered valid.

Using the *RegularExpressionValidator* Control

The *RegularExpressionValidator* control performs its validation based on a regular expression. A regular expression is a powerful pattern-matching language that can be used to identify simple and complex character sequences that would otherwise require writing code to accomplish. This *ValidationExpression* property is set to a valid regular expression that is applied to the data that is to be validated. The data is vali dated if it matches the regular expression.

MORE INFO Regular Expressions

For more information about regular expressions such as tutorials and sample regular expressions, refer to the following URLs:

http://www.regexlib.com/

http://www.regular-expressions.info/

The *CustomValidator* Control

The *CustomValidator* control performs its validation based on custom validation code that you provide. You can write the client-side validation code using JavaScript or server-side validation code using your preferred .NET language.

The client-side validation code must contain a JavaScript function that has the follow ing method signature:

```
function ClientFunctionName(source, arguments)
```

The *source* parameter contains a reference to the validation control that is performing the validation. The *arguments* parameter is an object that has a property called *Value* that contains the data to be validated and an *IsValid* property that you set to *false* if the data does not validate or *true* if the data does validate.

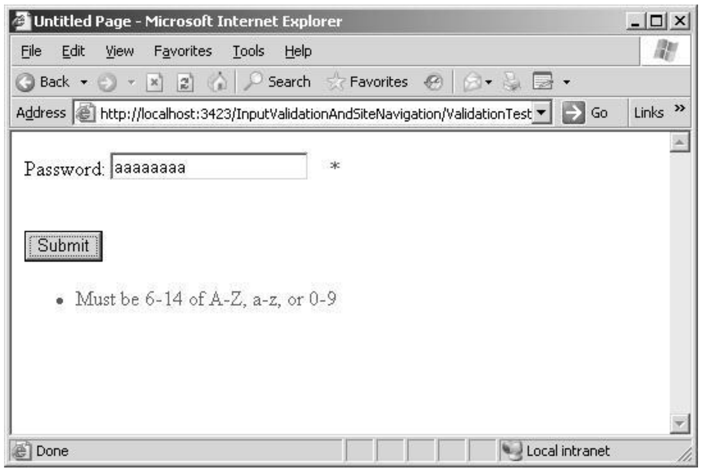
To attach your client-side code to the *CustomValidator*, set the *ClientFunctionName* property to the name of your validation function.

In the following code example, a Web page contains a *TextBox* called *txtPassword*, an associated *CustomValidator* called *cusCheckPassword,* and a *RequiredFieldValidator* called *reqPassword* because the custom script will not execute if a password is not entered. A valid password must be between 6 and 14 characters and must contain at least one uppercase letter, one lowercase letter, and one numeric character. A *ValidationSummary* has also been added to the bottom of the Web page to show the validation error.

JavaScript Client-Side Validation

```
<script language="javascript" type="text/javascript">
      function ValidatePassword(source, arguements)
       {
       var data = arguements.Value.split('');
      //start by setting false
      arguements.IsValid=false;

      //check length
      if(data.length < 6 || data.length > 14) return;

      //check for uppercase
      var uc = false;
      for(var c in data)
        {
              if(data[c] >= 'A' && data[c] <= 'Z')
              {
                uc=true; break;
              }
        }
      if(!uc) return;

      //check for lowercase
      var lc = false;
      for(var c in data)
        {
              if(data[c] >= 'a' && data[c] <= 'z')
              {
                lc=true; break;
              }
        }
      if(!lc) return;

      //check for numeric
      var num = false;
      for(var c in data)
        {
              if(data[c] >= '0' && data[c] <= '9')
              {
                num=true; break;
              }
        }
      if(!num) return;

      //must be valid
      arguements.IsValid=true;
       }
</script>
```

The Web page is run and lowercase letters are entered into the *txtPassword* control. When the *txtPassword* control loses focus, the client-side validation is executed, as shown in Figure 6-2.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:3423/InputValidationAndSiteNavigation/ValidationTest Go Links
Submit
Done
Local intranet

Password: aaaaaaaa *

- Must be 6-14 of A-Z, a-z, or 0-9

Figure 6-2 The client-side validation causes the *ValidationSummary* control to display the error.

The *CustomValidator* has an event called *ServerValidate* that is a server-side event. The following is an example of using the *ServerValidate* event to perform server-side vali dation:

ServerValidate Handler

```
'VB
Protected Sub cusCheckPassword_ServerValidate(ByVal source As Object, _
            ByVal args As System.Web.UI.WebControls.ServerValidateEventArgs) _
            Handles cusCheckPassword.ServerValidate
     Dim data As String = args.Value
     'start by setting false
     args.IsValid = False

     'check length
     If (data.Length < 6 Or data.Length > 14) Then Return

     'check for uppercase
     Dim uc As Boolean = False
     For Each c As Char In data
            If (c >= "A" And c <= "Z") Then

                  uc = True : Exit For
            End If

      Next
     If Not uc Then Return

     'check for lowercase
     Dim lc As Boolean = False
     For Each c As Char In data
            If (c >= "a" And c <= "z") Then
```

```
                lc = True : Exit For
            End If
      Next
     If Not lc Then Return

     'check for numeric
     Dim num As Boolean = False
     For Each c As Char In data
            If (c >= "0" And c <= "9") Then
                num = True : Exit For
            End If
      Next
     If Not num Then Return

     'must be valid
     args.IsValid = True
End Sub
```

//C#

```
protected void cusCheckPassword_ServerValidate(object source,
     ServerValidateEventArgs args)
{
     string data = args.Value;
     //start by setting false
     args.IsValid = false;

     //check length
     if (data.Length < 6 || data.Length > 14) return;

     //check for uppercase
     bool uc = false;
     foreach (char c in data)
      {
            if (c >= 'A' && c <= 'Z')
            {
                uc = true; break;
            }
      }
     if (!uc) return;

     //check for lowercase
     bool lc = false;
     foreach (char c in data)
      {
            if (c >= 'a' && c <= 'z')
            {
                lc = true; break;
            }
      }
     if (!lc) return;

     //check for numeric
     bool num = false;
```

```
    foreach (char c in data)
     {
         if (c >= '0' && c <= '9')
         {
             num = true; break;
         }
     }
    if (!num) return;

    //must be valid
    args.IsValid = true;
}
```

Like client-side validation, server-side validation also provides access to the source validator and the *Value* to be validated, and the *IsValid* property can be set to false to indicate validation failure.

Note that, when using the *CustomValidator*, the server-side validation does need to provide the same validation at the client-side validation. For example, the custom cli ent-side script for a *CustomValidator* that validates a five-character customer ID might simply test to ensure that five characters are provided within the acceptable range (uppercase, lowercase). The server-side validation may perform a database query to ensure that the customer ID is that of a valid customer in the database.

Ensuring Server-Side Validation

To test server-side validation, disable all client-side validation by setting the *EnableCli entScript* property of the validation controls to false.

Server-side validation occurs after the *Load* event handler method is executed, at which time the runtime calls the *Validate* method on the Web page. You need to place code into your event handler methods to test the *IsValid* property, as shown in the fol lowing example:

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) _
        Handles Button1.Click
    If Not IsValid Then Return
    'use page data
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    if (!IsValid) return;
    //use page data
}
```

Determining When to Validate

Although client-side validation is considered to be a convenience for the normal user and is certainly not secure, the primary benefit of client-side validation is that the page is not posted until all client-side validation has successfully occurred. This can be a problem when the user wants to press a cancel or help button and the page is not valid. The problem is that the default behavior of the button is to attempt *PostBack* to the server, but if the page is not valid, clicking the button won't cause *PostBack* to the server.

Controls that should be able to bypass validation can do so by setting their *CausesVal idation* property to *false*. This property defaults to *true*.

Using Validation Groups

In earlier versions of ASP.NET, all of the validation controls were checked when a *Post-Back* occurred. You could set the *CausesValidation* property to *false* on the control that caused the *PostBack* to occur, but you often wanted more control than that for scenar ios where a Web page contained several sections and you only wanted a particular sec tion to be validated.

NOTE New in ASP.NET 2.0

Validation groups are new in ASP.NET 2.0.

In ASP.NET 2.0, there is a new property called the *ValidationGroup* that can be assigned a string to specify a section. This property exists on the validation controls and on the controls that cause *PostBacks* to occur. When a control performs a *PostBack*, the validator controls that have a matching *ValidationGroup* property are validated.

On *PostBack,* the *IsValid* property on the *Page* object only reflects the validity of the val idation controls that have been validated. By default, these are the validation controls that are in the same *ValidationGroup*, but you can call a validation control's *Validate* method to add that control to the set of controls that the *IsValid* reports on.

With the addition of the *ValidationGroup* property is a new overload to the *Page* object's *Validate* method that accepts a string to specify the *ValidationGroup* to authen ticate. This overload is executed when a *PostBack* that causes validation occurs.

The *Page* object has a *GetValidators* method that accepts a string containing the name of the *ValidationGroup*. This method returns the list of validators in the *Validation-Group*.

Quick Check

1. Which validator control can be used to determine if data that is entered into a *TextBox* control is *Currency*?
2. What control can be used to display all validation errors in a pop-up win dow?

Quick Check Answers

1. The *CompareValidator* control.
2. The *ValidationSummary* control.

Lab: Working with Validation Controls

In this lab, you create a registration page that contains *TextBox* controls for the user name, password, confirm password, and Zip Code fields. All fields are required. The user name must be between 6 and 14 characters that can be uppercase, lowercase, numeric, or underscores. The password and confirm password will be 6 to 14 charac ters that must contain at least one uppercase letter, one lowercase letter, and one num ber, as described in the custom validator example. The Zip Code must be a valid U.S. Zip Code, which can be in the format 99999 or 99999-9999.

� **Exercise 1: Create the Web Site and add Controls**

In this exercise, you create the Web site and add the controls.

1. Open Visual Studio 2005 and create a new Web site called **WorkingWithVali dationControls** using your preferred programming language. The new Web site is created, and a Web page called Default.aspx is displayed.
2. Add an HTML table to the Default.aspx Web page. This table will have four rows and two columns.
3. Add the descriptions in the first column of each of the four rows. The descrip tions are **User Name**, **Password**, **Confirm Password**, and **Zip Code.**
4. Add a *TextBox* control into the second column of the four rows. Name the *Text-Box* controls **txtUser**, **txtPassword**, **txtConfirm**, and **txtZip**.

5. Set the *TextMode* property to **txtPassword** and *txtConfirm* to **Password**.
6. Add a *Button* control under the table. Set the *Text* of the *Button* control to **Submit**. Figure 6-3 shows the Web page.

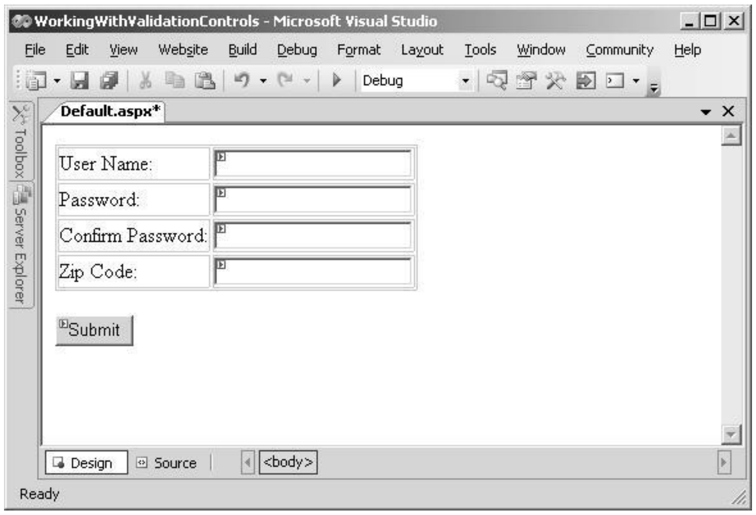

WorkingWithValidationControls - Microsoft Visual Studio
File Edit View Website Build Debug Format Layout Tools Window Community Help
Debug
Default.aspx*
Toolbox
Server Explorer
User Name:
Password:
Confirm Password:
Zip Code:
Submit
Design
Source
<body>
Ready

Figure 6-3 The registration page prior to adding validation.

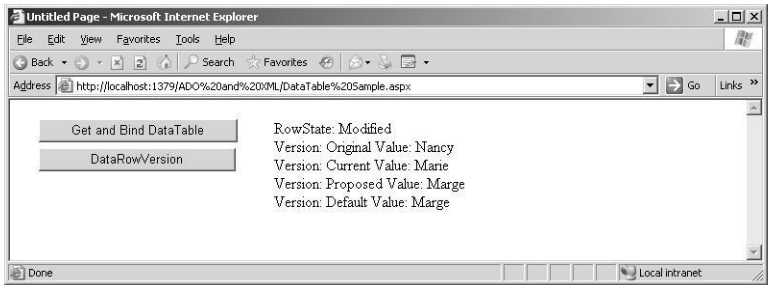
� **Exercise 2: Add the Validation Controls**

In this exercise, you add and configure the validation controls.

1. Continue with the project from the previous exercise, or open the completed Lesson 1, Exercise 1 project from the CD.
2. All of the *TextBox* controls require user input, so add the *RequiredFieldValidator* next to each *TextBox* control.
3. For each of the *RequiredFieldValidator* controls, set the *ControlToValidate* prop erty to the *TextBox* that is being validated.
4. For each of the *RequiredFieldValidator* controls, set the *ErrorMessage* property to **User name is required.**, **Password is required.**, **Confirm password is required.**, and **Zip code is required.**, respectively.
5. Add a *RegularExpression* control next to the *txtUser* control and set the *Control-ToValidate* property to **txtUser**. Set the *ErrorMessage* to **Must be 6-14 of A-Z, a-z, 0-9, or _**. Set the *ValidationExpression* to **\w{6,14}**.
6. Add a *CustomValidator* next to the *txtPassword* control. Set the *ControlToValidate* property to **txtPassword**. Set the *ErrorMessage* to **Must be 6-14 characters, at**

least 1 upper, 1 lower, and 1 number.

7. Set the *ClientValidationFunction* to **ValidatePassword**. In the head section of the HTML source, add the client-side code from the listing "JavaScript Client-Side Validation," shown earlier in this lesson.
8. Add the *ServerValidate* event handler method to the code-behind page. In this method, add the code from the listing "ServerValidate Handler," shown earlier in this lesson.
9. The password and confirm password must be the same, so add a *CompareValidator* next to the *txtConfirm TextBox*. Set the *ControlToValidate* to the *txtConfirm* con trol. Set the *ControlToCompare* property to **txtPassword**. Set the *ErrorMessage* to **Password and Confirm Password must match**.
10. Add a *RegularExpressionValidator* beside the *txtZip* control. Set the *ControlToValidate* to the *txtZip* control. Set the *ErrorMessage* to **Must be formatted as 99999 or 99999-9999**. Set the *ValidationExpression* to U.S. Zip Code to provide a regular expression of *\d{5}(-\d{4})?*.
11. For each of the validator controls, set the *Display* property to **Dynamic**.
12. Copy the *ErrorMessage* contents to the *ToolTip* for each of the validator controls.
13. Notice that setting the *ErrorMessage* property changes the text that displays beside each *TextBox* control. The *ErrorMessage* should only be displayed in a *Validation-Summary* control at the bottom of the Web page, so set the *Text* property of each of the validator controls to an asterisk (*).
14. Add a *ValidationSummary* control to the bottom of the Web page. The completed Web page is shown in Figure 6-4.


Untitled Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://localhost:1379/ADO%20and%20XML/DataTable%20Sample.aspx
Go Links
Get and Bind DataTable
DataRowVersion
Done
Local intranet

```
RowState: Modified
Version: Original Value: Nancy
Version: Current Value: Marie
Version: Proposed Value: Marge
Version: Default Value: Marge
```

Figure 6-4 The completed Web page containing all validation controls.

� **Exercise 3: Test the Validation Controls**

In this exercise, you run the Web page and test the validation controls.

1. Continue with the project from the previous exercise, or open the completed Lesson 1, Exercise 2 project from the CD.
2. Run the Web page.
3. Before entering any information into the *TextBox* controls, press the Submit but ton. Verify that the *RequiredFieldValidators* are displayed by noting the errors that are displayed in the *ValidationSummary* control and by hovering your pointer over each of the asterisks to see each *ToolTip*.
4. Test the user name validation by typing fewer than six characters into *txtUser* and click the Submit button. Note the validation error. Also, try typing 15 or more characters. Attempt to type 10 characters, but use an invalid character, such as the apostrophe ('). Finally, attempt valid input to ensure the validator's ability to report valid input.
5. Test the password for the appropriate input by trying to input fewer than 6 char acters or more than 14 characters. Also, attempt a password that is all lowercase, or all uppercase, or all numeric. Notice that special characters, such as plus sign (+), minus sign (-), and percent sign (%), are allowed in the password, but not required. Finally, attempt to enter a valid password.
6. Test the confirmation password by typing a confirmation password that does not match the password. Test again with a matching password.
7. Test the Zip Code by entering fewer than five characters, or characters that don't match the format specified in the regular expression. Finally, test with a valid Zip Code.

Lesson 2: Performing Site Navigation

Controls that perform *PostBacks* typically post to the same Web page as part of the typ ical Web page life cycle, but there are many scenarios where you want to collect data from the user while navigating from one Web page to another. Seamless navigation from one Web page to another is what makes a collection of Web pages feel like a Web application. In this lesson, you will learn the ways to navigate between Web pages on your site.

After this lesson, you will be able to:

- Assign focus to a control on a page when it is displayed.
- Avoid round trips by using client-side scripts.
- Redirect users to another page by using server-side methods.
- Use the *SiteMap* Web server control to display a representation of a site's navigation structure.
- Implement pagination for controls on a page by using the *Pager* Web server control.

Estimated lesson time: 60 minutes

Is Site Navigation Necessary?

When collecting data from users, you can provide navigation to many Web pages to display prompts and collect the data, but you can also provide the illusion of navigat ing many pages to collect data. To provide the illusion of navigating many pages to dis play prompts to collect data, you may choose to use the *Wizard* control or *FormView*, which are covered in Chapter 3, "Exploring Specialized Server Controls." These con trols provide a *Pager* control to navigate from one data collection screen to another, but both of the screens are on the same Web page, which means that it is somewhat easier to gather all of the data for processing.

The *Wizard* and *FormView* controls can simplify your data presentation and collection efforts but may not be suitable for every possible scenario.

Choosing a Method to Navigate Pages

There are many ways to navigate from page to page, so it's helpful to first identify these ways and then look at each in detail.

- **Provide client-side code or markup to request a new Web page.** Your client code or markup requests a new Web page in response to a client-side event, such as a button click.
- **Cross-page posting.** A control is configured to perform a *PostBack* to a different Web page.
- **Issue client-side browser redirect.** Your server-side code sends a message to the browser, informing the browser to request a different Web page.
- **Issue server-side transfer.** Your server-side code transfers control to a different Web page.

Providing Client-Side Code or Markup to Request a New Web Page

One of the easiest ways to navigate to a different Web page is to provide a *HyperLink* control on the form and set the *NavigateUrl* property to the desired destination. The *HyperLink* control generates an *<a>* element in the HTML and the *NavigateUrl* prop erty is placed into the *href* attribute of the *<a>* element. The following example shows the source of a *HyperLink* control and its rendered HTML.

HyperLink Control: Source

```
<asp:HyperLink ID="HyperLink1"
runat="server" NavigateUrl="~/NavigateTest2.aspx">
Goto NavigateTest2
</asp:HyperLink>
```

HyperLink Control: Rendered HTML

```
<a id="HyperLink1" href="NavigateTest2.aspx">Goto NavigateTest2</a>
```

In this example, if this control is placed on a Web page called NavigateTest1.aspx, and the HyperLink control is clicked, the browser simply requests the NavigateTest2.aspx page. This means that no data is posted to NavigateTest2.aspx, and if data is required to pass to NavigateTest2.aspx, you need to find a way to get the data to the page.

Your client-side code can also perform Web page navigation by changing the docu ment object's location property to a new URL. The document object is the object that represents the Web page; setting its location property causes the browser to request the Web page at the new URL.

The following example contains an HTML *<input type="button">* element with a bit of client-side JavaScript to request the NavigateTest2.aspx page when the button is clicked.

```
<input id="Button1" type="button"
        value="Goto NavigateTest2"
        onclick="return Button1_onclick()" />
```

Notice that the *onclick* event is configured to call the client-side method (called *Button1_onclick)*. The JavaScript source for the *Button1_onclick* method is added into the *<head>* element as follows:

```
<script language="javascript" type="text/javascript">
// <!CDATA[

function Button1_onclick() {
      document.location="NavigateTest2.aspx";
}

// ]]>

</script>
```

Once again, the NavigateTest2.aspx page is requested and no data is posted back to the Web server.

Cross-page Posting

Cross-page posting is frequently desired in a scenario where data is collected on one Web page and processed on another Web page that displays the results. In this sce nario, a *Button* control has its *PostBackUrl* property set to the Web page to post back to. In the processing page, which is the Web page that you post back to, the data from the first Web page is available.

NOTE New in ASP.NET 2.0

The *Page* class's *PreviousPage* property is new in ASP.NET 2.0.

The processing page typically needs to access the data from the first page, which is possible by using the *PreviousPage* property of the *Page* object. The *PreviousPage* prop erty is set if you are cross-page posting, and if the *PreviousPage* is set to *Nothing* (C# *null*), no cross-page posting occurs. You can access any of the controls in the previous page by using the *FindControl* method on the *NamingContainer* of the control that you are trying to locate.

In the following example, the Web page called NavigateTest2.aspx contains a *TextBox* control called *txtData* and a *Button* control with its *PostBackUrl* set to *~/ NavigateTest3.aspx*. The NavigateTest3.aspx page contains a *Label* control called *lbl-Data* that is populated with the data from *txtData* if NavigateTest3.aspx, which was called by using a cross-page *PostBack*, as shown in the following example:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, _
     ByVal e As System.EventArgs) _
     Handles Me.Load
    If PreviousPage Is Nothing Then
         lblData.Text = "No PreviousPage"
     Else
         lblData.Text = _
           CType(PreviousPage.FindControl("txtData"), TextBox).Text
    End If
End Sub

//C#
protected void Page_Load(object sender, EventArgs e)
{
    if(PreviousPage == null)
     {
         lblData.Text = "No PreviousPage";
     }
     else
    {
         lblData.Text  =
              ((TextBox)PreviousPage.FindControl("txtData")).Text;
     }
}
```

Accessing Strongly Typed Data

Another way to access the previous page data is to create public properties that expose the data that you need to access. After creating public properties, you need to set the *PreviousPageType* directive on the result page.

NOTE New in ASP.NET 2.0

The *PreviousPageType* directive is new in ASP.NET 2.0.

In the following example, the NavigateTest3.aspx page performs a cross-page *PostBack* to NavigateTest4.aspx using a public property and the *PreviousPageType* directive. The NavigateTest3.aspx contains a *TextBox* control named *txtData* and a *Button* control on which the *PostBackUrl* property has been set to *~/NavigateTest4.aspx*. The following property was placed into the NavigateTest3.aspx code-behind page:

```
'VB
public readonly property PageData
     Get
         return txtData.Text
    End Get
End Property
```

```
//C#
public string PageData
{
    get { return txtData.Text; }}
```

In order to access this property, you need to set *PreviousPageType* directive in the NavigateTest4.aspx page. This directive is added after the *Page* directive and looks like this:

```
<%@ PreviousPageType VirtualPath="~/NavigateTest3.aspx" %>
```

The NavigateTest4.aspx page contains a *Label* control named *lblData* and is popu lated from the *PageData* property, as is shown in the following code snippet:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, _
            ByVal e As System.EventArgs) Handles Me.Load
    If PreviousPage Is Nothing Then
            lblData.Text = "No PreviousPage"
     Else
            lblData.Text = _
              PreviousPage.PageData
    End If
End Sub

//C#
protected void Page_Load(object sender, EventArgs e)
{
    if (PreviousPage == null)
     {
            lblData.Text = "No PreviousPage";
     }
     else
    {
            lblData.Text =
                    PreviousPage.PageData;
     }
}
```

When you attempt to enter this code snippet, you may find that IntelliSense doesn't show the *PageData* property. Simply build the page that causes the data type of the *PreviousPage* property to be set to *NavigateTest3_aspx*, and the *PageData* property is vis ible in the IntelliSense window.

Issuing Client-Side Browser Redirect

The *Response* object has a method called *Redirect* that you can use in your server-side code to instruct the browser to request a different page. In this scenario, you post back to the original page. The server-side code can process the *PostBack* and then execute the *Redirect*, as shown in the following example, where the NavigateTest4.aspx page contains a *Button* control that performs a redirect to the NavigateTest5.aspx page when the *Button* is clicked:

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
          ByVal e As System.EventArgs) Handles Button1.Click
    Response.BufferOutput = True
    'process data
    Response.Redirect("NavigationTest5.aspx")
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    Response.BufferOutput = true;
    //process data
    Response.Redirect("NavigationTest5.aspx");
}
```

Notice that the *BufferOutput* must be set to *true* in order to perform the redirect to ensure that no data is sent to the browser prior to executing the *Redirect* method. If data is sent to the browser prior to executing the *Redirect* method, an *HttpException* is thrown, indicating that you cannot redirect after the Hypertext Transfer Protocol (HTTP) headers are sent.

The redirect is accomplished by sending an HTTP response code of 302 to the browser along with the URL of the page to redirect to. The address that is displayed in the browser is updated to reflect the new URL location. Note that this comes at the cost of performing an extra round trip to the server.

The *PreviousPage* property does not get populated when using the *Redirect* method. To access data from the original page, you need to resort to traditional methods of pass ing data, such as placing the data into cookies, session state variables, or passing the data in the *QueryString*.

Issuing Server-Side Transfer

In your server-side code, you can switch control to a different Web page by using the *Transfer* method on the *HttpUtility* object. An instance of the *HttpUtility* class is stored on the *Page* object, in the *Server* property. Like the previous redirect example, you post back to the original page. The server-side code can process the *PostBack* and then execute the *Transfer* method, as shown in the following example, where the NavigateTest5.aspx page contains a *Button* control that performs a transfer to the NavigateTest6.aspx page when the *Button* is clicked.

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button1.Click
      Server.Transfer("NavigationTest6.aspx", False)
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
      Server.Transfer("NavigationTest6.aspx", false);
}
```

The *Transfer* method accepts a Boolean parameter called *preserveForm* that you set to indicate your desire to keep the form and QueryString data. It is generally better to set this to *false*. You can also access the *PreviousPage* property to pass data between pages, just as you do when cross-page posting.

Using the Site Map Web Server Control

ASP.NET 2.0 provides a means to specify a site structure and a number of controls that perform navigation and display the site map on your Web page.

NOTE New in ASP.NET 2.0

The Site Map is new in ASP.NET 2.0.

The following controls can be used to display site map data:

- ***Menu*** Shows the site structure and allows the user to select a location to navi gate to.
- ***TreeView*** Shows the site structure in a collapsible tree format and allows the user to select a location to navigate to.
- ***SiteMapPath*** Shows the current location and the path of pages to go through to get there as a breadcrumb-like trail. For example, if you are on the Microsoft Web site getting help on Visual Studio .NET, the site map path might display some thing like this:

  ```
  Home > Visual Studio > Support
  ```

These controls typically provide client-side markup to navigate the Web site hierarchy. The *TreeView* and *Menu* controls use the *SiteMapDataSource* control as a source for the site map data that is displayed. By default, the *SiteMapDataSource* gets its data from the Web.sitemap file, which is a specially formatted XML file that is located in the root of the Web site. The *SiteMapPath* control gets its data directly from the Web.sitemap file.

You can add the Web.sitemap file to your Web application by right-clicking your Web site, selecting Add New Item | Site Map, and accepting the default name of Web.sitemap. The Web.sitemap looks like the following:

```
<?xml version="1.0" encoding="utf-8" ?>
<siteMap xmlns="http://schemas.microsoft.com/AspNet/SiteMap-File-1.0" >
    <siteMapNode url="" title=""  description="">
        <siteMapNode url="" title=""  description="" />
        <siteMapNode url="" title=""  description="" />
    </siteMapNode>
</siteMap>
```

Using the *SiteMap* Class

The *SiteMap* class provides programmatic access to the site navigation hierarchy. Its two primary properties are *RootNode* and *CurrentNode*, and both return *SiteMapNode* instances. The *SiteMapNode* object represents a node in the site map and has proper ties called *Title*, *Url*, and *Description*. To access nodes in the hierarchy, you can use the *SiteMapNode* instance's *ParentNode*, *ChildNodes*, *NextSibling*, and *PreviousSibling* prop erties. For example, the following code snippet can be used to navigate to the Web page that is listed as the parent Web page in the Web.sitemap file.

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Button1.Click
    Response.Redirect(SiteMap.CurrentNode.ParentNode.Url)
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    Response.Redirect(SiteMap.CurrentNode.ParentNode.Url);
}
```

Quick Check

- Which method of navigation requires the most communication between the browser and the Web server?

Quick Check Answer

- Client-side browser redirect requires the most communication because this is a server-side method that tells the browser to request a new page, thus causing multiple round trips to the server.

Lab: Working With Site Navigation

In this lab, you create a Web application using frames. The top frame contains a title for your Web application and a *SiteMapPath* control. The left frame contains a *Tree-View* control for navigation. Clicking any node on the *TreeView* or *SiteMapPath* con trols cause the main frame to load the desired page.

� **Exercise 1: Create the Web Application Project and Its Frames**

In this exercise, you create the Web application project. You also configure Default.aspx to be a frames page and add the top and left frames.

1. Open Visual Studio 2005 and create a new Web Application project called Work ingWithSiteNavigation using your preferred programming language.

   The new project will create a Web page called Default.aspx, which will be con figured to be the frames page for the Web application.

2. Configure the Default.aspx page to have a top frame, a left frame, and a main frame. Remove the code-behind page as well. Your Default.aspx should look like the following:

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Frameset//EN"
    Error! Hyperlink reference not valid.
<html xmlns="http://www.w3.org/1999/xhtml">
<head id="Head1" runat="server">
     <title>Frame Page</title>
</head>
<frameset rows="70, *" >
  <frame src="TitlePage.aspx">
  <frameset cols="20%, 80%">
       <frame src="MenuPage.aspx" >
       <frame src="MainPage.aspx" name="MainFrame">
  </frameset>
  <noframes>
       This is a frames page.
  </noframes>
</frameset>
</html>
```

3. Add a new Web page called TitlePage.aspx for the top frame.
4. On the TitlePage.aspx page, add a textual title called Working With Site Naviga tion. Set the font size for the title to xx-large and center the title text.
5. Add a new Web page called MenuPage.aspx for the left frame.
6. On the MenuPage.aspx page, add a *TreeView* control.
7. Select the *TreeView* control and click the symbol in the upper-right corner of the control to reveal the TreeView Tasks window. Click the drop-down list for the Choose Data Source option and click New Data Source. Click Site Map as the data source and click OK.
8. In the Source View window, locate the <*head*> element and add the following directive to specify that the hyperlinks use the MainFrame as their target window:

```
<base target="MainFrame"/>
```

9. Add a Site Map to the Web application by right-clicking the Web application in the Solution Explorer and clicking Add New Item. Click Site Map, keep the default file name of Web.sitemap, and click Add.
10. Change the Web.sitemap file to look like the following:

```
<?xml version="1.0" encoding="utf-8" ?>
<siteMap xmlns="http://schemas.microsoft.com/AspNet/SiteMap-File-1.0" >
     <siteMapNode url="~/MainPage.aspx" title="Main Page"
               description="This is the main page.">
       <siteMapNode url="~/Support.aspx" title="Support Page"
                    description="The support page." >
              <siteMapNode url="~/Faqs.aspx" title="FAQs Page"
                      description="The frequently asked questions page." />
       </siteMapNode>
       <siteMapNode url="~/Products.aspx" title="Products Page"
                    description="The products page." />
     </siteMapNode>
</siteMap>
```

11. Add the following Web pages to the Web application: MainPage.aspx, Support.aspx, Faqs.aspx, and Products.aspx. On each of these pages, add a *SiteMapPath* control.
12. Build the Web application project.

� Exercise 2: Test the Site Navigation

In this exercise, you test the site navigation on the Web application.

1. Continue with the project from the previous exercise, or open the completed Lesson 2, Exercise 1 project from the CD.
2. Right-click the Default.aspx page, and select Start As Start Page.
3. Test the Web application by pressing F5 to display the Default.aspx frame page. You should see the frames page, as shown in Figure 6-5.

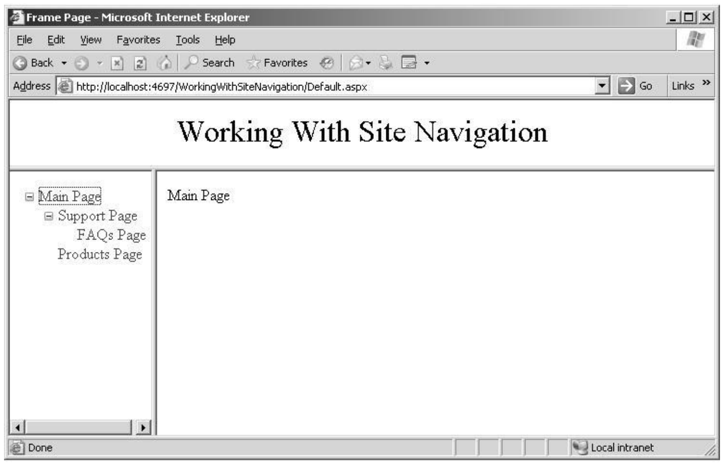


Figure 6-5 The frames page with the *TreeView* and *SiteMapPath* controls.

4. Try clicking the links on the *TreeView* control.
5. Try clicking the links on the *SiteMapPath* controls.

Chapter 7

ASP.NET State Management

Web pages rarely stand alone. Applications almost always need to track users who visit multiple pages within a Web site, whether to provide personalization, store infor mation about a user, or track usage for reporting purposes.

At a high level, ASP.NET provides two different types of state management: client-side and server-side. Client-side state management stores information on the client's com puter by embedding the information into a Web page, a Uniform Resource Locator (URL), or a cookie. Server-side state management tracks the user with a cookie or a URL but stores the information about a user in the server's memory or a database.

Exam objectives in this chapter:

- Manage state and application data.
  - Manage state of an application by using client-based state management options.
  - Manage state of an application by using server-based state management options.
  - Maintain state of an application by using database technology.
- Create event handlers for pages and controls.
  - Respond to application and session events.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic or C# and be comfortable with the following:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed on your computer with SQL Server 2005 Express Edition.
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.

Real World

Tony Northrup

Back in the old days (you know, before the .NET Framework), tracking a user's visit across a Web site was a real pain because I had to write all the code to asso ciate data with cookies. Of course, that only worked if the browser supported cookies—if I wanted to provide an alternate technique for tracking users, I had to write that code, too.

State management in ASP.NET now provides those capabilities for developers, saving us the hassle of writing the same type of code over and over again. That's exactly what development frameworks should do—minimize redundant devel opment so developers can focus on the more interesting coding. As you're work ing through this lesson, think about how long it would take you to duplicate all the state management functionality provided with the .NET Framework.

Lesson 1: Using Client-Side State Management

The most scalable way to perform state management is to store the data on the client. ASP.NET provides several techniques for storing state management information on the client:

- **View state** ASP.NET uses *view state* to track values in controls. You can add cus tom values to view state, too.
- **Control state** If you create a custom control that requires view state to work properly, you should use *control state* to ensure other developers don't break your control by disabling view state.
- **Hidden fields** Like view state, *hidden fields* store data in an HTML form without displaying it in the user's browser. That data is available only when the form is processed.
- **Cookies** *Cookies* store a value in the user's browser that the browser sends with every page request to the same server. Cookies are the best way to store state data that must be available for multiple Web pages on a Web site.
- **Query strings** *Query strings* store values in the URL that are visible to the user. Use query strings when you want a user to be able to e-mail or instant message state data with a URL.

In this lesson, you will first learn when to choose client-side over server-side state management. Then you will learn how to implement view state, control state, hidden fields, cookies, and query strings.

After this lesson, you will be able to:

- Choose between client-side and server-side state management.
- Use view state to store custom values.
- Use control state to store values for custom controls even if view state is disabled.
- Use hidden fields to store values in a Web form.
- Use cookies to track state management data as a user browses multiple pages in a Web site.
- Use query strings to pass values to a page using a hyperlink.

Estimated lesson time: 30 minutes

Choosing Client-Side or Server-Side State Management

State management information, such as user name, personalization options, or shopping cart contents, can be stored at either the client or the server. If the state management information is stored on the client, the client submits the information to the server with each request. If the state management information is stored on the server, the server stores the information, but tracks the client using a client-side state management technique. Figure 7-1 illustrates both client-side and server-side state management.

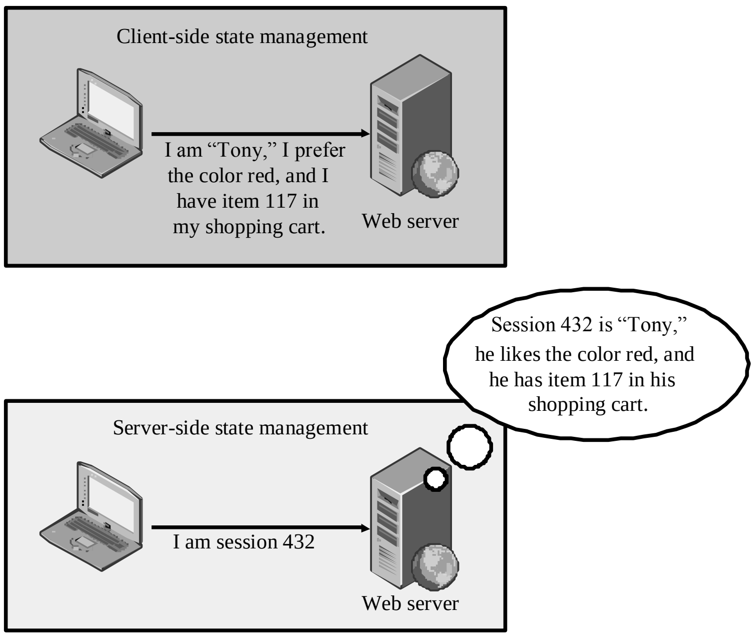

Client-side state management
I am "Tony," I prefer the color red, and I have item 117 in my shopping cart.
Web server
Session 432 is "Tony," he likes the color red, and he has item 117 in his shopping cart.
Server-side state management
I am session 432
Web server

Figure 7-1 Client-side state management stores data on the client, while server-side state manage ment requires the server to store the data.

Storing information on the client has the following advantages:

- **Better scalability** With server-side state management, each client that connects to the Web server consumes memory on the Web server. If a Web site has hun dreds or thousands of simultaneous users, the memory consumed by storing state management information can become a limiting factor. Pushing this bur den to the clients removes that potential bottleneck.

- **Supports multiple Web servers** With client-side state management, you can dis tribute incoming requests across multiple Web servers with no changes to your application because the client provides all the information the Web server needs to process the request. With server-side state management, if a client switches servers in the middle of the session, the new server does not necessarily have access to the client's state information. You can use multiple servers with server-side state management, but you need either intelligent load-balancing (to always forward requests from a client to the same server) or centralized state manage ment (where state is stored in a central database that all Web servers access).

Storing information on the server has the following advantages:

- **Better security** Client-side state management information can be captured (either in transit or while it is stored on the client) or maliciously modified. Therefore, you should never use client-side state management to store confi dential information, such as a password, authorization level, or authentication status.
- **Reduced bandwidth** If you store large amounts of state management informa tion, sending that information back and forth to the client can increase band width utilization and page load times, potentially increasing your costs and reducing scalability. The increased bandwidth usage affects mobile clients most of all, because they often have very slow connections. Instead, you should store large amounts of state management data (say, more than 1 KB) on the server.

View State

As you might have already noticed, if a user clicks a button to submit an ASP.NET page, the page retains all its values and settings. For example, if you modify the text on a label and the user clicks a button, the modified text is still displayed when the page reappears. This happens because ASP.NET has a client-side state management tech nique built in: *ViewState*.

The *ViewState* property provides a dictionary object for retaining values between mul tiple requests for the same page. When an ASP.NET page is processed, the current state of the page and controls is hashed into a string and saved in the page as a hidden field. If the data is too long for a single field (as specified in the *MaxPageStateField-Length* property), then ASP.NET performs view state chunking to split it across multi ple hidden fields. The following code sample demonstrates how view state adds data as a hidden form within a Web page's HTML:

```
<input type="hidden" name="__VIEWSTATE" id="__VIEWSTATE" value="/
wEPDwUKMTIxNDIyOTM0Mg9kFgICAw9kFgICAQ8PFgIeBFRleHQFEzQvNS8yMDA2IDE6Mzc6MTEgUE1kZGROWHn/
rt75XF/pMGnqjqHlH66cdw==" />
```

NOTE .NET 2.0
View state chunking is new in ASP.NET, version 2.0.

The sections that follow describe how to encrypt view state data, disable view state data, and add custom values to the view state.

Encrypting View State Data

You can enable view state encryption to make it more difficult for attackers and mali cious users to directly read view state information. This adds processing overhead to your Web server; however, it is necessary if you plan to store confidential information in the view state. To configure view state encryption for an application, set the *<pages viewStateEncryptionMode>* attribute to Always in your Web.config file, as the following example shows:

```
<configuration>
  <system.web>
        <pages viewStateEncryptionMode="Always"/>
  </system.web>
</configuration>
```

Alternatively, you can enable view state encryption for a specific page by setting the value in the page directive, as the following sample demonstrates:

```
<%@ Page Language="C#" AutoEventWireup="true"  CodeFile="Default.aspx.cs" Inherits="_Default"
ViewStateEncryptionMode="Always"%>
```

Because *ViewState* supports encryption, it is the most secure method of client-side state management. Encrypted *ViewState* is secure enough for most security require ments; however, it is always more secure to store data on the server.

Disabling ViewState Data

View state is enabled by default for every control, including Label controls, which you might never change. Unfortunately, view state adds overhead to ASP.NET forms. If you do not need to use view state, you should disable it by setting the *EnableViewState* property for each Web control to False. This reduces server processing time and decreases page size.

Reading and Writing Custom ViewState Data

You can also add and retrieve custom values with *ViewState*. If you have a value that you'd like to keep track of while the user is visiting a single ASP.NET Web page, add ing a custom value to *ViewState* is the most efficient and secure way to do that. How ever, *ViewState* is lost if the user visits a different Web page, so it is useful only for temporarily storing values.

The following code demonstrates how to determine whether the time of the last visit was recorded in *ViewState*, how to display the value in a *Label* control named Label1, and then to set the value using the current time. To use this code, create a form with a *Label* control named Label1 and a *Button* control:

```
'VB
' Check if ViewState object exists, and display it if it does
If (Me.ViewState("lastVisit") IsNot Nothing) Then
    Label1.Text = CType(Me.ViewState("lastVisit"), String)
Else
    Label1.Text = "lastVisit ViewState not defined!"
End If

' Define the ViewState object for the next page view
Me.ViewState.Add("lastVisit", DateTime.Now.ToString())

//C#
// Check if ViewState object exists, and display it if it does
if (ViewState["lastVisit"] != null)
    Label1.Text = (string)ViewState["lastVisit"];
else
    Label1.Text = "lastVisit ViewState not defined.";

// Define the ViewState object for the next page view
ViewState.Add("lastVisit", DateTime.Now.ToString());
```

While cookies must be strings, you can store a wide variety of serializable objects in *ViewState*. The following example stores a *DateTime* object in *ViewState* without con verting it to a string and also uses a different technique for adding a *ViewState* value:

```
'VB
' Check if ViewState object exists, and display it if it does
If (Me.ViewState("lastVisit") IsNot Nothing) Then
    Dim lastVisit As DateTime = CType(Me.ViewState("lastVisit"), DateTime)
    Label1.Text = lastVisit.ToString()
```

```
Else
    Label1.Text = "lastVisit ViewState not defined!"
End If

' Define the ViewState object for the next page view
Me.ViewState("lastVisit") = DateTime.Now

//C#
// Check if ViewState object exists, and display it if it does
if (ViewState["lastVisit"] != null)
    Label1.Text = ((DateTime)ViewState["lastVisit"]).ToString();
else
    Label1.Text = "lastVisit ViewState not defined.";

// Define the ViewState object for the next page view
ViewState["lastVisit"] = DateTime.Now;
```

Quick Check

1. How do ASP.NET Web forms remember the settings for controls between user requests?
2. Is view state lost if a user refreshes a Web page? What if the user e-mails a URL to a friend?

Quick Check Answers

1. View state, which is enabled by default, remembers values for control prop erties on a form.
2. View state is maintained within a page's HTML, so it is lost if a page is refreshed or if the URL is copied.

Control State

If you create a custom control that requires *ViewState*, a developer who uses the con trol might break its functionality by disabling *ViewState* for the control or the entire page. To solve this, you can use the *ControlState* property to store state information for your control. *ControlState* allows you to persist property information that is specific to a control and cannot be turned off like the *ViewState* property. To use control state in a custom control, your control must override the *OnInit* method and call the *Register-RequiresControlState* method during initialization and then override the *SaveControl-State* and *LoadControlState* methods.

NOTE .NET 2.0

ControlState is new in ASP.NET version 2.0

ControlState takes away the developer's choice of turning off *ViewState* for a control. Typically, it's better to let developers choose how to use the controls. However, if a con trol simply cannot function without *ViewState*, you should implement *ControlState*.

Hidden Fields

ViewState stores information in the Web page using hidden fields. Hidden fields are sent back to the server when the user submits a form; however, the information is never displayed by the Web browser (unless the user chooses to view the page source). ASP.NET allows you to create your own custom hidden fields and store val ues that are submitted with other form data.

A *HiddenField* control stores a single variable in its *Value* property and must be explic itly added to the page. You can use hidden fields only to store information for a single page, so it is not useful for storing session data. If you use hidden fields, you must sub mit your pages to the server using Hypertext Transfer Protocol (HTTP) *POST* (which happens if the user presses a button) rather than requesting the page using *HTTP GET* (which happens if the user clicks a link). Unlike view state data, hidden fields have no built-in compression, encryption, hashing, or chunking, so users can view or modify data stored in hidden fields.

Cookies

Web applications can store small pieces of data in the client's Web browser by using cookies. A *cookie* is a small amount of data that is stored either in a text file on the cli ent file system (if the cookie is persistent) or in memory in the client browser session (if the cookie is temporary). The most common use of cookies is to identify a single user as he or she visits multiple Web pages. You can also use cookies to store state information, user preferences, or an encrypted token indicating that the user has been successfully authenticated.

Figure 7-2 illustrates how Web clients and servers use cookies. First (Step 1), the Web client requests a page from the server. Because the client has not visited the server before, it does not have a cookie to submit. When the Web server responds to the request (Step 2), the Web server includes a cookie. The Web client submits that cookie with each subsequent request for any page on the same server (Steps 3, 4, and any future page views).

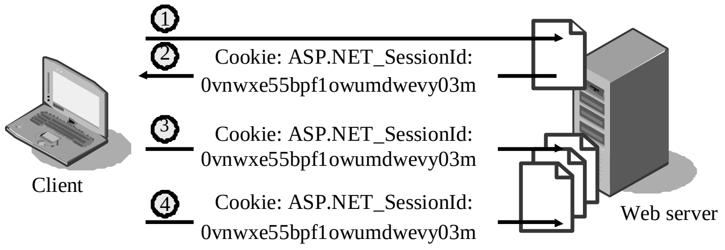

1
2
Cookie: ASP.NET_SessionId: 0vnwxe55bpf1owumdwevy03m
3
Cookie: ASP.NET_SessionId: 0vnwxe55bpf1owumdwevy03m
4
Cookie: ASP.NET_SessionId: 0vnwxe55bpf1owumdwevy03m
Client
Web server

Figure 7-2 Web servers use cookies to track Web clients.

NOTE Inside ASP.NET

As described in Lesson 2 of this chapter, ASP.NET uses cookies to track user sessions.

Cookies are the most flexible and reliable way of storing data on the client. However, users can delete the cookies on their computers at any time. Even if you store cookies with long expiration times, a user might decide to delete all cookies, wiping out any settings you might have stored in them. Therefore, if you rely on persistent cookies to store information about a user between visits, you should also allow users to log in to your Web application so you can restore persistent cookies in the event the users remove their cookies.

Reading and Writing Cookies

A Web application creates a cookie by sending it to the client as a header in an HTTP response. The Web browser then submits the same cookie to the server with every new request.

To create a cookie, add a value to the *Response.Cookies HttpCookieCollection*. To view a cookie sent back by the Web browser, read values in *Request.Cookies*. The following sample code (which belongs in the *Page_Load* event handler) demonstrates both defining and reading cookie values by setting a cookie named "lastVisit" to the cur rent time. If the user already has the cookie set, the code displays the time the user last visited the page in the *Label1* control.

```
'VB
' Check if cookie exists, and display it if it does
If Not (Request.Cookies("lastVisit") Is Nothing) Then
    ' Encode the cookie in case the cookie contains client-side script
    Label1.Text = Server.HtmlEncode(Request.Cookies("lastVisit").Value)
Else
    Label1.Text = "No value defined"
End If
```

```
' Define the cookie for the next visit
Response.Cookies("lastVisit").Value = DateTime.Now.ToString
Response.Cookies("lastVisit").Expires = DateTime.Now.AddDays(1)

//C#
// Check if cookie exists, and display it if it does
if (Request.Cookies["lastVisit"] != null)
    // Encode the cookie in case the cookie contains client-side script
    Label1.Text = Server.HtmlEncode(Request.Cookies["lastVisit"].Value);
else
    Label1.Text = "No value defined";

// Define the cookie for the next visit
Response.Cookies["lastVisit"].Value = DateTime.Now.ToString();
Response.Cookies["lastVisit"].Expires = DateTime.Now.AddDays(1);
```

NOTE The *HttpCookie* class

This example shows the simplest and most common way of creating cookies. You can also create instances of the *HttpCookie* class and add them to the *HttpCookieCollection*.

The first time the user visits the page in the previous example, the code displays “No value defined” because the cookie has not yet been set. However, if you refresh the page, it displays the time of the first visit. Note that the code sample defines the *Expires* property for the cookie. You must define the *Expires* property and set it for the time period you would like the client to store the cookie if you want the cookie to per sist between browser sessions. If you do not define the *Expires* property, the browser stores it in memory and the cookie is lost if the user closes his or her browser.

To delete a cookie, overwrite the cookie and set an expiration date in the past. You can’t directly delete cookies because they are stored on the client’s computer.

NOTE Viewing and troubleshooting cookies

As described in Chapter 1, “Introducing the ASP.NET 2.0 Web Site,” you can use Trace.axd to view cookies for every page request.

Controlling Cookie Scope

Some Web sites store private information in cookies. For that reason, you don’t want a browser to send your cookie to other Web sites. By default, browsers won’t send a cookie to a Web site with a different hostname (although, in the past, vulnerabilities in browsers have allowed attackers to trick a browser into submitting another Web site’s cookie).

You can control a cookie's scope to either limit the scope to a specific folder on the Web server or expand the scope to any server in a domain. To limit the scope of a cookie to a folder, set the *Path* property, as the following example demonstrates:

```
'VB
Response.Cookies("lastVisit").Value = DateTime.Now.ToString
Response.Cookies("lastVisit").Expires = DateTime.Now.AddDays(1)
Response.Cookies("lastVisit").Path = "/Application1"

//C#
Response.Cookies["lastVisit"].Value = DateTime.Now.ToString();
Response.Cookies["lastVisit"].Expires = DateTime.Now.AddDays(1);
Response.Cookies["lastVisit"].Path = "/Application1";
```

With the scope limited to "/Application1", the browser submits the cookie to any page in the /Application1 folder, but not to pages in other folders, even if they are on the same server.

To expand the scope to an entire domain, set the *Domain* property, as the following example demonstrates:

```
'VB
Response.Cookies("lastVisit").Value = DateTime.Now.ToString
Response.Cookies("lastVisit").Expires = DateTime.Now.AddDays(1)
Response.Cookies("lastVisit").Domain = "contoso.com"

//C#
Response.Cookies["lastVisit"].Value = DateTime.Now.ToString();
Response.Cookies["lastVisit"].Expires = DateTime.Now.AddDays(1);
Response.Cookies["lastVisit"].Domain = "contoso.com";
```

Setting the *Domain* property to "Contoso.com" causes the browser to submit the cookie to any server in the contoso.com domain, which might include www.con toso.com, intranet.contoso.com, or private.contoso.com. Similarly, you can use the *Domain* property to specify a full hostname, limiting the cookie to that specific server.

Storing Multiple Values in a Cookie

Though it depends on the browser, you typically can't store more than 20 cookies per site, and each cookie can be a maximum of 4 KB in length. To work around the 20-cookie limit, you can store multiple values in a cookie, as the following code demonstrates:

```
'VB
Response.Cookies("info")("visit") = DateTime.Now.ToString()
Response.Cookies("info")("firstName") = "Tony"
Response.Cookies("info")("border") = "blue"
Response.Cookies("info").Expires = DateTime.Now.AddDays(1)
```

```
//C#
Response.Cookies["info"]["visit"].Value = DateTime.Now.ToString();
Response.Cookies["info"]["firstName"].Value = "Tony";
Response.Cookies["info"]["border"].Value = "blue";
Response.Cookies["info"].Expires = DateTime.Now.AddDays(1);
```

Running the code in this example sends a cookie with the following value to the Web browser:

```
(visit=4/5/2006 2:35:18 PM)          (firstName=Tony)       (border=blue)
```

Cookie properties, such as *Expires*, *Domain*, and *Path*, apply for all values within a cookie. You can access individual values within the cookie using *Request.Cookies* in exactly the same way you define the values.

Query Strings

Query strings are commonly used to store variables that identify specific pages, such as search terms or page numbers. A query string is information that is appended to the end of a page URL. A typical query string might look like the following real-world example:

```
http://support.microsoft.com/Default.aspx?kbid=315233
```

In this example, the URL identifies the Default.aspx page. The query string (which starts with a question mark [?]) contains a single parameter named “kbid,” and a value for that parameter, “315233.” Query strings can also have multiple parameters, such as the following real-world URL, which specifies a language and query when search ing the Microsoft.com Web site:

```
http://search.microsoft.com/results.aspx?mkt=en-US&setlang=en-US&q=hello+world
```

The values in this query string can be retrieved from within the ASP.NET page using the objects shown in Table 7-1.

Table 7-1 Sample Query String Values

Value Name	ASP.NET Object	Value
mkt	Request.QueryString["mkt"]	en-US
setlang	Request.QueryString["setlang"]	en-US
q	Request.QueryString["q"]	hello world

Query strings provide a simple but limited way to maintain state information between multiple pages. For example, they are an easy way to pass information from one page to another, such as passing a product number from a page that describes a product to a page that adds the item to a user's shopping cart. However, some browsers and cli ent devices impose a 2083-character limit on the length of the URL. Another limita tion is that you must submit the page using an *HTTP GET* command in order for query string values to be available during page processing. Therefore, you shouldn't add query strings to button targets in forms.

IMPORTANT Always validate user input

You should expect users to modify data in query strings. For that reason, you must always validate data stored in query strings.

Query string data is included in bookmarks and when users e-mail URLs. In fact, it's the only way to enable a user to include state data when copying and pasting a URL to another user. For that reason, you should use query strings for any information that uniquely identifies a Web page, even if you are also using another state-management technique.

IMPORTANT Practical query string character limits

Browsers have 2083-character limits on URLs, but you'll start to have problems with much shorter-length URLs if users e-mail them using plain-text e-mail or send them to other users via instant message. To allow a URL to be e-mailed, limit the length to 70 characters (including the http:// or https://). To allow a URL to be sent via instant message, limit the length to 400 characters.

Real World

Tony Northrup

While only the most sophisticated users are comfortable modifying cookies or hidden fields, many casual users know how to change query strings. For exam ple, the first interactive Web application I ever wrote allowed a user to rate pic tures on a scale from 1 to 10, and the user's rating was submitted as a query string value. For example, if the user rated a picture 7, the query string might read "page.aspx?pic=342&rating=7." One day I noticed a picture with a rating above 100—a clever user had manually changed the query string to include a very large value, and my application had added the rating to the database with out validation. To fix the problem, I added code to reject any request with a rat ing more than 10 or less than 1.

A common mistake I see is that developers use query strings to allow users to navigate search results but do not validate the query strings properly. Often, query strings for search results have query strings for the search terms, the num ber of results per page, and the current page numbers. If you don't validate the query string, the user can set the number of results per page to a huge number, such as 10,000. Processing thousands of search results can take several seconds of your server's processing time and cause your server to transmit a very large HTML page. This makes it very easy for an attacker to perform a denial-of-service attack on your Web application by requesting the search page repeatedly.

Don't ever trust values from a query string; they must always be validated.

To write query string values, modify the URL for any hyperlink the user might click. For example, if you have a *HyperLink* control with *NavigateUrl* defined as "page.aspx," you can add the string "?user=tony" to the *HyperLink.NavigateUrl* property so that the full URL is "page.aspx?user=tony." Separate multiple query string values with amper sands (&). For example, the URL "page.aspx?user=tony&prefs=1&page=1252" passes three query string values to Page.aspx: user (with a value of "tony"), prefs (with a value of 1), and page (with a value of 1252).

One of the biggest drawbacks to using query strings is that there are no tools built into the .NET Framework to simplify the creation of query strings. You must manually add query string values to every hyperlink that the user might click.

To read a query string value, access the *Request.QueryStrings* collection just like you would access a cookie. To continue the previous example, the page.aspx page could process the "user" query string by accessing Request.QueryStrings("user") in Visual Basic or Request.QueryStrings["user"] in C#. For example, the following code displays values for the user, prefs, and page query strings in the *Label1* control:

```
'VB
Label1.Text = "User: " + Server.HtmlEncode(Request.QueryString("user")) + _
    ", Prefs: " + Server.HtmlEncode(Request.QueryString("prefs")) + _
    ", Page: " + Server.HtmlEncode(Request.QueryString("page"))

//C#
Label1.Text = "User: " + Server.HtmlEncode(Request.QueryString["user"]) +
    ", Prefs: " + Server.HtmlEncode(Request.QueryString["prefs"]) +
    ", Page: " + Server.HtmlEncode(Request.QueryString["page"]);
```

Security Alert You should always encode cookie or query string values using *Server.HtmlEncode* before displaying the value in an HTML Web page to any user. *Server.HtmlEncode* replaces HTML code with special characters that a Web browser cannot process. For example, *Server.HtmlEncode* replaces a "<" sign with "&lt." If you display the value in a browser, the user sees the "<" sign, but the browser does not process any HTML code or client-side scripts.

To provide extra protection, the runtime throws a *System.Web.HttpRequestValidationException* if it detects HTML or client-side scripting in a query string. Therefore, you cannot pass HTML code in a query string. This can be disabled by an administrator, however, so you should not rely on it for protection.

Lab: Store State Management Data on the Client

In this lab, you use different client-side state management techniques to track the number of pages a user opens.

� **Exercise 1: Store Data in View State**

In this exercise, you add custom values to the *ViewState* object and then test the behavior when browsing to different pages.

1. Create a new ASP.NET Web site named ClientState in either C# or Visual Basic using Visual Studio 2005.
2. In the blank project, on the Default.aspx page, add a label named Label1, a button named Button1, and a hyperlink named HyperLink1. Set the *HyperLink1.Navigate-Url* property to "Default2.aspx."
3. Create a second Web form named Default2.aspx, add a label named Label1, a button named Button1, and a hyperlink named HyperLink1. Set the *HyperLink1.NavigateUrl* property to "Default.aspx."
4. In the *Page_Load* method for both Default.aspx and Default2.aspx, add code to store the current number of clicks in the *ViewState* object and display the clicks in the *Label* control. The following code demonstrates how to do this:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Me.Load
    If (ViewState("clicks") IsNot Nothing) Then
            ViewState("clicks") = CInt(ViewState("clicks")) + 1
     Else
            ViewState("clicks") = 1
    End If
    Label1.Text = "ViewState clicks: " + CInt(ViewState("clicks")).ToString
End Sub
```

```
//C#
if (ViewState["clicks"] != null)
    ViewState["clicks"] = (int)ViewState["clicks"] + 1;
else
    ViewState["clicks"] = 1;
Label1.Text = " ViewState clicks: " + ((int)ViewState["clicks"]).ToString();
```

5. Build your Web site and visit the Default.aspx page. Click the button several times and verify that the clicks counter increments.
6. Click the hyperlink to load the Default2.aspx page. Notice that the counter returns to 1—the value stored in ViewState is lost because you opened a different page.
7. Click the hyperlink to return to Default.aspx. Notice that the counter is again reset. Switching between pages loses all ViewState information.

� Exercise 2: Store Data in a Hidden Field

In this exercise, you add a *HiddenField* control and use it to store state management data.

1. Continue editing the project you created in the previous exercise. Alternatively, you can open the completed Lesson 1, Exercise 1 project from the CD.
2. On the Default.aspx page, add a *HiddenField* control named HiddenField1.
3. In the *Page_Load* method for Default.aspx, add code to store the current number of clicks in the *HiddenField1* object and display the clicks in the *Label* control. The following code demonstrates how to do this:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Me.Load
    ' Store value in HiddenField
    Dim clicks As Integer
    Integer.TryParse(HiddenField1.Value, clicks)
    clicks += 1
    HiddenField1.Value = clicks.ToString

    Label1.Text = "HiddenField clicks: " + HiddenField1.Value
End Sub

//C#
int clicks;
int.TryParse(HiddenField1.Value, out clicks);
clicks++;
HiddenField1.Value = clicks.ToString();

    Label1.Text = "HiddenField clicks: " + HiddenField1.Value
```

4. Notice that *HiddenField.Value* is a *String*, which requires converting data to and from the *String* type. This makes it less convenient than other methods of storing data.
5. Build your Web site and visit the Default.aspx page. Click the button several times and verify that the clicks counter increments. If you browse to other pages, the *HiddenField* value is lost.

� **Exercise 3: Store Data in a Cookie**

In this exercise, you use a cookie to track user clicks.

1. Continue editing the project you created in the previous exercise. Alternatively, you can open the completed Lesson 1, Exercise 2 project from the CD.
2. In the *Page_Load* method for both Default.aspx and Default2.aspx, add code to retrieve the current number of clicks from a cookie named "clicks," increment the value, and store the new value in the same cookie. Display the clicks in the *Label* control. The following code demonstrates how to do this:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Me.Load
    ' Retrieve value from a cookie
    Dim cookieClicks As Integer
    If Not (Request.Cookies("clicks") Is Nothing) Then
        cookieClicks = Integer.Parse(Request.Cookies("clicks").Value) + 1
     Else
        cookieClicks = 1
    End If

    ' Define the cookie for the next visit
    Response.Cookies("clicks").Value = cookieClicks.ToString

    Label1.Text = "Cookie clicks: " + cookieClicks.ToString
End Sub

//C#
// Retrieve value from a cookie
int cookieClicks;
if (Request.Cookies["clicks"] != null)
    cookieClicks = int.Parse(Request.Cookies["clicks"].Value) + 1;
else
    cookieClicks = 1;

// Define the cookie for the next visit
Response.Cookies["clicks"].Value = cookieClicks.ToString();

Label1.Text = "Cookie clicks: " + cookieClicks.ToString();
```

3. Build your Web site and visit the Default.aspx page. Click the button several times and verify that the clicks counter increments.
4. Click the hyperlink to load Default2.aspx. Notice that the counter is not reset.
   With cookies, you can browse to any page on the same Web site and access the same value.

� **Exercise 4: Store Data in a Query String**

In this exercise, you use a query string to track user clicks.

1. Continue editing the project you created in the previous exercise. Alternatively, you can open the completed Lesson 1, Exercise 3 project from the CD.
2. In the *Page_Load* method for both Default.aspx and Default2.aspx, add code to retrieve the current number of clicks from a query string parameter named "clicks," increment the value, and store the new value in the Hyperlink1.Navigate-Url. Display the clicks in the *Label* control. The following code demonstrates how to do this:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Me.Load
    ' Retrieve value from the query string
    Dim queryClicks As Integer
    If Not (Request.QueryString("clicks") Is Nothing) Then
        queryClicks = Integer.Parse(Request.QueryString("clicks")) + 1
     Else
        queryClicks = 1
    End If

    ' Define the query string in the hyperlink
    HyperLink1.NavigateUrl += "?clicks=" + queryClicks.ToString
    Label1.Text = "Query clicks: " + queryClicks.ToString
End Sub

//C#
// Retrieve value from the query string
int queryClicks;
if (Request.QueryString["clicks"] != null)
    queryClicks = int.Parse(Request.QueryString["clicks"]) + 1;
else
    queryClicks = 1;

// Define the query string in the hyperlink
HyperLink1.NavigateUrl += "?clicks=" + queryClicks.ToString();
Label1.Text = "Query clicks: " + queryClicks.ToString();
```

IMPORTANT Why does this example not use *Server.HtmlEncode*?

Earlier, this lesson warned you to always use *Server.HtmlEncode* to encode cookies or query strings before displaying them in an HTML page. These exercises don't seem to practice what they preach, however. Instead, the exercises use strong typing to ensure there is no malicious code contained in the values before they are displayed. By converting the values from strings to integers and back to strings, there is no possibility that HTML code or client-side scripts can be displayed. If the user inserts malicious code in a cookie or query string, the runtime throws an exception when it attempts to parse the value, preventing the malicious code from being displayed. However, you must always use *Server.HtmlEncode* before directly displaying the string value of a cookie or query string.

3. Build your Web site, visit the Default.aspx page, and click the hyperlink to load Default2.aspx. Notice that the counter is incremented.
4. Click the hyperlink several times to switch between pages. Notice that the URL includes the number of clicks; this is visible to the user.

If the user bookmarks the link and returns to the page later, or even returns to the same URL on a different computer, the current clicks counter is retained. With query strings, you can e-mail or bookmark Web pages and have the state information stored in the URL. However, you must include the query string in any link the user might click on the page, or the information is lost.

Lesson 2: Using Server-Side State Management

ASP.NET provides two ways to share information between Web pages without send ing the data to the client: application state and session state. *Application state* informa tion is available to all pages, regardless of which user requests a page. *Session state* information is available to all pages opened by a user during a single visit. Both appli cation state and session state information are lost when the application restarts. To persist user data between application restarts, you can store it using profile properties.

After this lesson, you will be able to:

- Use application state to store information that should be accessible to all Web pages.
- Use session state to store information that should be accessible to all Web pages opened by a user during a single visit to your Web site.
- Describe the purpose of profile properties.

Estimated lesson time: 30 minutes

Application State

ASP.NET allows you to save values using application state, a global storage mecha nism that is accessible from all pages in the Web application. Therefore, you can use application state to store information that must be maintained between server round trips and between requests for pages.

Application state is stored in the *Application* key/value dictionary (an instance of the *HttpApplicationState* class). You can add application-specific information to this struc ture to store it between page requests. Once you add your application-specific infor mation to application state, the server manages it, and it is never exposed to the client. Application state is a great place to store information that is not user-specific. By stor ing it in the application state, all pages can access data from a single location in mem ory, rather than keeping separate copies of the data.

IMPORTANT Choosing application or session state

You should not store user-specific information in application state. Instead, you should use session state, as described later in this lesson. Any user might theoretically be able to access the *Application* object, so storing user information in the *Application* object could expose you to security risks.

Data stored in the *Application* object is not permanent and is lost any time the appli cation is restarted. IIS regularly restarts ASP.NET applications to improve reliability, and applications are restarted if the computer is restarted. To persist information, read and write the values using application events, as described in the next section.

Responding to Application Events

ASP.NET provides three events that enable you to initialize *Application* variables (free resources when the application shuts down) and respond to *Application* errors:

- ***Application_Start*** Raised when the application starts. This is the perfect place to initialize *Application* variables.
- ***Application_End*** Raised when an application shuts down. Use this to free appli cation resources and perform logging.
- ***Application_Error*** Raised when an unhandled error occurs. Use this to perform error logging.

To implement these events, add the Global.asax file to your project by following these steps:

1. In Microsoft Visual Studio 2005, click Website, and then click Add New Item.
2. Click Global Application Class, and then click Add.

   Visual Studio adds a default Global.asax f ile t hat has met hods for *Application_Start*, *Application_End*, and *Application_Error*, as well as *Session_Start* and *Session_End* (described later in this lesson). The following code demon strates how to implement these services in the Global.asax file to keep track of users in the Application[“UsersOnline”] object:

```
'VB
Sub Application_Start(ByVal sender As Object, ByVal e As EventArgs)
    Application("UsersOnline") = 0
End Sub

Sub Session_Start(ByVal sender As Object, ByVal e As EventArgs)
    Application.Lock()
    Application("UsersOnline") = CInt(Application("UsersOnline")) + 1
    Application.UnLock()
End Sub

Sub Session_End(ByVal sender As Object, ByVal e As EventArgs)
    Application.Lock()
    Application("UsersOnline") = CInt(Application("UsersOnline")) – 1
    Application.UnLock()
End Sub
```

```
//C#
void Application_Start(object sender, EventArgs e)
{
    // Code that runs on application startup
    Application["UsersOnline"] = 0;
}

void Session_Start(object sender, EventArgs e)
{
    // Code that runs when a new session is started
    Application.Lock();
    Application["UsersOnline"] = (int)Application["UsersOnline"] + 1;
    Application.UnLock();
}

void Session_End(object sender, EventArgs e)
{
    // Code that runs when a session ends.
    // Note: The Session_End event is raised only when the sessionstate mode
    // is set to InProc in the Web.config file. If session mode is set to StateServer
    // or SQLServer, the event is not raised.
    Application.Lock();
    Application["UsersOnline"] = (int)Application["UsersOnline"] - 1;
    Application.UnLock();
}
```

Reading and Writing Application State Data

You can read and write application state data using the *Application* object (an instance of the *HttpApplicationState* class) just like you would read and write data to the *View-State* object—as a collection. However, because multiple Web pages might be running simultaneously, you must lock the *Application* object when making calculations and performing updates, exactly as you need to lock a shared resource in a multi-threaded application. For example, the following code locks the *Application* update and incre ments a variable:

```
'VB
Application.Lock()
Application("PageRequestCount") = CInt(Application("PageRequestCount")) + 1
Application.UnLock()

//C#
Application.Lock();
Application["PageRequestCount"] = ((int)Application["PageRequestCount"])+1;
Application.UnLock();
```

If you don't lock the *Application* object, it is possible for another page to change the variable between the time that the process reads the current value and the time it writes the new value, causing a calculation to be lost. You do not need to lock the *Application* object when initializing variables in *Application_Start*.

To read *Application* values, simply cast the value to the correct type. The following example demonstrates how to read an Integer that has been stored in *Application*:

```
'VB
CInt(Application("PageRequestCount"))

//C#
(int)Application["PageRequestCount"]
```

Session State

ASP.NET allows you to save values using session state, a storage mechanism that is accessible from all pages requested by a single Web browser session. Therefore, you can use session state to store user-specific information that must be maintained between server round trips and between requests for pages.

Session state is similar to application state, except that it is scoped to the current browser session. If different users are using your application, each user session has a different session state. In addition, if a user leaves your application and then returns later after the session timeout period, session state information is lost and a new ses sion is created for the user.

Session state is stored in the *Session* key/value dictionary (an instance of the *HttpSes sionState* class). You can add session-specific information to this structure to store it between page requests. Once you add your session-specific information to session state, the server manages it, and it is never exposed to the client.

You can use session state to accomplish the following tasks:

- Uniquely identify browser or client-device requests and map them to individual session instances on the server. This allows you to track which pages a user saw on your site during a specific visit.
- Store session-specific data on the server for use across multiple browser or client-device requests during the same session. This is perfect for storing shopping cart information.
- Raise appropriate session management events. In addition, you can write appli cation code leveraging these events.

Once you add your application-specific information to session state, the server man ages this object. Depending on which options you specify, session information can be stored in cookies, on out-of-process servers, or on computers running Microsoft SQL Server. Because session state can be centrally stored, it is perfect for storing data when using multiple front-end Web servers.

Reading and Writing Session State Data

The following code sample demonstrates how to store the time the user last loaded a page in a session variable and then later retrieve that value by casting it to the appro priate type. While this performs a similar function to the *ViewState* example in Lesson 1, the *Session* object is available to any page, the count is incremented whether the user submits a form or just clicks a link, and the count is stored on the server rather than the client:

```
'VB
' Check if Session object exists, and display it if it does
If (Session("lastVisit") IsNot Nothing) Then
      Label1.Text = Session("lastVisit").ToString()
Else
      Label1.Text = "Session does not have last visit information."
End If

' Define the Session object for the next page view
Session("lastVisit") = DateTime.Now

//C#
// Check if Session object exists, and display it if it does
if (Session["lastVisit"] != null)
      Label1.Text = ((DateTime)Session["lastVisit"]).ToString();
else
      Label1.Text = "Session does not have last visit information.";

// Define the Session object for the next page view
Session["lastVisit"] = DateTime.Now;
```

To track a user’s session, ASP.NET uses the ASP.NET_SessionId cookie with a random 24-byte value. Values stored in *Session* must be serializable.

Disabling Session State

If you don’t use session state, you can improve performance by disabling session state for the entire application by setting the *sessionState mode* property to Off in the Web.config file, as the following example shows:

```
<configuration>
  <system.web>
      <sessionState mode="off"/>
  </system.web>
</configuration>
```

If you want to disable session state for only a particular page of an application, set the *EnableSessionState* page directive to False. You can also set the *EnableSessionState* page directive to ReadOnly to provide read-only access to session variables. The following code sample shows how to disable session state for a single page:

```
<%@ Page Language="C#" AutoEventWireup="true"  CodeFile="Default.aspx.cs"
Inherits="_Default" EnableSessionState = "False"%>
```

Configuring Cookieless Session State

By default, session state uses cookies to track user sessions. This is the best choice for the vast majority of applications. Almost all Web browsers support cookies, and those that don't are typically clients you don't want to track session data for, such as search engines or other robots.

However, you can enable a cookieless session state to have ASP.NET track sessions using a query string in the URL. The session ID is embedded in the URL after the slash that follows the application name and before any remaining file or virtual direc tory identifier. For example, the following URL has been modified by ASP.NET to include the unique session ID lit3py55t21z5v55vlm25s55:

```
http://www.example.com/s(lit3py55t21z5v55vlm25s55)/orderform.aspx
```

The following example shows a Web.config file that configures an ASP.NET applica tion to use cookieless session identifiers.

```
<configuration>
  <system.web>
      <sessionState cookieless="true"
        regenerateExpiredSessionId="true" />
  </system.web>
</configuration>
```

Responding to Session Events

ASP.NET provides two events that help you manage user sessions:

- **Session_Start** Raised when a new session begins. This is the perfect place to ini tialize session variables.
- **Session_End** Raised when a session is abandoned or expires. Use this to free per-session resources.

To implement these events, add the Global.asax file to your project and write code in the appropriate event handler, as discussed in the section "Responding to Application Events," earlier in this lesson.

Choosing a Session State Mode

ASP.NET session state supports several different storage options for session data:

- **InProc** Stores session state in memory on the Web server. This is the default, and it offers much better performance than using the ASP.NET state service or storing state information in a database server. InProc is fine for simple applica tions, but robust applications that use multiple Web servers or must persist ses sion data between application restarts should use StateServer or SQLServer.
- **StateServer** Stores session state in a service called the ASP.NET State Service. This ensures that session state is preserved if the Web application is restarted and also makes session state available to multiple Web servers in a Web farm. ASP.NET State Service is included with any computer set up to run ASP.NET Web applications; however, the service is set up to start manually by default. Therefore, when configuring the ASP.NET State Service, you must set the startup type to Automatic.
- **SQLServer** Stores session state in a SQL Server database. This ensures that ses sion state is preserved if the Web application is restarted and also makes session state available to multiple Web servers in a Web farm. On the same hardware, the ASP.NET State Service outperforms SQLServer. However, a SQL Server data base offers more robust data integrity and reporting capabilities.
- **Custom** Enables you to specify a custom storage provider. You also need to implement the custom storage provider.
- **Off** Disables session state. You should disable session state if you are not using it to improve performance.

Configuring Session State Modes

You can specify which mode you want ASP.NET session state to use by assigning *Ses sionStateMode* enumeration values to the mode attribute of the *sessionState* element in your application's Web.config file. Modes other than *InProc* and *Off* require additional parameters, such as connection-string values. You can examine the currently selected session state by accessing the value of the *System.Web.SessionState.HttpSession-State.Mode* property.

For example, the following settings in a Web.config file cause the session state to be stored in a SQL server database identified by the specified connection string:

```
<configuration>
 <system.web>
      <sessionState mode="SQLServer"
            cookieless="true "
            regenerateExpiredSessionId="true "
            timeout="30"
            sqlConnectionString="Data Source=MySqlServer;Integrated Security=SSPI;"
            stateNetworkTimeout="30"/>
 </system.web>
</configuration>
```

While you can configure session state for your application, that is typically the respon sibility of systems administrators. For example, a systems administrator might ini tially configure your Web application on a single server using the InProc mode. Later, if the server gets too busy or requires redundancy, the systems administrator adds a second Web server, configures the ASP.NET state service on a server, and modifies the Web.config file to use the StateServer mode. Fortunately, the session state mode is transparent to your application, so you won't need to change your code. Besides con figuring the Web.config file, you don't need to change how your application deals with session states to support different modes.

Quick Check

1. Which typically consumes more memory: application state or session state?
2. Which might not work if a user has disabled cookies in his or her Web browser: application state or session state?

Quick Check Answers

1. Session state tends to use much more memory than application state, because copies of all variables are stored for each user.
2. Session state, by default, won't work if a Web browser that supports cook ies has cookies disabled. Application state isn't user-specific, though, and doesn't need to be tracked in cookies. Therefore, application state works regardless.

Profile Properties

ASP.NET provides a feature called profile properties, which allows you to store user-specific data. This feature is similar to session state, except that the profile data is not lost when a user's session expires. The profile-properties feature uses an ASP.NET pro file, which is stored in a persistent format and associated with an individual user. The ASP.NET profile allows you to easily manage user information without requiring you to design your own database. In addition, the profile makes the user information available using strongly typed classes that you can access from anywhere in your application. You can store objects of any type in the profile.

NOTE .NET 2.0

Profile properties are new in ASP.NET version 2.0.

To use profile properties, you must configure a profile provider. ASP.NET includes a *SqlProfileProvider* class that allows you to store profile data in a SQL database, but you can also create your own profile provider class that stores profile data in a cus tom format and to a custom storage mechanism, such as an XML file, or even to a Web service.

Because data that is placed in profile properties is not stored in application memory, it is preserved through Internet Information Services (IIS) restarts and worker-process restarts without losing data. Additionally, profile properties can be persisted across multiple processes, such as in Web farms or Web gardens.

MORE INFO Profile properties

For more information about profile properties, refer to Chapter 9, "Customizing and Personalizing a Web Application."

Lab: Store State Management Data on the Server

In this lab, you use different server-side state management techniques to track the number of pages a user has opened.

� Exercise 1: Store Data in the Application Object

In this exercise, you add custom values to the *Application* object and then test the behavior when browsing to different pages.

1. Create a new ASP.NET Web site named ServerState in either C# or Visual Basic using Visual Studio 2005.
2. In the blank project, on the Default.aspx page, add labels named Label1 and Label2, and a hyperlink named HyperLink1. Set the *HyperLink1.NavigateUrl* property to "Default2.aspx."
3. Create a second Web form named Default2.aspx, add labels named Label1 and Label2, and a hyperlink named HyperLink1. Set the *HyperLink1.NavigateUrl* property to "Default.aspx."
4. Add the Global.asax file to your project.
5. In the Global.asax file, in the *Application_Start* method, initialize an Integer named "clicks" in the Application object, as the following example shows:

```
'VB
Sub Application_Start(ByVal sender As Object, ByVal e As EventArgs)
    ' Code that runs on application startup
    Application("clicks") = 0
End Sub

//C#
void Application_Start(object sender, EventArgs e)
{
    // Code that runs on application startup
    Application["clicks"] = 0;
}
```

6. In the *Page_Load* method for both Default.aspx and Default2.aspx, add code to increment the number of clicks in the *Application* object. Don't forget to lock the application object before updating the value. Then display the value in Label1. The following code demonstrates how to do this:

```
'VB
Application.Lock()
Application("clicks") = CInt(Application("clicks")) + 1
Application.UnLock()

Label1.Text = "Application clicks: " + Application("clicks").ToString

//C#
Application.Lock();
Application["clicks"] = ((int)Application["clicks"]) + 1;
Application.UnLock();

Label1.Text = "Application clicks: " + Application["clicks"].ToString();
```

7. Build your Web site and visit the Default.aspx page. Click the hyperlink several times to switch between pages and verify that the clicks counter increments.

8. From a different computer, open the same page. Notice that the click count includes the clicks you made from the first computer because the *Application* object is shared among all user sessions.
9. Restart your Web server and visit the same page again. Notice that the click count is reset; the *Application* object is not persisted between application restarts.

� **Exercise 2: Store Data in the Session Object**

In this exercise, you add custom values to the *Session* object and then test the behavior when browsing to different pages.

1. Continue editing the project you created in the previous exercise. Alternatively, you can open the completed Lesson 2, Exercise 1 project from the CD.
2. In the Global.asax file, in the *Session_Start* method, initialize an Integer named "clicks" in the Session object, as the following example shows:

```
'VB
Sub Session_Start(ByVal sender As Object, ByVal e As EventArgs)
    ' Code that runs when a new session is started
    Session("clicks") = 0
End Sub

//C#
void Session_Start(object sender, EventArgs e)
{
    // Code that runs when a new session is started
    Session["clicks"] = 0;
}
```

3. In the *Page_Load* method for both Default.aspx and Default2.aspx, add code to increment the number of clicks in the *Session* object. Don't forget to lock the application object before updating the value. Then display the value in Label2. The following code demonstrates how to do this:

```
'VB
Protected Sub Page_Load(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Me.Load
    Session("clicks") = CInt(Session("clicks")) + 1
    Label2.Text = "Session clicks: " + Session("clicks").ToString
End Sub

//C#
Session["clicks"] = ((int)Session["clicks"]) + 1;
Label2.Text = "Session clicks: " + Session["clicks"].ToString();
```

Notice that *HiddenField.Value* is a *String*, which requires converting data to and from the *String* type. This makes it less convenient than other methods of storing data.

4. Build your Web site and visit the Default.aspx page. Click the hyperlink several times to switch between pages and verify that both the *Application* and *Session* clicks counters increment.
5. From a different computer, open the same page. Notice that the *Application* click count includes the clicks you made from the first computer because the *Applica tion* object is shared among all user sessions. However, the *Session* clicks counter includes only clicks made from that computer.
6. Restart your Web server and visit the same page again. Notice that both click counts are reset; the *Application* and *Session* objects are not persisted between application restarts.

Chapter 9

Customizing and Personalizing a Web Application

Modern Web applications are flexible, customizable, and personalized for individual users. You've probably seen personalized consumer Web sites, such as portal and news sites, where users can choose what types of content they want to see and even control the layout of Web pages. However, business applications are also moving in the direction of giving users the ability to customize how they view data and to see more of the information they care about most.

This chapter discusses four ways to provide customizable, personalized Web applica tions: master pages, themes, user profiles, and Web Parts.

Exam objectives in this chapter:

- Implement a consistent page design by using master pages.
  - Create a master page.
  - Add a ContentPlaceHolder control to a master page.
  - Specify default content for a ContentPlaceHolder.
  - Reference external resources in a master page.
  - Define the content of a particular page in a content page.
  - Create a content page.
  - Add content to a content page.
  - Reference a master page member from a content page.
  - Handle events when using master pages.
  - Create a nested master page.
  - Change master pages dynamically.
- Customize a Web page by using themes and user profiles.
  - Apply a theme declaratively.
  - Apply a theme programmatically.

    - Apply a user-selected theme programmatically.
    - Define custom themes.
    - Define the appearance of a control by using skins.
    - Enable users to personalize an application by using Web Parts.
    - Track and store user-specific information by using user profiles.
    - Personalize a Web page by dynamically adding or removing child controls in a Placeholder control at run time.
- Implement Web Parts in a Web application.
    - Track and coordinate all Web Parts controls on a page by adding a WebPartManager control.
    - Connect Web Parts to each other by using connection objects.
    - Divide a page that uses Web Parts into zones by using WebPartZones.
    - Present a list of available Web Parts controls to users by using CatalogPart controls.
    - Enable users to edit and personalize Web Parts controls on a page by using EditorPart controls.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Microsoft Visual Basic or C# and be comfortable with the following tasks:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed with SQL Server 2005 Express Edition and Internet Information Services (IIS).
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.

Real World

Tony Northrup

In the early ’90s, having any Web site at all was an accomplishment, and all it took to impress people was an animated GIF. Near the mid-1990s, developers started adding simple scripting to create static Web sites that incorporated a few dynamic Web components, such as e-mail forms.

Over time, the Web development community has continued to raise the bar. Today, almost all Web pages incorporate some dynamic content. Almost all e-commerce and other business Web sites enable users to identify themselves to get permissions to view personalized versions of the Web site and to maintain their own accounts.

Creating a large personalized Web site like this would have been next-to impossible with the Perl scripts most of us used in the early to mid-1990s. Today, with the .NET Framework, you can build dynamic, personalized Web sites with very little code. The Web sites are not only easier to create, but are more secure, reliable, and manageable. That means that, unlike some of the Perl scripts I wrote in the ’90s, I probably won’t have script kiddies hacking my site just for the fun of it.

Lesson 1: Using Master Pages

Many developers tend to focus primarily on functionality, not aesthetics. As a result, complex Web applications with dozens of pages can be both ugly and inconsistent. After all, if you discover a better way to provide site navigation while developing the thirteenth Web page in an application, you might not take the time to go back and adjust the first twelve pages.

ASP.NET master pages solve this problem by allowing you to create a consistent layout for all pages in your application. A single master page defines the look, feel, and stan dard behavior that you want for all pages (or a group of pages) in your application. You can then create individual content pages that contain just the information you want to fit into the template provided by the master page. When users request the content pages, ASP.NET merges the content with the master page.

This lesson describes how to create and use master pages and content pages.

Real World

Tony Northrup

All Web sites require consistency. Before master pages were available, I used to create custom controls for every component that would be repeated throughout a Web site, including the logo, the navigation bar, and the page footer. This way, if I needed to change an aspect of one of the common components, I could make the change in one place and have it reflected throughout the site.

That worked great unless I wanted to add or remove a component, or change the layout of the components. Then I'd have to go into every single Web page and make the change. After that, I'd have to test every Web page to make sure I hadn't made any mistakes.

Now master pages allow me to make centralized changes to the entire site by editing one file. It speeds up the development of content pages, too, because I don't have to worry about copying and pasting the structure for the shared controls.

After this lesson, you will be able to:

- Explain the purpose of master and content pages.
- Describe the process of creating master and content pages.
- Use different techniques for attaching content to a master page.
- Reference controls and properties on a master page from a content page.
- Explain how event handling works in master pages.
- Create nested master pages.
- Programmatically switch between master pages to provide user-selected templates.

Estimated lesson time: 45 minutes

Overview of Master and Content Pages

Master pages consist of two separate parts:

- **Master page** An ASP.NET file with a .master file extension. A *master page* con tains a layout that includes text, HTML, and server controls. Instead of an "@ Page" directive, it contains an "@ Master" directive. The master page contains all top-level HTML elements for a page, including <*html*>, <*head*>, and <*form*>. A master page typically includes the page structure (usually an HTML table), com pany name and logo, and site navigation. To enable pages to insert content, a master page contains one or more *ContentPlaceHolder* controls. A master page inherits from the *MasterPage* class.
- **Content page** A *content page* defines the *ContentPlaceHolder* controls in a master page, essentially filling in the blanks. A content page is a standard .aspx file and is bound to the master page using the *MasterPageFile* attribute in the "@ Page" directive.

Figure 9-1 illustrates how master pages and content pages work together.

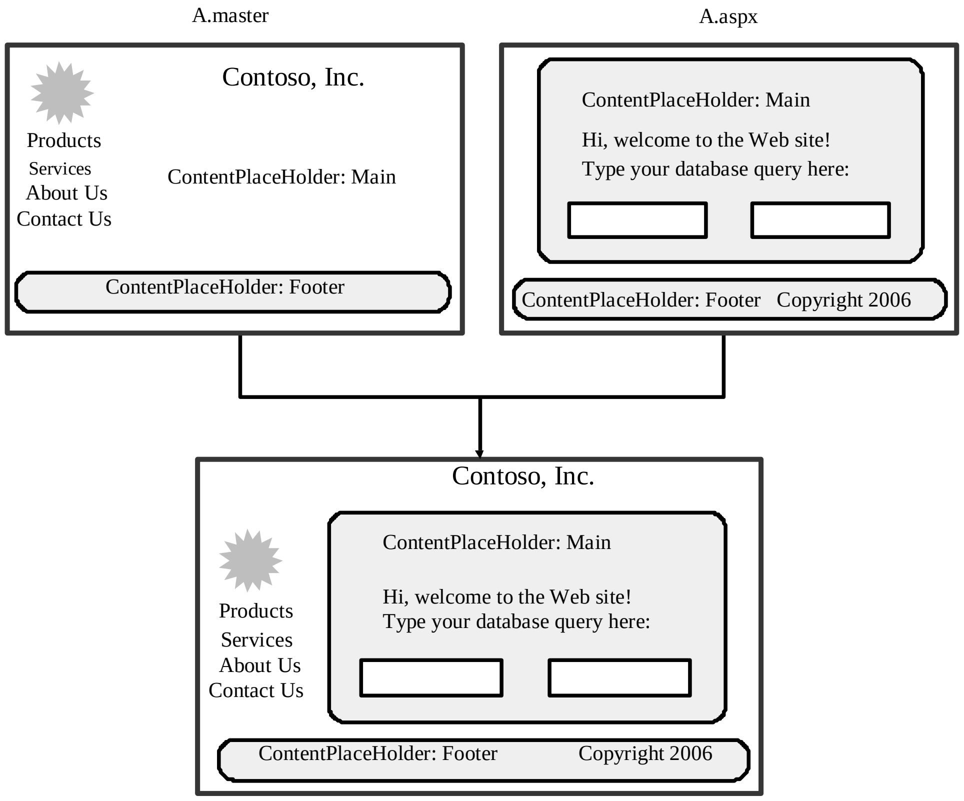

A.master
Contoso, Inc.
Products
Services
About Us
Contact Us
ContentPlaceHolder: Main
ContentPlaceHolder: Footer
A.aspx
ContentPlaceHolder: Main
Hi, welcome to the Web site!
Type your database query here:
ContentPlaceHolder: Footer Copyright 2006
Contoso, Inc.
ContentPlaceHolder: Main
Hi, welcome to the Web site!
Type your database query here:
Products
Services
About Us
Contact Us
ContentPlaceHolder: Footer Copyright 2006

Figure 9-1 Master pages define a structure, and content pages fill in the blanks.

The following demonstrates a master page with two *ContentPlaceHolder* controls:

```
'VB
<% @ Master Language="VB" %>
<html>
<head runat="server">
  <title>Master page title</title>
</head>
<body>
  <form id="form1" runat="server">
      <table>
        <tr>
            <td><asp:contentplaceholder id="Main" runat="server" /></td>
            <td><asp:contentplaceholder id="Footer" runat="server" /></td>
        </tr>
      </table>
  </form>
</body>
</html>
```

```
//C#
<%@ Master Language="C#" %>
<html>
<head runat="server">
  <title>Master page title</title>
</head>
<body>
  <form id="form1" runat="server">
      <table>
        <tr>
            <td><asp:contentplaceholder id="Main" runat="server" /></td>
            <td><asp:contentplaceholder id="Footer" runat="server" /></td>
        </tr>
      </table>
  </form>
</body>
</html>
```

The following demonstrates a content page. Note that all text and controls must be within a *Content* control, or the page generates an error. Otherwise, the page behaves exactly like a standard ASP.NET page. Note the "@ Page" directive and *MasterPageFile* attribute.

```
'VB
<% @ Page Language="VB" MasterPageFile="~/Master.master" Title="Content Page 1" %>
<asp:Content ID="Content1" ContentPlaceHolderID="Main" Runat="Server">
    Main content.
</asp:Content>

<asp:Content ID="Content2" ContentPlaceHolderID="Footer" Runat="Server" >
    Footer content.
</asp:content>

//C#
<% @ Page Language="C#" MasterPageFile="~/Master.master" Title="Content Page 1" %>
<asp:Content ID="Content1" ContentPlaceHolderID="Main" Runat="Server">
    Main content.
</asp:Content>

<asp:Content ID="Content2" ContentPlaceHolderID="Footer" Runat="Server" >
    Footer content.
</asp:content>
```

Master pages provide functionality that developers have traditionally created by:

- Copying and pasting existing code, text, and control elements repeatedly.
- Using framesets.
- Using include files for common elements.
- Using ASP.NET user controls.

Advantages of master pages include the following:

- They allow you to centralize the common functionality of your pages so that you can make updates in just one place.
- They make it easy to create one set of controls and code and apply the results to a set of pages. For example, you can use controls on the master page to create a menu that applies to all pages.
- They give you fine-grained control over the layout of the final pages by allowing you to control how the placeholder controls are rendered.
- They provide object models that allow you to customize the master pages from individual content pages.

At run time, master pages are handled in the following sequence:

1. A user requests a page by typing the URL of the content page.
2. When the page is fetched, the "@ Page" directive is read. If the directive refer ences a master page, the master page is read as well. If this is the first time the pages have been requested, both pages are compiled.
3. The master page with the updated content is merged into the control tree of the content page.
4. The content of individual *Content* controls is merged into the corresponding *ContentPlaceHolder* control in the master page.
5. The resulting merged page is rendered to the browser as a single page.

In general, the master page structure has no effect on how you construct your pages or program them. However, in some cases, if you set a page-wide property on the master page, it can affect the behavior of the content page, because the master page is the closest parent for the controls on the page. For example, if you set the *Enable-ViewState* property on the content page to *true* but set the same property to *false* in the master page, view state is effectively disabled because the setting on the master page takes priority.

The Process of Creating Master and Content Pages

At a high level, you will follow this process to create master and content pages with Visual Studio 2005:

1. Add a master page to your Web site with a .master extension.

2. To the master page, add layout tables, graphics, copyright information, and other content that should appear on multiple pages. Then add one or more *Con tentPlaceHolder* controls where pages can add unique content.
3. Add a Web form to the Web site with an .aspx extension. Select the Select Master Page check box when creating the page and select your master page.
4. To the content page, add text, graphics, and controls to each *Content* control to map to the *ContentPlaceHolder* controls in the master page.

At the hands-on level, creating content is just as straightforward. In fact, you can cre ate master and content pages without writing a single line of code. Exercise 1 of this lesson's lab walks you through the process step by step.

Quick Check

1. Which control must you have on a master page?
2. Which control must you have on a content page?

Quick Check Answers

1. You must have the *ContentPlaceHolder* control on a master page.
2. You must have the *Content* control, which is inserted into a *ContentPlace-Holder* control, on a content page.

Techniques for Attaching Content Pages to a Master Page

You can attach content pages to a master page at three levels:

- **At the page level** You can use a page directive in each content page to bind it to a master page, as in the following code example:

```
'VB
<%@ Page Language="VB" MasterPageFile="MySite.Master" %>

//C#
<%@ Page Language="C#" MasterPageFile="MySite.Master" %>
```

- **At the application level** By making a setting in the *<pages>* element of the appli cation's configuration file (Web.config), you can specify that all ASP.NET pages (.aspx files) in the application automatically bind to a master page. If you use this strategy, all ASP.NET pages in the application that have *Content* controls are merged with the specified master page. (If an ASP.NET page does not contain

Content controls, the master page is not applied.) The element might look like the following:

```
<pages masterPageFile="MySite.Master" />
```

- **At the folder level** This strategy is like binding at the application level, except that you make the setting in a Web.config file in one folder only. The master-page bindings then apply to the ASP.NET pages in that folder.

Referencing Master Page Properties and Controls from Content Pages

Ideally, content pages depend upon the master page to define any application-specific settings. For example, if your master page has your company name in the upper-left corner, content pages read the company name from a master page property rather than having the company name hard-coded into every content page.

To reference master page properties from a content page, follow this process:

1. Create the property in the master page.
2. Add the "@ MasterType" declaration to the .aspx content page.
3. Reference the property from the content page using *Master.Property_Name*.

The sections that follow describe this process in more detail.

Creating a Property in the Master Page

Content pages can reference any public property declared in the master page class. For example, in the following code sample from a master page code-behind file, con tent pages can access both the address and the company name:

```
'VB
Public Address As String = "123 Anywhere"
Public Property CompanyName() As String
    Get
        Return CType(ViewState("CompanyName"), String)
    End Get
    Set(ByVal value As String)
        ViewState("CompanyName") = value
    End Set
End Property

//C#
public String Address = "123 Anywhere";
public String CompanyName
{
    get { return (String)ViewState["companyName"]; }
    set { ViewState["companyName"] = value; }
}
```

NOTE Avoid hard-coding information

This example uses hard-coded variables to illustrate how to declare properties. Typically, properties such as company name and address should be defined in the application configuration.

Adding an "@ MasterType" Declaration in a Content Page

Before you can reference master properties in a content page, you must add the "@ MasterType" declaration to the .aspx content page below the "@ Page" declaration, as the following demonstrates:

```
'VB
<%@ Page Language="VB" MasterPageFile="~/Master1.Master" CodeFile="Home.aspx.vb"
Inherits="Home" Title="Contoso Home Page" %>
<%@ MasterType virtualpath="~/Master1.master" %>

//C#
<%@ Page Language="C#" MasterPageFile="~/Master1.Master" CodeFile="Home.aspx.cs"
Inherits="Home" Title="Contoso Home Page" %>
<%@ MasterType virtualpath="~/Master1.master" %>
```

You are now ready to reference master properties. However, the Visual Studio 2005 development environment might not recognize the property names until you save the Web page.

If you are creating multiple master pages that might be referenced by the same set of content pages, you should derive all master pages from a single base class. Then spec ify the base class name in the "@ MasterType" declaration. This enables the content page to reference the same properties regardless of which master page is being used.

Referencing Master Properties

Once you add the "@ MasterType" declaration, you can reference properties in the master page using the *Master* class. For example, the following code defines a Label control named *CompanyName* using the *CompanyName* public property defined in the master page:

```
'VB
CompanyName.Text = Master.CompanyName

//C#
CompanyName.Text = Master.CompanyName;
```

If you later change the master page associated with a content page, make sure you implement the same public properties to ensure the content pages continue to func tion correctly.

Referencing Controls in the Master Page

Besides properties, you can also reference and update controls in the master page from a content page by calling the *Master.FindControl* method and supplying the con trol name. *Master.FindControl* returns a *Control* object, which you need to cast to the correct type to create a new object. You can then read or update the object as if it were local.

The following code (which belongs in the *Page_Load* method of the content page) demonstrates this by updating a *Label* control in the master page named *Brand*:

```
'VB
Dim _Brand As Label = CType(Master.FindControl("Brand"), Label)
_Brand.Text = "Fabrikam"

//C#
Label _Brand = (Label)Master.FindControl("Brand");
_Brand.Text = "Fabrikam";
```

Use this technique any time a content page needs to customize information in a mas ter page.

Handling Events When Working with Master Pages

Responding to events is only slightly more complicated when using master pages than when using standard ASP.NET pages, because events can occur in either the master page or a content page. Typically, however, responding to these events is intuitive.

Respond to control events, such as *Button_Click*, in the page containing the control. If the control is in the master page, add the code to respond to the control event in the master page. If the control is in the content page, add the code to respond to the con trol event in the control page.

When responding to page events, the sequence of events in the master and content page can be significant. The following is the sequence in which events occur when a master page is merged with a content page:

1. Master page controls *Init* event.
2. Content controls *Init* event.

3. Master page *Init* event.
4. Content page *Init* event.
5. Content page *Load* event.
6. Master page *Load* event.
7. Content controls *Load* event.
8. Content page *PreRender* event.
9. Master page *PreRender* event.
10. Master page controls *PreRender* event.
11. Content controls *PreRender* event.

Creating a Nested Master Page

Master pages can be nested, with one master page referencing another as its master. Nested master pages allow you to create componentized master pages. For example, a large site might contain an overall master page that defines the look of the site. Dif ferent site content partners can then define their own child master pages that refer ence the site master and that, in turn, define the look for that partner’s content.

A child master page has the file name extension .master, as with any master page. However, the child master page also has a master attribute in the “@ Master” declara tion. The following example demonstrates a child master page whose parent master page is named “Parent.master”:

```
'VB
<%@ Master Language="VB" master="Parent.master"%>
<asp:Content id="Content1" ContentPlaceholderID="MainContent" runat="server">
    <asp:panel runat="server" id="panelMain" backcolor="lightyellow">
    <h2>Child master</h2>
      <asp:panel runat="server" id="panel1" backcolor="lightblue">
            <p>This is childmaster content.</p>
            <asp:ContentPlaceHolder ID="Content1" runat="server" />
      </asp:panel>
      <asp:panel runat="server" id="panel2" backcolor="pink">
            <p>This is childmaster content.</p>
            <asp:ContentPlaceHolder ID="Content2" runat="server" />
      </asp:panel>
    </asp:panel>
</asp:Content>

//C#
<%@ Master Language="C#" master="Parent.master"%>
<asp:Content id="Content1" ContentPlaceholderID="MainContent" runat="server">
```

```
    <asp:panel runat="server" id="panelMain" backcolor="lightyellow">
    <h2>Child master</h2>
      <asp:panel runat="server" id="panel1" backcolor="lightblue">
            <p>This is child master content.</p>
            <asp:ContentPlaceHolder ID="Content1" runat="server" />
      </asp:panel>
      <asp:panel runat="server" id="panel2" backcolor="pink">
            <p>This is child master content.</p>
            <asp:ContentPlaceHolder ID="Content2" runat="server" />
      </asp:panel>
    </asp:panel>
</asp:Content>
```

The child master page typically contains content controls that are mapped to content placeholders on the parent master page. In this respect, the child master page is laid out like any content page. However, the child master page also has content placehold ers of its own to display content supplied by its own child pages.

Dynamically Changing Master Pages

You define the master page in a content page's "@ Page" declaration, but that doesn't mean you can't switch to a different master page programmatically. Changing master pages allows you to provide different templates for different users. For example, you might give users a choice of different colors and styles. You could also use different master pages to format data for different browsers or different mobile devices.

MORE INFO Mobile devices

For more information about creating Web pages for mobile devices, read Chapter 12, "Creating ASP.NET Mobile Web Applications."

To dynamically change master pages, follow these high-level steps:

1. Create two or more master pages with the same *ContentPlaceHolder* controls and public properties. Typically, you create one master page, copy it to create the sec ond master page, and make any modifications necessary. Note that, from this point forward, you must make any changes to the *ContentPlaceHolder* controls or public properties to all master pages to ensure compatibility.
2. Optionally, provide a way for users to switch between master pages. If the master page should be the user's choice (for example, if color and layout are the primary differences), add links to your master pages to enable users to switch between pages. You need to define the current master page within the content page, however, so store the setting in the *Session* variable or in another object that is

accessible to both the master and content pages. For example, this code can be called from a link or button on the master page to set a *Session* variable to the name of a different master page. After you define the master page within the content page, reload the page:

```
'VB
Session("masterpage") = "Master2.master"
Response.Redirect(Request.Url.ToString)

//C#
Session["masterpage"] = "Master2.master";
Response.Redirect(Request.Url.ToString());
```

3. Define the master page in the content page's *Page_PreInit* method. *Page_PreInit* is the last opportunity you have to override the default master page setting, because later handlers (such as *Page_Init*) reference the master page. For exam ple, this code defines the master page based on the *Session* object:

```
'VB
Sub Page_PreInit(ByVal sender As Object, ByVal e As EventArgs)
    If Not (Session("masterpage") Is Nothing) Then
        MasterPageFile = CType(Session("masterpage"), String)
    End If
End Sub

//C#
void Page_PreInit(Object sender, EventArgs e)
{
    if (Session["masterpage"] != null)
        MasterPageFile = (String)Session["masterpage"];
}
```

Exercise 2 in this lesson's lab walks you through this process step by step.

Lab: Using Master and Child Pages

In this lab, you create multiple master and child pages.

� **Exercise 1: Create master pages and a child page**

In this exercise, you create a new ASP.NET Web site with two master pages and a child page.

1. Create a new ASP.NET Web site named MasterContent in either C# or Visual Basic using Visual Studio 2005.
2. Add a new Master Page to your Web site named Professional.master.

3. In the design view for Professional.master, add a Label named CompanyName with a large font and the phrase **Contoso, Inc.** Then add a Label named Wel come with the phrase **Welcome, visitor!** Figure 9-2 demonstrates this.

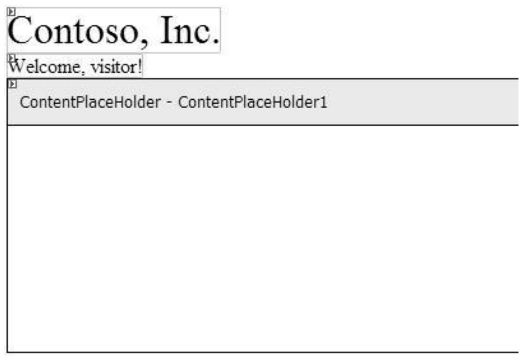


Figure 9-2 Create a sample master page.

4. Repeat the previous step to create an identical page named Colorful.master. Add *Label* controls with the same names. Then set the page background color and the font colors to your favorite colors.
5. Add a new Web Form to your Web site named Home.aspx. In the Add New Item dialog box, select the Select Master Page check box. In the Select A Master Page dialog box, select Professional.master.
6. To Home.aspx, add a TextBox named UserName, a DropDownList named Tem plate, and a Button named Submit. Add two items to the DropDownList: Profes sional and Colorful. Optionally, add labels to improve the appearance of the form. Figure 9-3 demonstrates this.

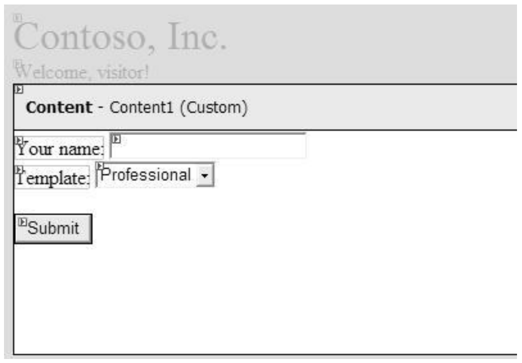


Figure 9-3 Create a sample content page.

7. Build your project and open the resulting Home.aspx page in a browser. Verify that it displays correctly, as shown in Figure 9-4. None of the controls do any thing yet, however.

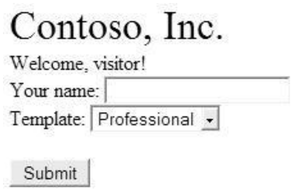


Figure 9-4 Verifying that the content page displays within the default master page.

As this exercise demonstrated, master and content pages can be created in just a few minutes without writing any code.

� **Exercise 2: Modify Master Page Properties and Switch Master Pages**

In this exercise, you add functionality to a child page to change controls on a master page and to switch between two different master pages.

1. Continue working with the project you created in Exercise 1.
2. Double-click the Submit button to open the button's event handler.
3. In the *Submit_Click* method, add code that determines whether the user pro vided a value in the UserName text box. If the user did, use the name he or she typed to define a *Session* variable named *UserName*, and change the welcome message in the master page to read **Welcome, user_name!** The following code demonstrates this:

```
'VB
If Not (UserName.Text Is Nothing) Then
    Session("UserName") = UserName.Text
    Dim _Welcome As Label = CType(Master.FindControl("Welcome"), Label)
    _Welcome.Text = "Welcome, " + UserName.Text + "!"
End If

//C#
if (UserName.Text != null)
{
    Session["UserName"] = UserName.Text;
    Label _Welcome = (Label)Master.FindControl("Welcome");
    _Welcome.Text = "Welcome, " + Session["UserName"] + "!";
}
```

4. Build your project and open the Home.aspx page. In the *UserName* text box, type your name, and then click the Submit button. Verify that the page successfully changes the *UserName* label in the master page. While this works now, it only

works within the Home.aspx content page. If a user loads a different page, the welcome message reverts to "Welcome, visitor!"

5. If you are using Visual Basic, edit the Home.aspx "@ Page" declaration to set the *AutoEventWireup* attribute to *true*. This is set to *true* by default in C#. Then create a *Page_Load* method in the code-behind file. This demonstrates the proper "@ Page" declaration:

```
<%@ Page Language="VB" MasterPageFile="~/Professional.master" AutoEventWireup="true"
CodeFile="Home.aspx.vb" Inherits="Home" title="Untitled Page" %>
```

6. Within the *Page_Load* method, check to see if there is a *Session* variable named *UserName*. If there is, change the welcome message in the master page to read **Welcome, *user_name*!** The following code demonstrates this:

```
'VB
Protected Sub Page_PreInit()
    If Not (Session("UserName") Is Nothing) Then
        Dim _Welcome As Label = CType(Master.FindControl("Welcome"), Label)
        _Welcome.Text = "Welcome, " + Session("UserName") + "!"
    End If
End Sub

//C#
protected void Page_PreInit()
{
    if (Session["UserName"] != null)
     {
        Label _Welcome = (Label)Master.FindControl("Welcome");
        _Welcome.Text = "Welcome, " + Session["UserName"] + "!";
     }
}
```

7. Build your application, and then open the Home.aspx page. In the UserName text box, type your name, and then click the Submit button. The page should change to show the name you typed. Browse to a different page, and then return to Home.aspx to verify that the user name is being retrieved from the *Session* object, and not *ViewState*.

8. In the Home.aspx design view, double-click the Template drop-down list. In the event handler, define the Template variable of the *Session* object using the selected value. The following code demonstrates this:

```
'VB
Session("Template") = Template.SelectedValue

//C#
Session["Template"] = Template.SelectedValue;
```

9. Create a *Page_PreInit* method. In the *Page_PreInit* method, check to see if there is a *Session* variable named *Template*. If there is, use it to change the *MasterPageFile* object to the selected template's filename. The following code demonstrates this:

```
'VB
If Not (Session("Template") Is Nothing) Then
    MasterPageFile = CType(Session("Template"), String) + ".master"
End If

//C#
if (Session["Template"] != null)
    MasterPageFile = (String)Session["Template"] + ".master";
```

10. Build your application, and then open the Home.aspx page. Switch to the Color ful template, and then click Submit. Then reload the page. Notice that the page does not change templates until after you reload it. This happens because the *Template_SelectedIndexChanged* method runs after the *Page_PreInit* method. Therefore, the *Page_PreInit* method cannot detect the *Session("Template")* (in Visual Basic) or the *Session["Template"]* (in C#) variable until the second time you load the page.

As you can see, using the master page model doesn't prevent you from accessing con trols contained in the master page from the content page.

Lesson 2: Using Themes and User Profiles

An ASP.NET *theme* is a collection of properties that define the appearance of pages and controls in your Web site. A theme can include skin files, which define property settings for ASP.NET Web server controls, and cascading style sheet files (.css files) and graphics. By applying a theme, you can give the pages in your Web site a consis tent appearance.

This lesson describes how to create themes and store information in user profiles.

Real World

Tony Northrup

At the time of this writing, my personal Web site is a mess. I made it years ago, when ASP.NET was brand new and themes weren't yet available.

Here's the thing: I hate the Times New Roman default font. I much prefer sans-serif fonts. So, I manually set the font for every control. But, because I was doing it manually, I overlooked some controls. Later, when I added new controls, I for got to set the font correctly every time. So, my fonts are inconsistent.

That's one reason why themes are great—they save you time and they let you define your own defaults.

After this lesson, you will be able to:

- Use themes to specify attributes for controls on a single page or an entire Web site.
- Use user profiles to track information about a user between visits.
- Dynamically add controls to a specific location on a Web page.

Estimated lesson time: 45 minutes

Using Themes

Typically, all the Web pages in a Web site have a set of properties in common, includ ing background color, font size and style, and foreground color. You can manually set the properties for every control on every page, but that isn't a good use of your time, and you'll probably overlook some settings.

Themes save you time and improve the consistency of a site by applying a common set of properties across all pages in a Web site or on a Web server to define the look of pages and controls. Basically, themes change the default appearance of controls. Themes can be made up of a set of elements:

- **Skins** Files with .skin extensions that contain property settings for buttons, labels, text boxes, and other controls. Skin files resemble control markups, but contain only the properties you want to define as part of the theme.
- **Cascading style sheets (CSS)** Files with .css extensions that ASP.NET automati cally applies to all pages.
- **Images and other resources** You can add images (such as a corporate logo) or other resources to themes as necessary.

However, many themes simply have skin files to set default attributes for controls. The sections that follow describe different ways you can use themes and show you how to implement them.

Applying Control Attributes for Themes with ASP.NET

When you use themes, attributes for controls could be defined in a standard or style sheet theme defined in the "@ Page" directive, in a standard or style sheet theme defined in the Web.config file, or in the control properties themselves. Within ASP.NET, attributes and elements take precedence in the following order:

1. *Theme* attribute in the "@ Page" directive.
2. *<pages Theme="themeName">* element in the Web.config file.
3. Local control attributes.
4. *StyleSheetTheme* attribute in the "@ Page" directive.
5. *<pages StyleSheetTheme="themeName">* element in the Web.config file.

In other words, if you specify a *Theme* attribute in the "@ Page" directive, settings in the theme override any settings you've specified for controls on the page. However, by simply changing the *Theme* attribute to *StyleSheetTheme*, the control-specific settings take precedent over the theme settings.

For example, this directive applies a theme that would override control properties. In other words, if *SampleTheme* specifies that *Label* controls use a red font, but you spec ify a blue font for a *Label* control, the Labels appear with red font:

```
<%@ Page Theme="SampleTheme" %>
```

This directive applies a style sheet theme. Any changes you make to local control prop erties override settings in the style sheet theme. Therefore, continuing the previous example, a blue *Label* control appears blue even if *SampleTheme* specifies that *Label* controls are red:

```
<%@ Page StyleSheetTheme="SampleTheme" %>
```

However, *Label* controls that do not have a color specified appear as red. In this regard, if you choose to use a style sheet theme, your theme's properties are overrid den by anything declared locally within the page. Similarly, if you use a standard theme (sometimes referred to as a "customization theme" in Microsoft Developer Net work [MSDN] documentation), your theme's properties override anything within the local page and anything within any style sheet theme in use.

You can also disable themes for a specific page by setting the *EnableTheming* attribute of the "@ Page" directive to *false*:

```
<%@ Page EnableTheming="false" %>
```

Similarly, to disable themes for a specific control, set the control's *EnableTheming* property to *false*.

Creating a Theme

It takes only a few minutes to create a theme. If you plan to use the theme only within a single Web application, create an application theme within your application folder. If you need to access the theme from multiple Web applications, you can create a glo bal theme instead. Once you have created your theme folders, add skin files and cas cading style sheets. The sections that follow describe how to do this.

Creating an Application Theme If you only need to access a theme from within a sin gle Web application, you should create the theme within your Web application fold ers. To create an application theme, follow these steps:

1. Create an App_Themes folder in your Web application. In Visual Studio, right-click your Web site in the Solution Explorer, select Add ASP.NET Folder, and then select Theme.
2. Within your App_Themes folder, create a subfolder with your theme name. For example, you could name the theme "RedTheme" or "BlueTheme." You use this name for both the folder name and when referencing the theme in page declara tions and configuration files. You can have multiple themes for a Web applica tion, as Figure 9-5 illustrates.

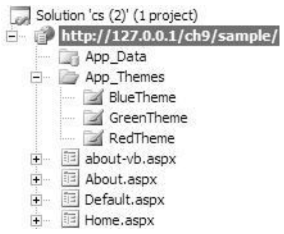


Figure 9-5 Create multiple themes by adding subfolders to the App_Themes folder.

3. Within your theme subfolder, add skin files, style sheets, and images that make up your theme.
4. In each page that you want to apply the skin to, add the *Theme* or *StyleSheetTheme* attribute to the "@ Page" directive. To apply the theme to an entire Web application, add the *<pages Theme="themeName">* element or the *<pages StyleSheetTheme="themeName">* element to the Web.config file.

Creating a Global Theme A global theme is available to all the Web sites on your Web server. To create a global theme, follow these steps:

Create a Themes folder using the path *iisdefaultroot*\aspnet_client\system_web\ver sion\Themes. For example, if the default Web root folder is in C:\Inetpub\wwwroot\ folder on the Web server and the version of the .NET Framework is 2.0.50727, the new Themes folder is C:\Inetpub\wwwroot\aspnet_client\system_web\2_0_50727 \Themes.

NOTE Using global themes with file-based Web site development

If you are creating a file-based Web site in your development environment, create the themes fold ers in the %windows%\Microsoft.NET\Framework\<*version*>\ASP.NETClientFiles\Themes folder.

1. Within your Themes folder, create a subfolder with your theme name.
2. Within your theme subfolder, add skin files, style sheets, and images that make up your theme. You can't do this directly with the Visual Web Developer; however, you can create a theme for a Web application and then move it to the global folder.
3. In each page that you want to apply the skin to, add the *Theme* or *StyleSheet-Theme* attribute to the "@ Page" directive. To apply the theme to an entire Web application, add the *<pages Theme="themeName">* element or the *<pages StyleSheetTheme="themeName">* to the Web.config file. The Visual Web Devel oper does not recognize the global theme name; however, ASP.NET processes it properly when you retrieve the page from IIS.

Quick Check

1. In which folder should you place themes for an application?
2. In which folder should you place global themes?

Quick Check Answers

1. Place themes for an application in the App_Themes folder.
2. Place global themes in the *iisdefaultroot*\aspnet_client\system_web\version \Themes folder.

Creating a Skin File Skin files are the most common theme components; they serve to define default settings for control appearance attributes. To create a skin file, create a .skin file in your theme folder with control and attribute definitions. A .skin file can contain several skins for multiple control types, or you can create a separate .skin file for each control.

There are two types of control skins:

- **Default skins** A default skin automatically applies to all controls of the same type when a theme is applied to a page. A control skin is a default skin if it does not have a *SkinID* attribute. For example, if you create a default skin for a *Calen dar* control, the control skin applies to all *Calendar* controls on pages that use the theme. Default skins are matched exactly by control type, so that a *Button* control skin applies to all *Button* controls, but not to *LinkButton* controls or to controls that derive from the *Button* object.
- **Named skins** A named skin is a control skin with a *SkinID* property set. Named skins do not automatically apply to controls by type. Instead, you explicitly apply a named skin to a control by setting the control's *SkinID* property. Creat ing named skins allows you to set different skins for different instances of the same control in an application.

The following is a control skin for a *Button* control that defines the foreground and background colors:

```
<asp:Button runat="server"
    BackColor="lightblue"
    ForeColor="black" />
```

Similarly, you can define other attributes, including font attributes:

```
<asp:Button runat="server"
    BackColor="Red"
    ForeColor="White"
    Font-Name="Arial"
    Font-Size="9px" />
```

Control skins are exactly like ASP.NET source code for the controls; however, skins never define the control IDs. The easiest way to create a skin file is to follow these steps:

1. Add controls to an .aspx file.
2. Specify the appearance of the controls using the Visual Studio designer.
3. Create a new skin file. To do this with Visual Studio 2005, right-click the name of your theme in Solution Explorer, select Add New Item, and then select the Skin File template.
4. Copy the source for the controls to the skin file.
5. Remove the ID properties from the control definitions in the skin file. Be sure to leave the *runat="server"* attribute.

Adding a Cascading Style Sheet to Your Theme A cascading style sheet (CSS) con tains style rules that are applied to elements in a Web page. CSS styles define how ele ments are displayed and where they are positioned on the page. Instead of assigning attributes to each element on your page individually, you can create a general rule that applies attributes whenever a Web browser encounters an instance of an element or an element that is assigned to a certain style class.

To add a CSS to your Web site, right-click the name of your theme in Solution Explorer, select Add New Item, and then select the Style Sheet template. When the theme is applied to a page, ASP.NET adds a reference to the style sheet to the head ele ment of the page.

MORE INFO Cascading Style Sheets

CSS is not part of ASP.NET; CSS works for any type of Web site. It isn't specifically covered in the exam objectives and won't be covered in detail in this book. However, CSS is still extremely useful, and all Web developers should be familiar with CSS. For more information about CSS, see "Cascad ing Style Sheets Overview" at *http://msdn2.microsoft.com/en-US/library/240ww6sz(VS.80).aspx*.

Applying a Theme Programmatically

If you just want to provide a consistent appearance for your Web site, you should spec ify a theme in page declarations or configuration files. This provides a single interface for all users who visit your Web site.

You can also give users a choice of themes. While this isn't usually necessary for busi ness Web sites, it's a great way to allow users to customize consumer-oriented portal, forum, and shopping sites.

To apply a theme programmatically, set the page's *Theme* property in the *Page_PreInit* method. The following code demonstrates how to set the theme based on a query string value; however, this works equally well using cookies or session state:

```
'VB
Protected Sub Page_PreInit(ByVal sender As Object, ByVal e As System.EventArgs) _
            Handles Me.PreInit
     Select Case Request.QueryString("theme")
            Case "Blue"
                  Page.Theme = "BlueTheme"
            Case "Pink"
                  Page.Pink = "PinkTheme"
     End Select
End Sub

//C#
Protected void Page_PreInit(object sender, EventArgs e)
{
     switch (Request.QueryString["theme"])
      {
            case "Blue":
                  Page.Theme = "BlueTheme";
                  break;
            case "Pink":
                  Page.Theme = "PinkTheme";
                  break;
      }
}
```

Similarly, you can apply a theme to specific controls by setting the control's *SkinID* property in the *Page_PreInit* method. The following code shows how to set the skin for a control named *Calendar1*:

```
'VB
Sub Page_PreInit(ByVal sender As Object, ByVal e As System.EventArgs) _
            Handles Me.PreInit
     Calendar1.SkinID = "BlueTheme"
End Sub
```

```
//C#
void Page_PreInit(object sender, EventArgs e)
{
      Calendar1.SkinID = "BlueTheme";
}
```

To programmatically apply a style sheet theme (which works just like a theme but doesn't override control attributes), override the *StyleSheetTheme* property, and in the *Get* accessor, return the name of the style sheet theme. The following code example shows how to set a theme named BlueTheme as the style sheet theme for a page:

```
'VB
Public Overrides Property StyleSheetTheme() As String
     Get
        Return "BlueTheme"
     End Get
     Set(ByVal value As String)
     End Set
End Property

//C#
public override String StyleSheetTheme
{
  get { return "BlueTheme"; }
}
```

Using User Profiles

You can provide users with a custom experience in your Web site by defining and using profile properties, which you can use to track user information (address, city), preferences (color scheme, list of stocks to follow), or any custom information required by your application (shopping cart). Once you define profile properties, ASP.NET automatically associates individual instances of the profile properties with each user, and you can use code to set or get the values. ASP.NET persists property val ues in a data store (which you can configure), and the next time a user visits your site, ASP.NET automatically retrieves the profile property value for that user.

The sections that follow describe different ways you can utilize *user profiles* and shows you how to implement profiles.

Configuring the SQL Server Database

Though you can create your own ASP.NET profile provider, by default, ASP.NET stores profile information in a SQL Server database using the *SqlProfileProvider* class. If you are using a SQL Server 2005 Express Edition database that is installed using the default configuration on the same computer as the Web server (as it might be on your development computer), you don't need to do anything to configure the database.

However, if you are using a different database, such as the standard SQL Server 2005, you must create a database to be used by the *SqlProfileProvider*. You can create the data base by running the Aspnet_regsql.exe command, which is found in the following path:

```
%windows%\Microsoft .NET\Framework\<version>
```

When you run the tool, you specify the -Ap option. The following command shows the syntax that you use to create the database required to store ASP.NET profiles using the *SqlProfileProvider*:

```
aspnet_regsql.exe -Ap
```

Comparing Authenticated and Anonymous Profiles

You can use profiles with either authenticated or non-authenticated users. If your Web application requires user authentication, you can immediately begin using pro files, because profiles are automatically enabled for authenticated users.

MORE INFO Authentication

For more information about user authentication, read Chapter 11, "Implementing Authentication and Authorization."

To use profiles on a site that does not authenticate users, you must explicitly enable profiles. After you enable anonymous profiles, ASP.NET creates a unique identification for each user the first time he or she visits your site, and tracks the user with a cookie. The cookie is set to expire about 70 days after the user last visited your site. User pro files can also function without cookies by storing unique identifiers in the URL of the page request; however, the profile is lost when the user closes his or her browser.

Enabling Anonymous User Profiles

To use profiles for unauthenticated users, you first enable profiles in your Web.config file. To do this, add an *<anonymousIdentification>* element to your <system.web> section and set the *enabled* attributes to *true*, as is demonstrated here:

```
<configuration>
  <system.web>
      <anonymousIdentification enabled="true" />
  </system.web>
</configuration>
```

The <*anonymousIdentification*> element has several other attributes that you can define to control how cookies are used. However, the defaults are typically sufficient. Additionally, when you define properties, you must set the *allowAnonymous* attribute for each property to *true*.

Migrating Anonymous User Profiles to Authenticated User Profiles

If you enable anonymous user profiles and later require authentication, ASP.NET cre ates a new profile for the user. To avoid losing the user's profile information, respond to the *MigrateAnonymous* event which ASP.NET raises when the user logs in. The fol lowing code demonstrates how to migrate information when a user is authenticated:

```
'VB
Public Sub Profile_OnMigrateAnonymous(sender As Object, args As ProfileMigrateEventArgs)
    Dim anonymousProfile As ProfileCommon = Profile.GetProfile(args.AnonymousID)

    Profile.ZipCode = anonymousProfile.ZipCode
    Profile.CityAndState = anonymousProfile.CityAndState
    Profile.StockSymbols = anonymousProfile.StockSymbols

    ' Delete the anonymous profile. If the anonymous ID is not
    ' needed in the rest of the site, remove the anonymous cookie.
    ProfileManager.DeleteProfile(args.AnonymousID)
    AnonymousIdentificationModule.ClearAnonymousIdentifier()
End Sub

//C#
public void Profile_OnMigrateAnonymous(object sender, ProfileMigrateEventArgs args)
{
    ProfileCommon anonymousProfile = Profile.GetProfile(args.AnonymousID);

    Profile.ZipCode = anonymousProfile.ZipCode;
    Profile.CityAndState = anonymousProfile.CityAndState;
    Profile.StockSymbols = anonymousProfile.StockSymbols;

    // Delete the anonymous profile. If the anonymous ID is not
    // needed in the rest of the site, remove the anonymous cookie.

    ProfileManager.DeleteProfile(args.AnonymousID);
    AnonymousIdentificationModule.ClearAnonymousIdentifier();
}
```

Configuring Profile Properties

Before you can use profiles, you must first define the properties that you want to track for each user in the Web.config file. For example, if you want to track the user's first and last name in string values, and the date he or she first visited the site in a *DateTime* object, the <profile> section of the configuration file could look like this:

```
<configuration>
 <system.web>
     <profile>
         <properties>
          <add name="FirstName" />
          <add name="LastName" />
          <add name="FirstVisit" type="System.DateTime" />
         </properties>
     </profile>
 </system.web>
</configuration>
```

Notice that you don't have to explicitly declare the type for string values, but you do need to set the *type* attribute for any other class. By default, each property is enabled only for authenticated users. To enable properties to be used by anonymous users, set the *allowAnonymous* attribute to *true* for each property:

```
<anonymousIdentification enabled="true" />
<profile>
 <properties>
    <add name="FirstName" allowAnonymous="true" />
    <add name="LastName" allowAnonymous="true" />
    <add name="FirstVisit" type="System.DateTime" allowAnonymous="true" />
 </properties>
</profile>
```

You can also define groups of properties, as the following configuration segment dem onstrates:

```
<profile enabled="true">
 <properties>
    <group name="Address">
     <add name="Street" />
     <add name="City" />
     <add name="PostalCode" />
    </group>
 </properties>
</profile>
```

In this example, you could access the street using *Profile.Address.Street*.

MORE INFO Adding user-defined types to profile properties

You can also add custom classes to profiles. For more information, read "Defining ASP.NET Profile Properties" at *http://msdn2.microsoft.com/en-us/library/d8b58y5d(VS.80).aspx*.

Defining and Retrieving User Properties

Once you've configured which properties you want to track for users, you can pro grammatically define and retrieve these values using the *Profile* object, as the follow ing example shows:

```
'VB
Profile.FirstName = firstNameTextBox.Text
Profile.LastName = lastNameTextBox.Text
greetingTextBox = "Welcome, " + Profile.FirstName + " " + Profile.LastName

//C#
Profile.FirstName = firstNameTextBox.Text;
Profile.LastName = lastNameTextBox.Text;
greetingTextBox = "Welcome, " + Profile.FirstName + " " + Profile.LastName;
```

Using profiles in this way is extremely easy compared to the alternatives, because you do not need to explicitly determine who the user is nor perform any database look ups. Simply getting the property value out of a profile causes ASP.NET to perform the necessary actions to identify the current user and look up the value in the persistent profile store.

Dynamically Adding Controls

Another way to customize Web pages for users is to dynamically add controls. While you can add controls programmatically, the task is greatly simplified if you add a *PlaceHolder* control at design time. To use a *PlaceHolder* control to enable you to dynamically add other controls, follow these steps:

1. Add a *PlaceHolder* control to your Web page.
2. In your code (typically the *Page_Load* event handler), create an instance of the control you want to add to the page.
3. Call the *PlaceHolder*.*Controls*.*Add* method to add your control to the *Place-Holder*'s location.

You can even add multiple controls using a single *PlaceHolder*, which is useful for building more complex dynamic pages. The following code demonstrates this by add ing a Button, a Label containing an HTML line break, and then a second Button:

```
'VB
Protected Sub Page_Load(ByVal sender As System.Object, _
        ByVal e As System.EventArgs) Handles MyBase.Load
    Dim Button1 As Button = New Button()
    Button1.Text = "Button 1"
    PlaceHolder1.Controls.Add(Button1)
    Dim Literal1 As New Literal()
    Literal1.Text = "<br>"
    PlaceHolder1.Controls.Add(Literal1)

    Dim Button2 As New Button()
    Button2.Text = "Button 2"
    PlaceHolder1.Controls.Add(Button2)
End Sub

//C#
void Page_Load(object sender, EventArgs e)
{
    Button Button1 = new Button();
    Button1.Text = "Button 1";
    PlaceHolder1.Controls.Add(Button1);

    Literal Literal1 = new Literal();
    Literal1.Text = "<br>";
    PlaceHolder1.Controls.Add(Literal1);

    Button Button2 = new Button();
    Button2.Text = "Button 2";
    PlaceHolder1.Controls.Add(Button2);
}
```

Lab: Applying Themes and User Profiles

In this lab, you work with local and global themes, and then track information about users in profiles.

� **Exercise 1: Apply local and global themes**

In this exercise, you create two local themes to color buttons and labels: blue and green. You will test the themes, move them to the global location, and verify that they still work.

1. Create a new ASP.NET Web site named MyThemes in either C# or Visual Basic using Visual Studio 2005. Use Hypertext Transfer Protocol (HTTP) to store the files on a Web server (such as IIS installed on your local computer), rather than storing the Web site on your file system.
2. Add the App_Themes folder to your Web site and add two subfolders: BlueTheme and GreenTheme.
3. In both BlueTheme and GreenTheme, create skin files named Button.skin and Label.skin. Solution explorer should resemble Figure 9-6.

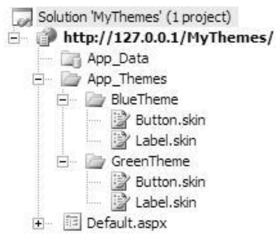


Figure 9-6 Create skin files for *Label* and *Button* controls in two custom themes.

4. Open Default.aspx in design view and add a *Label* and a *Button* control.
5. Edit the properties of the two controls so that they have dark blue text on a light blue background.
6. Switch to the source view of Default.aspx and copy the source code for your *Label* control to the clipboard.
7. Open the App_Themes\BlueTheme\Label.skin file. Paste the source code for your *Label* control into the file. Then remove the ID and Text attributes, as shown here:

```
<asp:Label runat="server" BackColor="#C0FFFF" ForeColor="#0000C0"></asp:Label>
```

8. Switch to the source view of Default.aspx and copy the source code for your *But ton* control to the clipboard.
9. Open the App_Themes\BlueTheme\Button.skin file. Paste the source code for your *Button* control into the file. Then remove the *ID* and *Text* attributes, as shown here:

```
<asp:Button runat="server" BackColor="#C0FFFF" ForeColor="#0000C0" />
```

10. Repeat steps 5 through 9, but define green colors for the *Label* and *Button* con trols and use the source code to create the Label.skin and Button.skin files in the GreenTheme.
11. Add a new Web Form to your application and name it Home.aspx. Add default *Label* and *Button* controls to the form. Then press Ctrl+F5 to save your files and view Home.aspx in your browser. Note that the *Label* and *Button* controls both appear with black text on a white background.
12. In the design view for Home.aspx, view the document properties and set the *StyleSheetTheme* attribute to BlueTheme. Then change the foreground color of the *Button* control to Red. Press Ctrl+F5 to save your files and view Home.aspx in your browser. Note that the style sheet theme affects both the foreground and background colors of the *Label* control, but it does not change the red text of the

Button control. Because you defined the foreground color of the *Button* control, the setting overrode the *StyleSheetTheme*.

13. In the design view for Home.aspx, view the document properties, remove the *StyleSheetTheme* attribute, and set the *Theme* attribute to BlueTheme. Press Ctrl+F5 to save your files and view Home.aspx in your browser. Note that the theme affects both the foreground and background colors of both controls, because the *Theme* attribute overrides control settings.
14. Using Windows Explorer, create a folder at the following location on your Web server: \wwwroot\aspnet_client\system_web\<*version*>\Themes. Move both the BlueTheme and GreenTheme folders from your application directory to this new global theme folder.
15. Now return to Visual Studio and press Ctrl+F5 to view Home.aspx in your browser. Note that the two controls are still affected by BlueTheme. Because the themes are now located in a global theme folder, any Web application can apply the theme.
16. View the source for Home.aspx, and look at the "@ Page" declaration. Manually change the *Theme* attribute to GreenTheme. You could also change this attribute using the designer. Now press Ctrl+F5 to view Home.aspx in your browser and verify that the controls are colored green.

As this exercise demonstrates, it takes only a few minutes to customize the appear ance of all controls in a Web application.

Exercise 2: Create anonymous user profiles

In this exercise, you enable user profiles for anonymous users and track information for Web site visitors.

1. Create a new ASP.NET Web site named TrackUsers in either C# or Visual Basic using Visual Studio 2005. For simplicity, store the Web site using the file system instead of HTTP or File Transfer Protocol (FTP).
2. If necessary, add a Web.config file to your project. Then configure it to enable anonymous user profiles. For example, you can use this Web.config file:

```
<configuration>
  <system.web>
        <anonymousIdentification enabled="true" />
  </system.web>
</configuration>
```

3. Edit the Web.config file to enable the following profile attributes:
   a. Name, as a String
   b. FirstVisit, as a DateTime object

Then save the Web.config file so that the properties are immediately available in Visual Studio. The following Web.config example demonstrates this:

```
<configuration>
 <system.web>
      <anonymousIdentification enabled="true" />
      <profile>
        <properties>
              <add name="Name" allowAnonymous="true" />
              <add name="FirstVisit" type="System.DateTime" allowAnonymous="true" />
        </properties>
      </profile>
 </system.web>
</configuration>
```

4. Add the following controls to the Default.aspx Web form:
   a. *TextBox* with an ID of nameTextBox.
   b. *Label* with an ID of greetingLabel. Remove the default text.
   c. *Button* with an ID of Button1.
5. Now create a method named *Greet_User* in the Default.aspx code-behind file to define the user's first visit if it hasn't already been defined, and then display the user's name and first visit time using the *greetingLabel* control. The following code demonstrates one way to do this:

```
'VB
Protected Sub Greet_User()
'Check if the user's name is defined, and greet him or her if it is
      If Profile.Name.Length > 0 Then
              greetingLabel.Text = "Welcome, " + Profile.Name + "! "
       Else
              greetingLabel.Text = "Welcome, unidentified user! "
      End If

'Define the first visit time if necessary
      If Profile.FirstVisit.Year < 1900 Then
              Profile.FirstVisit = DateTime.Now
      End If

'Display the first visit time
      greetingLabel.Text += "Your first visit was " + Profile.FirstVisit
End Sub

//C#
protected void Greet_User()
{
      // Check if the user's name is defined, and greet him or her if it is
      if (Profile.Name.Length > 0)
              greetingLabel.Text = "Welcome, " + Profile.Name + "! ";
       else
              greetingLabel.Text = "Welcome, unidentified user! ";
```

```
    // Define the first visit time if necessary
    if (Profile.FirstVisit.Year < 1900)
        Profile.FirstVisit = DateTime.Now;

    // Display the first visit time
    greetingLabel.Text += "Your first visit was " + Profile.FirstVisit;
}
```

6. If you are using Visual Basic, edit the Default.aspx "@ Page" declaration to set the *AutoEventWireup* attribute to *true*. This is set to *true* by default in C#. This dem onstrates the proper "@ Page" declaration:

```
<%@ Page Language="VB" AutoEventWireup="true" CodeFile="Default.aspx.vb"
Inherits="_Default" %>
```

7. In the *Page_Load* method (which you need to create if you are using Visual Basic), call your *Greet_User* method.

```
'VB
Protected Sub Page_Load()
    Greet_User()
End Sub

//C#
protected void Page_Load(object sender, EventArgs e)
{
    Greet_User();
}
```

8. Using the design view for the Default.aspx file, double-click the button to create a *Click* event handler. In the event handler, use the contents of the *nameTextBox* control to define *Profile.Name*. Then call *Greet_User*. The following code demon strates this:

```
'VB
Protected Sub Button1_Click(ByVal sender As Object, ByVal e As System.EventArgs) Handles
Button1.Click
    Profile.Name = nameTextBox.Text
    Greet_User()
End Sub

//C#
protected void Button1_Click(object sender, EventArgs e)
{
    Profile.Name = nameTextBox.Text;
    Greet_User();
}
```

9. Press Ctrl+F5 to build your Web page. Verify that the Web page greets you as an unidentified user and displays the current time as your first visit.

10. In the text box, type your name. Then click the button. The Web page displays your name and first visit time.

11. Verify that the profile persists between user visits. Close all instances of your Web browser, and then re-open the Web page. It greets you with your name and the time of your first visit.

12. In Window Explorer, open the App_Data application subdirectory. Note that it contains two files: Aspnetdb.mdf (the main SQL Server user profile database) and Aspnetdb_log.ldf (the database log file).

As you can see, user profiles are easy to implement, but extremely powerful.

Chapter 11

Implementing Authentication and Authorization

When the Web was young, most Web sites were public spaces that did not require users to identify themselves. Today, most Web sites allow users to authenticate so that the users can gain access to private information, site customization, and members-only features.

With the Microsoft .NET Framework version 2.0, adding user-management capabili ties to a Web application is easier than ever. As with earlier versions of the .NET Framework, ASP.NET integrates with Windows security, allowing users to authenti cate automatically with their Windows or Active Directory user names and pass words. New to the .NET Framework is a set of Login controls and the *Roles* and *Membership* classes. Together, these tools enable you to build simple user manage ment into a Web application without writing a line of code, or, you can provide com plex, customized user management by building on the framework.

Exam objectives in this chapter:

- Establish a user's identity by using forms authentication.
  - Configure forms authentication for a Web application by using a configu ration file.
  - Enable cookieless forms authentication by setting the *cookieless* attribute.
  - Use membership APIs and the *Membership* class to manage users.
  - Enable anonymous identification.
- Use authorization to establish the rights of an authenticated user.
  - Manage roles in the Web Site Administration Tool.
  - Ascertain whether a specific user is in a role.
  - Determine the roles for a specific user by using the *Roles* object or the *User* object.
  - Store role information in a cookie.

- Restrict access to files by using file authorization.
- Restrict access to portions of an application by using URL authorization.

- Implement Microsoft Windows authentication and impersonation.
  - Establish a user's identity by using Windows authentication.
  - Use impersonation to control access to resources.
- Use login controls to control access to a Web application.
  - Use the *Login* Web server control.
  - Use the *LoginView* Web server control to view a user's login status.
  - Use the *PasswordRecovery* Web server control to allow a user to recover a password.
  - Use the *LoginStatus* Web server control to display either a login or logout link.
  - Use the *LoginName* Web server control to display a user's login name on a Web page.
  - Use the *CreateUserWizard* Web server control as a UI for creating new Web application user accounts.
  - Use the *ChangePassword* Web server control to allow a user to change his or her password.
  - Specify the membership provider used for logging on.
  - Configure a mail server so that login controls can be used to send e-mail messages to users.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with Visual Basic (VB) or C# and be comfortable with the following tasks:

- Have Microsoft Windows XP and Microsoft Visual Studio 2005 installed with Microsoft SQL Server 2005 Express Edition.
- Be familiar with the Visual Studio 2005 Integrated Development Environment (IDE).
- Have a basic understanding of Hypertext Markup Language (HTML) and client-side scripting.

Real World

Tony Northrup

People are going to try to hack into your application. It happens to everyone. Even if your data isn't all that important, script kiddies (people who use auto mated tools to attempt to exploit security vulnerabilities) will explore your Web server and Web site.

For that reason, you must create all Web applications with security in mind. If you assume your site will be attacked, your odds of avoiding a compromise are much greater.

Lesson 1: Using ASP.NET Membership

The .NET Framework version 2.0 includes ASP.NET membership, which makes it easy to add user-management capabilities to your Web site. ASP.NET membership includes several different features:

- Wizard-based configuration of user-management capabilities.
- Browser-based user management and access control configuration.
- A set of ASP.NET controls that provides users with the ability to log in, log out, create new accounts, and recover lost passwords.
- The *Membership* and *Roles* classes, which you can use to access user-manage ment capabilities within your code.

This lesson describes these features and shows you how to use them in your own Web applications.

MORE INFO Protecting Web servers

This chapter strives to provide the information that you need to maximize the security of your Web applications. The topic of improving security for Web servers is massive, and most of the burden of protection falls on the shoulders of system administrators. For more information about protecting servers, read "Securing Your Web Server" in Microsoft Developer Network (MSDN) on the Microsoft Web site at *http://msdn.microsoft.com/library/en-us/secmod/html/secmod89.asp*. For more informa tion about protecting ASP.NET applications, read "Building Secure ASP.NET Applications: Authenti cation, Authorization, and Secure Communication" at *http://msdn.microsoft.com/library/en-us/dnnetsec/html/SecNetch08.asp*.

After this lesson, you will be able to:

- List the login controls and describe each control's purpose.
- Describe how the *Membership* class can be used.
- Describe how the *Roles* class can be used.
- Configure an ASP.NET Web application to support user management.

Estimated lesson time: 45 minutes

Login Controls

ASP.NET version 2.0 provides controls, classes, and management tools for authenti cating users with Web forms and then storing user information in a database, enabling you to track and authenticate users without relying on Active Directory or the Windows local user database. Before the .NET Framework version 2.0 was released, custom user *authentication* required creating many complex components from scratch, including:

- A login page.
- A user database.
- User-management tools.
- Password-management tools.

Creating these components was once very time-consuming. Additionally, it was risky to create these components from scratch, because a bug could compromise your application's security.

The .NET Framework includes controls and classes to simplify the process of adding login capabilities to your Web application. The login controls include:

- ***Login*** A user interface that prompts for user names and passwords and enables users to select whether they want to be automatically authenticated the next time they visit. You can use the *Login* control with ASP.NET membership without writing any code, or you can write your own authentication code by adding a handler for the *Authenticate* event.
- ***LoginView*** Enables you to display different information to users who are logged in. For example, you could use this link to go to site features that are available only to authenticated users.
- ***LoginStatus*** Displays a login link for users who haven't been authenticated and a logout link for users who are currently logged in.
- ***LoginName*** Displays the current user's user name, if logged in.
- ***PasswordRecovery*** Enables password retrieval for a user by sending an e-mail message to the user or by having the user answer a security question.
- ***CreateUserWizard*** Gathers information from a new user and creates a new account.
- ***ChangePassword*** Enables a user who is logged in to change his or her password.

Additionally, you can use a *ValidationSummary* control to display detailed error infor mation provided by some of these controls.

The functionality built into these controls enables you to create a Web site that enables users to create their own accounts, change and reset their passwords, and log on and log off without writing any code. Additionally, administrators can use the ASP.NET Web Site Administration Tool to manage user accounts and security settings from a Web browser without understanding how the underlying Web.config files work.

Quick Check

1. Which control would you use to provide a login link?
2. Which login controls are useful only to authenticated users?

Quick Check Answers

1. The *LoginStatus* control.
2. The *LoginName*, *ChangePassword*, and *LoginView* controls.

The *Membership* Class

There are several classes and interfaces for user management; however, the most important class is the *System.Web.Security.Membership* class.

NOTE .NET 2.0

The *Membership* class is new in the .NET Framework version 2.0.

Membership provides capabilities to add, remove, and find users. These capabilities are provided by the following static methods:

- ***CreateUser*** Adds a user to the database. Use this method if you create a custom page to enable users or administrators to add new accounts.
- ***DeleteUser*** Removes a user from the data store. Use this method if you create custom user management tools.
- ***FindUsersByEmail*** Gets a collection of membership users for whom the e-mail addresses contain the specified e-mail addresses to match.
- ***FindUsersByName*** Gets a collection of membership users for whom the user names contain the specified user names to match.
- ***GeneratePassword*** Creates a random password of the specified length. Use this if you are implementing custom controls to generate or reset passwords.
- ***GetAllUsers*** Returns a collection of all users in the database.
- ***GetNumberOfUsersOnline*** Returns the number of users currently logged on.

- ***GetUser*** Returns a *MembershipUser* object representing the current logged-on user. Call this method any time you need to access the current user's account.
- ***GetUserNameByEmail*** Gets a user name for which the e-mail address for the user matches the specified e-mail address.
- ***UpdateUser*** Updates the database with the information for the specified user. Use this method if you create a page to enable users or administrators to modify existing accounts.
- ***ValidateUser*** Verifies that the supplied user name and password are valid. Use this method to check a user's credentials if you create your own custom login controls.

The *Roles* Class

Role management consists of a set of classes and interfaces that establish roles for the current user and manage role information. In ASP.NET user management, roles func tion as user groups, enabling you to assign access controls to all users who are part of a specific role. The most useful of these classes is *System.Web.Security.Roles,* which pro vides capabilities to add users to or remove users from roles, create new roles, and determine which roles a user is a member of.

NOTE .NET 2.0

The *Roles* class is new in the .NET Framework 2.0.

Roles provides many static methods, including the following:

- ***AddUserToRole*, *AddUsersToRoles*, *AddUsersToRole*, and *AddUsersToRoles*** Adds a user to a role
- ***CreateRole*** Creates a new role
- ***DeleteRole*** Deletes an existing role
- ***FindUsersInRole*** Returns a collection of users in a role
- ***GetAllRoles*** Returns a collection of all roles that currently exist
- ***GetRolesForUser*** Returns a collection of roles for the current user
- ***IsUserInRole*** Returns true if the user is a member of a specified role
- ***RemoveUserFromRole*, *RemoveUsersFromRole*, *RemoveUserFromRoles*, and *RemoveUsersFromRoles*** Removes a user from a role

For example, if you want to add the current user to a role named Users, you could use the following code (assuming an instance of *CreateUserWizard* is named *CreateUserWizard1*):

```
'VB
Roles.AddUserToRole(CreateUserWizard1.UserName, "Users")

//C#
Roles.AddUserToRole(CreateUserWizard1.UserName, "Users");
```

You cannot use the *Roles* class to manage Windows user groups when using Windows authentication. Windows authentication is discussed in more detail in Lesson 2 of this chapter.

Ideally, you structure your Web application so that you can control access by config uring *authorization* for subfolders using the ASP.NET Web Site Administration Tool (described later in this lesson). This capability, combined with the built-in login con trols, can enable you to create your Web application without using either the *Member ship* class or the *Roles* class. However, you should be familiar with these classes and their functions so that you can provide customized user-management capabilities when required.

Configuring Web Applications to Use ASP.NET Membership

To create a Web site that uses ASP.NET membership, follow these high-level steps:

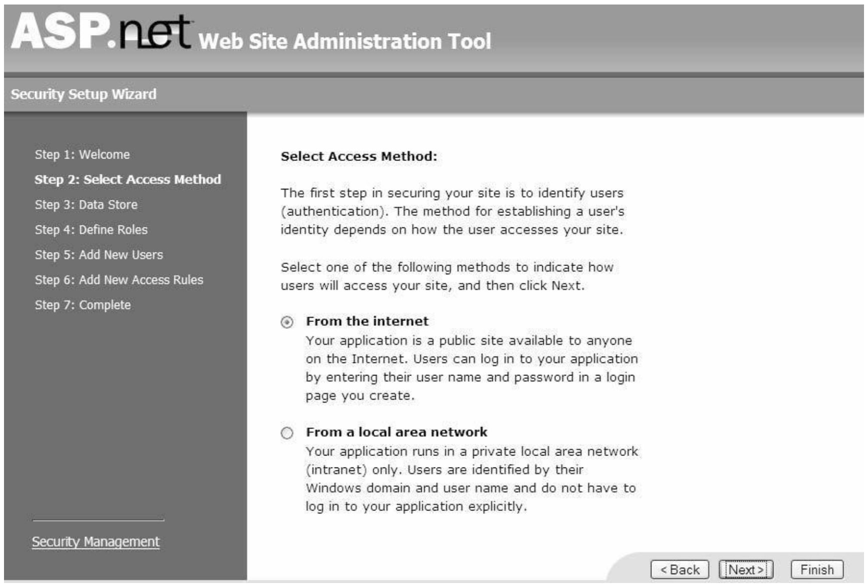
1. Create a Web site structure. If a portion of your Web site requires authentication or membership in a specific role, place the pages that should be protected in a separate subfolder. If authentication is optional (for example, a user forum where unauthenticated users can browse but not add messages), a separate sub-folder is not required.
2. Configure ASP.NET Membership.
3. Create roles that function as user groups.
4. Optionally, create users and add them to the appropriate roles.
5. Create access rules to control which folders users and roles have access to.
6. Configure Simple Mail Transport Protocol (SMTP) e-mail settings to enable e-mail notification and password resetting. You can do this from the Application tab of the ASP.NET Web Site Administration Tool.
7. Create login pages using Visual Studio.

The sections that follow describe these steps in more detail.

Configuring ASP.NET Membership

To configure ASP.NET membership by using the Web Site Administration Tool, follow these steps:

1. Create an ASP.NET Web application using Visual Studio. If you plan to have sep arate subfolders for different groups (for example, a folder that only authenti cated users are allowed to access, or a folder for application administration tool pages), create those folders first.
2. On the Website menu, select ASP.NET Configuration.
3. Select the Security tab and click the Use The Security Setup Wizard To Configure Security Step By Step link.
4. In Step 1, click Next.
5. In Step 2, select From The Internet to use ASP.NET membership (as shown in Figure 11-1) or select From A Local Area Network to use Windows authentica tion. Click Next.



Select Access Method:

The first step in securing your site is to identify users (authentication). The method for establishing a user's identity depends on how the user accesses your site.

Select one of the following methods to indicate how users will access your site, and then click Next.

[✓ **From the internet**]
Your application is a public site available to anyone on the Internet. Users can log in to your application by entering their user name and password in a login page you create.

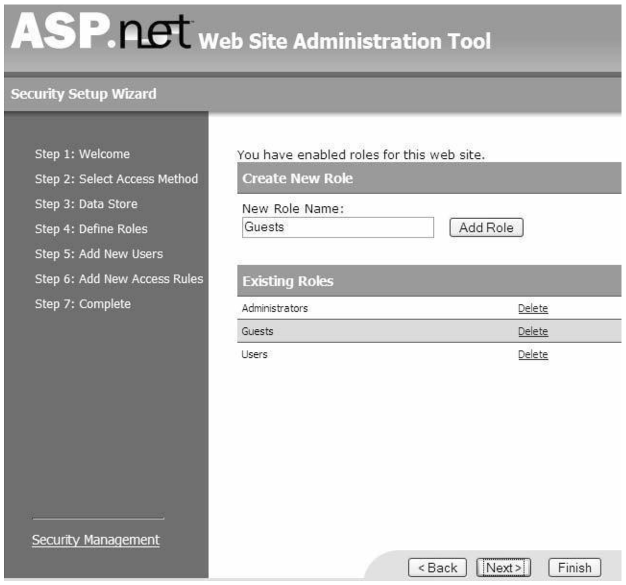
From a local area network
Your application runs in a private local area network (intranet) only. Users are identified by their Windows domain and user name and do not have to log in to your application explicitly.

Figure 11-1 Choose From The Internet to create a custom user database or From A Local Area Network to use Windows authentication.

6. In Step 3, the wizard displays a message stating that user information will be stored using Advanced Provider Settings. By default, membership information is stored in a Microsoft SQL 2005 Server Express Edition database file in the

App_Data folder of your Web site. Click Next.

7. In Step 4, the wizard displays an option to create roles. Roles are essentially group memberships, and you'll need them for most membership scenarios. To enable roles, select the Enable Roles For This Web Site check box. Then click Next.
8. If you choose to enable roles, the wizard displays a page where you can create roles. For example, you might create roles for Users and Administrators, as shown in Figure 11-2. When you have created any roles you need, click Next.



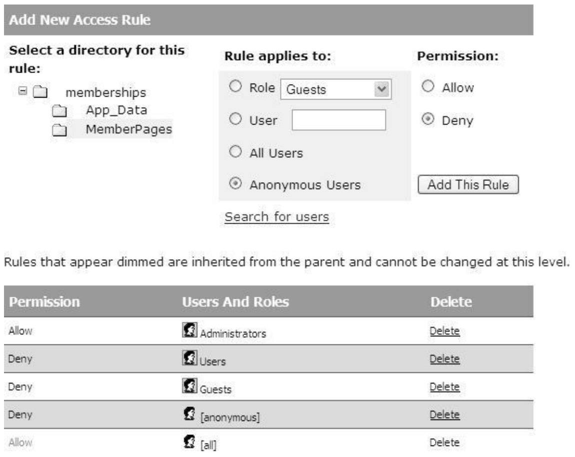
You have enabled roles for this web site.

New Role Name: Guests

Administrators	Delete
Guests	Delete
Users	Delete

Figure 11-2 Create roles to group users into categories.

9. In Step 5, you can create user accounts by entering the requested information and then clicking Create User. You can also add user accounts later. When you have created any user accounts you need, click Next.
10. In Step 6, add access rules to control which users and roles can access which folders. Figure 11-3 illustrates rules restricting access to folders. When you have added your access rules, click Next.



Add New Access Rule

Select a directory for this rule:

- memberships
  - App_Data
  - MemberPages

Rule applies to:

- Role: Guests
- User
- All Users
- [✓ Anonymous Users]

Search for users

Permission:

- Allow
- [✓ Deny]

Add This Rule

Rules that appear dimmed are inherited from the parent and cannot be changed at this level.

Permission	Users And Roles	Delete
Allow	Administrators	Delete
Deny	Users	Delete
Deny	Guests	Delete
Deny	[anonymous]	Delete
Allow	[all]	Delete

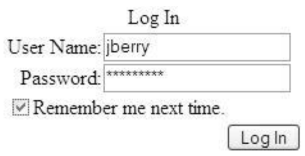
Figure 11-3 Add access rules to restrict access to folders.

11. In Step 7, click Finish. You return to the Security tab of the Web Site Administra tion Tool, where you can manage users, roles, and access rules.

Creating a Login Page

To create a login page, follow these steps:

1. Create a login page named Login.aspx. If you use another file name, you will need to configure the new file name in your Web.config file. For more informa tion about configuring forms authentication, read Lesson 2 in this chapter.
2. On your login page, add a *Login* control. The *Login* control prompts the user for his or her credentials, as shown in Figure 11-4. The *Login* control includes fea tures such as validation to ensure the user types a password.



Log In

User Name: jberry

Password: *********

[✓] Remember me next time.

Log In

Figure 11-4 The *Login* control prompts the user for credentials.

MORE INFO **Changing the appearance of controls**

You can use templates to change the appearance of login controls. For more information, refer to Chapter 9, "Customizing and Personalizing a Web Application."

3. Add a *ValidationSummary* control to your login page and set the *ValidationSum mary.ValidationGroup* property to the ID of your *Login* control. This describes detailed error messages in the event the user forgets to type his or her password, or if another validation event occurs. For example, if a user forgets to type the password, the *Login* control displays a red asterisk by the Password field. If you add a *ValidationSummary* control, it displays the message "Password is required." Invalid credential errors display in the *Login* control itself, but not in the *Valida tionSummary* control.
4. Optionally, add a *PasswordRecovery* control to the login page. If a user forgets his or her password, this control enables the user to type his or her user name and receive a new, random password via e-mail, as shown in Figure 11-5. Optionally, users can be required to answer a security question.

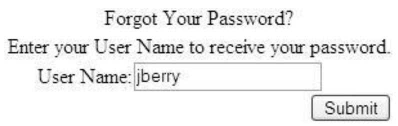

Forgot Your Password?
Enter your User Name to receive your password.
User Name: jberry

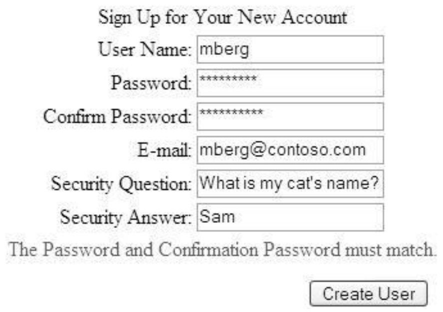
Figure 11-5 The *PasswordRecovery* control can send e-mail to users who request their passwords.

5. Add a *LoginStatus* control to all pages of your site. The *LoginStatus* control gives users a link to access your login page if they have not yet authenticated. If you are using master pages, add the *LoginStatus* control to your master page.
6. That's all you have to do if you are using ASP.NET membership and you plan to handle user management by using the Web Site Administration Tool, because the *Login* control automatically handles authentication. If the user provides valid credentials, the user is logged in, and membership controls such as *LoginStatus* automatically reflect that.
7. If the user does not provide valid credentials, the *Login* control prompts to retype the password. You should create a handler for the *Login.LoginError* event and perform security auditing by adding an event to the Security event log. Sim ilarly, you should respond to the *PasswordRecovery.UserLookupError* and *Passwor dRecovery.AnswerLookupError* events. Otherwise, users can guess passwords and user names without administrators discovering it.

Creating a User Account-Creation Page

If you are creating a public Web application, you should create an account-creation page to enable users to add their own user accounts. To create a user account-creation page, follow these steps:

1. Create a user account-creation page. For example, you might name it NewUser.aspx.
2. On your user account-creation page, add a *CreateUserWizard* control. The *Cre ateUserWizard* control prompts the user for user name, password, e-mail, security question, and security answer, as shown in Figure 11-6. The *CreateUserWizard* control includes features such as validation to ensure the user types a password.


Sign Up for Your New Account

User Name: mberg

Password: *********

Confirm Password: **********

E-mail: mberg@contoso.com

Security Question: What is my cat's name?

Security Answer: Sam

The Password and Confirmation Password must match.

Figure 11-6 The *CreateUserWizard* control enables users to create accounts for themselves.

3. Create a handler for *ContinueButtonClick* event. At a minimum, you should redi rect the user to a page linking to members-only content, as the following code demonstrates:

```
'VB
Protected Sub CreateUserWizard1_ContinueButtonClick(ByVal sender As Object, ByVal e As
EventArgs)
    Response.Redirect("Members/Default.aspx")
End Sub

//C#
protected void CreateUserWizard1_ContinueButtonClick(object sender, EventArgs e)
{
    Response.Redirect("Members/Default.aspx");
}
```

By default, new user accounts do not belong to any roles. To add a new user to a role (such as a default Users role), add a handler for the *CreateUserWizard.CreatedUser* event, and then call the *Roles.AddUserToRole* method as described earlier in this lesson.

Creating a Password Change Page

To create a page to allow users to change their own passwords, follow these steps.

1. Create an account-management page. For example, you might name it Man ageUser.aspx.
2. Add a *ChangePassword* control to the page.

3. Add a *ValidationSummary* control to your login page and set the *ValidationSum mary.ValidationGroup* property to the ID of your *ChangePassword* control. This describes detailed error messages in the event the user forgets to type his or her password, or another validation event occurs. For example, if a user forgets to complete the Confirm New Password field, the *ChangePassword* control displays a red asterisk by the Confirm New Password field. If you add a *ValidationSum mary* control, the *ValidationSummary* control displays the message "Confirm New Password is required." Invalid credential errors are displayed in the *Login* control itself, and not the *ValidationSummary* control, however.
4. Create a handler for *ContinueButtonClick* event. At a minimum, you should redi rect the user to a page linking to members-only content.

Lab: Configuring Authentication in ASP.NET Applications

In these exercises, you create an ASP.NET Web application and then configure it to restrict access using role manager.

� Exercise 1: Create a Web site that uses ASP.NET Memberships

In this exercise, you create a new ASP.NET Web site and add support for ASP.NET Memberships.

1. Create an ASP.NET Web application using Visual Studio.
2. Create two subfolders named Members and Admin. To each subfolder, add a blank ASP.NET Web form named Default.aspx. Later, you'll access these pages to verify that ASP.NET requires proper authentication.
3. On the Website menu, select ASP.NET Configuration.
4. Select the Security tab and click the Use The Security Setup Wizard To Configure Security Step By Step link.
5. On Step 1, click Next.
6. On Step 2, select the From The Internet option button. Then click Next.
7. On Step 3, click Next.
8. On Step 4, select the Enable Roles For This Web Site check box. Then click Next.
9. On the Create New Role page, create two roles: Users and Administrators. Then click Next.
10. On Step 5, create two users: StandardUser and Admin. Provide your e-mail address for each and make note of the passwords you assign. Then click Next.

11. On Step 6, select the Admin directory. Create a rule that grants the Administra tors role Allow access. Then create a rule that grants All Users Deny access. Note that the new Deny rule appears before the default Allow-All rule, which means users who are not members of the Administrators role have their access denied.
12. While still on Step 6, select the Members directory. Create a rule that grants the Users role Allow access. Then create a rule that grants All Users Deny access. Click Next.
13. On Step 7, click Finish.
14. You return to the Security tab of the Web Site Administration Tool. Click Create Or Manage Roles.
15. For the Administrator role, click Manage. Click All, and then select User Is In Role for Admin. Click Back.
16. For the Users role, click Manage. Click All, and then select User Is In Role for StandardUser and Admin. Click Back.
17. Click the Application tab. Click Configure SMTP E-mail Settings. Configure your SMTP server, type a From e-mail address, and then click Save. Click OK.
18. Return to Visual Studio and open the root Web.config file. Notice that the *role-Manager* element is enabled and the *authentication* element is set to *Forms*.
19. Open Members/Web.config and Admin/Web.config. Notice that the Web Site Administration Tool created these files and used them to specify the permissions for each folder. You can also do this using a single Web.config file by specifying the <*location*> element, as described in the next lesson.

Now the Web site is ready to use ASP.NET memberships, and you have created users, roles, and access rules. Continue working with this Web site for the next exercise.

� **Exercise 2: Create Web forms that use *Login* controls**

In this exercise, you create Web forms using *Login* controls to take advantage of ASP.NET membership.

1. Continue working with the Web site you created in the previous exercise, which is configured to support ASP.NET membership and has users and roles added to the database. Alternatively, you can open the completed Lesson 1, Exercise 1 project from the CD.
2. Create a new ASP.NET Web form named Login.aspx. Add the following controls:
   - **A.** A *Login* control
   - **B.** A *PasswordRecovery* control

3. Open the root Default.aspx page. Add the following controls:
   - A. A *HyperLink* control with the *Text* property set to **Members only** and the *NavigateUrl* set to **Members/Default.aspx**.
   - B. A *HyperLink* control with the *Text* property set to **Administrators only** and the *NavigateUrl* set to **Admin/Default.aspx**.
   - C. A *LoginStatus* control.
4. Press Ctrl+F5 to open Default.aspx in a Web browser.
5. On the Default.aspx page, click the Members Only link to attempt to access a protected page. Notice that ASP.NET detects that you are not authenticated and redirects you to the default Login.aspx page. Also notice that the URL includes a parameter named *ReturnUrl* that contains the page you were attempting to access.
6. On the Login.aspx page, in the User Name box, type **StandardUser**. Type your password in the Password box, and then click Log In. ASP.NET takes you to the Members/Default.aspx page, which is blank. However, because it does not return an error, you know you are successfully authenticated.
7. Click the Back button in your browser twice to return to the root Default.aspx page, and then click the Administrators Only link. Even though you are already authenticated, ASP.NET redirects you to the Login.aspx page because the Stan dardUser account does not have access to the Admin folder.
8. On the Login.aspx page, in the User Name box, type **Hacker**. Then click Log In. Notice that ASP.NET rejects your authentication attempt.
9. Under Forgot Your Password, type **Admin**, and then click Submit. Provide an answer to your security question, and then click Submit to request a new pass word. Check your e-mail for a message from the Web server containing your new password.
10. After you have your new password, use the new credentials to authenticate. ASP.NET takes you to the Admin/Default.aspx page, which is blank. However, because it does not return an error, you know you are successfully authenticated.

Lesson 2: Using Windows, Forms, Passport, and Anonymous Authentication

Though ASP.NET membership is a perfect fit for many Web applications, ASP.NET actually supports four types of authentication:

- Windows authentication
- Forms authentication (which ASP.NET membership uses)
- Passport authentication
- Anonymous access

This lesson describes how to configure both Internet Information Services (IIS) and your applications for each of the standard Web authentication types.

After this lesson, you will be able to:

- Configure an ASP.NET Web application to require Windows authentication.
- Create an ASP.NET Web application that uses custom forms for user authentication.
- Configure an ASP.NET Web application to require Passport authentication.
- Configure Web applications for anonymous access.
- Configure impersonation so that ASP.NET uses non-default user credentials.
- Restrict access to Web applications, files, and folders by manually editing Web.con fig files.

Estimated lesson time: 45 minutes

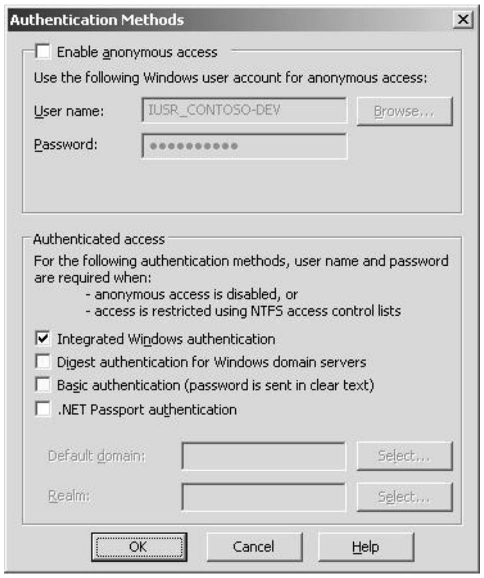
Configuring Web Applications to Require Windows Authentication

If your application is targeted for use inside an organization, and users accessing the application have existing user accounts within the local user database of the Web server or Active Directory, you should authenticate users with Windows authentica tion. You can configure Windows authentication in two ways: within IIS and within your ASP.NET application. To provide defense in depth, use both techniques to require authentication.

When a Web application requires Windows authentication, the application rejects any request that does not include a valid user name and password in the request header. The user's browser then prompts the user for a user name and password. Because the browser prompts the user for credentials, you do not have to create a page to request the user's user name and password. Some browsers, such as Microsoft Internet Explorer, automatically provide the user's current user name and password when the server is located on the intranet. This seamlessly authenticates the user, relieving the need to retype the password for intranet site visits.

Additionally, because users are authenticated against the server's local user database or Active Directory domain, using Windows authentication saves you from creating a database to store user credentials. Leveraging the Windows authentication mecha nism is, therefore, the simplest way to authenticate users. To configure IIS to require all users to authenticate on computers running Microsoft Windows Server 2003, fol low these steps:

1. In the Administrative Tools program group, open the IIS Manager.
2. In the IIS Manager console, click to expand your server name, to expand Web Sites, and then to expand the Web site.
3. Right-click the site or folder name you are configuring authentication for and select Properties.
4. Click the Directory Security tab. In the Authentication And Access Control group, click the Edit button.
5. Clear the Enable Anonymous Access check box, which is selected by default.
6. Select the Integrated Windows Authentication check box, as shown in Figure 11-7. Optionally, select Digest Windows Authentication For Windows Domain Servers to enable authentication across proxy servers.


Authentication Methods

☐ Enable anonymous access
Use the following Windows user account for anonymous access:
User name: IUSR_CONTOSO-DEV
Password: ●●●●●●●●●●

Authenticated access
For the following authentication methods, user name and password are required when:
- anonymous access is disabled, or
- access is restricted using NTFS access control lists

☑ Integrated Windows authentication
☐ Digest authentication for Windows domain servers
☐ Basic authentication (password is sent in clear text)
☐ .NET Passport authentication

Default domain:
Realm:

Figure 11-7 For best results, configure Windows authentication in both IIS and your application.

7. Click OK twice to return to the IIS Manager console.

At this point, all Web requests to the virtual directory will require Windows authentication, even if ASP.NET is configured for anonymous access only. Even though configuring IIS is sufficient to require users to present Windows credentials, it is good practice to edit the application's Web.config file to also require Windows authentication.

Real World

Tony Northrup

I've spent time as both a developer and a systems administrator. Each role has different responsibilities. Typically, systems administrators should be responsible for configuring Windows security for a Web application. This doesn't require them to write any code, because they can configure it using the IIS Manager and the ASP.NET Web Site Administration Tool.

So, if you're creating an application that should use Windows authentication, it's okay to leave it up to the systems administrator to configure. Not all systems administrators know how to properly configure it, however, so you should be familiar with the process and be able to demonstrate how it's done when you hand off application support. You do need to configure forms authentication and passport authentication, however, because those require application-specific configuration settings, such as specifying the login page. Typically, you would provide all the configuration information as part of your Web.config file.

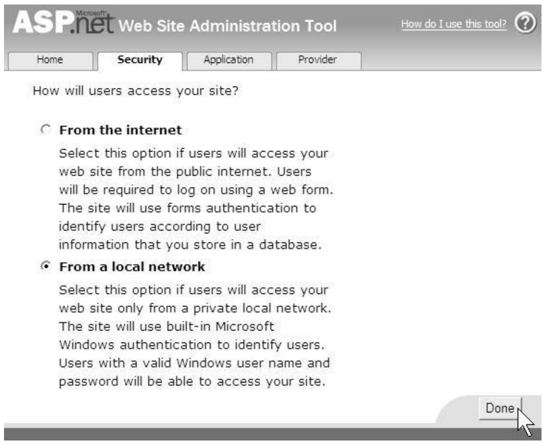
To configure an ASP.NET application for Windows Authentication, edit the <authentication> section of the Web.config file. This section, like most sections related to ASP.NET application configuration, must be defined within the <system.web> section. The <system.web> section, in turn, must exist within the <configuration> section. This example shows the <authentication> section of the Web.config file configured to use Windows authentication:

```
<configuration>
    <system.web>
        <authentication mode="Windows" />
        <authorization>
            <deny users="?" />
        </authorization>
    </system.web>
</configuration>
```

The <authorization> section simply requires all users to be successfully authenticated. Specifying <deny users="?" /> within <authorization> requires users to be authenti cated, whereas specifying <allow users="*" /> within <authorization> bypasses authentication entirely. The "?" symbol represents unauthenticated users, while the "*" symbol represents all users, both authenticated and unauthenticated.

You can also configure Windows authentication in your application's Web.config file by following these steps, which are more user-friendly:

1. Create an ASP.NET Web application using Visual Studio.
2. On the Website menu, select ASP.NET Configuration.
3. Select the Security tab, and then click Select Authentication Type.
4. Under How Will Your Users Access The Site, click From A Local Network. Then click Done, as shown in Figure 11-8.



How will users access your site?

○ **From the internet**

Select this option if users will access your web site from the public internet. Users will be required to log on using a web form. The site will use forms authentication to identify users according to user information that you store in a database.

[✓ ◉] **From a local network**

Select this option if users will access your web site only from a private local network. The site will use built-in Microsoft Windows authentication to identify users. Users with a valid Windows user name and password will be able to access your site.

Figure 11-8 Select From A Local Network to enable Windows authentication.

Creating Custom ASP.NET Forms to Authenticate Web Users

Windows authentication presents the end user with a browser-generated dialog box. Although giving the browser the responsibility of gathering the user's user name and password enables automatic authentication on intranet sites, it gives you, as a devel oper, very little flexibility. Web applications developed for external sites commonly use form-based authentication instead. Form-based authentication presents the user with an HTML-based Web page that prompts the user for credentials.

Once authenticated via forms authentication, ASP.NET generates a cookie to serve as an authentication token. The browser presents this cookie with all future requests to the

Web site, allowing the ASP.NET application to validate requests. This cookie can, option ally, be encrypted by a private key located on the Web server, enabling the Web server to detect an attacker who attempts to present a cookie that the Web server did not generate.

ASP.NET membership allows you to quickly add forms authentication to your Web application. Because Microsoft thoroughly tests the controls and classes involved in authentication and storing the user information, these controls are probably more secure than controls that any developer might make. Therefore, you should use ASP.NET membership whenever possible.

However, if you need complete control over how users are authenticated and man aged, you can also create custom forms authentication controls and pages. In the sec tions that follow, you will learn how to configure an ASP.NET configuration file to require forms authentication, how to add user credentials to a Web.config file, and how to create an ASP.NET Web form to authenticate users.

Configuring a Web.Config File for Forms Authentication

To configure forms authentication, you have to create an authentication page that uses an HTML form to prompt the user for credentials. Therefore, forms authentication can be used on only those ASP.NET Web applications developed with this authenti cation method in mind. Although you can choose to rely on administrators to config ure Windows or on anonymous authentication, you *must* distribute a Web.config file for your application to use forms authentication.

Administrators deploying your application should not need to modify the Web.config file, but they can control some aspects of how Forms authentication behaves, such as configuring the timeout period after which a user will need to log on again. A simple Web.config file requiring Forms authentication is shown here:

```
<configuration>
    <system.web>
        <authentication mode="Forms">
            <forms loginURL="LoginForm.aspx" />
        </authentication>
        <authorization>
            <deny users="?" />
        </authentication>
    </system.web>
</configuration>
```

In the preceding example, all users who have not yet signed in are redirected to the LoginForm.aspx page when they attempt to access any ASP.NET file. Typically, the form prompts the user for a user name and password and handles authentication within the application itself.

Regardless of the way the application handles the user's input, the user's credentials are sent to the server as a *Hypertext Transfer Protocol (HTTP)* request—without any automatic encryption. HTTP is the protocol Web browsers and Web servers use to communicate. The best way to ensure privacy of user credentials submitted by using forms authentication is to configure an Secure Sockets Layer (SSL) certificate within IIS and require *Hypertext Transfer Protocol Secure (HTTPS)* for the login form. HTTPS is an encrypted form of the HTTP protocol, which is used by virtually every e-commerce Web site on the Internet to protect private information about end users and to protect end users from submitting private information to a rogue server impersonating another server.

The user name and password can be checked against a database, a list contained in the Web.config file, an Extensible Markup Language (XML) file, or any other mecha nism you create. Forms authentication is tremendously flexible; however, you are entirely responsible for protecting your authentication mechanism from attackers. Because proof of authentication is stored in a cookie provided by the Web server (by default), and that cookie generally contains only the user's user name, an attacker can potentially create a fake cookie to trick the Web server into considering the user as authenticated. ASP.NET includes the ability to encrypt and validate authentication cookies, but naturally, this protection includes some overhead for the Web server.

The type of encryption and validation used is controlled by the protection attribute of the <authentication> section. If the protection attribute is not set, it defaults to All. If the protection attribute is set to Encryption, the cookie is encrypted with 3DES. This encryption protects the privacy of the data contained in the cookie but performs no validation. If the protection attribute is set to Validation, as the following example demonstrates, the server verifies the data in the cookie upon each transaction to reduce the likelihood of it being modified between the time it is sent from the browser and the time it is received by the server. If the protection attribute is set to None, nei ther encryption nor validation is performed. This setting reduces the overhead on the server, but it is suitable only in situations where privacy is not a concern, such as Web site personalization. Note its usage here:

```
<authentication mode="Forms" protection="Validation" >
    <forms loginURL="LoginForm.aspx" />
</authentication>
```

IMPORTANT Optimizing security for forms authentication

For optimal security (with a slight performance cost), leave protection at the default setting of All.

By default, ASP.NET stores the authentication token in a cookie for most devices. However, if the browser does not support cookies, ASP.NET will store the authentica tion information as part of the URL. You can control this behavior by setting the *cook ieless* attribute of the <forms> element to one of the following settings:

- **UseCookies** Always attempts to send a cookie to the client, even if the client indi cates it cannot support cookies.
- **UseUri** Always stores the authentication token as part of the URL rather than a cookie. Technically, the token is stored in the Uniform Resource Identifier (URI), which is the last portion of the URL.
- **AutoDetect** If a browser indicates that it supports cookies, the AutoDetect set ting causes ASP.NET to test whether the browser actually does support cookies. If it does not, or if the browser indicates that it does not support cookies, ASP.NET uses cookieless authentication instead.
- **UseDeviceProfile** The default setting, UseDeviceProfile, uses a cookie to prove authentication if the browser profile indicates that it supports cookies. You might find that some users have changed the default setting to not allow cookies. In this case, forms authentication does not work properly unless you change this setting to AutoDetect.

For example, the following section of a Web.config file enables cookieless forms authentication for all clients. This works well, but it causes the authentication token to be included in bookmarks and whenever the user sends a URL to another user:

```
<authentication mode="Forms" >
    <forms
     Cookieless="UseUri"
     loginURL="LoginForm.aspx" />
</authentication>
```

Another important attribute of the <forms> section is timeout, which defines, in minutes, the amount of idle time allowed between requests before the user is forced to log on again. If the <forms> section is <forms loginUrl="YourLogin.aspx" timeout="10">, the user is forced to log on again if he or she does not send any requests to the ASP.NET application within 10 minutes. This number should be decreased to reduce the risk of the browser being misused while the user is away from the computer. The <forms> sec tion has other attributes, but LoginUrl, protection, and timeout are the most important.

Quick Check

1. By default, under what circumstances does forms authentication provide cookies to the browser?
2. If you have users who have disabled cookies in their browsers, what can you do to enable them to use forms authentication?

Quick Check Answers

1. By default, cookies are provided to browser types that support cookies, whether or not the browser has cookies enabled.
2. Use the AutoDetect setting.

Configuring User Accounts in the Web.Config File

To avoid creating a database to store user credentials, you can store the user creden tials directly in the Web.config file. The passwords can be stored in one of three for mats: clear text, encrypted with the MD5 one-way *hash algorithm*, or encrypted with the SHA1 one-way hash algorithm. Using one of the two hash algorithms to mask the user credentials reduces the likelihood that a malicious user with read access to the Web.config file will gather another user's login information. Define the hashing method used within the <forms> section, in the <credentials> section. An example is shown here:

```
<authentication mode="Forms">
    <forms loginUrl="login.aspx" protection="Encryption" timeout="30" >
        <credentials passwordFormat="SHA1" >
          <user name="Eric" password="07B7F3EE06F278DB966BE960E7CBBD103DF30CA6"/>
          <user name="Sam" password="5753A498F025464D72E088A9D5D6E872592D5F91"/>
        </credentials>
    </forms>
</authentication>
```

To enable administrators to use hashed password information in the Web.config file, your ASP.NET application must include a page or tool to generate these passwords. The passwords are stored in hexadecimal format and hashed with the specified hash ing protocol. You can use the *System.Security.Cryptography* namespace to generate such a hash. The following console application demonstrates this by accepting a password as a command-line parameter and displaying the hash of the password. The resulting hash can be pasted directly into the Web.config file.

```
'VB
Imports System.Security.Cryptography
Imports System.Text

Module Module1
    Sub Main(ByVal args As String())
        Dim myHash As SHA1CryptoServiceProvider = New SHA1CryptoServiceProvider
        Dim password As Byte() = Encoding.ASCII.GetBytes(args(0))
        myHash.ComputeHash(password)
        For Each thisByte As Byte In myHash.Hash
            Console.Write(thisByte.ToString("X2"))
        Next
        Console.WriteLine()
    End Sub
End Module

//C#
using System;
using System.Security.Cryptography;
using System.Text;

namespace HashExample
{
    class Program
    {
        static void Main(string[] args)
        {
            SHA1CryptoServiceProvider myHash=new SHA1CryptoServiceProvider();

            byte[] password  = Encoding.ASCII.GetBytes(args[0]);
            myHash.ComputeHash(password);

            foreach (byte thisByte in myHash.Hash)
                Console.Write(thisByte.ToString("X2"));
            Console.WriteLine();
        }
    }
}
```

Alternatively, you can call the *FormsAuthentication.HashPasswordForStoringInConfigFile* method to generate a password hash. This method is described in the next section.

IMPORTANT Storing credentials in a .config file

You should store credentials in a .config file only during testing. Protecting passwords with a hash is little deterrent to an attacker who can read the contents of the .config file, because hashed pass word databases exist that can quickly identify common passwords.

The FormsAuthentication Class

The *FormsAuthentication* class is the basis for all forms authentication in ASP.NET. The class includes the following read-only properties, which you can use to programmat ically examine the current configuration:

- ***FormsCookieName*** Returns the configured cookie name used for the current application.
- ***FormsCookiePath*** Returns the configured cookie path used for the current appli cation.
- ***RequireSSL*** Gets a value indicating whether the cookie must be transmitted using SSL (that is, over HTTPS only).

IMPORTANT Improving security if the Web server has an SSL certificate

Enable *RequireSSL* for best security. This will ensure that forms authentication is encrypted.

- ***SlidingExpiration*** Gets a value indicating whether sliding expiration is enabled. Enabling sliding expiration resets the user's authentication timeout with every Web request.

IMPORTANT Improving security (at the cost of convenience)

Disable *SlidingExpiration* for the highest level of security. This prevents a session from remain ing open indefinitely.

Additionally, you can call the following methods:

- ***Authenticate*** Attempts to validate the credentials against those contained in the configured credential store, given the supplied credentials.
- ***Decrypt*** Returns an instance of a *FormsAuthenticationTicket* class, given a valid encrypted authentication ticket obtained from an HTTP cookie.
- ***Encrypt*** Produces a string containing an encrypted authentication ticket suit able for use in an HTTP cookie, given a *FormsAuthenticationTicket* object.
- ***GetAuthCookie*** Creates an authentication cookie for a given user name.
- ***GetRedirectUrl*** Returns the redirect URL for the original request that caused the redirect to the login page.
- ***HashPasswordForStoringInConfigFile*** Given a password and a string identifying the hash type, this routine produces a hash password suitable for storing in a configuration file. If your application stores user credentials in the Web.config

file and hashes the password, build this method into a management tool to enable administrators to add users and reset passwords.

- ***RedirectFromLoginPage*** Redirects an authenticated user back to the originally requested URL. Call this method after verifying a user's credentials with the *Authenticate* method. You must pass this method a string and a Boolean value. The string uniquely identifies the user, and the method uses it to generate a cookie based on that information. The Boolean value, if true, allows the browser to use the same cookie across multiple browser sessions. Generally, this unique piece of information should be the user's user name.
- ***RenewTicketIfOld*** Conditionally updates the sliding expiration on a *FormsAu thenticationTicket* object.
- ***SetAuthCookie*** Creates an authentication ticket and attaches it to the cookie's collection of the outgoing response. It does not perform a redirect.
- ***SignOut*** Removes the authentication ticket, essentially logging the user off.

Creating a Custom Forms Authentication Page

When using forms authentication, you must include two sections at a minimum:

- A forms authentication page
- A method for users to log off and close their current sessions

To create a forms authentication page, create an ASP.NET Web form to prompt the user for credentials and call members of the *System.Web.Security.FormsAuthentication* class to authenticate the user and redirect him or her to a protected page. The follow ing code sample demonstrates an overly simple authentication mechanism that just verifies that the contents of *usernameTextBox* and *passwordTextBox* are the same, and then calls the *RedirectFromLoginPage* method to redirect the user to the page originally requested. Notice that the Boolean value passed to *RedirectFromLoginPage* is *true*, indi cating that the browser saves the cookie after the browser is closed, enabling the user to remain authenticated if the user closes and reopens his or her browser before the authentication cookie expires.

```
'VB
If usernameTextBox.Text = passwordTextBox.Text Then
    FormsAuthentication.RedirectFromLoginPage(usernameTextBox.Text, True)
End If

//C#
if (usernameTextBox.Text == passwordTextBox.Text)
    FormsAuthentication.RedirectFromLoginPage(usernameTextBox.Text, true);
```

Although the authentication mechanism demonstrated in the previous code sample (verifying that the user name and password are equal) can never provide adequate protection for a Web application, it demonstrates the flexibility of forms authentica tion. You can check the user's credentials using any mechanism required by your application. Most often, the user name and a hash of the user's password is looked up in a database.

If user credentials are stored in the Web.config file, or you have configured them using ASP.NET membership, call the *FormsAuthentication.Authenticate* method to check the credentials. Simply pass to the method the user's user name and password. The method returns true if the user's credentials match a value in the Web.config file. Oth erwise, it returns false. The following code sample demonstrates the use of this method to redirect an authenticated user. Notice that the Boolean value passed to *RedirectFromLoginPage* is false, indicating that the browser does not save the cookie after the browser is closed, requiring the user to reauthenticate if he or she closes and reopens the browser, thus improving security:

```
'VB
If FormsAuthentication.Authenticate(username.Text, password.Text) Then
    ' User is authenticated. Redirect user to the page requested.
    FormsAuthentication.RedirectFromLoginPage(usernameTextBox.Text, False)
End If

//C#
if (FormsAuthentication.Authenticate(username.Text,
password.Text))
{
    // User is authenticated. Redirect user to the page requested.
    FormsAuthentication.RedirectFromLoginPage(usernameTextBox.Text, false);
}
```

In addition to creating a page to authenticate users, provide a method for users to log off of the application. Generally, this is a simple "Log out" hyperlink that calls the *FormsAuthentication.SignOut* static method to remove the user's authentication cookie.

Configuring Web Applications to Require Passport Authentication

You can also authenticate users using a service from Microsoft called Passport. Pass port is a centralized directory of user information that Web sites can use, in exchange for a fee, to authenticate users. Users can choose to allow the Web site access to per sonal information stored on Passport, such as the users' addresses, ages, and inter ests. Storing information about users worldwide within the Passport service relieves end users from maintaining separate user names and passwords on different sites. Further, it saves the user time by eliminating the need to provide personal informa tion to multiple Web sites.

Exam Tip Passport authentication probably won't be covered on the 70-528 exam.

MORE INFO Passport software development kit

For more detailed information about the requirements of building a Web application that uses Passport, you can download and review the free Passport software development kit from MSDN on the Microsoft Web site at *http://support.microsoft.com/?kbid=816418*.

Configuring Web Applications for Only Anonymous Access

You can explicitly disable authentication for your application if you know that it will be used only by anonymous users. However, in most cases where your application does not require authentication, you should simply not provide an authentication configuration setting in the Web.config file and allow the system administrator to configure authentication with IIS.

This example shows a simple Web.config file that allows only anonymous access to an ASP.NET application:

```
<configuration>
    <system.web>
        <authentication mode="None" />
    </system.web>
</configuration>
```

Configuring Impersonation by Using .config Files

By default, ASP.NET applications make all requests for system resources from the ASP NET account (IIS 5.0) or the Network Service account (IIS 6.0). This setting is config urable and is defined in the `<processModel>` item of the `<system.web>` section of the Machine.config file. The default setting for this section is:

```
<processModel autoConfig="true" />
```

Setting *autoConfig* to *true* causes ASP.NET to automatically handle *impersonation*. However, you can change *autoConfig* to *false* and set the *userName* and *password* attribute to define the account ASP.NET impersonates when requesting system resources on behalf of a Web user.

Automatic configuration is sufficient for most ASP.NET implementations. However, in many cases, administrators need to configure ASP.NET to impersonate the client's authenticated user account, IIS's anonymous user account, or a specific user account. This configuration is done by setting the *impersonate* attribute of the <identity> ele ment of the Machine.config (for server-wide settings) or Web.config (for application- or directory-specific settings) files. To enable impersonation of the client's authenti cated Windows account, or IIS's IUSR_*MachineName* account for anonymous access, add the following line to the <system.web> section of the Web.config file:

```
<identity impersonate="true" />
```

When IIS is configured for anonymous access, ASP.NET makes requests for system resources using the IUSR_*MachineName* account. When a user authenticates directly to IIS using a Windows logon, ASP.NET impersonates that user account. To enable ASP.NET to impersonate a specific user account, regardless of how IIS authentication is handled, add the following line to the <system.web> section of the Web.config file and replace the *DOMAIN*, *UserName*, and *Password* attributes with the account logon credentials:

```
<identity impersonate="true" userName="DOMAIN\UserName" password="Password"/>
```

Restricting Access to ASP.NET Web Applications, Files, and Folders

Authentication determines a user's identity, whereas authorization defines what the user might access. Before the .NET Framework, administrators controlled Web user authorization entirely with NTFS permissions. Although NTFS permissions are still a key part of configuring security for ASP.NET applications, these permissions are now complemented by ASP.NET's authorization capabilities. Authorization is now con trolled with Web.config files, just like authentication. This enables authorization to work with any type of authentication—even if the authorization doesn't use the local user database or Active Directory directory service that NTFS permissions are based on. The use of Web.config files also makes copying file permissions between multiple Web servers as easy as copying files.

In the sections that follow, you will learn how to restrict access according to user and group names, to restrict access to specific files and folders using either a .config file or file permissions, and to use impersonation in an ASP.NET application.

Restricting Access to Users and Groups

The default Machine.config file contains the following authorization information:

```
<authorization>
    <allow users="*"/>
</authorization>
```

Unless you modify this section of the Machine.config file, or override the Machine.config file by adding this section to your application's Web.config file, all users permitted by your authentication configuration are allowed to interact with all parts of your ASP.NET Web application. The <allow users="*"> subsection of the authorization section tells ASP.NET that all users who pass the authentication requirements are allowed access to all ASP.NET content.

To configure an ASP.NET application to provide access only to the users Eric and Sam, override the Machine.config security settings by editing the Web.config file in the root of the ASP.NET application and add the following lines within the <system.web> section:

```
<authorization>
    <allow users="Eric, Sam"/>
    <deny users="*"/>
</authorization>
```

The <allow> and <deny> subsections contain users and roles attributes. The users attribute should be set to a list of user names separated by commas, an asterisk (*) to indicate all authenticated or unauthenticated users, or a question mark (?) to indicate anonymous users. If Windows authentication is used, the user names should match names in the local user database or Active Directory directory service and need to include a domain name (that is, *DOMAIN\user* for domain accounts or *COMPUTER NAME\user* for local user accounts).

The roles element contains a comma-separated list of roles. When Windows authen tication is used, roles correspond to Windows user groups. In this case, the names must exactly match group names in the local user database or Active Directory. Pro vide the domain name for groups in the Active Directory, but do not specify the com puter name for local groups. For example, to specify the IT group in the CONTOSO domain, use **CONTOSO\IT**. To specify the local users group, use **Users**.

If you are using Windows authentication, you must disable the *roleManager* element in your Web.config file to use role security to authorize Windows user groups. The *roleManager* element is disabled by default, so removing it from your Web.config file is sufficient to disable it. You can authorize Windows users with *roleManager* enabled, but it must be disabled to authorize Windows groups.

Controlling Authorization for Folders and Files by Using .config Files

The previous techniques are useful for controlling user access to an entire ASP.NET application. To restrict access to specific files or folders, add a <location> section to the <configuration> section of the Web.config file. The <location> section contains its own <system.web> subsection, so do not place it within an existing <system.web> section.

To configure access restrictions for a specific file or folder, add the <location> section to your Web.config with a single section: path. The path section must be set to the rel ative path of a file or folder; absolute paths are not allowed. Within the <location> sec tion, include a <system.web> subsection and any configuration information that is unique to the specified file or folder. For example, to require forms authentication for the file ListUsers.aspx and restrict access to the user named admin, add the following text to the <configuration> section of the Web.config file:

```
<location path="ListUsers.aspx">
    <system.web>
        <authentication mode="forms">
            <forms loginUrl="AdminLogin.aspx" protection="All"/>
        </authentication>
        <authorization>
            <allow users="admin"/>
            <deny users="*"/>
        </authorization>
    </system.web>
</location>
```

When using multiple <location> sections, file and subfolders automatically inherit all settings from their parents. Therefore, you do not need to repeat settings that are iden tical to the parents' configurations. When configuring authorization, inheritance has the potential to lead to security vulnerabilities. Consider the following Web.config file:

```
<configuration>
 <system.web>
    <authentication mode="Windows" />
    <authorization>
      <deny users="?" />
    </authorization>
 </system.web>

 <location path="Protected">
    <system.web>
      <authorization>
```

```
         <allow roles="CONTOSO\IT" />
      </authorization>
     </system.web>
  </location>
</configuration>
```

In this example, there are actually *three* layers of inheritance. The first is the Machine.config file, which specifies the default <allow users="*"/>. The second layer is the first <system.web> section in the example, which applies to the entire application. This setting, <deny users="?"/>, denies access to all unauthenticated users. By itself, this second layer denies access to any user. However, combined with the Machine.config file, this layer allows access to all authenticated users and denies access to everyone else.

The third layer is the <location> section, which grants access to the CONTOSO\IT group. However, this section also inherits the <deny users="?"/> and <allow users="*"/> settings. Therefore, the effective settings for the Protected subfolder are the same as for the parent folder: all authenticated users have access. To restrict access to *only* users in the CONTOSO\IT group, you must explicitly deny access to users who are not specifically granted access, as the following code demonstrates:

```
<location path="Protected">
  <system.web>
     <authorization>
       <allow roles="CONTOSO\IT" />
       <deny users="*" />
     </authorization>
  </system.web>
</location>
```

NOTE Using file permissions

You can also control access to files and folders by setting NTFS file permissions. However, file per missions are typically managed by systems administrators. Additionally, because file permissions cannot be distributed as easily as a Web.config file and they can only be used with Windows secu rity, they should not be relied upon as the primary method of file authorization for developers.

Lab: Controlling Authorization in ASP.NET Applications

In this lab, you modify an ASP.NET Web application to use Windows authentication.

� **Exercise: Create a Web site that uses ASP.NET memberships**

In this exercise, you update a previously created ASP.NET Web site to disable role manager and use Windows authentication instead.

1. Continue working with the Web site you created in Lesson 1, Exercise 2, which has been configured to support ASP.NET membership and has users and roles added to the database. Alternatively, you can open the completed Lesson 1, Exercise 2 project from the CD.
2. On the Website menu, select ASP.NET Configuration.
3. Click the Security tab, and then click Select Authentication Type.
4. Click From A Local Network, and then click Done.
5. In Visual Studio, examine the Web.config file. Notice that the *authentication* ele ment has been removed, which means forms authentication is no longer enabled. Now remove the <roleManager> element so that the *roles* element refers to Windows groups, instead of the roles you added using role manager.
6. In Visual Studio, add a *LoginName* control to the Default.aspx page. This enables you to see the user account you are using to access the Web site.
7. With the Default.aspx page still open, press Ctrl+F5 to open the page in a browser. Notice that the *LoginName* control shows that you are automatically logged in using your Windows user account.
8. Click the Members Only link. If your current account is a member of the local Users group, you are allowed to access the page. Otherwise, ASP.NET denies you access.
9. Click the Administrators Only link. If your current account is a member of the local Administrators group, you are allowed to access the page. Otherwise, ASP.NET denies you access.
10. On the Website menu of Visual Studio, select ASP.NET Configuration. Click the Security tab. Notice that you can no longer use the Web Site Administration Tool to manage roles. When role manager is disabled, ASP.NET uses Windows groups as roles. Therefore, you must manage the groups using tools built into Windows, such as the Computer Management console.
11. On the Security tab of the Web Site Administration Tool, click Manage Access rules. Then click the Admin subfolder. Notice that it displays the existing rules. Click Add New Access Rule and notice that you can add a rule for specific users, all users, or anonymous users. You cannot, however, add rules to grant access to roles, because role manager has been disabled. To add access rules for Windows Groups using roles, you must manually edit the <authorization> section of the Web.config files