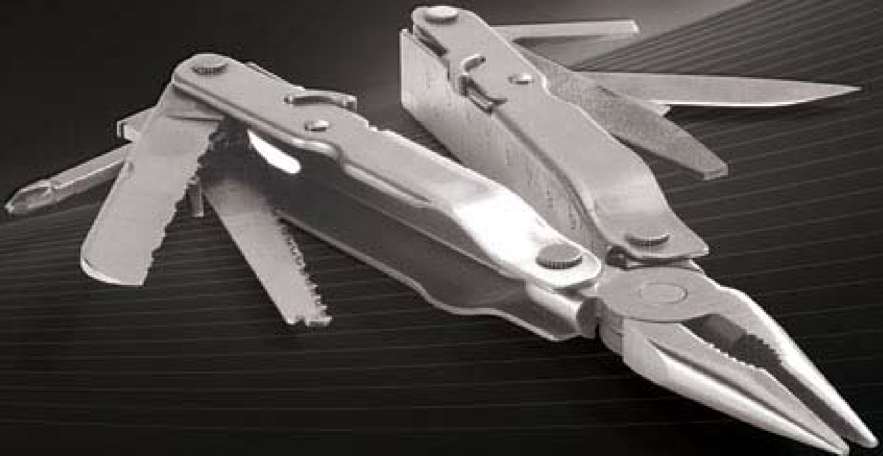
Microsoft

MCTS EXAM

70-515

Web Applications Development with Microsoft® .NET Framework 4



Tony Northrup
and Mike Snell

SELF-PACED

Training Kit

Contents

CHAPTER 8

Debugging and Deploying

A large part of the development process involves removing bugs and resolving other issues in your application. Microsoft Visual Studio and Microsoft ASP.NET provide several tools to support these tasks. These tools allow you to set breakpoints in code, step through your code by using the Integrated Development Environment (IDE), view variable values in watch windows and DataTips, execute code in the command window, and more. These debugging tools work for all the applications you create with Visual Studio, not just websites. Websites do, however, present their own set of challenges. A website runs in a distributed environment in which the network, database, and client are all running on separate processes. This can make it difficult just to get debugging set up and to get the right troubleshooting information from your application and its environment.

After you've developed and tested your application, it's time to deploy it to a production environment. In most real-world scenarios, deployment involves moving an application from a staged area, where users have reviewed and tested its functionality, to one or more production servers. The deployment process can be automated with tools and scripts, managed and governed by IT departments, or deployed directly by developers through Visual Studio. The method you will use to build, verify, and deploy your application really depends on your scenarios, the type of application, and the environment.

This chapter explores how you debug, monitor, troubleshoot, and deploy websites. The first lesson covers setting up debugging, creating custom error pages, debugging on a remote server, and debugging client script. The second lesson is about troubleshooting and monitoring a running ASP.NET site. The third lesson explores those tools and features of Visual Studio that make deploying websites easier.

Exam objectives in this chapter:

- Configuring and Extending a Web Application
  - Debug a Web application.
  - Deploy a Web application.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with developing applications with Visual Studio by using Microsoft Visual Basic or Microsoft Visual C#. In addition, you should be comfortable with all of the following:

- The Visual Studio 2010 IDE
- Debugging Windows applications
- Using Hypertext Markup Language (HTML) and client-side scripting
- Creating ASP.NET websites and forms

REAL WORLD

Tony Northrup

If you're like me and you hate debugging, give this chapter extra attention. After you learn how to use the ASP.NET and Visual Studio 2010 debugging tools, you'll be able to diagnose and fix bugs faster than ever.

I prefer to debug an ASP.NET website the same way I debug a traditional Windows application. I run the website on my local computer, and I make use of breakpoints, watch lists, and DataTips to examine the inner workings of the website. Those technologies are all discussed in the first lesson. I only resort to tracing, as discussed in the second lesson, when a website is running on a remote server and I can't set up a remote debugger.

For more complex problems, I make use of troubleshooting tools that I don't describe in this book. Microsoft Network Monitor (or any sniffer) allows you to see the communications sent between browsers and web servers. For troubleshooting communications between the web server and the database, I use the Microsoft SQL Server Profiler. For troubleshooting performance issues, I use Page Speed (available at *http://code.google.com/speed/page-speed/*) when I can reproduce the problem locally, and WebPagetest (available at *http://webpagetest.org*) when I need to analyze requests sent across the Internet.

Lesson 1: Debugging Websites

Debugging websites is more complex than debugging Windows applications because web requests are very short-lived, the client and server are typically running on different computers, and client browsers have widely varying capabilities. In addition, the state that the application uses is also distributed among database, web server, cache, session, cookie, and so on. Fortunately, Visual Studio and ASP.NET have several tools that allow you to get debugging information from your site during development.

This lesson covers the setup and configuration of the ASP.NET debugging features. Coverage includes remote debugging and client-side script debugging.

NOTE **SCOPE OF CHAPTER CONTENT**

This lesson covers the configuration and setup of debugging with ASP.NET and Visual Studio. It does not cover the basics of using the Visual Studio debugger, such as how to set breakpoints and how to view variables in watch windows. Rather, it focuses on managing the debugging of an ASP.NET website.

After this lesson, you will be able to:

- Configure a website for debugging with Visual Studio.
- Set up remote debugging between a development machine and a server.
- Redirect users to a default error page or custom error pages based on Hypertext Transfer Protocol (HTTP) status codes.
- Debug client-side script.

Estimated lesson time: 30 minutes

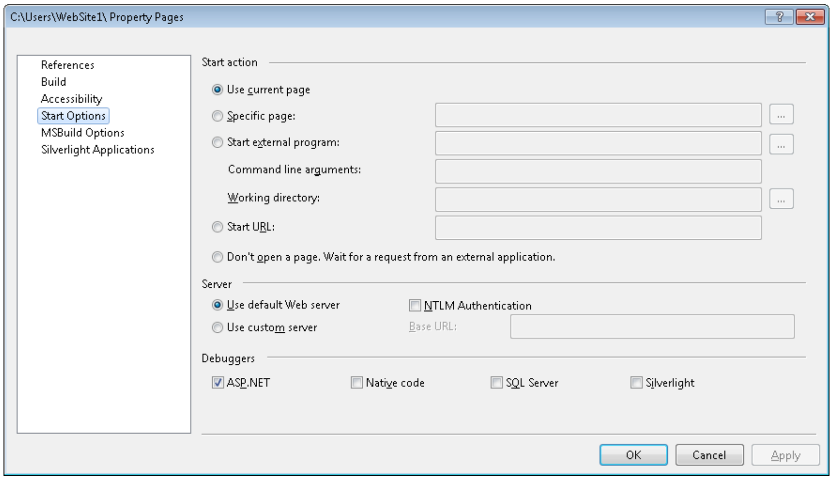
Configuring ASP.NET for Debugging

You can debug an ASP.NET application by using the standard features of the Visual Studio debugger, such as breakpoints, watch windows, code step-through, and error information. To do so, you must first configure ASP.NET for debugging. There are two areas where you set this information: the project's property page and the Web.config file.

Activating the ASP.NET Debugger

The first step is to configure the ASP.NET debugger settings in your project's Property Pages dialog box, including those that determine whether or not to allow Visual Studio to run the debugger. When installed, Visual Studio enables ASP.NET debugging and establishes default debugger settings. However, if you need to set or modify this setting, you can do so by following these steps:

1. Right-click the website in Solution Explorer and then click Property Pages. This will open the Property Pages dialog box for the website, as shown in Figure 8-1.
2. Select Start Options from the left side of the dialog box.
3. In the Debuggers section, at the bottom of the dialog box, select (or clear) the ASP.NET check box to enable (or disable) the ASP.NET debugger for Visual Studio.



C:\Users\WebSite1\ Property Pages

References
Build
Accessibility
Start Options
MSBuild Options
Silverlight Applications

Start action
- ● Use current page
- ○ Specific page:
- ○ Start external program:
  - Command line arguments:
  - Working directory:
- ○ Start URL:
- ○ Don't open a page. Wait for a request from an external application.

Server
- ● Use default Web server
- ○ Use custom server
- ☐ NTLM Authentication
- Base URL:

Debuggers
- ☑ ASP.NET
- ☐ Native code
- ☐ SQL Server
- ☐ Silverlight

FIGURE 8-1 The project Property Pages dialog box for an ASP.NET website.

Configuring Debugging

Assuming that you allow Visual Studio to run the ASP.NET debugger, the second step is to enable debugging either for your entire site or on a page-by-page basis. Even though ASP.NET debugging in general might be enabled from a Visual Studio perspective, individual sites can disable debugging for security reasons. By default, websites that Visual Studio creates individually disable the debugger for just this reason. Enabling debugging for your site will add debug symbols into the compiled code. Visual Studio uses these symbols to provide debugging support. However, this can slow the performance of your website. In addition, turning on debugging will transmit error information to the web browser when you run the page outside of Visual Studio. This can present a security risk, because error information provides potential attackers with a lot of information about how your site works. For these reasons, you should only turn debugging on during development.

You enable debugging for your entire site by editing a setting in the Web.config file. In Web.config, you set the debug attribute of the compilation element to true. If you use Visual Studio to start debugging, Visual Studio will prompt you to automatically enable this setting. The following markup shows an example that includes the nesting level of the compilation element.

```
<configuration>
  <system.web>
    <compilation debug="true" targetFramework="4.0"/>
  <system.web>
</configuration>
```

You might not always want to turn on debugging for your entire site. In these cases, you can switch debugging on and off at the individual page level. This will ensure that only the designated pages will be compiled with the debug symbols. The rest of the site will be compiled without debugging. To enable page-level debugging, set the Debug attribute of the @ Page directive (found at the top of the markup for an ASPX page). The following shows an example.

```
<%@ Page Debug="true" ... %>
```

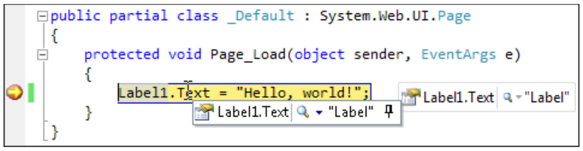
After you have debugging enabled, you can use the many features of the Visual Studio debugger. When you run your application, Visual Studio automatically attaches to the running ASP.NET web server process (unless you are developing remotely, which is discussed later in this lesson). You can then set breakpoints in your code, step through line by line, and view variable values in the watch window. In addition, if debugging is enabled, you can get error information sent to the browser window even when you are not running your application through Visual Studio.

New Debugging Features in Visual Studio 2010

This book assumes that you have some familiarity with the Visual Studio development environment and does not explain the details of setting breakpoints and monitoring values. It is assumed that you know that you can set a breakpoint to pause a running webpage at a specific line and then examine the values of different variables.

In Visual Studio 2010, you can export and import a set of breakpoints by using the Debug window. First, display the window by clicking the Debug menu, selecting Windows, and then selecting Breakpoints. On the Breakpoints toolbar, click the Export button to save the current set of breakpoints to a file. Later, use the Import button to read them back in. This allows you to quickly set up debugging for a recurring problem.

While debugging, you can point to a variable to view its current value in a DataTip. With Visual Studio 2010, you can click the pushpin icon on the DataTip, as shown in Figure 8-2. The value will then always appear in the debugger, and you can add comments that you can view later. After you stop debugging, Visual Studio displays a pushpin icon in the left margin. Point to the pushpin to view the DataTip's value from the last debugging session. You can import and export pinned DataTips by using the Debug menu.



```
public partial class _Default : System.Web.UI.Page
{
    protected void Page_Load(object sender, EventArgs e)
    {
        Label1.Text = "Hello, world!";
    }
}
```

FIGURE 8-2 Pinning a value in Visual Studio 2010.

There are many other useful debugging improvements. For detailed information, see "VS 2010 Debugger Improvements" at *http://weblogs.asp.net/scottgu/archive/2010/04/21/vs-2010-debugger-improvements-breakpoints-datatips-import-export.aspx*.

Defining Custom Error Pages

In your production environment, it is likely that you do not want to show users the default ASP.NET error page if your site breaks. This holds true for the default Internet Information Services (IIS) error pages as well. Rather, you most likely want users to see a page that tells them how to contact support to resolve the problem. You can also configure your site to display a generic error page if users encounter an unhandled error. You can set this page at the site level. You can also set individual pages for specific error types.

Configuring a Custom Site-Level Error Page

You configure custom errors inside the Web.config file by using the <customErrors> element nested inside <system.web>. This element has the mode and defaultRedirect attributes. The mode attribute can be set to on to turn custom errors on, off to turn them off, or RemoteOnly to turn custom errors on for remote clients only. With RemoteOnly, if the user (typically an administrator) is on the server, he or she will not get the custom error, but instead will get the real error message.

The defaultRedirect attribute is used to indicate the path to a default error page. This page will be displayed when an unhandled exception occurs on the site. The only time this will not happen is when a specific custom error page is added to the <error> child elements of <customErrors> (as discussed in the next section). The following example shows markup for a custom error definition inside Web.config.

```
<configuration>
  <system.web>
    <customErrors defaultRedirect="SiteErrorPage.aspx" mode="RemoteOnly">
    </customErrors>
  <system.web>
</configuration>
```

Notice that in this markup, the page is set to an ASPX page. You can set this to an HTM page, an ASPX page, or another resource to which the web server can redirect.

On redirection, the server passes the path of the page that caused the error. This path is provided as part of the query string by using the named parameter aspxErrorPath; you can use this information to track errors on your site. For example, the following shows the browser's URL when the SiteErrorPage.aspx page is displayed based on an error thrown on Default.aspx:

```
http://localhost/examples/SiteErrorPage.aspx?aspxerrorpath=/examples/Default.aspx
```

Configuring Error-Specific Error Pages

It is also possible to define specific pages for various HTTP status codes. This allows you to provide more specific information to users when a configured status code is returned. For example, if users do not have access to a requested page or resource, their request results in an HTTP 403 return code. This status code indicates that they are denied access to the resource. You can then write a custom page that explains the process for requesting access to the page. Use the <error> element to redirect to that custom page. The following markup shows an example.

```
<configuration>
  <system.web>
    <customErrors defaultRedirect="SiteErrorPage.aspx" mode="RemoteOnly">
      <error statusCode="403" redirect="RestrictedAccess.aspx" />
    </customErrors>
  <system.web>
</configuration>
```

There are many HTTP status codes. Errors fall in the range from 400 to 600. Codes with numbers 400 to 499 are reserved for request errors and codes 500 to 599 are set aside for server errors. Table 8-1 lists some common HTTP status codes for errors. For a complete list, see *http://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html#sec10*.

TABLE 8-1 Common HTTP Status Codes

CODE	DESCRIPTION
400	The request is not understood (unintelligible).
403	The user does not have access to the requested resource.
404	The file is not found at the requested URL.
405	The request method is not supported.
406	The requested Multipurpose Internet Mail Extensions (MIME) type is not accepted.
408	The request has timed out.
500	An internal server error has occurred.
503	The capacity of the server has been reached.

MORE INFO **IIS 7 HTTP STATUS CODES**

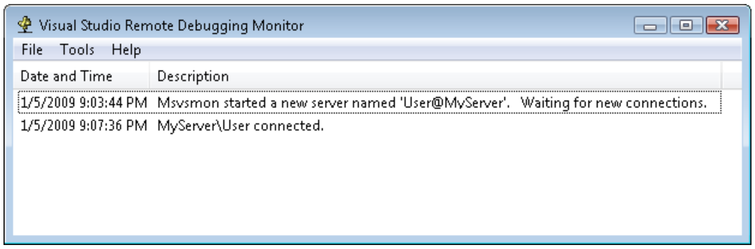
The HTTP status codes in IIS 7 have been extended to provide some additional information—they now include decimal point values. For example, the 403 code indicating that access is forbidden includes 403.1 to 403.19, to provide details on why access was forbidden. For more information, see "The HTTP status codes in IIS 7.0" (which also applies to IIS 7.5) in the MSDN Knowledge Base at *http://support.microsoft.com/kb/943891*.

Debugging Remotely

In most scenarios, you debug a website by running it locally on your development machine. This puts the client browser, the development environment (Visual Studio), and the web server on a single machine. In this case, Visual Studio automatically connects to the running site's process and allows you to debug your website. However, there might be occasions when you need to debug an issue against a remote server—when an error appears after a website has been deployed to the production environment, for example. In these scenarios, you will need to enable remote debugging.

Some of the details of enabling remote debugging are specific to the environment. There are slight modifications to the process depending on your domain, credentials, and the operating systems in use by the developer and the server. However, the process of enabling remote debugging is made easier with the Visual Studio Remote Debugging Monitor (msvsmon.exe). You run this tool on the server you intend to debug. The tool can be found inside your 32-bit development environment installation folder (for example, Program Files\Microsoft Visual Studio 10.0\Common7\IDE\Remote Debugger\). If you have installed a 64-bit version of Visual Studio, it will be installed within the Program Files (x86) folder. You can copy the file to a file share or over to the server. You can also install the tool from the Visual Studio DVD set.

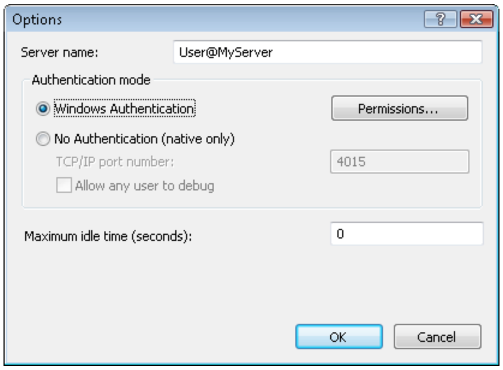
When you run the tool, it first determines whether Windows Firewall is configured to allow remote debugging, and prompts you to open the remote debugging port if necessary. You can find a detailed walkthrough of manual configuration of the firewall in the MSDN documentation (see "How to: Manually Configure the Windows Vista Firewall for Remote Debugging," at *http://msdn.microsoft.com/library/bb385831.aspx*). When it is running, the remote debugger (as shown in Figure 8-3) displays debugging events.



```
1/5/2009 9:03:44 PM  Msvsmon started a new server named 'User@MyServer'.  Waiting for new connections.
1/5/2009 9:07:36 PM  MyServer\User connected.
```

FIGURE 8-3 The Remote Debugging Monitor user interface.

You can use the Remote Debugging Monitor tool to set remote debugging security options on the server. To do so, from the Tools menu, select Options. This opens the Options dialog box, as shown in Figure 8-4. Here you set the server name to a user and a server. Each instance of the remote debugger running on a server has a unique server name. You typically run an instance of the remote debugger for each developer who is doing remote debugging on the server. The Options dialog box also allows you to set the user authentication mode and permissions. Typically this is set to Windows Authentication. You then give the appropriate user in the Active Directory repository access rights to remotely debug.



Options

Server name: User@MyServer

Authentication mode

[✓ Windows Authentication] Permissions...

No Authentication (native only)

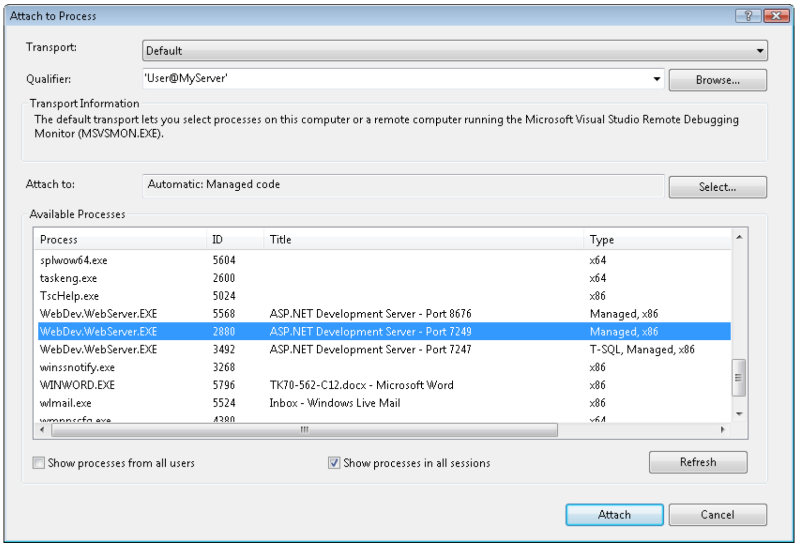
TCP/IP port number: 4015

☐ Allow any user to debug

Maximum idle time (seconds): 0

FIGURE 8-4 The Options dialog box for the Remote Debugging Monitor.

You begin a remote debugging session by opening Visual Studio and a solution that includes the code you intend to debug. You can then attach to the server that is running the Remote Debugging Monitor application by selecting Attach To Process from the Debug menu. This opens the Attach To Process dialog box shown in Figure 8-5.



Attach to Process

Transport: Default

Qualifier: 'User@MyServer' Browse...

Transport Information

The default transport lets you select processes on this computer or a remote computer running the Microsoft Visual Studio Remote Debugging Monitor (MSVSMON.EXE).

Attach to: Automatic: Managed code Select...

Available Processes

Process	ID	Title	Type
splwow64.exe	5604		x64
taskeng.exe	2600		x64
TscHelp.exe	5024		x86
WebDev.WebServer.EXE	5568	ASP.NET Development Server - Port 8676	Managed, x86
WebDev.WebServer.EXE	2880	ASP.NET Development Server - Port 7249	Managed, x86
WebDev.WebServer.EXE	3492	ASP.NET Development Server - Port 7247	T-SQL, Managed, x86
winssnotify.exe	3268		x86
WINWORD.EXE	5796	TK70-562-C12.docx - Microsoft Word	x86
wlmail.exe	5524	Inbox - Windows Live Mail	x86

☐ Show processes from all users ☑ Show processes in all sessions

FIGURE 8-5 The Attach To Process dialog box in Visual Studio.

In this dialog box, you set the qualifier to the name of the server running the Remote Debugging Monitor. Recall that this is the server name you set in the Options dialog box for the Remote Debugging Monitor and typically is defined as *User@Server*. You will then see a list of running processes on the server. Select the ASP.NET web server process, and click Attach to start remote debugging. You can then access the server through a browser to cause a breakpoint to fire or an error to occur. Doing so will send you into debug mode in Visual Studio.

EXAM TIP

For the exam, and for real life, know how to configure ASP.NET debugging for a remote Web server running IIS. Be sure you understand the permissions you need and how to attach to a remote process.

For information on debugging an ASP.NET application running on a Server Core installation of Windows Server 2008 R2, see "How to Get Started with ASP.NET Applications on Server Core" at *http://code.msdn.microsoft.com/R2CoreASPNET*.

Debugging Client-Side Script

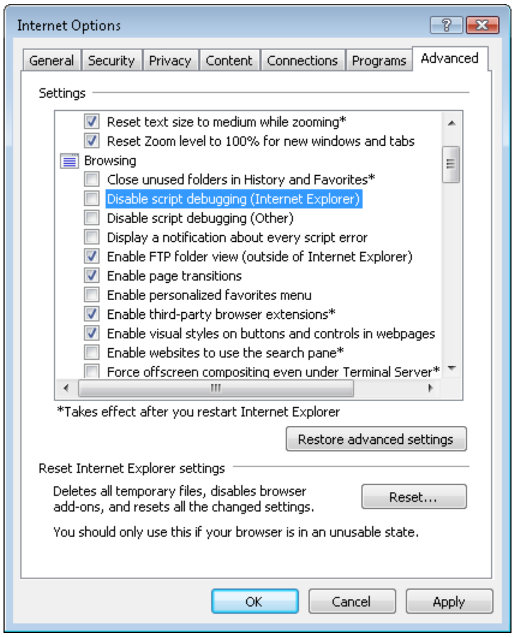
Visual Studio also allows you to debug client script running in a browser. This is useful if you write a lot of JavaScript and need to walk through the code line by line and use the other features of the debugging toolset.

To get started, you need to enable script debugging support in the browser. To do so, open Windows Internet Explorer and select Tools | Internet Options. Click the Advanced tab of the Internet Options dialog box, as shown in Figure 8-6. Find the Browsing node in the Settings tree and clear the Disable Script Debugging (Internet Explorer) check box.

You can then begin debugging client script. You can get started by setting a breakpoint in your client script and running the site through Visual Studio. You can also manually attach to code running in a browser. You do this by first opening the source code in Visual Studio and then using the Attach To Process dialog box discussed in the previous section to attach to the browser's process. Any error will give you the option to debug.

NOTE **DEBUGGING AJAX**

For more information on debugging client script that uses the Microsoft Asynchronous JavaScript and XML (AJAX) Library, see "Tracing AJAX Applications" in Lesson 2 of this chapter.


Internet Options

General | Security | Privacy | Content | Connections | Programs | Advanced

Settings

- [✓] Reset text size to medium while zooming*
- [✓] Reset Zoom level to 100% for new windows and tabs
- Browsing
  - [ ] Close unused folders in History and Favorites*
  - [ ] Disable script debugging (Internet Explorer)
  - [ ] Disable script debugging (Other)
  - [ ] Display a notification about every script error
  - [✓] Enable FTP folder view (outside of Internet Explorer)
  - [✓] Enable page transitions
  - [ ] Enable personalized favorites menu
  - [✓] Enable third-party browser extensions*
  - [✓] Enable visual styles on buttons and controls in webpages
  - [ ] Enable websites to use the search pane*
  - [ ] Force offscreen compositing even under Terminal Server*

*Takes effect after you restart Internet Explorer

Restore advanced settings

Reset Internet Explorer settings

Deletes all temporary files, disables browser add-ons, and resets all the changed settings.

Reset...

You should only use this if your browser is in an unusable state.

OK | Cancel | Apply

FIGURE 8-6 Using the Internet Options dialog box to enable script debugging for Internet Explorer.

✓ Quick Check

1. In which dialog box do you enable the ASP.NET debugger for a project?
2. What is the name of the element in the Web.config file that you use to define the debug attribute to turn on debugging for your site?

Quick Check Answers

1. You can enable the ASP.NET debugger from your project's Property Pages dialog box.
2. You can turn on debugging by using the debug attribute of the compilation element.

PRACTICE Configuring Debugging in ASP.NET

In this practice, you configure a website to support debugging and custom error pages. You also set up Internet Explorer to support script debugging.

ON THE COMPANION MEDIA

If you encounter a problem completing an exercise, you can find the completed projects in the samples installed from this book's companion CD. For more information about the project files and other content on the CD, see "Using the Companion Media" in this book's Introduction.

EXERCISE 1 Configuring a Website for Debugging

In this exercise, you create a website and configure it for debugging.

1. Open Visual Studio. Create a new, file-based website.
2. Open the Web.config file and navigate to the compilation node. Change the default <compilation debug /> setting from false to true.
3. Create a new web form named **Default2.aspx** without a master page. Inside the Page.Load event handler (which you will need to add if you are using Visual Basic), throw an exception. The following code shows an example.

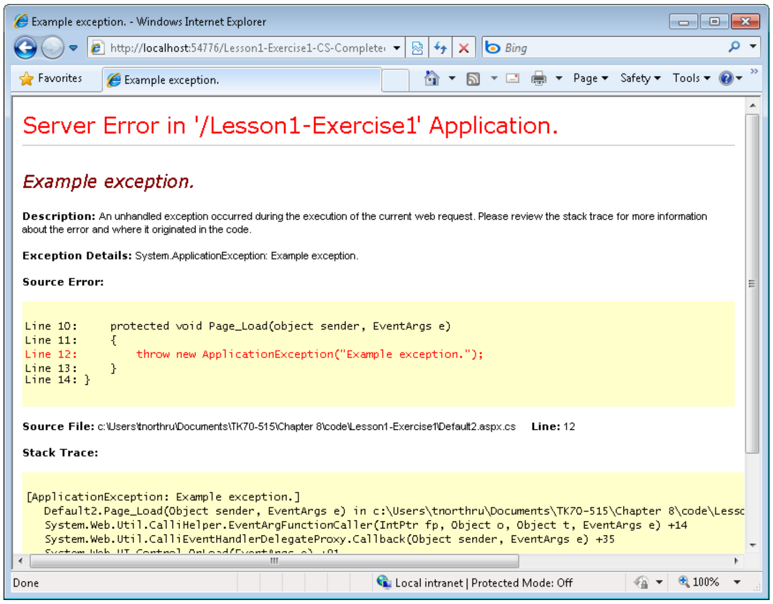
Sample of Visual Basic Code

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

  Throw New ApplicationException("Example exception.")

End Sub
```

Sample of C# Code

```
protected void Page_Load(object sender, EventArgs e)
{
  throw new ApplicationException("Example exception.");
}
```

4. Run the Default2.aspx page in a browser by right-clicking the page in Solution Explorer and choosing View In Browser. This displays the debugging error information, as shown in the example in Figure 8-7.


Example exception. - Windows Internet Explorer
http://localhost:54776/Lesson1-Exercise1-CS-Complete
Bing
Favorites
Example exception.
Page
Safety
Tools
Done
Local intranet | Protected Mode: Off
100%

Server Error in '/Lesson1-Exercise1' Application.

Example exception.

Description: An unhandled exception occurred during the execution of the current web request. Please review the stack trace for more information about the error and where it originated in the code.

Exception Details: System.ApplicationException: Example exception.

Source Error:

```
Line 10:     protected void Page_Load(object sender, EventArgs e)
Line 11:     {
Line 12:         throw new ApplicationException("Example exception.");
Line 13:     }
Line 14: }
```

Source File: c:\Users\tnorthru\Documents\TK70-515\Chapter 8\code\Lesson1-Exercise1\Default2.aspx.cs **Line:** 12

Stack Trace:

```
[ApplicationException: Example exception.]
   Default2.Page_Load(Object sender, EventArgs e) in c:\Users\tnorthru\Documents\TK70-515\Chapter 8\code\Lesso
   System.Web.Util.CalliHelper.EventArgFunctionCaller(IntPtr fp, Object o, Object t, EventArgs e) +14
   System.Web.Util.CalliEventHandlerDelegateProxy.Callback(Object sender, EventArgs e) +35
   System.Web.UI.Control.OnLoad(EventArgs e) +91
```

FIGURE 8-7 The ASP.NET debugging error information in a web browser.

EXERCISE 2 Adding a Custom Error Page

In this exercise, you create a custom error page and configure your site to redirect to it for a specific HTTP status code.

1. Open the project you created in the previous exercise. Alternatively, you can open the completed Lesson 1, Exercise 1 project in the samples installed from the CD.
2. Add a new web form to the site. Name this form **ResourceNotFound.aspx**. Add text to the body of this page to display a custom error message to users when they try to access a resource that is not on the web server. You can use the aspxerrorpath query string parameter to display the path of the requested resource in the message.
3. Open the Web.config file again. Add the customErrors section and turn on custom errors. Add an error element for HTTP status code 404 (resource not found). The following markup shows an example.

```
<customErrors mode="On">
  <error statusCode="404" redirect="ResourceNotFound.aspx" />
</customErrors>
```

4. View Default.aspx in a browser again. Notice that the debugging error message is no longer shown. This is because the on setting in the customErrors node indicates that the site should only display custom errors. Next, change the URL in your browser to request fakepage.aspx (which should not exist in your site). This will redirect the browser to the ResourceNotFound.aspx page.

EXERCISE 3 Enabling Script Debugging

In this exercise, you enable client script debugging for a website.

1. Open the project you created in the previous exercise. Alternatively, you can open the completed Lesson 1, Exercise 2 project in the samples installed from the CD.
2. Add a new web form to your site. Name the page **ScriptDebug.aspx**.
3. Add a JavaScript function to the markup. This can be a simple script, as follows.

```
<script language="javascript" type="text/jscript">
  function buttonClick() {
    alert('Button clicked.');
  }
</script>
```

4. Add an HTML button to the page. Set the OnClick event to call the JavaScript function, as follows.

```
<input id="Button1" type="button" value="button" onclick="buttonClick()" />
```

5. Open Internet Explorer and select Tools | Internet Options. Click the Advanced tab and clear the Disable Script Debugging (Internet Explorer) check box. If Internet Explorer is not currently your default browser, configure it as the default to allow client script debugging from Visual Studio. To make it the default browser, click the Make Default button on the Programs tab. Click OK.
6. Return to Visual Studio. Set a breakpoint on the buttonClick function in the markup. You can do so by clicking the margin area in the code editor (on the left side).
7. Run the application from Visual Studio by choosing Start Debugging from the Debug menu (or by simply pressing F5). Navigate to the ScriptDebug.aspx page. Click the button to break into the script debugger.

Lesson Summary

- You turn on debugging for your website in the Web.config file by setting the debug attribute of the compilation element to true. You can also turn on debugging at the individual page level by using the Debug attribute of the @ Page directive.
- You can set a custom error page for your entire site by setting the defaultRedirect attribute of the customErrors element. You can also map specific pages to HTTP status codes by using the errors child element.

- The Remote Debugging Monitor (msvsmon.exe) allows you to configure debugging on a remote server. After it is configured, you need to attach to your site's ASP.NET process from Visual Studio.
- You can set an option in Internet Explorer to allow you to debug client script from Visual Studio. This allows you to use the debugging features of Visual Studio with client-side JavaScript.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 1, "Debugging Websites." The questions are also available on the companion CD as a practice test, if you prefer to review them in electronic form.

NOTE **ANSWERS**

Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You are debugging an application on a test server. You have an issue on a particular page and need to get the error details. You do not want to turn on debugging for the entire site. What actions should you take? (Choose all that apply.)
   A. In the Web.config file, set the debug attribute of the compilation element to true.
   B. In the Web.config file, set the debug attribute of the compilation element to false.
   C. On the page that throws the error, set the debug attribute of the @ Page directive to true.
   D. On the page that throws the error, set the debug attribute of the @ Page directive to false.
2. You are deploying your application to a production environment. You want to redirect users to a default error page if they encounter any unhandled exceptions or HTTP errors within the site. You also want to indicate the user's requested resource on the error page to help with support calls. What actions should you take? (Choose all that apply.)
   A. Set the redirect attribute of the error element to an error page within your site.
   B. Set the defaultRedirect attribute of the customErrors element to an error page within your site.
   C. Use the statusCode query string parameter to retrieve the requested resource to display on the error page.
   D. Use the aspxerrorpath query string parameter to retrieve the requested resource to display on the error page.

3. You are investigating an error that only occurs when the application is deployed to the development or test server. You need to debug this error remotely. What actions should you take? (Choose all that apply.)
   - **A.** Run the Remote Debugging Monitor (Msvsmon.exe) on the development computer that is doing the debugging. Use the tool to define connection rights to the server you want to debug.
   - **B.** Run the Remote Debugging Monitor (Msvsmon.exe) on the server you want to debug. Use the tool to define connection rights for the developer doing the debugging.
   - **C.** In Visual Studio, use the Attach To Process dialog box to attach to the ASP.NET process on the server you want to debug.
   - **D.** In Visual Studio, use the Attach To Process dialog box to attach to the browser process that is running the application you want to debug.

Lesson 2: Troubleshooting Websites

Not all issues can be found by using Visual Studio. Therefore, ASP.NET provides tools with which you can trace and monitor your code as it executes in a test or production environment. These facilities of ASP.NET can be used to troubleshoot and diagnose problems that might otherwise prove impossible to recreate. In addition, these features allow you to examine statistics and usage on your website.

This lesson first covers enabling and configuring tracing in ASP.NET. It then explores how you can monitor a running website.

After this lesson, you will be able to:

- Enable and configure ASP.NET tracing.
- Understand the data that is available through ASP.NET tracing.
- Work with monitoring tools to evaluate a running ASP.NET site.

Estimated lesson time: 20 minutes

Implementing Tracing

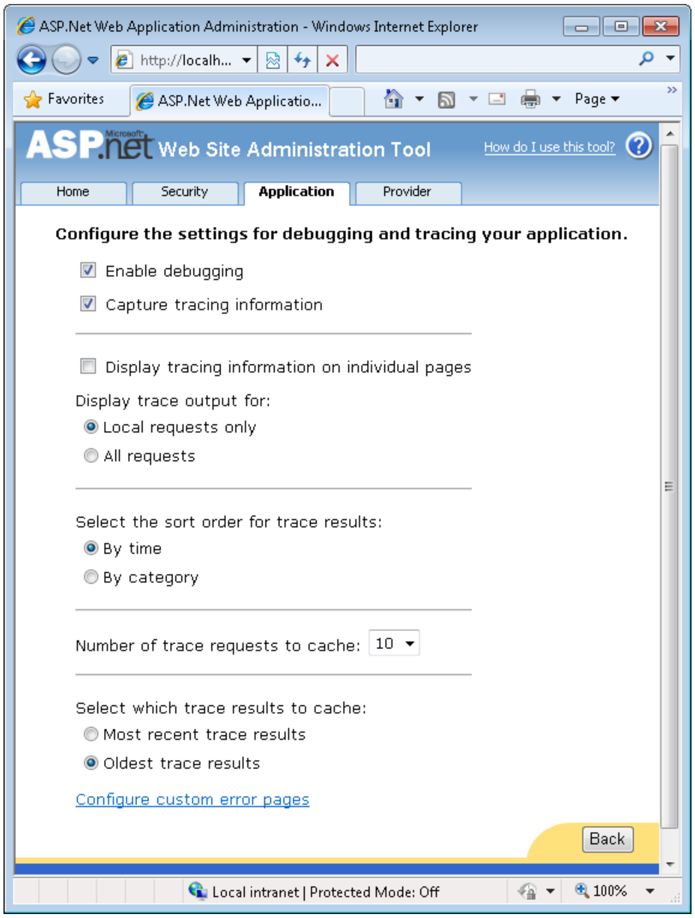
Tracing is the process of emitting data about a running application. In ASP.NET, this data is logged to a trace log file that you can access through a web browser. The data provides important information about your site, such as who accessed the site, what the results were, what the HTTP data looked like, and much more. You can also inject your own tracing calls into your code. This data will be emitted alongside the ASP.NET data.

You enable tracing through the Web.config file. You can edit this file manually, or you can use the ASP.NET Web Site Administration Tool (WSAT) to provide an administrator-friendly interface to enable and configure tracing.

Enabling Tracing by Using the WSAT

The following steps show how to enable and configure the trace facility by using the WSAT:

1. Open the WSAT by selecting Website | ASP.NET Configuration from the Visual Studio menu.
2. On the home page, click the Application tab of the WSAT. This will bring up settings for your application.
3. On the Application tab, click Configure Debugging And Tracing (in the lower-right corner). This will display the configuration options for debugging and tracing, as shown in Figure 8-8.


ASP.Net Web Application Administration - Windows Internet Explorer
http://localh...
Favorites
ASP.Net Web Applicatio...
Page
ASP.net Web Site Administration Tool
How do I use this tool?
Home
Security
Application
Provider
Back
Local intranet | Protected Mode: Off
100%

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
- ○ By category

Number of trace requests to cache: 10

Select which trace results to cache:
- ○ Most recent trace results
- ● Oldest trace results

Configure custom error pages

FIGURE 8-8 The debugging and tracing options in the WSAT.

4. Select the Capture Tracing Information check box. This enables the tracing features to be changed as necessary.

As you can see from Figure 8-8, there are many options you can configure with respect to tracing. These options also map to Web.config settings (because that is what the WSAT administers). Table 8-2 describes each of the options, from the perspective of both the WSAT and Web.config.

TABLE 8-2 ASP.NET Trace Settings

WSAT SETTING	WEB.CONFIG SETTING	DESCRIPTION
Capture Tracing Information	enabled	Enables tracing for your application. When this is set to true, the other trace options are also made available.
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 webpage or behind the regular webpage content.
Display Trace Output For	localOnly	Designates whether you intend to display tracing just for local requests or for all requests. When set to Local Requests Only, the trace facility operates only with requests from the computer on which the web server is running. The All Requests setting enables tracing for all requests from any computer to the website.
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 number of records to hold in the cache (or trace log).
Select Which Trace Results To Cache	mostRecent	Designates whether to store the most recent trace result or the oldest trace results. When set to Most Recent Trace Results, the cache continues to update, holding only 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 website is restarted or the log is cleared.

Enabling Tracing by Using the Web.config File

You can enable tracing manually by editing the Web.config file of an ASP.NET site. You do so by editing attributes (as listed in Table 8-2 in the previous section) of the <trace> element. This element is nested under <configuration><system.web>. The following markup shows an example.

```
<configuration>
  <system.web>
    <trace enabled="true"
      requestLimit="100"
      pageOutput="false"
      traceMode="SortByTime"
      localOnly="false"
      mostRecent="true" />
  <system.web>
</configuration>
```

In the preceding markup, tracing is enabled (enabled="true") for all requests to the server (localOnly="false"). The trace log will cache the most recent 100 requests (requestLimit="100" and mostRecent="true"). The trace log will be sorted by time (raceMode="SortByTime"). The data will only be viewable through the trace log and not on each individual page (pageOutput="false").

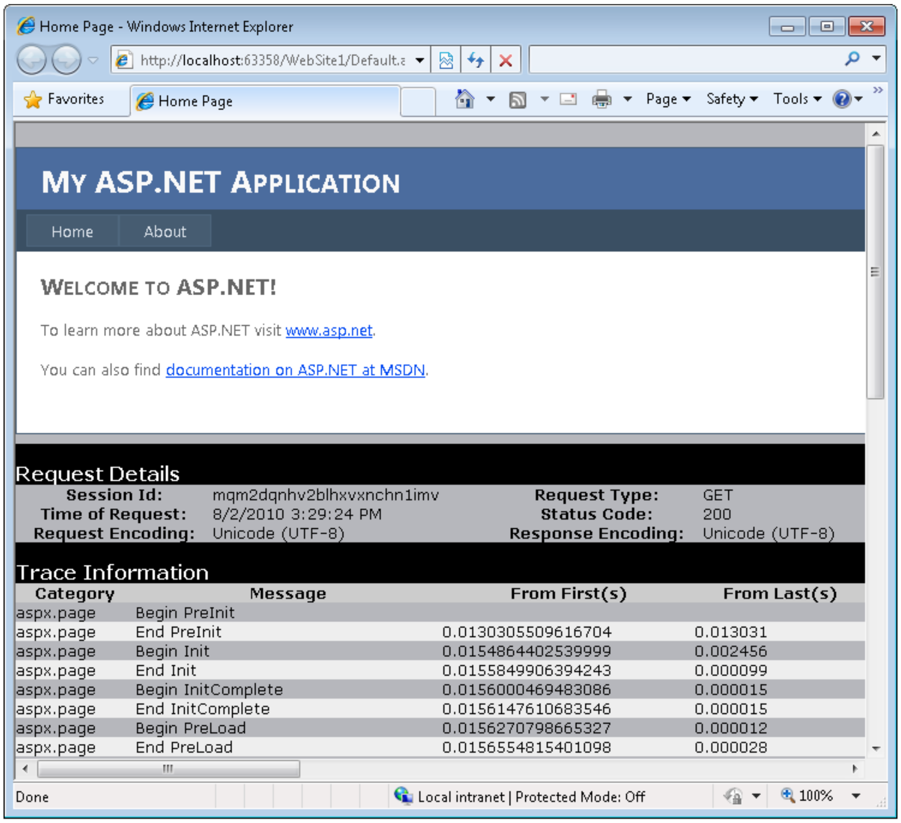
Enabling Tracing at the Page Level

You can also enable tracing for specific pages only. This is useful if you do not want to turn on tracing at the site level, but instead enable it only on a page that you are troubleshooting. You enable tracing at the page level by setting the trace attribute of the @ Page directive to true. This attribute is found at the top of the page's markup. The following shows an example.

```
<@Page trace="true" ... />
```

Viewing Trace Data

After ASP.NET trace data has been configured and turned on, you can view the data on each webpage (Trace="true") or view the trace output by navigating to the Trace.axd page on the current website (*http://*server/application*/trace.axd*). When viewed on the same page, the trace information is appended to the bottom of the page (for pages that use flow layout). Figure 8-9 shows an example.


Home Page - Windows Internet Explorer
http://localhost:63358/WebSite1/Default.a
Favorites
Home Page
Page
Safety
Tools
MY ASP.NET APPLICATION
Home
About
Done
Local intranet | Protected Mode: Off
100%

WELCOME TO ASP.NET!

To learn more about ASP.NET visit www.asp.net.

You can also find documentation on ASP.NET at MSDN.

Request Details

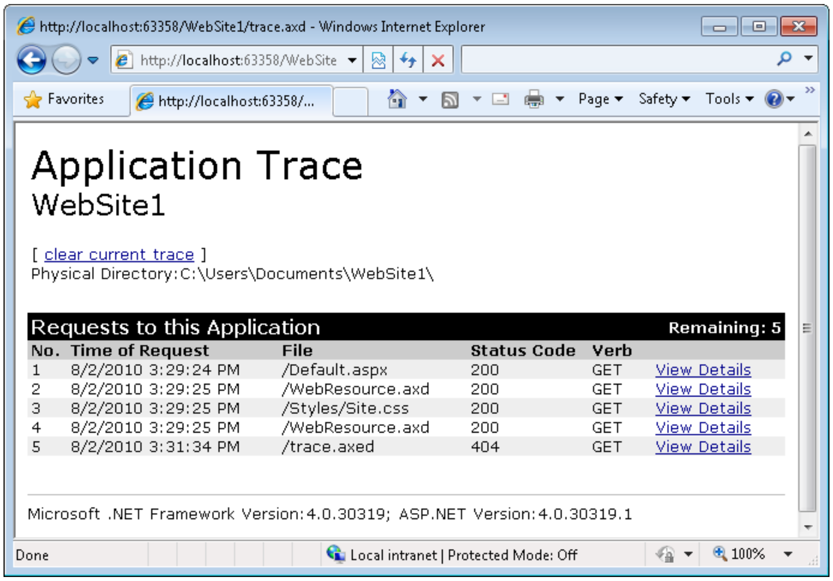
```
      Session Id:     mqm2dqnhv2blhxvxnchn1imv          Request Type:      GET
 Time of Request:     8/2/2010 3:29:24 PM                Status Code:      200
Request Encoding:     Unicode (UTF-8)               Response Encoding:     Unicode (UTF-8)
```

Trace Information

```
  Category         Message                    From First(s)          From Last(s)
aspx.page    Begin PreInit
aspx.page    End PreInit              0.0130305509616704       0.013031
aspx.page    Begin Init               0.0154864402539999       0.002456
aspx.page    End Init                 0.0155849906394243       0.000099
aspx.page    Begin InitComplete       0.0156000469483086       0.000015
aspx.page    End InitComplete         0.0156147610683546       0.000015
aspx.page    Begin PreLoad            0.0156270798665327       0.000012
aspx.page    End PreLoad              0.0156554815401098       0.000028
```

FIGURE 8-9 Trace information displayed on an ASP.NET page.

To view your entire log, you navigate to the Trace.axd page for your site. This page will show a log event if pageOutput is set to true. The first page of the log is a summary page. This page contains a list of trace results that are in the cache. Figure 8-10 shows an example.


http://localhost:63358/WebSite1/trace.axd - Windows Internet Explorer
Favorites
Page
Safety
Tools
Done
Local intranet | Protected Mode: Off
100%

Application Trace
WebSite1

[clear current trace]
Physical Directory:C:\Users\Documents\WebSite1\

Requests to this Application — Remaining: 5

No.	Time of Request	File	Status Code	Verb	
1	8/2/2010 3:29:24 PM	/Default.aspx	200	GET	View Details
2	8/2/2010 3:29:25 PM	/WebResource.axd	200	GET	View Details
3	8/2/2010 3:29:25 PM	/Styles/Site.css	200	GET	View Details
4	8/2/2010 3:29:25 PM	/WebResource.axd	200	GET	View Details
5	8/2/2010 3:31:34 PM	/trace.axed	404	GET	View Details

Microsoft .NET Framework Version:4.0.30319; ASP.NET Version:4.0.30319.1

FIGURE 8-10 The Trace.axd page.

You can click one of the cached results to view the details of the trace record for a single page request. These details are similar to the information that is shown on each webpage (as shown previously, in Figure 8-9).

SECURITY ALERT

If you opt to display 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 be displayed. Be sure to disable page tracing on production web servers.

The trace result page is separated into sections, as described in Table 8-3. The information in these sections can be very useful when you are trying to identify performance issues and resource usage.

TABLE 8-3 Trace Result Sections

TRACE RESULT SECTION	DESCRIPTION
Request Details	Provides general details about the page request.
Trace Information	Displays performance information related to the webpage'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 time elapsed since the previous event.
Control Tree	Displays information about each control on the webpage, 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.

Emitting Custom Trace Data

You can use the Trace class in the System.Diagnostics namespace to add your own trace messages to the data that is displayed by ASP.NET tracing. This class is exposed as a member of the Page object. This allows you to call Page.Trace (or just Trace). You use the Write method of this object to write a message to the trace log. When doing so, you can provide a category and the message.

The following shows an example of writing to the trace log. Here a message is added to the log when the page is loaded and when a user clicks the button on the page. The category of the message is set to Custom Category. This category allows you to find your message easily. Custom messages are embedded in the Trace Information section of the trace details.

Sample of Visual Basic Code

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

  Trace.Write("Custom Category", "Page_Load called")

End Sub

Protected Sub Button1_Click(ByVal sender As Object, _
  ByVal e As System.EventArgs) Handles Button1.Click

  Trace.Write("Custom Category", "Button1_Click called")

End Sub
```

Sample of C# Code

```
protected void Page_Load(object sender, EventArgs e)
{
  Trace.Write("Custom Category", "Page_Load called");
}

protected void Button1_Click(object sender, EventArgs e)
{
  Trace.Write("Custom Category", "Button1_Click called");
}
```

Tracing AJAX Applications

Debugging an AJAX application presents its own issues. You do not have a server process on which to rely. Instead, you have to try to debug the code as it executes in the browser. In the previous section, you saw how to do this. However, AJAX-enabled applications tend to have a lot of client code, so they might present more issues when they are being debugged. For this reason, the Microsoft AJAX Library provides the Sys.Debug client-side namespace.

The tracing you enable on the server is not fired for AJAX partial-page requests. Therefore, you will see nothing in the Trace.axd log for these types of requests. Instead, you must use the features of Sys.Debug to write out trace messages. The Debug class includes the assert, trace, clearTrace, traceDump, and fail methods. These methods can be used to display and manage messages to a trace log based on your needs.

As an example, suppose you write out a message by using Sys.Debug.trace. Of course, your page must include the Microsoft AJAX Library JavaScript file. You make this happen by adding a ScriptManager control to your page. (See Chapter 9, “Working with Client-Side Scripting, AJAX, and jQuery,” for more details on working with AJAX.) The following markup shows part of an ASPX page that includes a ScriptManager control and a JavaScript function named button1_ onclick. When this function is fired (when the user clicks button1), the trace method is called.

```
<html xmlns="http://www.w3.org/1999/xhtml">
<head id="Head1" runat="server">
  <title>AJAX Trace Example</title>

  <script language="javascript" type="text/javascript">
    function button1_onclick() {
      Sys.Debug.trace("Button1 clicked");
    }
  </script>

</head>
<body>
  <form id="form1" runat="server">
    <div>

    <asp:ScriptManager ID="ScriptManager1" runat="server">
    </asp:ScriptManager>

    <input id="Button1" type="button" value="button"
      onclick="button1_onclick()" />

  </div>
  </form>
</body>
</html>
```

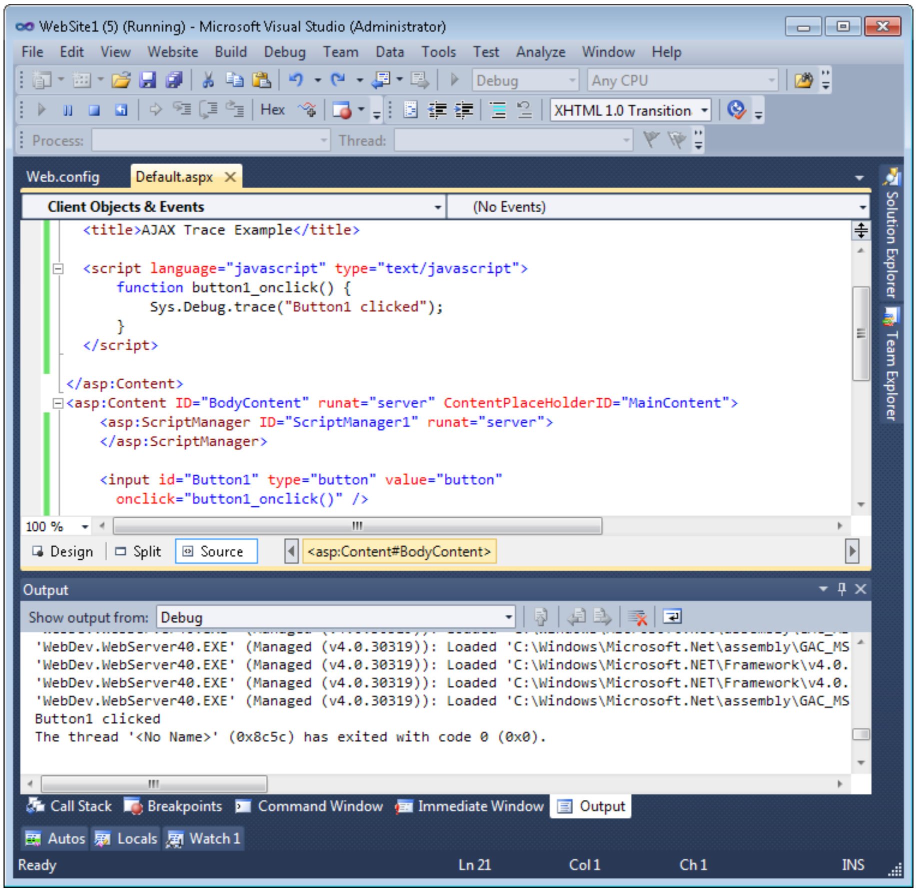
REAL WORLD

Tony Northrup

Visual Studio 2010 is definitely the best tool for writing and debugging ASP.NET code. When it comes to debugging complex problems in client-side JavaScript, however, you can do better. Visual Studio almost always gives you broad errors that make it difficult to isolate the real problem, and it often highlights code within a library, rather than in your JavaScript.

The most efficient tool I've found for debugging JavaScript is the free Firebug plug-in for the Firefox browser. It provides excellent warnings about inconsistencies in your code (such as a missing quote or bracket), and it gives genuinely useful feedback about problems.

You can view the trace messages displayed by the Microsoft AJAX Library in the Visual Studio Output window. This works if you are using Internet Explorer and Visual Studio, and if you are debugging on the same machine on which the website is running. However, you can also create a TextArea control on the page that includes your JavaScript. If you set the TextArea control's ID to TraceConsole. this tells the Microsoft AJAX Library to display its trace messages to this TextArea for you to view. If the browser you are using for debugging has a debugging console (as the Apple Safari and Opera browsers do), that console can also be used to view the trace messages. Figure 8-11 shows the result of the preceding markup as displayed to the Visual Studio Output window (at the bottom of the screen).



```
    <title>AJAX Trace Example</title>

    <script language="javascript" type="text/javascript">
        function button1_onclick() {
            Sys.Debug.trace("Button1 clicked");
        }
    </script>

</asp:Content>
<asp:Content ID="BodyContent" runat="server" ContentPlaceHolderID="MainContent">
    <asp:ScriptManager ID="ScriptManager1" runat="server">
    </asp:ScriptManager>

    <input id="Button1" type="button" value="button"
      onclick="button1_onclick()" />
```

```
'WebDev.WebServer40.EXE' (Managed (v4.0.30319)): Loaded 'C:\Windows\Microsoft.Net\assembly\GAC_MS
'WebDev.WebServer40.EXE' (Managed (v4.0.30319)): Loaded 'C:\Windows\Microsoft.NET\Framework\v4.0.
'WebDev.WebServer40.EXE' (Managed (v4.0.30319)): Loaded 'C:\Windows\Microsoft.NET\Framework\v4.0.
'WebDev.WebServer40.EXE' (Managed (v4.0.30319)): Loaded 'C:\Windows\Microsoft.Net\assembly\GAC_MS
Button1 clicked
The thread '<No Name>' (0x8c5c) has exited with code 0 (0x0).
```

FIGURE 8-11 The Sys.Debug.trace message in the Output window.

Quick Check

1. How can you make trace data display on your webpage?
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 webpage?

Quick Check Answers

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

Monitoring a Running Web Application

Tracing provides diagnostic information about a page. This can be very useful for troubleshooting problems with pages in a test environment. However, you often need information about the overall health of your application. You should be able to monitor the application and be notified of various events such as error conditions, security issues, and request failures. You can do so by using the features of ASP.NET health monitoring.

ASP.NET health monitoring provides a set of classes in the System.Web.Management namespace for tracking the health of your application. You can use these classes to create your own events and your own custom event listeners (and viewers). You can also use the default features exposed by these classes to monitor most aspects of any running website. This section focuses on the latter option.

The Health Monitoring Classes

The health monitoring system works by raising and logging ASP.NET events based on your configuration. You enable these events based on what you want to monitor with respect to your application's performance and health. The monitoring occurs in a deployed environment. You can use the features of health monitoring to receive email messages about important activities, log information to the event log, and log information to SQL Server.

The first step in health monitoring is to determine which events to listen for. These events are defined as classes. The classes are based on a class hierarchy that defines the data that is logged with the event. For example, a web health monitoring event class might contain information about the process that is executing your code, the HTTP request, the HTTP response, and error conditions.

You can also use the base web event classes in the System.Web.Management namespace to write your own web events for health monitoring purposes. Table 8-4 lists the key web event classes and their basic use.

TABLE 8-4 The Web Event Classes in ASP.NET

CLASS NAME	DESCRIPTION
WebBaseEvent	The base class for creating your own web events
WebManagement-Event	The base class for creating web events that contain application process information
WebHeartbeatEvent	Serves as a periodic event that raises information about your application at set intervals
WebRequestEvent	The base class that contains web request information
WebApplication-LifetimeEvent	Raised when a significant application event occurs, such as application start or shutdown
WebBaseErrorEvent	The base class for creating error-based events
WebErrorEvent	Used to provide information about an error when it occurs in your application

CLASS NAME	DESCRIPTION
WebRequestErrorEvent	Contains request data for request errors
WebAuditEvent	The base class for creating audit (security) events
WebSuccessAuditEvent	Raised when a successful security operation occurs for your application
WebAuthentication-SuccessAuditEvent	Used to provide information when a successful user authentication occurs on the site
WebFailureAuditEvent	Raised when a failed security operation occurs
WebAuthentication-FailureAuditEvent	Used to provide information when a failed attempt at user authentication occurs on the site
WebViewStateFailure-AuditEvent	Raised when the view state fails to load (typically as a result of tampering)

When you know which events to listen for, the second step is to enable a listener (or log). The ASP.NET health monitoring system defines a set of providers (or listeners) that are used to collect the web event information. These listeners consume the web health events and typically log the event details. You can use the default listeners or write your own by extending the existing WebEventProvider class. The default providers include EventLogWebEventProvider, WmiWebEventProvider, and SqlWebEventProvider. You configure web events and web providers in ASP.NET configuration files, which are discussed next.

Configuring Health Monitoring

To configure health monitoring, you turn on web events and connect them to listeners in the Web.config file. You do so by configuring the <healthMonitoring> element of the <system.web> section of the Web.config file. The <healthMonitoring> element contains the enabled attribute, which you set to true to enable health monitoring. It also contains the heartbeatInterval attribute, which you can set to the number of seconds to wait between raising the WebHeartbeatEvent events. The individual events themselves also contain the minInterval attribute, which works in a similar fashion.

The process of configuring a web event and provider is as follows:

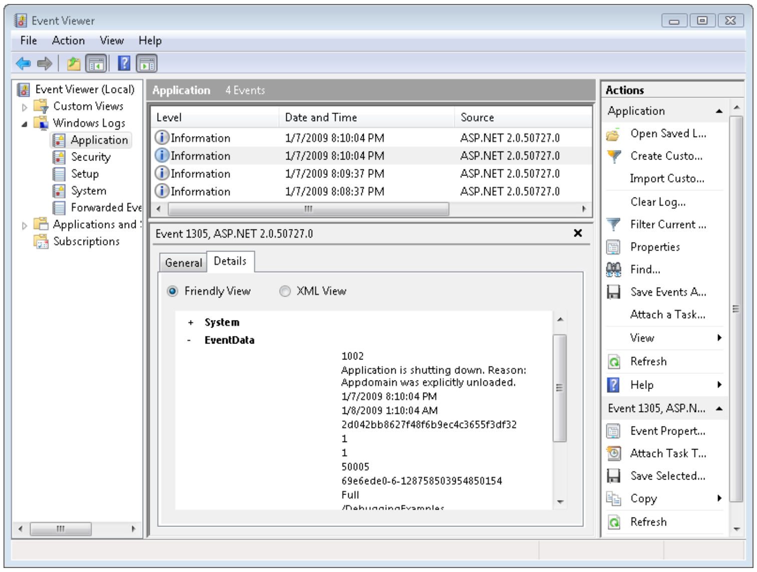
1. Add an eventMappings child element to healthMonitoring. You use the add element to add the web event class you want to use.
2. Add a providers child element to healthMonitoring. This indicates your health monitoring listener(s).
3. Finally, add a rules element to healthMonitoring. You use the add child element of rules to indicate an association between a registered web event and a registered listener.

Fortunately, you do not need to register the default web events and providers. These are already registered for you by the overall configuration file on your server. Therefore, you need only add rules to your Web.config file to turn these events on. As an example, the following configuration turns on the heartbeat and application lifetime events. These events are written to the EventLogProvider.

```
<configuration>
  <system.web>
    <healthMonitoring enabled="true" heartbeatInterval="1">

      <rules>
        <add name="Heart Beat"
          eventName="Heartbeats"
          provider="EventLogProvider"
          profile="Default"/>
        <add name="App Lifetime"
          eventName="Application Lifetime Events"
          provider="EventLogProvider"
          profile="Default"
          minInstances="1" minInterval=""
          maxLimit="Infinite"/>
      </rules>

    </healthMonitoring>
  <system.web>
<configuration>
```

Notice that this configuration requires you to know the configured name of the event class and the provider. You can look up these names in your root configuration file. You can also find them on MSDN in the “healthMonitoring Element (ASP.NET Settings Schema)” article. The default configuration markup is listed there.

Figure 8-12 shows a logged event in Event Viewer. Notice that this event fired when the application unexpectedly shut down. This was the result of the firing of the application lifetime event (WebApplicationLifetimeEvent).



Level	Date and Time	Source
Information	1/7/2009 8:10:04 PM	ASP.NET 2.0.50727.0
Information	1/7/2009 8:10:04 PM	ASP.NET 2.0.50727.0
Information	1/7/2009 8:09:37 PM	ASP.NET 2.0.50727.0
Information	1/7/2009 8:08:37 PM	ASP.NET 2.0.50727.0

Event 1305, ASP.NET 2.0.50727.0

```
+ System
- EventData
                    1002
                    Application is shutting down. Reason:
                    Appdomain was explicitly unloaded.
                    1/7/2009 8:10:04 PM
                    1/8/2009 1:10:04 AM
                    2d042bb8627f48f6b9ec4c3655f3df32
                    1
                    1
                    50005
                    69e6ede0-6-128758503954850154
                    Full
                    /DebuggingExamples
```

FIGURE 8-12 The web event data displayed in the Event Viewer.

PRACTICE Using the ASP.NET Trace Facility

In this practice, you create a basic website and enable ASP.NET tracing. You then execute the site and view the trace details both at the page level and by using the ASP.NET trace listener.

ON THE COMPANION MEDIA

If you encounter a problem completing an exercise, you can find the completed projects in the samples installed from this book's companion CD. For more information about the project files and other content on the CD, see "Using the Companion Media" in this book's Introduction.

EXERCISE Enabling ASP.NET Tracing

In this exercise, you work with ASP.NET tracing to view details about a running page in your site.

1. Open Visual Studio. Create a new, file-based website called **TracingCode**.
2. Open the WSAT from the Visual Studio menu by selecting Website | ASP.NET Configuration.
3. Click the Application tab to display the application settings. Click Configure Debugging And Tracing.
4. Select the Capture Tracing Information check box. This enables tracing for your site. Make the following additional changes on this page:
   - Ensure that the Display Tracing Information On Individual Pages check box is cleared.
   - 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 Number Of Trace Requests To Cache to 50.
   - Set the Select Which Trace Results To Cache option to Most Recent Trace Results.
   - Close the WSAT when finished.
5. Open the Web.config file. Navigate to the trace element. The trace element should look as follows (notice that the defaults are not listed; only the items that had to be overridden must be specified).

```
<trace
  enabled="true"
  mostRecent="true"
  requestLimit="50" />
```

6. Run the website. Refresh the webpage a few times to write more results to the trace log.
7. In the Address bar of the browser, change the URL to access Trace.axd for the site. This will bring up the trace log. You should see an entry for each time you requested the page. Click one of the View Details links to open a record. Notice that the Trace Information section contains the timings for the events in the webpage life cycle. Close the web browser.
8. Open Default.aspx in Visual Studio. Add the Trace="true" attribute to the @ Page directive at the top of the page. Run the site again; notice that the page now includes the trace information written out. Close the web browser.

9. Open the code-behind file for Default.aspx in Visual Studio. Add an event handler for the Page_Load event, the handler for which will already exist in the code-behind file if you are using C#. In the event handler, use Page.Trace to write out a tracing message. Your code should look as follows.

Sample of Visual Basic Code

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

  Trace.Write("Custom Category", "Page.Load called")

End Sub
```

Sample of C# Code

```
protected void Page_Load(object sender, EventArgs e)
{
  Trace.Write("Custom Category", "Page.Load called");
}
```

10. Run the application again. Notice your custom tracing message in the Trace Information section of the page's trace output.

Lesson Summary

- You can use ASP.NET tracing to troubleshoot and diagnose problems with a page in your website. It displays information about the request, the response, and the environment.
- You can use the trace method to display custom trace messages to the trace log.
- An AJAX-enabled page can use the client-side Sys.Debug.trace method to render tracing information to a webpage (by using a TextArea control), to the Visual Studio Output window, or to a browser's debug console.
- ASP.NET provides health monitoring tools (which you'll find in the System.Web.Management namespace) to enable you to monitor a running website. You can configure web events with listeners by using rule child elements of the <healthMonitoring> element inside Web.config.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 2, "Troubleshooting Websites." The questions are also available on the companion CD as a practice test, if you prefer to review them in electronic form.

NOTE **ANSWERS**

Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You want to identify which event in the webpage life cycle takes the longest time to execute. How can you accomplish this?
   - **A.** Turn on ASP.NET tracing and run the website. After that, review the trace results.
   - **B.** To each of the life-cycle events, add a line of code that will print the current time.
   - **C.** In the Web.config file, add the monitorTimings attribute and set it to true.
   - **D.** In the website properties, turn on the performance monitor and run the website. After that, open the performance monitor to see the timings.
2. You want to run a trace continuously to enable you to quickly look at the 10 most recent traces from anyone using your website, but you are concerned about filling your hard drive with excessive data. Which of the following settings will accomplish your objective?
   - **A.**
     ```
     <trace
        enabled="false"
        requestLimit="10"
        pageOutput="false"
        traceMode="SortByTime"
        localOnly="true"
        mostRecent="true"
     />
     ```
   - **B.**
     ```
     <trace
        enabled="true"
        requestLimit="10"
        pageOutput="true"
        traceMode="SortByTime"
        localOnly="true"
        mostRecent="true"
     />
     ```
   - **C.**
     ```
     <trace
        enabled="true"
        requestLimit="10"
        pageOutput="false"
        traceMode="SortByTime"
        localOnly="true"
        mostRecent="false"
     />
     ```
   - **D.**
     ```
     <trace
        enabled="true"
        requestLimit="10"
        pageOutput="false"
        traceMode="SortByTime"
        localOnly="false"
        mostRecent="true"
     />
     ```

3. You are interested in examining the data that is posted to the web server. What trace result section can you use to see this information?
   - **A.** The Control Tree section
   - **B.** The Headers Collection section
   - **C.** The Form Collection section
   - **D.** The Server Variables section
4. You want to configure ASP.NET health monitoring to log information every time a user fails to log on to the server. Which web event class should you use?
   - **A.** WebRequestEvent
   - **B.** WebAuditEvent
   - **C.** WebApplicationLifetimeEvent
   - **D.** WebAuthenticationSuccessAuditEvent

Lesson 3: Deploying Websites

With Windows applications, you have no choice but to consider deployment; typically, the client needs to be installed on every user's computer. With websites, deployment tends to be an afterthought, because users already have their web browsers installed.

However, developers often need to deploy code to staging and production servers on a regular basis, which can be tedious. In addition, many websites are deployed to multiple web servers simultaneously to provide high availability and performance. Finally, many web developers must release their applications commercially; this means that other people need to be able to deploy them in environments that the developer knows nothing about.

For each of these scenarios, the developer must create a plan to deploy the application and any updates that need to be released in the future. This lesson describes the different techniques available for deploying websites: manually copying files, publishing web applications, creating a Web Deployment Project, creating a Web Setup Project, using the Copy Web tool, and publishing websites.

After this lesson, you will be able to:

- Create a Web Setup Project and use the resulting files to deploy your application.
- Update and deploy websites in environments with multiple developers and servers by using the Copy Web tool.
- Precompile websites by using the Publish Web Site tool.

Estimated lesson time: 60 minutes

Publishing Web Applications

Depending on the scenario, a Microsoft .NET Framework website can be extremely easy to deploy. Websites, by default, are entirely file based. This means that the source code is usually deployed to the server. The server then compiles that code when pages are requested. In this scenario, you can deploy a website to a web server by simply copying the files to the correct directory on the server.

Even if you are deploying a new version of your site, in most cases you can simply overwrite the old files with the new ones. In addition, if you are creating a website that works on a single server and is file based, there is often no real need to run any type of setup process, edit the registry, or add items to the start menu. Configuration settings are defined with the Web.config file, and application code is contained entirely within the website folder structure. This means that you can deploy the entire website by using the simple xcopy shell command; no special deployment software is required.

This simplicity provides a great deal of flexibility in other scenarios, too. If your website is to be deployed to an array of web servers (in which multiple web servers host the same website for scalability and availability), you can use any file-synchronization tool to copy the files between the servers. This allows you to deploy to a master server and have the deployment synchronized across the web farm.

If your website has a database, requires special web server configuration, or needs different configuration settings in a release environment, simply copying files will be insufficient. In these cases, publishing a website typically involves:

- Configuring an application in IIS.
- Copying website files to the web server.
- Setting up a database.
- Configuring the website with the production database connection.
- Modifying other configuration settings, such as disabling detailed error messages.

Visual Studio 2010 includes a new Publish Web dialog box that allows you to configure each of these settings once, and then publish a website to one or more web servers with a single click. This section describes this tool in more detail.

Web.config Transformations

Applications that have different debugging, staging, and release environments typically have different application settings as well. For example, during debugging, an application might use a local file system database. However, in the production environment, the application might connect to a central database running Microsoft SQL Server.

Web.config transformations allow you to create separate Web.config files for different release types. Therefore, you can create debugging, staging, and release versions of the Web.config file with settings specific to each release type. To simplify management, you only need to specify settings that must be added, changed, or removed from the base Web.config file.

By default, Visual Studio adds Web.config transformations for the Debug and Release configurations for new ASP.NET Web Application projects. You can view and edit the transformations from Solution Explorer by expanding the Web.Config node and then double-clicking either Web.Debug.Config or Web.Release.Config. If you add more configurations (such as a staging configuration), you can add an associated transformation by right-clicking Web.config in Solution Explorer and then clicking Add Config Transformations.

The sections that follow describe the syntax for adding, replacing, and removing settings. For detailed information about more complex transformations, read "Web.config Transformation Syntax for Web Application Project Deployment" at *http://msdn.microsoft.com/en-us/library/dd465326.aspx*.

ADDING A SETTING

Web.config transformations contain only those settings that should be different from the standard Web.config file. To add a new setting to a Web.config file that is generated when publishing a web application, simply add the setting to the Web.config transformation file. For example, defining the following Web.Release.Config file will add the connection string to the Web.config file when you publish the web application by using the Release setting:

```
<configuration>
  <connectionStrings>
    <add name="MyDatabase"
         connectionString="data source=.\SQLEXPRESS;Integrated
           Security=SSPI;AttachDBFilename=|DataDirectory|\mydb.mdf;User Instance=true"
           providerName="System.Data.SqlClient" />
  </connectionStrings>
</configuration>
```

REPLACING A SETTING

If you need to define different settings for the same value in your base Web.config file and in a Web.config transformation, add the element to the Web.config transformation and specify the xdt:Transform="Replace" property. Any settings defined within the element will replace those in the base Web.config file when your web application is published.

For example, to replace the settings for custom errors so that the release version of your web application does not display detailed error information to remote users, you could add the following code to the Web.Release.Config file. Notice the xdt:Transform property in bold.

```
<configuration>
  <system.web>
      <customErrors defaultRedirect="GenericError.htm"
        mode="RemoteOnly" xdt:Transform="Replace">
        <error statusCode="500" redirect="InternalError.htm"/>
      </customErrors>
  </system.web>
</configuration>
```

You can use the xdt:Locator property to selectively replace settings when a property matches a specified value. Set the value of xdt:Locator to a conditional method call. For example, to verify that one of the properties you specify must match the property in the base Web.config file, use the Match method. The following example would replace an <add> connection string element only if the name property matched exactly.

```
<configuration>
    <connectionStrings>
      <add name="MyDB"
        connectionString="Data Source=ReleaseSQLServer;
          Initial Catalog=MyReleaseDB;Integrated Security=True"
        xdt:Transform="SetAttributes" xdt:Locator="Match(name)"/>
    </connectionStrings>
</configuration>
```

If you were to remove the xdt:Locator property, the Web.config transformation would replace all connection strings.

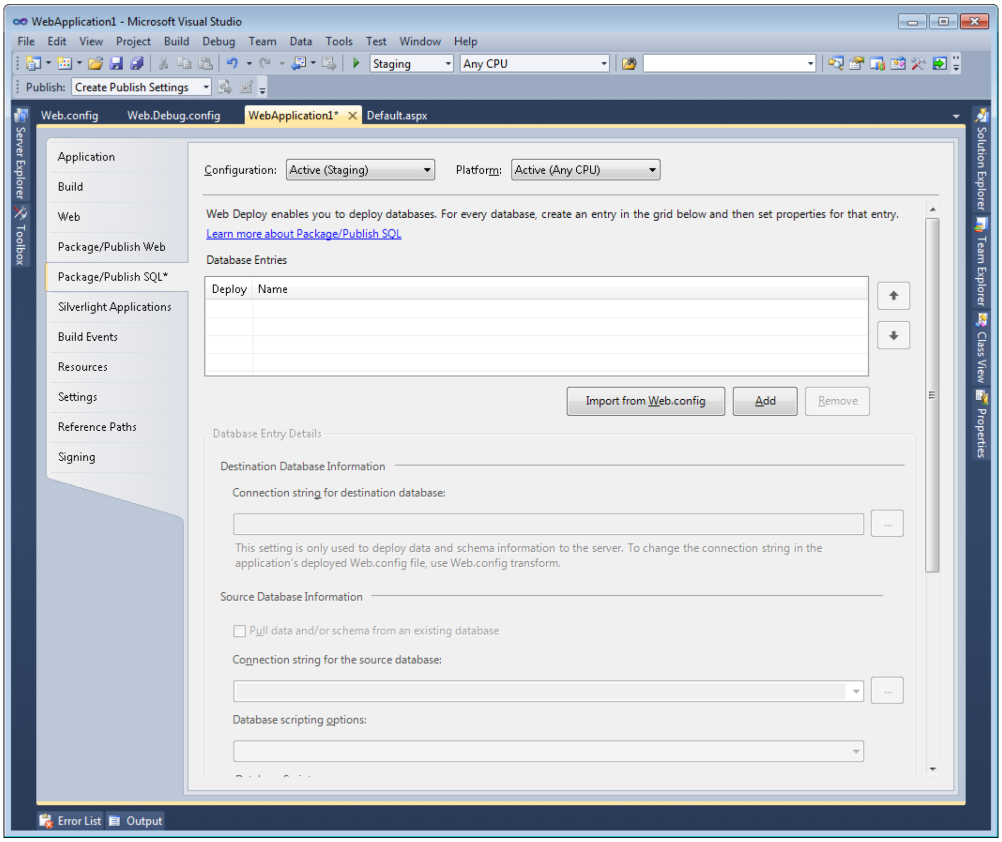
REMOVING A SETTING

You can remove an attribute by using the RemoveAttributes() method and specifying the name of the attribute to remove as the parameter. For example, to remove the <debug> attribute from the <compilation> section, you would add the following code to your Web.Release.Config file:

```
<configuration>
  <system.web>
    <compilation xdt:Transform="RemoveAttributes(debug)" />
  </system.web>
</configuration>
```

Configuring Deployment

You can deploy databases along with your web application. To configure the database to be deployed, right-click the project in Solution Explorer and then click Package/Publish Settings. Then click Package/Publish SQL. The Package/Publish SQL tab appears, as shown in Figure 8-13.


Configuration: Active (Staging)   Platform: Active (Any CPU)

Web Deploy enables you to deploy databases. For every database, create an entry in the grid below and then set properties for that entry.
Learn more about Package/Publish SQL

Database Entries

Deploy	Name

Destination Database Information

Connection string for destination database:

This setting is only used to deploy data and schema information to the server. To change the connection string in the application's deployed Web.config file, use Web.config transform.

Source Database Information

Pull data and/or schema from an existing database

Connection string for the source database:

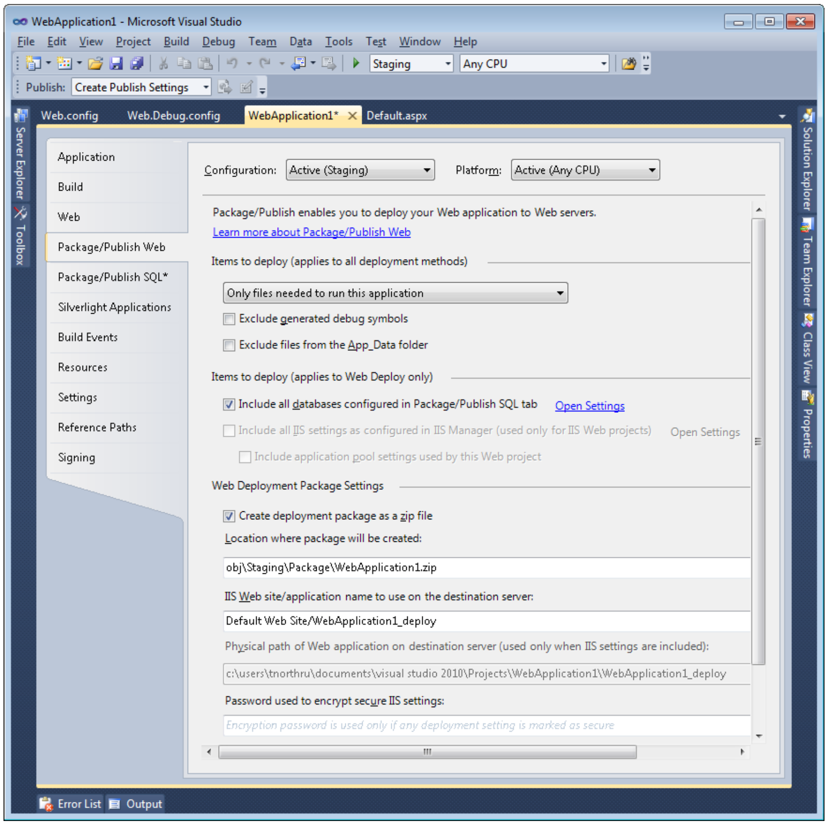
Database scripting options:

FIGURE 8-13 The Package/Publish SQL tab.

From this tab, click Import From Web.config to automatically configure any databases you have added to the <connectionStrings> section. For databases not in the Web.config file, click the Add button to configure a database to be deployed, and then type a connection string or click the ellipses to connect to the database.

If the database does not yet exist on the server to which you are deploying your web application, select the Pull Data And/Or Schema From An Existing Database check box to have Visual Studio create a database schema and optionally populate the database with data. Then configure the connection string for the source database from which Visual Studio will create the new database. Click the Database Scripting Options list to select whether to deploy the schema, the data, or both. Finally, you can add SQL scripts to perform additional, custom database configuration.

After you have configured the database, you can configure additional deployment settings by selecting the Package/Publish Web tab (as shown in Figure 8-14).



Configuration: Active (Staging)   Platform: Active (Any CPU)

Package/Publish enables you to deploy your Web application to Web servers.
Learn more about Package/Publish Web

Items to deploy (applies to all deployment methods)

Only files needed to run this application

☐ Exclude generated debug symbols

☐ Exclude files from the App_Data folder

Items to deploy (applies to Web Deploy only)

☑ Include all databases configured in Package/Publish SQL tab   Open Settings

☐ Include all IIS settings as configured in IIS Manager (used only for IIS Web projects)   Open Settings

☐ Include application pool settings used by this Web project

Web Deployment Package Settings

☑ Create deployment package as a zip file

Location where package will be created:

obj\Staging\Package\WebApplication1.zip

IIS Web site/application name to use on the destination server:

Default Web Site/WebApplication1_deploy

Physical path of Web application on destination server (used only when IIS settings are included):

c:\users\tnorthru\documents\visual studio 2010\Projects\WebApplication1\WebApplication1_deploy

Password used to encrypt secure IIS settings:

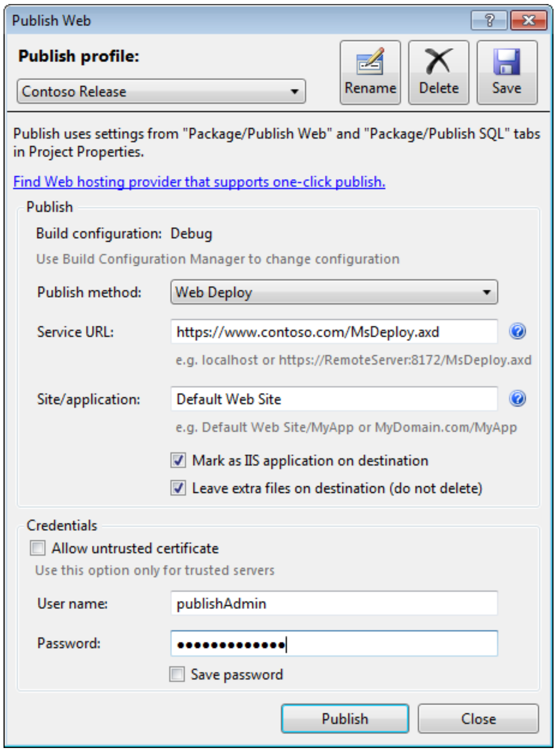
Encryption password is used only if any deployment setting is marked as secure

FIGURE 8-14 The Package/Publish Web tab.

If you configured databases for deployment, select the Include All Databases Configured In Package/Publish SQL Tab check box. If your application requires settings configured in IIS manager (but not defined in Web.config), select the Include All IIS Settings As Configured In IIS Manager check box. This setting also enables you to specify the Physical Path Of Web Application On Destination Server check box. The remaining settings define whether Visual Studio will create a .zip file containing all of your project files and where it will be stored.

Publishing a Website

After you have configured the publishing settings, you can publish a web application by right-clicking the project in Solution Explorer and then clicking Publish. Visual Studio displays the Publish Web dialog box, as shown in Figure 8-15.



Contoso Release

Publish uses settings from "Package/Publish Web" and "Package/Publish SQL" tabs in Project Properties.

Find Web hosting provider that supports one-click publish.

Build configuration: Debug

Use Build Configuration Manager to change configuration

Publish method: Web Deploy

Service URL: https://www.contoso.com/MsDeploy.axd

e.g. localhost or https://RemoteServer:8172/MsDeploy.axd

Site/application: Default Web Site

e.g. Default Web Site/MyApp or MyDomain.com/MyApp

✓ Mark as IIS application on destination

✓ Leave extra files on destination (do not delete)

☐ Allow untrusted certificate

Use this option only for trusted servers

User name: publishAdmin

Password: •••••••••••••

☐ Save password

FIGURE 8-15 The Publish Web dialog box.

You can use the Publish Web dialog box to define the publication settings and save them as a publish profile by defining the profile name. The individual settings are:

- **Publish Method** This is the communications protocol that Visual Studio will use to connect to the web server. Web Deploy uses HTTPS (HTTP Secure), FTP uses unencrypted File Transfer Protocol (FTP) communications, FPSE uses encrypted FTP communications, and File System uses standard network file sharing. Any of the settings allows you to deploy files. If you choose Web Deploy, you can publish IIS web server settings, database schema and data, database scripts, security settings, and more.
- **Service URL** This is the URL of the remote server's web service, which the web server's systems administrator will provide for you. If the hosting provider supports the Windows Management Service, the path will include MsDeploy.axd.
- **Site/Application** This is the name of the IIS website, which can include a virtual directory.

- **Mark As IIS Application On Destination** Select this check box if your website is the root of an IIS website or if the virtual directory should act as a separate application from the parent folder.
- **Leave Extra Files On Destination** Clear this check box to delete existing files in the web server virtual directory.
- **Credentials** This allows you to provide credentials to connect to the web server.

After you have defined the settings, click the Save button to save the profile. Click Publish to deploy the web application to the remote server.

After saving profile settings, you can publish the website by using the Web One-Click Publish toolbar; simply select the profile and then click the Publish Web button on the toolbar.

Deployment Packages

If you will not be deploying the website directly, you can package it (along with the database and settings) into a .zip file that a systems administrator can install. After configuring publishing for the project, right-click the project in Solution Explorer and then click Build Deployment Package. Visual Studio generates several files in the folder you specified in the Location Where Package Will Be Created box in the Package/Publish Web dialog box:

- ***<Application>*.zip** Your web application's files, database, and settings.
- ***<Application>*.deploy.cmd** The script that the IIS systems administrator will run, with administrative credentials, on the web server. The web server must have Web Deploy (MSDeploy.exe) installed. For more information about Web Deploy, go to *http://go.microsoft.com/?linkid=9278654*.
- ***<Application>*.deploy-readme.txt** The traditional "readme" file that administrators refer to before installing. You can edit this just like any text file to provide customized instructions.
- ***<Application>*.SourceManifest.xml** Contains settings to be added to the IIS manifest. You or the administrator can edit this prior to deployment.
- ***<Application>*.SetParameters.xml** Contains IIS parameters to be added during installation. You or the administrator can edit this prior to deployment.

You must provide all of the files to the administrator, who must keep them in the same folder. You cannot deploy the .zip file alone.

Web Deployment Projects

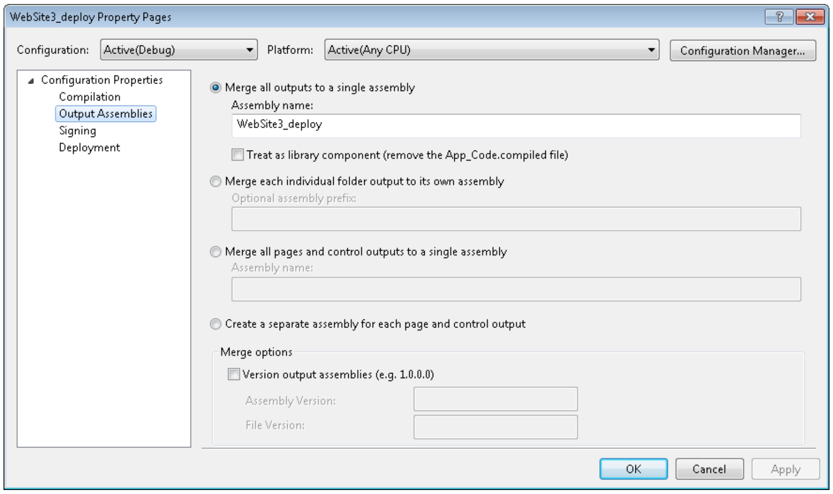
After the release of Visual Studio 2010, Microsoft released the Web Deployment Projects tool to extend Visual Studio 2010 by adding a user interface to manage build configurations, merging, and using pre-build and post-build tasks. Web Deployment Projects work with both ASP.NET web applications and websites.

Web Deployment Projects provide several capabilities not provided by other deployment technologies:

- The ability to precompile websites.
- The ability to merge all files into a single assembly, merge folders into individual assemblies, or create separate assemblies for each page and control. If you merge content into assemblies, users with access to the web server will not be able to directly access your source code.
- Strong naming and delayed signing of assemblies.

As with publishing websites, Web Deployment Projects allow you to change the Web.config file for the release environment and create IIS virtual directories.

To download the Web Deployment Projects tool, search the Microsoft Download Center for "Web Deployment Projects RTW" or go to *http://www.microsoft.com/downloads/en/details.aspx?FamilyID=89f2c4f5-5d3a-49b6-bcad-f776c6edfa63*. After you have the tool installed, you can add a Web Deployment Project to a website or web application by clicking the solution in Solution Explorer and then clicking Add Web Deployment Project. Then double-click the Web Deployment Project to edit its properties, as shown in Figure 8-16.


WebSite3_deploy Property Pages

Configuration: Active(Debug) Platform: Active(Any CPU) Configuration Manager...

Configuration Properties
- Compilation
- Output Assemblies
- Signing
- Deployment

● Merge all outputs to a single assembly
Assembly name: WebSite3_deploy
☐ Treat as library component (remove the App_Code.compiled file)
○ Merge each individual folder output to its own assembly
Optional assembly prefix:
○ Merge all pages and control outputs to a single assembly
Assembly name:
○ Create a separate assembly for each page and control output

Merge options
☐ Version output assemblies (e.g. 1.0.0.0)
Assembly Version:
File Version:

OK Cancel Apply

FIGURE 8-16 Web Deployment Project properties.

After configuring the Web Deployment Project, right-click it in Solution Explorer and then click Build to generate the assembly or assemblies.

EXAM TIP

For the real world, know that you need to use Web Deployment Projects when you do not want to store the source code on the web server or when management requires signed assemblies. Because it is an add-on for Visual Studio 2010, you probably will not see any questions about it on the exam, however.

Web Setup Projects

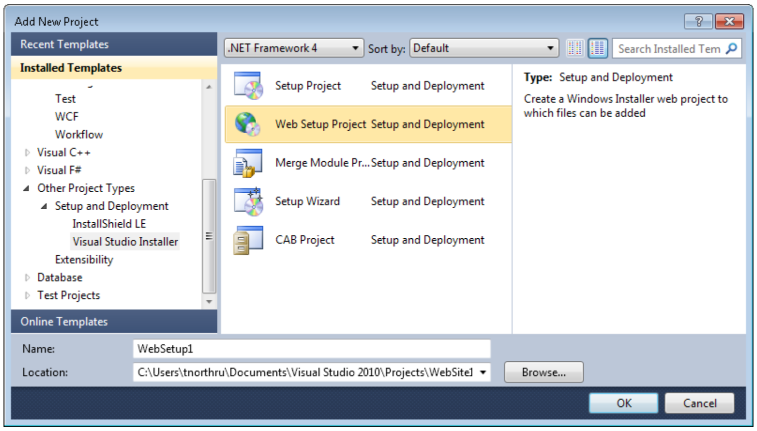
Publishing websites gives you a great deal of control over the website configuration while still providing a high level of automation. However, it requires administrators to have specially configured the web server to allow you to publish the website. Even if you create a package for the administrators to perform the installation, administrators will not be able to easily take advantage of a software distribution infrastructure that requires Microsoft Windows Installer (MSI) packages. Finally, Visual Studio does not precompile published websites.

The sections that follow describe how to create a Web Setup Project, which provides the highest level of flexibility for deploying a website. Although Web Setup Projects are more complex for the developer, they allow you to generate an MSI package, precompile a website, and perform virtually any setup task that your application might require. This section describes how to configure deployment properties, how to configure deployment conditions, and how to deploy websites that meet the requirements of the aforementioned scenarios.

Creating a Web Setup Project

Web Setup Projects are very similar to the standard setup projects used for Windows Forms applications; however, Web Setup Projects provide specialized capabilities that are required by websites. To add a Web Setup Project to a website, follow these steps:

1. Open your website in Visual Studio.
2. From the File menu (or by right-clicking your solution in Solution Explorer), select Add, and then select New Project to launch the Add New Project dialog box.
3. Under Installed Templates, expand Other Project Types, expand Setup And Deployment, and then select Visual Studio Installer. From the list of available templates, select Web Setup Project. In the Name text box, type a name for your project. An example of the Add New Project dialog box is shown in Figure 8-17.



Type: Setup and Deployment

Create a Windows Installer web project to which files can be added

Name: WebSetup1

Location: C:\Users\tnorthru\Documents\Visual Studio 2010\Projects\WebSite1

FIGURE 8-17 Adding a new project to a website to create a Web Setup Project.

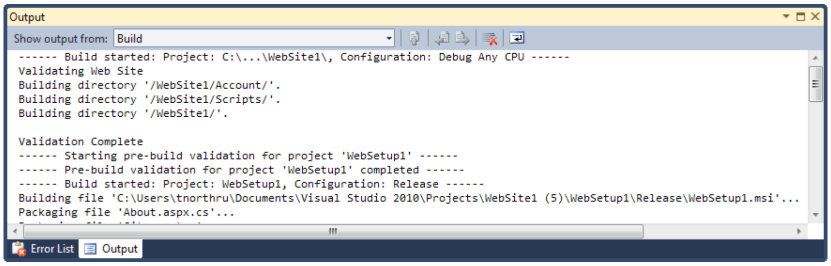
4. After you have created a new Web Setup Project, Visual Studio adds the project to your solution and displays the File System editor. The typical next step is to create a project output group by right-clicking the Web Application Folder, selecting Add, and then selecting Project Output. In the Add Project Output Group dialog box, you select the project to deploy, the Content Files option, and the configuration (which is Active by default). This ensures that your setup project will deploy the contents of the selected project.

After you have created a Web Setup Project, you can add more folders, files, assemblies, and configuration settings that are not part of your project output to the Web Setup Project. This might be necessary if, for example, you have a separate folder containing images that you have not added to your website project, or if you need to define registry values.

Building a Web Setup Project

Web Setup Projects are not automatically built when you build or run your website. You must manually select the Web Setup Project in Solution Explorer and choose Build. You can do so by right-clicking the project or by using the Build menu.

When you build the setup project, Visual Studio validates your code in the website. It then builds an MSI file and packages each element of your site in the MSI. You can follow the build process in Visual Studio in the Output window (View | Output). The script in the Output windows shows you each step and where the MSI file is generated. By default, the file is placed in the folder that contains your solution file. Figure 8-18 shows an example of a process as shown in the Output window.



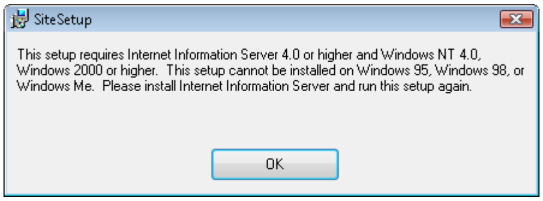
```
------ Build started: Project: C:\...\WebSite1\, Configuration: Debug Any CPU ------
Validating Web Site
Building directory '/WebSite1/Account/'.
Building directory '/WebSite1/Scripts/'.
Building directory '/WebSite1/'.

Validation Complete
------ Starting pre-build validation for project 'WebSetup1' ------
------ Pre-build validation for project 'WebSetup1' completed ------
------ Build started: Project: WebSetup1, Configuration: Release ------
Building file 'C:\Users\tnorthru\Documents\Visual Studio 2010\Projects\WebSite1 (5)\WebSetup1\Release\WebSetup1.msi'...
Packaging file 'About.aspx.cs'...
```

FIGURE 8-18 An MSI build in the Output window of Visual Studio.

Many websites do not require custom configuration. In these cases, you can simply build your MSI file and be ready to deploy. However, more complex scenarios include dependencies (such as particular operating system versions or service packs), custom registry entries, or administrator configuration. Web Setup Projects allow you to deploy websites that meet these requirements. The sections that follow help you with each of these specific scenarios.

Creating Launch Conditions

A launch condition is used to define the server requirements for your application installation. For example, you can check for specific versions of Windows or verify that specific service packs are present before you allow an installation. The web setup template includes the IIS launch condition. This searches for the presence of the correct version of IIS and displays an error message to users if this version is not present, as shown in Figure 8-19.



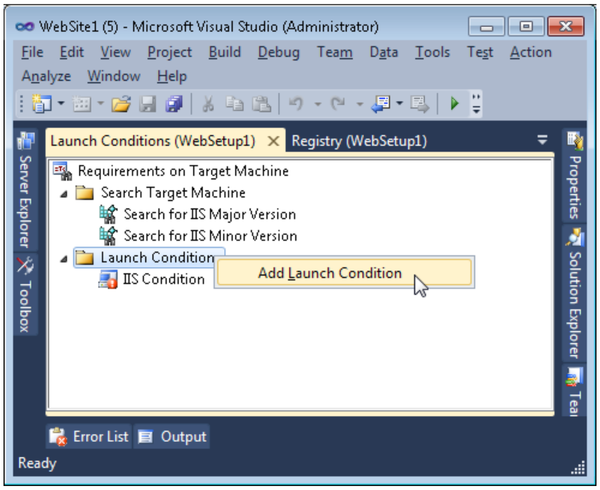
SiteSetup

This setup requires Internet Information Server 4.0 or higher and Windows NT 4.0, Windows 2000 or higher. This setup cannot be installed on Windows 95, Windows 98, or Windows Me. Please install Internet Information Server and run this setup again.

FIGURE 8-19 The Launch Conditions error message.

To create and manage launch conditions, you use the Launch Conditions editor in Visual Studio. You can access this tool by selecting your project in Visual Studio and then clicking the View menu. You will see an Editor submenu that contains several setup editors, including those for Registry, File System, File Types, User Interface, Custom Actions, and Launch Conditions.

Selecting the Launch Conditions submenu opens the Launch Conditions editor, as shown in Figure 8-20. Notice that you right-click the Launch Conditions folder to add a new condition (this is discussed more fully in the next section).



WebSite1 (5) - Microsoft Visual Studio (Administrator)

FIGURE 8-20 Using the Launch Conditions editor to configure requirements for a target computer.

There are two main branches of the Launch Conditions editor: Search Target Machine and Launch Conditions. Each is described here:

- **Search Target Machine** This branch allows you to define the criteria to search for prior to installation. By default, this node contains nodes for searching for major and minor versions of IIS. You can add file, registry, and Windows Installer search conditions. Typically, you pair a search condition that determines whether a change is necessary with a launch condition that performs the change.
- **Launch Conditions** This branch allows you to create new launch conditions that define conditions that must be met prior to installation. These conditions can be based on search conditions or other criteria (such as the operating system version). A launch condition can provide a useful message to the user if a requirement is missing. It can then automatically retrieve a webpage. By default, Web Setup Projects include conditions for ensuring the presence of the correct version of IIS (later than version 7, for example).

Typically, you must add an item to each of these two nodes to require a single component as part of your installation. For example, if you want to verify that a specific DLL is present, you must create a search condition under Search Target Machine and store the result of the search in a property. You then create a launch condition that uses the search condition's property. If the required condition is not met (if the file is missing), you specify an error message to be displayed to the user. You can also choose to add a URL that directs the user to the required component for download.

ADDING A SIMPLE SEARCH CONDITION

You can add both search and launch conditions manually by right-clicking the appropriate folder and choosing an item to add. This allows you to create both search and launch conditions at a granular level and decide how to connect them.

To add a basic search condition, start by right-clicking the Search Target Machine node in the Launch Conditions editor. You will have three search condition types to choose from: Add File Search, Add Registry Search, and Add Windows Installer Search. Each is a different search type. Depending on your selection, different property values must be set. The following provides an overview of each search type's options.

- **File Search** This search type allows you to define a search for a file. You set FileName to the name of the file you are searching for, Folder to the name of the folder in which to search, and Property to a variable name to be used for tracking the results of the search.
- **Registry Search** This search type allows you to specify a registry search. You set the Root property to a place to start looking in the registry, RegKey to a registry key to search for, and the Value property to a value you expect to be set for the specified key. You store the results of your search in the Property property as a variable name that can be used in a related launch condition.

- **Windows Installer Search** This search type allows you to search for a registered component. You set the ComponentId property to the globally unique identifier (GUID) of the component for which you are searching. You set the Property property to a variable that indicates the results of your search.

You can also rename your search and launch conditions to something that makes sense to your specific scenario.

ADDING A SIMPLE LAUNCH CONDITION

You can manually add a launch condition that must be met before your website can be installed. To do so, you right-click the Launch Conditions folder, and then select Add Launch Condition.

With the new launch condition selected, you access the Properties window to configure your launch condition. You can set the Condition property to match the Property value of a search condition or to specify a different condition entirely. To allow the user to download software to resolve the launch condition, provide a URL in the InstallUrl property. In the Message property, type a message to be displayed to the person installing your website if a condition is not met.

You can configure launch conditions to require specific operating system versions, specific service pack levels, and other criteria by setting the Condition property to an environment variable or keyword and using both an operand and a value. Table 8-5 lists some common launch conditions.

TABLE 8-5 Windows Installer Launch Conditions

CONDITION	DESCRIPTION
VersionNT	The version number for operating systems based on Windows NT, including Windows 2000, Windows XP, and Windows Server 2003
Version9X	The version number for early Windows consumer operating systems, including Windows 95, Windows 98, and Windows Millennium Edition
ServicePackLevel	The version number of the operating system service pack
WindowsBuild	The build number of the operating system
SystemLanguageID	The default language identifier for the system
AdminUser	The tool that determines whether the user has administrative privileges
PhysicalMemory	The size of the installed RAM in megabytes
IISMAJORVERSION	The major version of IIS, if installed
IISMINORVERSION	The minor version of IIS, if installed

To evaluate environment variables, preface the variable name with a % symbol, as this example illustrates.

```
%HOMEDRIVE = "C:" (verify that the home drive is C)
```

To simply check a property for a specific value, you can use the = operator, as the following example shows.

```
IISVERSION = "#6" (check for IIS 6.0)
VersionNT = 500 (check for Windows 2000)
```

You can also check for ranges.

```
IISVERSION >= "#7" (check for IIS 4.0 or later)
Version9X <= 490 (check for Windows Me or earlier)
```

You can also check for multiple conditions by using Boolean operators: Not, And (which returns true if both values are true), Or (which returns true if either value is true), Xor (which returns true if exactly one value is true), Eqv (which returns true if both values are the same), and Imp (which returns true if the left term is false or the right term is true). The following example demonstrates a Boolean operator.

```
WindowsBuild=2600 AND ServicePackLevel=1 (check for Windows XP with Service Pack 1)
```

CREATING PREGROUPED LAUNCH CONDITIONS

You can also create pregrouped search and launch condition sets for common scenarios. Doing so simply creates both a search and a launch condition, with both items preconfigured to work together. You simply need to adjust their properties according to your needs. To create a grouped launch condition, you right-click the root node in the Launch Conditions editor (Requirements On Target Machine) and select one of the following:

- Add File Launch Condition
- Add Registry Launch Condition
- Add Windows Installer Launch Condition
- Add .NET Framework Launch Condition
- Add Internet Information Services Launch Condition

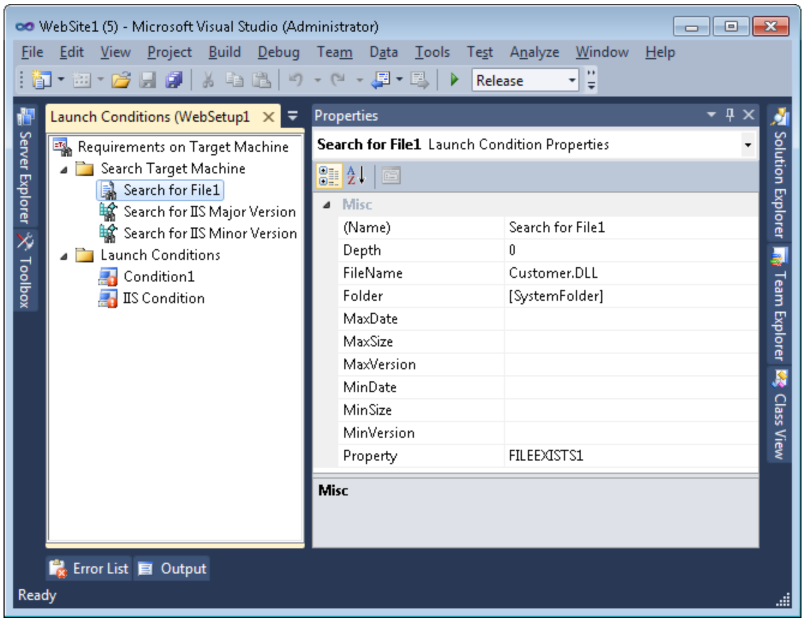
As an example, adding file-based conditions (such as DLL conditions) is a common practice. The following steps walk through the creation of a file-based, pregrouped launch condition:

1. In the Launch Conditions editor, right-click the Requirements On Target Machine root node. Select Add File Launch Condition to get started.

   The Launch Conditions editor adds a search condition (Search For File1) to the Search Target Machine node and a launch condition (Condition1) to the Launch Conditions node. The new search condition's Property property value has a default name of FILEEXISTS1. This value links it to the Condition property of the launch condition.

2. You can rename both the new search condition and the new launch condition so that the names indicate the file you are searching for.

   Figure 8-21 shows an example of both conditions added to the Launch Conditions editor. Notice that the Search For File1 condition is selected and its Properties window is displayed. Notice that the Property property is set to FILEEXISTS1.


WebSite1 (5) - Microsoft Visual Studio (Administrator)
File Edit View Project Build Debug Team Data Tools Test Analyze Window Help
Release
Server Explorer
Toolbox
Solution Explorer
Team Explorer
Class View
Error List
Output
Ready

Launch Conditions (WebSetup1

- Requirements on Target Machine
  - Search Target Machine
    - Search for File1
    - Search for IIS Major Version
    - Search for IIS Minor Version
  - Launch Conditions
    - Condition1
    - IIS Condition

Properties

Search for File1 Launch Condition Properties

Misc	
(Name)	Search for File1
Depth	0
FileName	Customer.DLL
Folder	[SystemFolder]
MaxDate	
MaxSize	
MaxVersion	
MinDate	
MinSize	
MinVersion	
Property	FILEEXISTS1

Misc

FIGURE 8-21 The file search criterion and related condition.

3. In Figure 8-21, notice that there are several search condition properties in the Properties window. For a file search, you typically configure these properties as described in Table 8-6.

TABLE 8-6 File Search Condition Properties

PROPERTY	DESCRIPTION
FileName	The name of the file to look for. Just specify the file name with its extension, not the folder.
Folder	The folder in which to search for the file. Here you can select a special folder such as [CommonFilesFolder] or [WindowsFolder]. You can also hardcode a direct path to the file. You can search subfolders by specifying the Depth field.
Depth	The number of nested folders within the specified folder to search.
MinDate, MaxDate	The minimum and maximum last modified date of the file.
MinSize, MaxSize	The minimum and maximum size of the file.
MinVersion, MaxVersion	The minimum and maximum version of the file.
Property	The name of the property that stores the results of this search. You specify this property name in the corresponding launch condition.

4. Next, you select the new launch condition and view its Properties window. The properties are typically configured as described in Table 8-7.

TABLE 8-7 Launch Condition Properties

PROPERTY	DESCRIPTION
Condition	The condition that must evaluate to true for installation to continue. By default, this is the name of a property assigned to a search condition, and if the search finds the required file or other object, the launch condition is fulfilled. You can specify more complex conditions to check for operating system version, service pack levels, and other criteria.
InstallUrl	The URL to be retrieved by the setup project if the launch condition is not met. The user can access this resource to install the required component. This is an optional setting.
Message	The message that is displayed to the user if the launch condition is not met.

In this example, the setup project would look for the dependent file as configured in the search condition. The launch condition would then execute and throw an error if the file is not found.

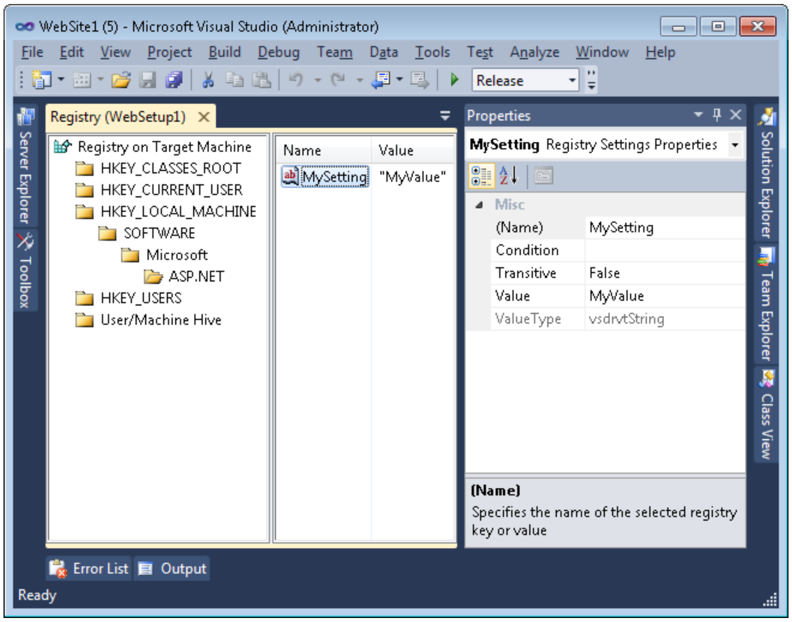
Writing to the Registry as Part of Deployment

Storing information in the registry used to be the preferred way to store application settings. With the .NET Framework, the best practice for configuring .NET Framework applications is to store settings in configuration files. However, there might still be times when you need to add registry entries during setup (although such situations are rare). For example, you might need to configure an aspect of the operating system or another application.

To configure a Web Setup Project to add a registry entry during setup, follow these steps:

1. In Solution Explorer, select your setup project.
2. From the View menu, select Editor, and then select Registry. The Registry editor opens.
3. The core folders of the registry are shown by default. To add a registry setting in a nested key, you need to add each nested key to the editor. For example, to add a setting to HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\ASP.NET\, you need to add the SOFTWARE, Microsoft, and ASP.NET keys to the HKEY_LOCAL_MACHINE hive in the Registry Settings editor.
4. Right-click the key to which you want to add a setting, select New, and then select String Value, Environment String Value, Binary Value, or DWORD Value. Type the name of the value, and then press Enter.
5. To define the value, select the registry value, view the Properties window, and set the Value property. To make the installation of the value conditional, define the Condition property.

Figure 8-22 shows an example of the Registry editor in Visual Studio.



Name	Value
MySetting	"MyValue"

Properties

MySetting Registry Settings Properties

Misc

(Name)	MySetting
Condition	
Transitive	False
Value	MyValue
ValueType	vsdrvtString

(Name)
Specifies the name of the selected registry key or value

FIGURE 8-22 Adding a registry entry to the deployment process.

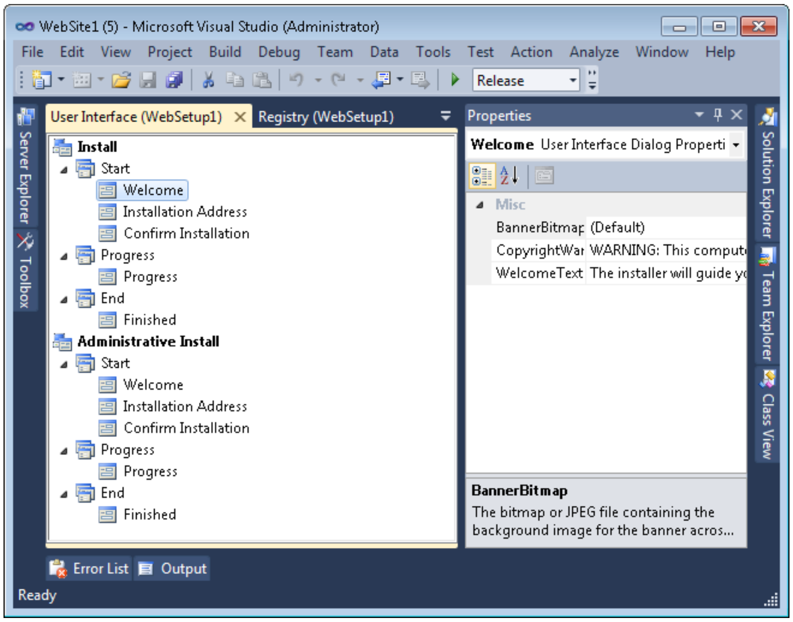
By default, registry keys are not removed when an application is uninstalled. To automatically remove a registry key during uninstallation, select the key and view the Properties window. Then set the DeleteAtUninstall property to true.

Adding a Custom Setup Page

Administrators responsible for deploying and managing your websites can customize settings by editing your Web.config file. To enable simpler configuration at setup time, you can add custom setup wizard pages. With these pages, you can prompt users to custom-configure information and then provide that information as parameters for custom actions. When combined, custom setup wizard pages and custom actions enable you to perform the following types of tasks at setup time:

- **Display a license agreement** The Web Setup Project template provides a dialog box template for requiring the user to accept a license agreement.
- **Modify settings in the Web.config file** You can use user input to modify configuration settings without requiring administrators to know how to configure an Extensible Markup Language (XML) file.
- **Perform custom configuration** You can use a custom configuration to prompt the user for information that will be stored in the registry or in another unusual location.
- **Activate or register your application** You can prompt the user for a product key or registration information. Prompts can specify either required or optional responses.

To add a custom setup wizard page to your Web Setup Project, you use the User Interface editor (View | Editor | User Interface). The User Interface editor displays the different setup phases for both standard and administrative installations of your application. Figure 8-23 shows the default view of the User Interface editor.


WebSite1 (5) - Microsoft Visual Studio (Administrator)
File Edit View Project Build Debug Team Data Tools Test Action Analyze Window Help
Release
User Interface (WebSetup1)
Registry (WebSetup1)
Server Explorer
Toolbox
Solution Explorer
Team Explorer
Class View
Error List
Output
Ready

Install
- Start
  - Welcome
  - Installation Address
  - Confirm Installation
- Progress
  - Progress
- End
  - Finished

Administrative Install
- Start
  - Welcome
  - Installation Address
  - Confirm Installation
- Progress
  - Progress
- End
  - Finished

Properties

Welcome User Interface Dialog Properti

Misc

BannerBitmap	(Default)
CopyrightWar	WARNING: This comput
WelcomeText	The installer will guide yo

BannerBitmap
The bitmap or JPEG file containing the background image for the banner acros...

FIGURE 8-23 Using the User Interface editor to add pages to a setup wizard.

To add a custom setup page, you right-click the setup phase to which you want to add, and then select Add Dialog. Normally you add dialog boxes to the Start phase under the Install node. The Add Dialog window, shown in Figure 8-24, shows you the dialog boxes that can be added to the selected installation setup.

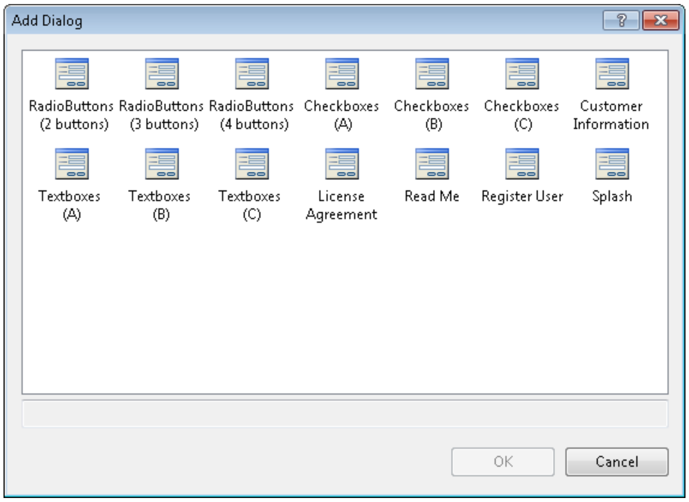


FIGURE 8-24 The Add Dialog setup pages.

The Administrative Install node is more restrictive. There you can add only a splash page, a license agreement page, or a readme page.

Each dialog box template allows you to collect a different type of information during setup. You can customize these dialog boxes only by hiding some controls and displaying different labels.

You customize these controls through the Properties window. There you can configure all aspects of a dialog box; Visual Studio does not provide a designer. To control the information for which a dialog box prompts the user, edit the labels and property names for the dialog box. For the text box and radio button types of dialog boxes, you can configure the label for each field (for example, Edit1Label or Button1Label), the name in which the value is to be stored (for example, Edit1Property or ButtonProperty), and the default value (for example, Edit1Value or DefaultValue). The License Agreement template allows you to specify a license agreement file, and the Splash template allows you to display a bitmap file.

You can also control the order in which your dialog boxes are shown to a user during setup. To do so, right-click a dialog box node in the editor, and then click Move Up or Move Down. You can delete a step in the process by right-clicking the step and then selecting Delete.

When you run the Web Setup Project, your custom dialog boxes appear as setup wizard pages. If you configured pages to collect custom information from users, you can reference that data in custom actions, as described in the next section.

Adding Custom Actions to Your Deployment

Web Setup Projects provide a great deal of flexibility and can meet most setup requirements. If you have more demanding requirements, such as submitting registration information to a web service or validating a product key, you can add custom actions to your setup project. Custom actions can run in any of the four phases of setup:

- **Install** This phase performs the bulk of the work done during setup by adding the files and creating the configuration settings that are required to run your application.
- **Commit** After the Install phase is complete and all of the changes that are required to run your application have been made, the Commit phase finalizes these changes. After the Commit phase is complete, setup cannot be rolled back, and the application must be uninstalled with Add Or Remove Programs if removal is required.
- **Rollback** The Rollback phase runs only if setup fails or is cancelled. In such a case, the Rollback phase occurs instead of the Commit phase and removes any new files or settings.
- **Uninstall** This phase removes files and settings from the computer when the application is removed with Add Or Remove Programs. Often, uninstall routines leave settings and databases in place so that they can be restored if the application is later reinstalled.

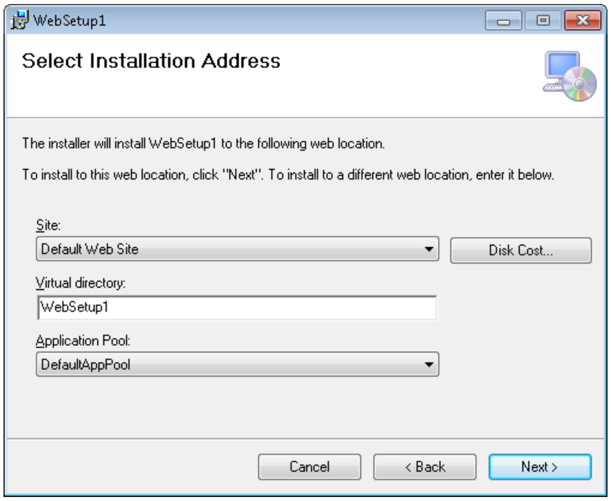
You add a custom action to your setup project through the Custom Actions editor. You can access this editor by first selecting your setup project in Solution Explorer and then selecting View | Editor | Custom Actions.

The Custom Actions editor displays the four setup phases. You can right-click the phase to which you want to add a custom action. You then select Add Custom Action. Doing so launches the Select Item In Project dialog box. From here you can choose to add a custom .exe or script file that will execute at the appropriate phase of deployment. If you add more than one custom action to a single phase, you can rearrange the custom actions by right-clicking an action and then clicking Move Up or Move Down.

Deploying Web Applications by Using a Web Setup Project

After you configure your Web Setup Project and build it with Visual Studio, you are ready to deploy it to an application server. To do so, you need to use the files generated as part of the build process. There are typically two generated to the target build directory for Web Setup Projects: an .exe file and an MSI file. These files are described in more detail here:

- **Setup.exe** This is an executable file that installs the files and settings you added to your Web Setup Project. When the file is being run, the setup wizard guides the user through the installation process and prompts for any required configuration settings, such as the website, virtual directory, and application pool (or process). Figure 8-25 shows an example.


WebSetup1

Select Installation Address

The installer will install WebSetup1 to the following web location.

To install to this web location, click "Next". To install to a different web location, enter it below.

Site: Default Web Site

Virtual directory: WebSetup1

Application Pool: DefaultAppPool

FIGURE 8-25 Web Setup Projects use a setup wizard to install a website.

- ***<WebSetupProjectName>*.msi** This is the Windows Installer file that contains any files you added to your Web Setup Project. The user can install this file by double-clicking it and launching the setup wizard. This is equivalent to running the Setup.exe file. Alternatively, network administrators can distribute the MSI file by using Active Directory software distribution.

Although most users are probably more familiar with using Setup.exe to install an application, the Windows Installer file is smaller, far more versatile, and familiar to most systems administrators.

Deploying Web Applications by Using the Copy Web Tool

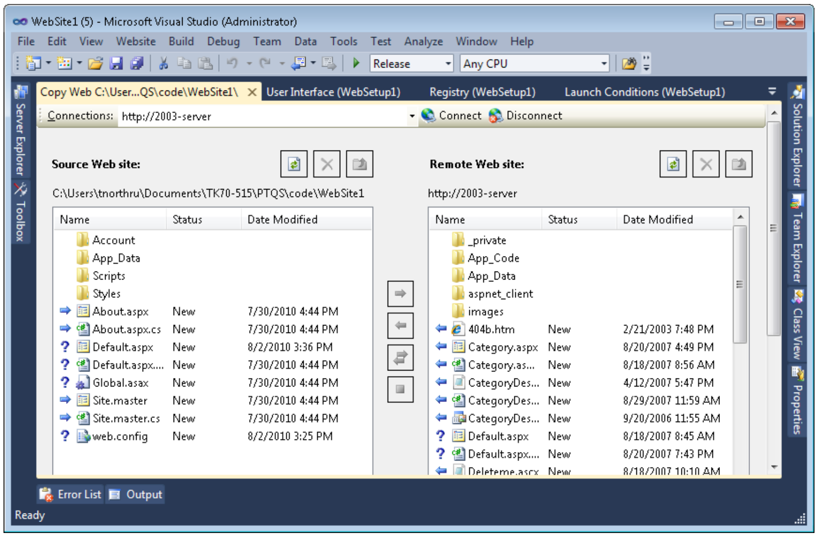
Web Setup Projects are useful if you are providing a website to many users or to an administrative team. However, if you are responsible for updating the website, it might be impractical to log on to the web server, copy over an installation, and run the Windows Installer package each time you make an update to the site. This is especially true if you frequently deploy to a development or test server.

For some development scenarios, you might be able to edit the website directly on the web server. However, changes you make are immediately implemented on that server. Of course, this includes any bugs that might be lurking in the new code.

There are many scenarios in which you simply need to copy changes between two servers. These might be changes from your development environment up to staging, or even from staging to production, in some limited scenarios. In these cases, you can use the Copy Web tool to publish changes between any two web servers.

The Copy Web tool can copy individual files or an entire website. You can select a source and a remote site and move files between them. You can also use the tool to synchronize files. This involves copying only changed files and detecting possible versioning conflicts in which the same file on both the source and the remote site have been separately edited. The Copy Web tool, however, does not merge changes within a single file; it only does complete file copies.

You launch the Copy Web tool from Visual Studio. To do so, you typically open the website you intend to use as the source (from which to copy). You can then right-click the site in Solution Explorer and choose Copy Web Site. This launches the Copy Web tool, as shown in Figure 8-26.


WebSite1 (5) - Microsoft Visual Studio (Administrator)
File Edit View Website Build Debug Team Data Tools Test Analyze Window Help
Release
Any CPU
Copy Web C:\User...QS\code\WebSite1\
User Interface (WebSetup1)
Registry (WebSetup1)
Launch Conditions (WebSetup1)
Server Explorer
Toolbox
Solution Explorer
Team Explorer
Class View
Properties
Connect
Disconnect
Error List
Output
Ready

Connections: http://2003-server

Source Web site:

C:\Users\tnorthru\Documents\TK70-515\PTQS\code\WebSite1

Name	Status	Date Modified
Account		
App_Data		
Scripts		
Styles		
About.aspx	New	7/30/2010 4:44 PM
About.aspx.cs	New	7/30/2010 4:44 PM
Default.aspx	New	8/2/2010 3:36 PM
Default.aspx....	New	7/30/2010 4:44 PM
Global.asax	New	7/30/2010 4:44 PM
Site.master	New	7/30/2010 4:44 PM
Site.master.cs	New	7/30/2010 4:44 PM
web.config	New	8/2/2010 3:25 PM

Remote Web site:

http://2003-server

Name	Status	Date Modified
_private		
App_Code		
App_Data		
aspnet_client		
images		
404b.htm	New	2/21/2003 7:48 PM
Category.aspx	New	8/20/2007 4:49 PM
Category.as...	New	8/18/2007 8:56 AM
CategoryDes...	New	4/12/2007 5:47 PM
CategoryDes...	New	8/29/2007 11:59 AM
CategoryDes...	New	9/20/2006 11:55 AM
Default.aspx	New	8/18/2007 8:45 AM
Default.aspx....	New	8/20/2007 7:43 PM
Deleteme.ascx	New	8/18/2007 10:10 AM

FIGURE 8-26 Using the Copy Web tool to synchronize two websites.

The Copy Web tool displays two panes: Source Web Site and Remote Web Site. The source website is the site from which you want to copy. The remote website is the copy-to site or destination. To set up a remote website, you must create a connection by clicking Connect at the top of the tool. This launches the Open Web Site dialog box, which allows you to find a website. There are four options for navigating to a remote website:

- **File system** This option provides a destination website on a local hard drive or a shared folder. A network drive connected to a shared folder on the remote web server is the fastest way to transfer a website to a server on your intranet. You must have previously configured the website on the server and shared the website folder. This technique transfers your source code across the network in clear text unless you have network-layer encryption, such as that provided by Internet Protocol security (IPsec).
- **Local IIS** This provides a destination website running within IIS on your local computer. You can use this interface to create a new website on your local server.
- **FTP site** This provides a destination remote website for which the server is configured to run an FTP server and allow uploads and downloads to the website folder. You must have previously configured the website on the server and shared the website folder. This technique transfers your user credentials and your source code across the network in clear text, and therefore is not recommended.
- **Remote site** This provides an interface with which you can transfer files to and from a remote website by using HTTP, if you have configured the web server to allow this type of update. You can use this interface to create a new website on your server. To prevent your source code from being sent across the network in clear text, configure the website with a Secure Sockets Layer (SSL) certificate and select the Connect Using Secure Sockets Layer check box in the Open Web Site dialog box.

Visual Studio will save configured connections for future use. After the connection has been established, you can copy or synchronize files between the source and the remote website in several different ways:

- **Copy individual files** Select files in either the source or the remote website, and then click the directional Copy Selected Files buttons.
- **Copy the entire site** Right-click the Source Web Site pane, and then select Copy Site To Remote. To copy the Remote Web Site to the source website, right-click the Remote Web Site pane, and then select Copy Site To Source.
- **Synchronize individual files** Select files in either the source or the remote website, and then click Synchronize Selected Files.
- **Synchronize the entire site** Right-click the Source Web Site pane, and then select Synchronize Site.

When you are copying or synchronizing files, versioning conflicts might arise if another developer modifies the remote copy of a file that you edited. Visual Studio doesn't have the capability to merge or analyze these changes. Therefore, the Copy Web tool simply notifies you of the conflict and lets you choose whether to overwrite the remote file with your local file, overwrite your local file, or not overwrite either file. Unless you know exactly what changed on a file, you should never overwrite it. Instead, you should analyze the file, determine what changed, and attempt to manually merge the changes. Otherwise, you might overwrite a coworker's development effort.

Precompiling and Publishing ASP.NET Websites

Projects created with the ASP.NET Web Site template are compiled by the web server the first time a user requests a page from a new or updated website. Compiling doesn't usually take long (often less than a second or two), but the first few webpage requests are delayed while the website is compiled. To avoid this delay, you can precompile your website before you publish it to a server.

NOTE **PRECOMPILING WEB APPLICATIONS**

This section applies to ASP.NET websites, but not to ASP.NET web applications. Projects created with the ASP.NET Web Application template are always precompiled.

To precompile and publish a website, follow these steps:

1. Open the website you want to precompile and publish. Next, right-click your website in Solution Explorer and select Publish Web Site. Alternatively, you can select the Build menu and then choose Publish Web Site.
2. In the Publish Web Site dialog box, specify a location to which to publish. If you click the ellipsis button (…), you can browse the file system, local IIS, an FTP site, or a remote site, exactly as you would if you were using the Copy Web tool.
3. In the Publish Web Site dialog box, select your options:
   - **Allow This Precompiled Site To Be Updatable** This check box, when selected, specifies that the content of ASPX pages are not compiled into an assembly; instead, the markup is left as is, allowing you to change HTML and client-side functionality after precompiling the website. Selecting this check box is equivalent to adding the -u option to the aspnet_compiler.exe command.
   - **Use Fixed Naming And Single Page Assemblies** This option specifies that batch builds are turned off during precompilation to generate assemblies with fixed names. Themes and skin files continue to be compiled to a single assembly. This option is not available for in-place compilation.

- **Emit Debug Information** Select this check box if you might need to debug the site after you publish it.
- **Enable Strong Naming On Precompiled Assemblies** This check box, when selected, specifies that the generated assemblies are strongly named by using a key file or key container to encode the assemblies and to ensure that they have not been tampered with. After you select this check box, you can do the following:
  - Specify the location of a key file to use to sign the assemblies. If you use a key file, you can select Delay Signing, which signs the assembly in two stages: first with the public key file, and then with a private key file that is specified later during a call to the aspnet_compiler.exe command.
  - Specify the location of a key container from the system's cryptographic service provider (CSP) to use to name the assemblies.
  - Specify whether to mark the assembly with the AllowPartiallyTrustedCallers property, which allows strongly named assemblies to be called by partially trusted code. If you do not specify this declaration, only fully trusted code can use such assemblies.

4. Click OK to compile and publish the website.

Publishing a website can be an easy way to move a website from a development server to a staging or production server.

Installing ASP.NET 4 on IIS

The .NET Framework 4 was released after Windows 7 and Windows Server 2008 R2 were released. Therefore, as of the time of this writing, no operating system has built-in support to run ASP.NET 4 applications. Before you can run an ASP.NET 4 application on a server, you will need to install the .NET Framework 4. Naturally, Visual Studio 2010 installs the .NET Framework 4 automatically, so your development computer will run your websites correctly with no additional software.

Microsoft released an optional Windows Update package to install the .NET Framework 4 on computers with Windows XP, Windows Vista, Windows 7, Windows Server 2003, Windows Server 2008, and Windows Server 2008 R2 operating systems. Therefore, systems administrators might have already installed the necessary components. If not, have the systems administrators install the update.

After the .NET Framework 4 is installed, you need to configure IIS to run ASP.NET 4 applications by using the aspnet_regiis.exe command-line tool. The tool is located in the .NET Framework directory, which is typically %windir%\Microsoft.NET\Framework\v4.0.30319\aspnet_regiis.exe (for 32-bit systems) or %windir%\Microsoft.NET\Framework64\v4.0.30319 (for 64-bit systems).

Usually you will only need to use the following options:

- **-i** This installs ASP.NET 4 and updates both the IIS Classic mode and IIS Integrated mode handlers and script mappings. When you use this option, aspnet_regiis.exe updates the standard DefaultAppPool and Classic .NETAppPool application pools to use the .NET Framework 4 version of the Common Language Runtime. This will not usually cause compatibility problems. However, because it changes the configuration of all existing ASP.NET websites, you should thoroughly test your applications with the newer version of the CLR prior to using this option. This option also interrupts running applications, causing active users to be logged out (when you are using forms-based logons) and ViewState to be lost. For those reasons, avoid using this option on production servers.
- **-ir** Like -i, this installs ASP.NET 4. This option does not change the existing application pools, however, reducing potential application compatibility problems.
- **-iru** This performs a -i installation if ASP.NET is not currently registered. If ASP.NET is currently registered, this performs a -ir installation.
- **-enable** This enables the ASP.NET Internet Server Application Programming Interface (ISAPI) extension for IIS 6.0 or IIS 7.0 in Classic mode.
- **-s *path*** This option updates scriptmaps and application-pool assignments for the specified path and all subdirectories to ASP.NET 4. If the server is running IIS 6.0, aspnet_regiis.exe updates the scriptmaps. If the server is running IIS 7.0, aspnet_regiis.exe maps the application to a new ASP.NET 4 application pool. Specify the metabase path, which might resemble W3SVC/1/ROOT/*myapp* or W3SVC/1634748923. To find the path for IIS 6.0, search the metabase.xml file in the %windir%\system32\inetsrv\ folder for the name of your website.
- **-sn *path*** This updates scriptmaps and application-pool assignments for the specified path to ASP.NET 4. Unlike –s, -sn does not apply to subdirectories.
- **-lv** This option displays the installation path of all versions of ASP.NET.

For a description of all available options, see "ASP.NET IIS Registration Tool" at *http://msdn.microsoft.com/en-us/library/k6h9cz8h.aspx*.

Quick Check

1. **What launch condition does a Web Setup Project include by default?**
2. **What are the four phases of a Web Setup Project deployment?**

Quick Check Answers

1. **By default, a Web Setup Project checks for an IIS version later than 4.0.**
2. **Install, Commit, Rollback, and Uninstall are the four phases of Web Setup Project deployment.**

PRACTICE Deploying Web Applications

In this practice, you deploy applications by using two techniques: a Web Setup Project and the Copy Web tool.

ON THE COMPANION MEDIA

If you encounter a problem completing an exercise, you can find the completed projects in the samples installed from this book's companion CD. For more information about the project files and other content on the CD, see "Using the Companion Media" in this book's Introduction.

EXERCISE Creating a Web Setup Project

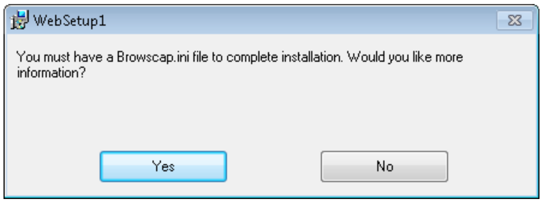
In this exercise, you create a new ASP.NET website and a related Web Setup Project.

1. Open Visual Studio and create a new website by using the language of your preference. This site will serve as the basis for your setup project.
2. Add some simple pages to the site. This will give you something to set up and deploy. These pages could include order.aspx, product.aspx, customer.aspx, and vendor.aspx.
3. Add a Web Setup Project to your solution. To do so, from the File menu, select Add, and then select New Project. Under Project Types, expand Other Project Types, expand Setup And Deployment, and then select Visual Studio Installer. Under Templates (on the right side), select Web Setup Project. Name the project **MyWebSetup**, and click OK.

   You should see a new project in Visual Studio Solution Explorer. You should also see the File System editor for the setup project.
4. Next, you need to connect the setup project to your website. Within the left pane of the editor, right-click Web Application Folder, select Add, and then select Project Output. In the Add Project Output Group dialog box, select Content Files, and click OK.

   If you were to build and install your project at this point, it would copy the site pages and code-behind files to the location specified by a user during setup.
5. In the File System editor, expand the Web Application Folder. Notice that there is a Bin directory. This is where you would embed any DLL files that might need to be included by your solution. You would embed these files by right-clicking Bin and selecting Add to add a file. For this practice, there are no dependent DLL files, so you can skip this.
6. Next, add a folder and a file that should be included with the build. To do so, right-click the Web Application Folder in the File System editor. Select Add, and then select Web Folder. Name the folder **Images**.
7. Right-click the Images folder, select Add, and then select File. Navigate to the Pictures folder on your computer. Select a few sample pictures, and click Open.

8. Now add a launch condition. From the View menu, select Editor, and then select Launch Conditions. In the Launch Conditions editor, right-click Requirements On Target Machine, and then select Add File Launch Condition. Rename the new search condition (currently named Search For File1) to **Search for Browscap**. Select the new search condition and view the Properties window.
   - Set the FileName property to **Nothing.ini**. (This file doesn't exist, but you'll fix the error later.)
   - Set the Folder property to [WindowsFolder] and set the Depth property to **4**. This tells setup to search the system folder and all subfolders four levels deep for a file named Nothing.ini. Note that the Property value is set to FILEEXISTS1.
9. Rename the new launch condition (currently named Condition1) to **Browscap Condition**. Select the new launch condition and view the Properties window.
   - Set the InstallUrl property to **http://blogs.iis.net/dmnelson/archive/2009/05/14/updating-browscap-ini-for-internet-explorer-8.aspx**, which contains information about the Browscap.ini file. In the real world, you would provide a link with instructions on how to fulfill the requirement.
   - Set the Message property to **You must have a Browscap.ini file to complete installation. Would you like more information?**. Notice that the Condition property is already set to FILEEXISTS1, which corresponds to the search condition Property value.
10. Build the Web Setup Project. Right-click your setup project in Solution Explorer and then select Build. In the Output window, make note of the folder containing the output files. Open the output folder in Windows Explorer and examine the files that are present. You should see both an MSI and a setup.exe file.
11. Open the folder that contains the MSI file. Double-click the MSI file to launch setup. After a few seconds, you should see an error message indicating that the Browscap.ini file does not exist, as shown in Figure 8-27.



You must have a Browscap.ini file to complete installation. Would you like more information?

FIGURE 8-27 The MSI file error message.

Recall that we added this condition in step 9. We also set the FileName property of the search condition to Nothing.ini in step 8, which is why this error is being thrown.

12. Click Yes. You will be taken to the InstallUrl set as part of the condition.
13. Return to Visual Studio. Open the Launch Conditions editor for the Web Setup Project.

14. Select Search For Browscap under Search Target Machine. View the Properties window. Change the FileName property to look for the file **Browscap.ini**.
15. Rebuild the Web Setup Project (right-click and select Rebuild).
16. Return to the directory in which the MSI file exists. Rerun the MSI file. This time, the computer should meet the setup requirements because the Browscap.ini file exists in the Windows folder.

NOTE **INSTALLATION ISSUES**

Depending on your environment, you might run into additional issues. If, for example, you are running Windows Vista and IIS 7.0, you need an IIS 6-compatible metabase for the IIS condition to validate. You can tweak the condition or add the IIS 6 metabase to IIS 7.0 from Control Panel (classic view) | Programs And Features | Turn Windows Feature On Or Off | Internet Information Services | Web Management Tools | IIS 6 Management Compatibility. Another issue is security in Windows Vista and Windows 7. You might have to run the Setup.exe file (and not the MSI file) by right-clicking Setup.exe and selecting Run As Administrator.

17. On the Select Installation Address page, notice that you have the opportunity to select the website, virtual directory, and application pool. Choose a unique virtual directory name and make note of it. Click Next.
18. Finish walking through the installation steps.
19. Open the Internet Information Services console (Control Panel | Administrative Tools | Internet Information Services [IIS] Manager). Find the virtual directory in which you installed the website. Verify that the pages, code-behind files, and images exist.

As you can see, deploying a website can be as easy as installing a Windows Forms application. Although this process takes you through a manual installation of a Windows Installer package, you can also deploy the MSI file in an automated manner.

Lesson Summary

- Web Setup Projects allow you to create executable Setup.exe files and Windows Installer packages (MSI files) that administrators can use to easily deploy your applications to a web server.
- The Copy Web tool can synchronize a website between a remote server and your local computer. This is useful if you want to do deployment and testing on your local computer and then upload the website to a remote web server. The Copy Web tool can also be useful in environments with multiple developers because it detects versioning conflicts.
- Precompiling a website removes the delay that occurs when ASP.NET compiles an application after the first user request. To precompile a website, use the Publish Web Site tool.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 1, "Deploying Websites." The questions are also available on the companion CD in a practice test, if you prefer to review them in electronic form.

NOTE **ANSWERS**

Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You need to add a registry entry to make your application function. In which phase of the Web Setup Project should you add the registry entry?
   - **A.** Install
   - **B.** Commit
   - **C.** Rollback
   - **D.** Uninstall
2. You need to make a change to an operating system–related registry entry to make your application function. You want to ensure that you remove this change if setup is cancelled or the application is removed from the computer. In which phases should you undo your registry modification? (Choose all that apply.)
   - **A.** Install
   - **B.** Commit
   - **C.** Rollback
   - **D.** Uninstall
3. Which of the following deployment tools enables multiple developers to work on a site simultaneously while detecting potential versioning conflicts?
   - **A.** A setup project
   - **B.** A Web Setup Project
   - **C.** The Copy Web tool
   - **D.** The Publish Web Site tool
4. Which of the following deployment tools has the potential to improve responsiveness of the website to end users?
   - **A.** A setup project
   - **B.** A Web Setup Project
   - **C.** The Copy Web tool
   - **D.** The Publish Web Site tool

Case Scenarios

In the following case scenarios, you apply what you've learned in this chapter. If you have difficulty completing this work, review the material in this chapter before beginning the next chapter. You can find answers to these questions in the "Answers" section at the end of this book.

Case Scenario 1: Debugging

You are an application developer for Fabrikam, Inc., a financial services company. You have been told that users are receiving errors on certain pages in the site. You need to turn off the detailed errors in production and direct users to a default error page. However, administrators executing code directly on the server should still be able to see the errors.

You also need to debug these errors. You cannot reproduce them on your machine. Therefore, you need to debug them against the staging server.

Answer the following questions based on the scenario just defined.

1. How will you disable transmitting error detail to users of the site?
2. How will you implement a default error page for users?
3. How will you ensure that errors are still available for administrators to view?
4. How can you debug against the staging environment?
5. How can you apply these settings when you publish the web application in the future, while keeping the current settings for use in your development environment?

Case Scenario 2: Troubleshooting

You are an application developer for Fabrikam, Inc., a financial services company. The configuration changes you made to your application in the previous scenario have been very successful. However, you still have one persistent issue that you cannot seem to solve in development or staging. Therefore, you want to turn tracing on for the specific page and view the results by accessing the page from the server. In addition, your manager has asked you to begin monitoring key events in the system to verify the application's health.

Answer the following questions based on the scenario just defined.

1. How should you configure tracing for the issue?
2. How should you enable health monitoring for your application?

Case Scenario 3: Deploying a Website

You are a developer for Contoso, Ltd, a video streaming company. You are the sole developer of the company's external website, which allows customers to rent and view videos online. The reliability of the application is critical, so the quality assurance team must test any changes you make on a staging server before you make changes to the production web server.

You frequently work from your home. Unfortunately, Contoso's virtual private network (VPN) is unreliable, so you must do your development on your laptop computer. You can only access the staging and production web servers from the internal network or the VPN, but that's not a problem because you don't need to make updates to those servers very frequently. Additionally, your Internet connection is a low-bandwidth cellular link, so you need to avoid sending large updates across the connection.

Answer the following questions.

1. Which tool would you use to update the staging server?
2. Which tool should the quality assurance people use to update the production server?

Suggested Practices

To successfully master the exam objectives presented in this chapter, complete the following tasks.

Debug a Website

For this task, you should complete the first practice to gain experience working with remote debugging. Practice 2 helps with client script debugging.

- **Practice 1** Find some ASP.NET code that matches code deployed on a development server. Deploy the remote debugging tool to the development server. Run the remote debugging tool from the server. Use Visual Studio to open the code, attach to the running server process, and step into code based on a request.
- **Practice 2** Find (or write) some code that contains client-side JavaScript. You can find appropriate code on this book's CD (in the samples for Chapters 7 and 8. Open the code in Visual Studio. Run the webpage in a browser. Configure Internet Explorer to allow script debugging. Use Visual Studio to connect to the browser's process and step into the client-side code.

Troubleshoot a Website

For this task, you should complete the first item for practice with tracing. The second practice should help with health monitoring.

- **Practice 1** Turn on tracing for one of your existing websites. Be sure to do so only in a test environment. Review the trace data about your pages. Look carefully and determine whether there are unexpected results.
- **Practice 2** Turn on health monitoring for one of your existing websites. Again, be sure to do so only in a test environment. Review the data logged over a few days and assess the results.

Publish a Web Application

For this task, complete at least Practices 1 and 2. If you want experience publishing to a public hosting provider, complete Practice 3 as well.

- **Practice 1** Complete the one-click publishing walkthroughs listed at *http://msdn.microsoft.com/en-us/library/dd394698.aspx*.
- **Practice 2** Configure an IIS Web server to support one-click publishing. For detailed instructions, read "Configuring MSDeploy in IIS 7" at *http://william.jerla.me/post/2010/03/20/Configuring-MSDeploy-in-IIS-7.aspx*.
- **Practice 3** Publish a database-driven web application to a public hosting provider that supports one-click publishing. Although none of them are free, Microsoft provides a list of hosting providers at *http://www.asp.net/find-a-hoster*.

Use a Web Setup Project

For this task, you should complete at least Practices 1 and 2 to get a solid understanding of how to use Web Setup Projects. If you want a better understanding of how applications are distributed in enterprises and you have sufficient lab equipment, complete Practice 3 as well.

- **Practice 1** Create a Web Setup Project that prompts the user to provide database connection information, and then stores the connection information as part of a connection string in the Web.config file.
- **Practice 2** Using the most recent real-world application you created or one of the applications you created for an exercise in this book, create a Web Setup Project. Deploy the Web Setup Project to different operating systems, including Windows 2000, Windows XP, Windows Server 2003, and Windows Server 2008. Verify that the deployed application works on all platforms. If it does not work, modify your Web Setup Project to make it work properly. Make note of how the Web Setup Project handles computers that lack the .NET Framework 4.
- **Practice 3** Create a Web Setup Project and generate a Windows Installer file. If you have sufficient lab equipment, use Active Directory software distribution to distribute the website automatically to multiple servers.

Use the Copy Web Tool

For this task, you should complete both practices to gain experience with using the Copy Web tool.

- **Practice 1** Use the Copy Web tool to create a local copy of your most recent real-world website. With your computer disconnected from the network, make an update to the website. Then use the Copy Web tool to update that single file on the remote web server.
- **Practice 2** Using a local copy of a website, make an update to different files on both your local copy and the remote website. Then use the Copy Web tool to synchronize the local and remote websites.

Precompile and Publish a Web Application

For this task, you should complete the practice to gain an understanding of the performance benefits that can be realized by precompiling an application.

- Enable tracing in a website. Then modify the Web.config file and save it to force the application to restart. Open a page several times, and then view the Trace.axd file to determine how long the first and subsequent requests took. Next, use the Publish Web Site tool to precompile the application. Open a page several times, and then view the Trace.axd file to determine how long the first and subsequent requests took with the precompiled application.

Take a Practice Test

The practice tests on this book's companion CD offer many options. For example, you can test yourself on just the lesson review questions in this chapter, or you can test yourself on all the 70-515 certification exam objectives. You can set up the test so it closely simulates the experience of taking a certification exam, or you can set it up in study mode so you can look at the correct answers and explanations after you answer each question.

MORE INFO **PRACTICE TESTS**

For details about all the practice test options available, see the "How to Use the Practice Tests" section in this book's Introduction.

CHAPTER 12

Working with Data Source Controls and Data-Bound Controls

Microsoft ASP.NET provides several server controls that build on top of the features of Microsoft ADO.NET, LINQ to SQL, and LINQ to Entities. These controls simplify the development of data-driven websites. They make it easier to build webpages that access, display, manipulate, and save data. Using these controls can provide development efficiency when you are building business applications that rely heavily on data.

This chapter first presents the ASP.NET data source controls. You use these controls to configure access to data that you intend to use on a webpage. A data source can be a relational database, data stored inside of in-memory objects (such as a DataSet or an Entity Data Model), XML-based data, or data you retrieve via Microsoft Language-Integrated Query (LINQ). The second lesson in this chapter demonstrates how you can bind to data to allow users to interact with it. The lesson covers using web server controls such as GridView, Repeater, DetailsView, and many more. The last lesson presents the new Dynamic Data features of ASP.NET that allow you to easily create websites for working with the create, read, update, and delete (CRUD) operations of an entire data model that exists as either a DataContext (such as LINQ to SQL) or an ObjectContext (such as LINQ to Entities).

Exam objectives in this chapter:

- Displaying and Manipulating Data
  - Implement DataSource controls.
  - Implement data-bound controls.
  - Create and configure a Dynamic Data project.

Lessons in this chapter:

Before You Begin

To complete the lessons in this chapter, you should be familiar with developing applications with Microsoft Visual Studio 2010 by using Microsoft Visual Basic or Microsoft Visual C#. In addition, you should be comfortable with all of the following:

- The Visual Studio 2010 Integrated Development Environment (IDE)
- Using Hypertext Markup Language (HTML) and client-side scripting
- Creating ASP.NET websites and forms
- Adding web server controls to a webpage
- Understanding how generic types work in C# or Visual Basic
- Understanding how to use ADO.NET to connect to and work with data
- Writing LINQ queries and working with LINQ data–specific providers

REAL WORLD

Mike Snell

Not all applications require developers to write custom, abstracted data layers and reusable frameworks. I've seen many simple business applications that suffered from over-engineering. Many of these smaller applications can take advantage of the simple data-binding techniques built into the Visual Studio ASP.NET tools. These applications can be created quickly, typically do not require much testing, and allow developers to focus on solving business problems rather than building frameworks and reusable objects that might never realize the goal of reusability. In fact, ASP.NET and ADO.NET can now generate a data layer for you by using LINQ to Entities.

Applications that can benefit from this approach often have a common profile: they typically have compressed schedules, are meant to be websites from beginning to end, and might fill a somewhat temporary need. When optimizing for these considerations, you might find that building data-bound applications by using the server controls in ASP.NET is fast, easy, and economical.

Lesson 1: Connecting to Data with Data Source Controls

Data source controls are server controls that you can drag onto your page at design time. A data source control does not have a direct visual component (you use data-bound controls for actual data display, as discussed in the next lesson). Instead, they allow you to declaratively define access to data found in objects, XML, and databases. This lesson examines how you can use data source controls to make connecting to and working with data in an ASP.NET webpage a fast and straightforward development process.

After this lesson, you will be able to:

- Use the data source controls (LinqDataSource, ObjectDataSource, SqlDataSource, AccessDataSource, XmlDataSource, SiteMapDataSource, and EntityDataSource) to select data and bind it to a data-bound control.
- Pass parameter values to data source controls to allow data filtering.
- Enable data sorting with data source controls.
- Modify data and save the changes to a data store by using data source controls.

Estimated lesson time: 40 minutes

Understanding the Data Source Controls

The data source controls in ASP.NET manage the tasks of selecting, updating, inserting, and deleting data on a webpage. They do so in combination with data-bound controls. The data-bound controls provide the user interface (UI) elements that allow a user to interact with the data by triggering events that call the data source controls.

There are multiple data source controls in ASP.NET. Each is meant to provide specialized access to a certain type of data, such as direct access to a database, objects, XML, or LINQ-based queries. These controls can be found in the System.Web.UI.WebControls namespace. Figure 12-1 shows an overview of the data source controls in ASP.NET.

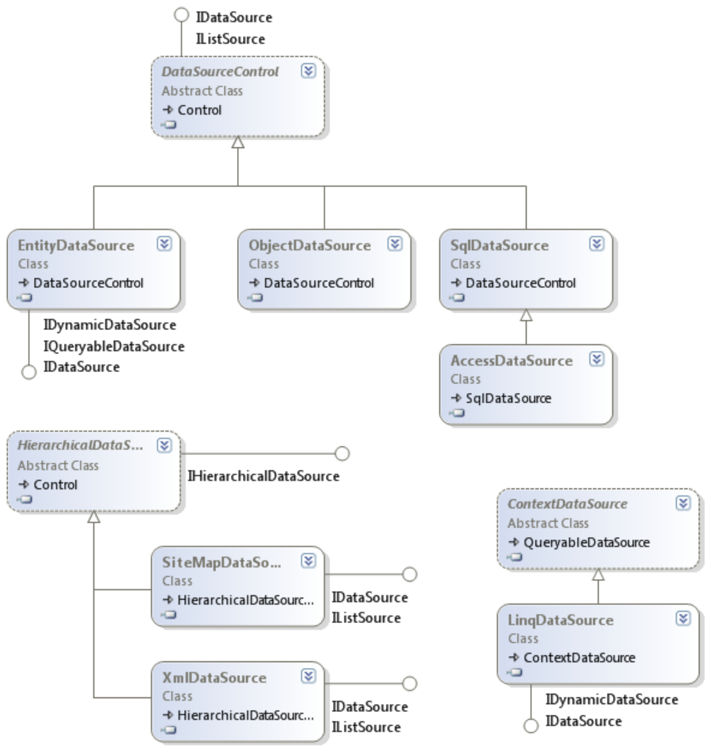
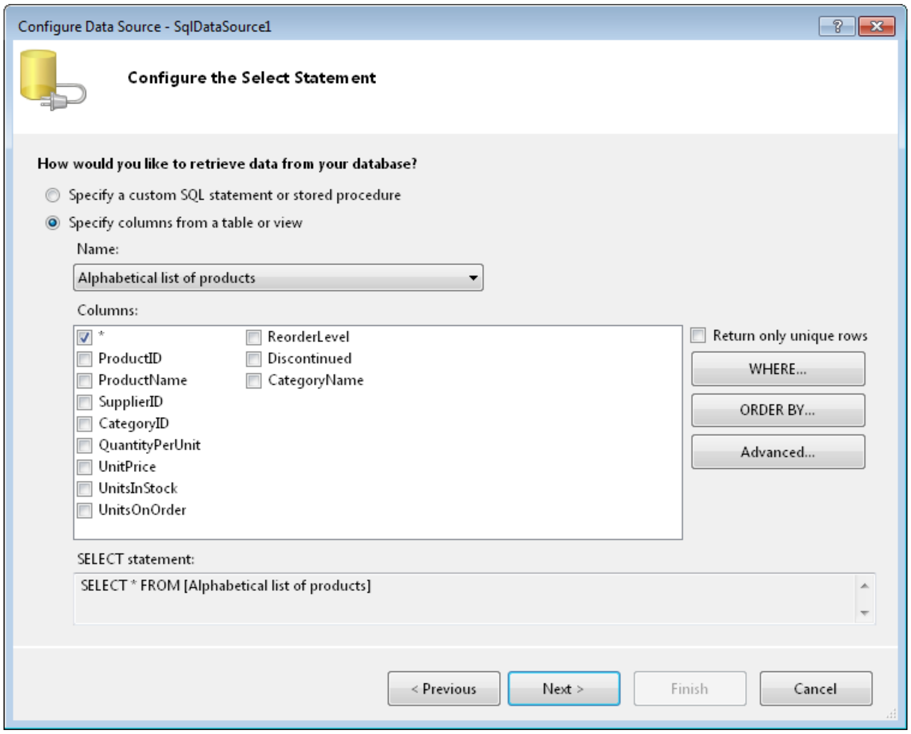


FIGURE 12-1 The DataSource web control classes.

Each data source control is used in a similar manner. You can drag the control onto your webpage from the Toolbox in Visual Studio. You can then use the Configure Data Source Wizard to connect to your data and generate markup for the data source control. Connecting to data with markup (instead of code) is referred to as *declarative data binding*, because you are declaring your data access rather than writing ADO.NET code. Figure 12-2 shows the step for selecting data in this wizard.

This wizard creates the declarative markup used to define the data source connection information. This markup can contain connection information, data manipulation statements (such as SQL), and more. The following shows an example of the SqlDataSource control's markup for connecting to the Products table in the Northwind database.

```
<asp:SqlDataSource ID="SqlDataSource1" runat="server"
    ConnectionString="<%$ ConnectionStrings:NorthwindCnnString %>"
    SelectCommand="SELECT * FROM [Alphabetical list of products]">
</asp:SqlDataSource>
```


Configure Data Source - SqlDataSource1

Configure the Select Statement

How would you like to retrieve data from your database?

- ○ Specify a custom SQL statement or stored procedure
- ● Specify columns from a table or view

Name: Alphabetical list of products

Columns:

☑ *	☐ ReorderLevel
☐ ProductID	☐ Discontinued
☐ ProductName	☐ CategoryName
☐ SupplierID	
☐ CategoryID	
☐ QuantityPerUnit	
☐ UnitPrice	
☐ UnitsInStock	
☐ UnitsOnOrder	

☐ Return only unique rows

SELECT statement:

```
SELECT * FROM [Alphabetical list of products]
```

FIGURE 12-2 The Configure Data Source Wizard in Visual Studio allows you to select the data to be exposed by your data source control.

EXAM TIP

The wizard-based UI is a great tool for defining many of your data source declarations. However, it is important that you know the markup syntax for working with these controls. This will help with both programming against the controls and taking the exam. Therefore, the rest of this lesson focuses on the markup (and not the wizard-based UI).

Each data source control is specialized for the type of data with which it is meant to work. The following sections provide an overview of what makes each of these controls unique. The discussion includes some of the common uses of data source controls, such as binding, filtering, sorting, and modifying data.

Using Objects as Data Sources with ObjectDataSource

Many web applications work with a middle tier, or business layer, for retrieving and working with application data. This middle tier encapsulates database code inside classes. Web developers can then call methods on these classes to select, insert, modify, and delete data. With this structure, developers do not have to write direct ADO.NET code, because the code is written by whoever wrote the middle tier. In addition, this middle tier is often reusable across different applications.

You can use the ObjectDataSource control in ASP.NET to connect to and work with middle-tier objects in much the same way that you would work with the other data source objects. This control can be added to a page and configured to create an instance of a middle-tier object and call its methods to retrieve, insert, update, and delete data. The ObjectDataSource control is responsible for the execution lifetime of the object. It creates it and disposes of it. Therefore, the business layer code should be written in a stateless manner. Alternatively, if the business layer uses static methods (or shared methods, in Visual Basic), the ObjectDataSource can use these methods without creating an instance of the actual business object. In this case, however, keep in mind that you could end up with performance issues related to thread contention as multiple requests try to access the same static method.

You configure an ObjectDataSource to connect to a class by setting its TypeName attribute to a string that represents a valid type to which the web application has access. This class might be inside your App_Code directory or inside a DLL file to which the website has a reference (it should not be in your webpage's code-behind file). You then set the SelectMethod attribute to a valid method name on the class. The ObjectDataSource control will then call this method when the data is requested.

As an example, imagine that you need to write an interface to allow a user to manage the shipper table inside the Northwind database. You might have a business object that can return all the shippers in the database and that looks as follows.

Sample of Visual Basic Code

```
Public Class Shipper

    Private Shared _cnnString As String = _
            ConfigurationManager.ConnectionStrings("NorthwindConnectionString").ToString

    Public Shared Function GetAllShippers() As DataTable
        Dim adp As New SqlDataAdapter( _
            "SELECT * FROM shippers", _cnnString)

        Dim ds As New DataSet("shippers")
        adp.Fill(ds, "shippers")

        Return ds.Tables("shippers")
    End Function

End Class
```

Sample of C# Code

```
public class Shipper
{
    private static string _cnnString =
        ConfigurationManager.ConnectionStrings["NorthwindConnectionString"].ToString();

    public static DataTable GetAllShippers()
    {
        SqlDataAdapter adp = new SqlDataAdapter(
            "SELECT * FROM shippers", _cnnString);

        DataSet ds = new DataSet("shippers");
        adp.Fill(ds, "shippers");

        return ds.Tables["shippers"];
    }
}
```

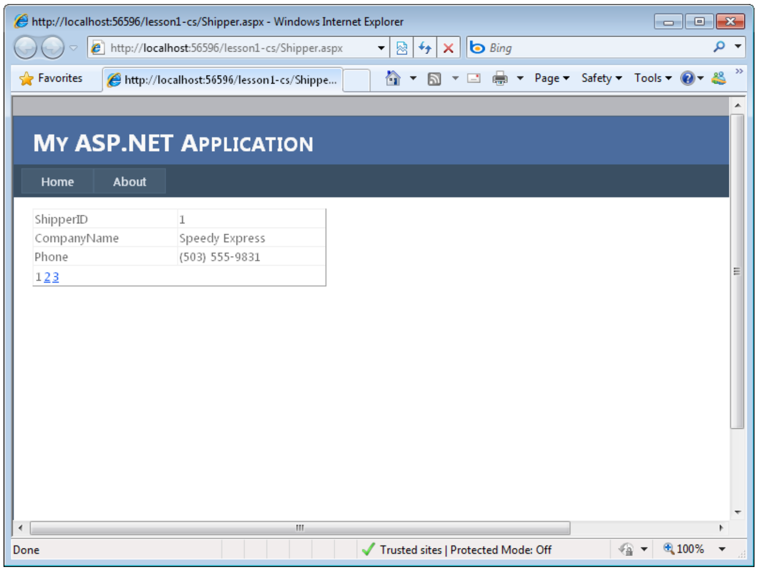
The Shipper class just listed returns a DataTable as a result of a call to GetAllShippers. You can configure an ObjectDataSource control to provide this data to a webpage by setting the TypeName and SelectMethod attributes as in the following code.

```
<asp:ObjectDataSource
  ID="ObjectDataSource1"
  runat="server"
  TypeName="Shipper"
  SelectMethod="GetAllShippers">
</asp:ObjectDataSource>
```

You can then use this data source control to bind to a web control (more on this in the next lesson). For example, the following markup binds the ObjectDataSource to a DetailsView control to display the information to the user.

```
<asp:DetailsView
  ID="DetailsView1"
  runat="server"
  DataSourceID="ObjectDataSource1"
  AllowPaging="true">
</asp:DetailsView>
```

Figure 12-3 shows an example of the output.


http://localhost:56596/lesson1-cs/Shipper.aspx - Windows Internet Explorer
Favorites
Page
Safety
Tools
MY ASP.NET APPLICATION
Home
About
Done
Trusted sites | Protected Mode: Off
100%

ShipperID	1
CompanyName	Speedy Express
Phone	(503) 555-9831
1 2 3	

FIGURE 12-3 An ObjectDataSource bound to a DetailsView control.

Notice that the Shipper.GetAllShippers method returns a DataTable. An ObjectDataSource class can work with any data that implements any of the following interfaces: IEnumerable, IListSource, IDataSource, or IHierarchicalDatasource. This means that as long as your business object class returns data as a DataTable, a DataSet, or some form of a collection, you can be sure that this data can be used with an ObjectDataSource control.

Passing Parameters

The business objects with which you work will undoubtedly define methods that take parameter values. These parameters might define a filter on the data or indicate values to be used when inserting or updating data. Fortunately, you can use the ObjectDataSource to map various page-level elements to parameters to be passed to your objects.

There are multiple sets of parameters you can define for an ObjectDataSource. These sets include Select, Insert, Update, Delete, and Filter parameters. These parameters work in conjunction with the method of the same name. For example, the <SelectParameters> set works with the method defined by the SelectMethod attribute.

The source of a parameter's value can come from multiple places in your page or site, including Cookie, Control, Session, QueryString, Form, or Profile objects. These options make defining and mapping a data source an easier task. You can also define the source value in code.

As an example, suppose that you have a business object name Customer. Assume that this object contains the GetCustomersByCity method, which takes a city value as string. The method then returns a list of customers for the specified city parameter. Now suppose that you need to create a data source control to map to this class. The ObjectDataSource should pass the value for the city to the method from the query string. In this case, you would create a SelectParameters set that includes a QueryStringParameter definition. The QueryStringParameter definition would map between the name of the query string parameter and the name of the method's parameter. The following code shows an example.

```
<asp:ObjectDataSource
    ID="ObjectDataSource1"
    runat="server"
    TypeName="Customer"
    SelectMethod="GetCustomersByCity">
    <SelectParameters>
        <asp:QueryStringParameter
            Name="city"
            QueryStringField="city"
            Type="String" />
    </SelectParameters>
</asp:ObjectDataSource>
```

You might then attach this data source to a GridView or similar control. You can then call the page by passing in the appropriate query string value, as follows.

```
http://localhost:5652/DataSourceSamples/Customers.aspx?city=London
```

You can use this same technique to pass multiple parameters of various types and from various sources. You can also use this same technique to pass parameters meant to handle inserting, updating, and deleting, as discussed in the next section.

Inserting, Updating, and Deleting

You can also use an ObjectDataSource control to define how data should be inserted, updated, and deleted. The InsertMethod, UpdateMethod, and DeleteMethod attributes can be mapped directly to the methods of an object that are to be called when these activities are invoked. You then use parameter definitions to map values to these method calls.

As an example, recall the Shipper class discussed previously. Now suppose that additional methods have been added to this object. These method signatures might look as follows.

Sample of Visual Basic Code

```
Public Shared Function GetAllShippers() As DataTable
Public Shared Sub InsertShipper(ByVal companyName As String, ByVal phone As String)
Public Shared Sub UpdateShipper(ByVal shipperId As Integer, _
  ByVal companyName As String, ByVal phone As String)
Public Shared Sub DeleteShipper(ByVal shipperId As Integer)
```

Sample of C# Code

```
public static DataTable GetAllShippers()
public static void InsertShipper(string companyName, string phone)
public static void UpdateShipper(int shipperId, string companyName, string phone)
public static void DeleteShipper(int shipperId)
```

You can map an ObjectDataSource control to each of these methods. In doing so, you need to define the parameters each method expects. The following markup shows an example.

```
<asp:ObjectDataSource ID="ObjectDataSource1" runat="server" TypeName="Shipper"
    SelectMethod="GetAllShippers" InsertMethod="InsertShipper"
    UpdateMethod="UpdateShipper" DeleteMethod="DeleteShipper">
    <DeleteParameters>
        <asp:Parameter Name="ShipperId" Type="Int32" />
    </DeleteParameters>
    <UpdateParameters>
        <asp:Parameter Name="shipperId" Type="Int32" />
        <asp:Parameter Name="companyName" Type="String" />
        <asp:Parameter Name="phone" Type="String" />
    </UpdateParameters>
    <InsertParameters>
        <asp:Parameter Name="companyName" Type="String" />
        <asp:Parameter Name="phone" Type="String" />
    </InsertParameters>
</asp:ObjectDataSource>
```

You can then use this ObjectDataSource control with a data-bound control such as a DetailsView. The following markup is an example. In this case, the fields are bound individually. This allows granular control over the ShipperId field because it is an auto-generated primary key (identity) in a Microsoft SQL Server database. Therefore, you set the InsertVisible property to false, to make sure that the DetailsView does not try to pass a value for ShipperId to the InsertMethod of the ObjectDataSource. You also set the ReadOnly attribute of the same field to true, to indicate that the value should not be available to change during an edit operation.

```
<asp:DetailsView ID="DetailsView1" runat="server" AllowPaging="True"
    DataSourceID="ObjectDataSource1" AutoGenerateRows="False" Width="450px"
    DataKeyNames="ShipperID">
    <Fields>
        <asp:BoundField DataField="ShipperID" HeaderText="ShipperId"
            ReadOnly="true" InsertVisible="false" />
        <asp:BoundField DataField="CompanyName" HeaderText="CompanyName" />
        <asp:BoundField DataField="Phone" HeaderText="Phone" />
        <asp:CommandField ShowInsertButton="True" ShowDeleteButton="True"
            ShowEditButton="True" />
    </Fields>
</asp:DetailsView>
```

Defining a Filter

You can also apply filters to an ObjectDataSource. Filters apply to data returned from the object's methods as a DataSet or DataTable. This is because the filter is a valid filter expression as defined by the ADO.NET DataColumn class.

To define a filter for an ObjectDataSource control, you set the FilterExpression attribute to a valid filter. This filter will be applied after the data is retrieved from the database. You can also use FilterParameters to map values from the page to the filter expression by defining a filter expression that contains parameter mappings as numbers enclosed in braces. You then add the appropriate filter parameters.

The following code shows an example. Here, the Customer.GetAllCustomers method is bound to an ObjectDataSource control. When the data is returned, the filter expression city='{0}' is applied to the result. The query string value for city is then passed as the {0} parameter to the filter expression.

```
<asp:ObjectDataSource
    ID="ObjectDataSource1"
    runat="server"
    TypeName="Customer"
    SelectMethod="GetAllCustomers"
    FilterExpression="city='{0}'">
    <FilterParameters>
        <asp:QueryStringParameter
            Name="city"
            QueryStringField="city"
            Type="String" />
    </FilterParameters>
</asp:ObjectDataSource>
```

Sorting and Paging

The data-bound controls that work with an ObjectDataSource control can be configured to page and sort the data returned by the data source control. However, it is often better to sort and page this data when the data is requested from the database. Doing so can reduce the consumption of resources on your server.

The ObjectDataSource control defines specific attributes for managing sorting and paging. You set these attributes to parameters of your SelectMethod. The SelectMethod must also define these properties and use them for sorting and paging. In addition, by using these specific properties, data-bound controls such as GridView can automatically work with your data source to provide input for sorting and paging.

As an example, suppose you want to provide a business object method to control how customer data is sorted and paged as it is retrieved before it is shown to the user. You could define a business method as follows.

Sample of Visual Basic Code

```
Public Shared Function GetPagedCustomersSorted( _
    ByVal sortCol As String, ByVal pageStart As Integer, _
    ByVal numRecords As Integer) As DataTable

    If numRecords <= 0 Then numRecords = 10
    If sortCol = "" Then sortCol = "CompanyName"

    Dim cnn As New SqlConnection(_cnnString)

    Dim sql As String = "SELECT * FROM customers"

    Dim cmd As New SqlCommand(sql, cnn)

    Dim adp As New SqlDataAdapter(cmd)
    cnn.Open()
    Dim ds As New DataSet("customers")
    adp.Fill(ds, pageStart, numRecords, "customers")

    Dim dsSort = From cust In ds.Tables("customers").AsEnumerable()
                 Order By cust.Field(Of String)(sortCol)
                 Select cust

    return dsSort.CopyToDataTable()

End Function
```

Sample of C# Code

```
public static DataTable GetPagedCustomersSorted(
    string sortCol, int pageStart, int numRecords)
{
    if (numRecords <= 0) numRecords = 10;
    if (sortCol == "") sortCol = "CompanyName";

    SqlConnection cnn = new SqlConnection(_cnnString);

    string sql = "SELECT * from customers";

    SqlCommand cmd = new SqlCommand(sql, cnn);

    SqlDataAdapter adp = new SqlDataAdapter(cmd);
    DataSet ds = new DataSet("customers");
    cnn.Open();
    adp.Fill(ds, pageStart, numRecords, "customers");

    var dsSort = from cust in ds.Tables["customers"].AsEnumerable()
                    orderby cust.Field<string>(sortCol)
                    select cust;

    return dsSort.CopyToDataTable();
}
```

Notice that this business method defines three parameters: one for sorting the data, one for setting the starting record (or page), and one for setting the number of records in a page. You can then use these parameters when defining an ObjectDataSource. You set the control's SortParameterName attribute to the parameter of your business object that is used for sorting data. You set the StartRowIndexParameterName to the parameter that defines the row number at which you want to start retrieving data. You then set the MaximumRowsParameterName to the parameter that is used to define the number of rows you want to include in a data page. The following markup shows an example.

```
<asp:ObjectDataSource
    ID="ObjectDataSource1"
    runat="server"
    TypeName="Customer"
    SelectMethod="GetPagedCustomersSorted"
    SortParameterName="sortCol"
    EnablePaging="true"
    StartRowIndexParameterName="pageStart"
    MaximumRowsParameterName="numRecords">
</asp:ObjectDataSource>
```

You can then bind this data source to a control such as a GridView. The following markup shows an example.

```
<asp:GridView ID="GridView1" runat="server"
    DataSourceID="ObjectDataSource1"
    AllowPaging="True" PageSize="10" AllowSorting="true">
</asp:GridView>
```

When the page is run, the GridView control passes sorting and paging information to the data source. However, because the paging is happening before the GridView is bound, the GridView does not know the number of pages to display. Therefore, you need to implement your own custom paging in this scenario to advance the PageIndex property of the GridView control on the user's request. After you reset this value, the GridView will pass the value on to the ObjectDataSource.

Caching Data

You can tell ASP.NET to cache your ObjectDataSource control. This will keep the data in memory between page calls and can increase the performance and scalability of your application if the data is to be shared and accessed often.

To indicate caching of an ObjectDataSource, you set the EnableCaching attribute to true. You then set the CacheDuration property to the number of seconds you want to have ASP.NET cache the data. The following shows an example of these settings.

```
<asp:ObjectDataSource
    ID="ObjectDataSource1"
    runat="server"
    TypeName="Shipper"
    SelectMethod="GetAllShippers"
    EnableCaching="true"
    CacheDuration="30">
</asp:ObjectDataSource>
```

The first call to this page will call the object and return its data. Subsequent calls within 30 seconds (such as moving through data pages) will use the cached data (and not call the underlying object).

Creating a DataObject Class

There are not many restrictions on which objects you can use as the source of ObjectDataSource controls. If you know that your business object will be used as an ObjectDataSource, you can define attributes on your class that make consuming your class inside an ObjectDataSource easier in the designer. These attributes are used to predefine which methods to use as Select, Insert, Update, and Delete methods.

To get started, you set the DataObject attribute at the top of your class. This simply indicates that your class is meant to be a DataObject. Again, this is not required for use with ObjectDataSource controls but simply makes things easier. The following shows an example of the class declaration and attribute.

Sample of Visual Basic Code

```
<System.ComponentModel.DataObject()> _
Public Class Shipper
```

Sample of C# Code

```
[DataObject()]
public class Shipper
```

You then add the DataObjectMethod attribute to the top of each method you intend to use as a data object method. You pass a DataObjectMethodType enum value to this attribute to indicate Delete, Insert, Update, or Select. The following code shows an example of the method signature and attribute.

Sample of Visual Basic Code

```
<System.ComponentModel.DataObjectMethod(ComponentModel.DataObjectMethodType.Select)> _
Public Shared Function GetAllShippers() As DataTable
```

Sample of C# Code

```
 [DataObjectMethod(DataObjectMethodType.Select)]
public static DataTable GetAllShippers()
```

By defining these attributes, you make the designer aware of your business object's intentions. This can ease the burden of configuring an ObjectDataSource control when large business objects with many methods are involved.

Connecting to Relational Databases by Using SqlDataSource

The SqlDataSource control is used to configure access to relational databases such as SQL Server and Oracle. It can also be configured to work with Open Database Connectivity (ODBC) and Object Linking and Embedding (OLE) Db data connections. You configure the control to connect to one of these database types. The code inside the control will then use the appropriate data provider based on your configuration settings, including ADO.NET provider classes for SqlClient, OracleClient, OleDb, and Odbc.

You configure the SqlDataSource control by first setting its ID property to a unique identifying string value. This property is similar to any other web control ID property. However, the value is used when referring to the data source during data binding (which will be discussed later in this section). You then set the ConnectionString property either to a valid connection string or to page script that reads the connection string from the Web.config file (as shown in the next code example).

You then set various command properties, including commands for selecting, inserting, updating, and deleting data. The command properties you set are based on how you intend to use the control. For example, you use the SelectCommand to define an SQL statement that can be used to retrieve data from a database. In this case, you would use the Text SelectCommandType (which is the default). You can also set the SelectCommandType to StoredProcedure and then provide a stored procedure name for the SelectCommand attribute.

The DataSourceMode attribute is used to define how the SqlDataSource control should retrieve your data. You have two options: DataSet and DataReader. The former connects to the database and returns all records as a DataSet instance. It then closes the database connection before continuing to process the page. The latter, DataReader, keeps an open connection to the database while it reads each row into the data source control.

The following markup shows an example of connecting to a Microsoft SQL Server Express Edition database by first reading the connection string from the Web.config file. It uses a text-based SQL statement and a DataReader. It then binds the data source to a GridView control for display.

```
<asp:SqlDataSource
    ID="SqlDataSource1"
    runat="server"
    ConnectionString="<%$ ConnectionStrings:NorthwindConnectionString %>"
    SelectCommandType="Text"
    SelectCommand="SELECT * FROM [products]"
    DataSourceMode="DataReader">
</asp:SqlDataSource>

<asp:GridView
    ID="GridView1"
    runat="server"
    DataSourceID="SqlDataSource1">
</asp:GridView>
```

You can also work with the data source controls from code. When doing so, you replace the markup attribute settings with object property settings. You first create the data source control inside the Page_Init method. You then add the data source control to the page to ensure that it is available to be bound to other controls. The following code shows the preceding markup example translated as code in a code-behind page.

Sample of Visual Basic Code

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

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

        Dim sqlDs As New SqlDataSource
        sqlDs.ConnectionString = _
            ConfigurationManager.ConnectionStrings("NorthwindConnectionString").ToString
        sqlDs.ID = "SqlDataSource1"
        sqlDs.SelectCommandType = SqlDataSourceCommandType.Text
        sqlDs.SelectCommand = "SELECT * FROM [products]"
        sqlDs.DataSourceMode = SqlDataSourceMode.DataReader
        Me.Controls.Add(sqlDs)
    End Sub

    Protected Sub Page_Load(ByVal sender As Object, _
        ByVal e As System.EventArgs) Handles Me.Load
        GridView1.DataSourceID = "SqlDataSource1"
    End Sub

End Class
```

Sample of C# Code

```
public partial class DefaultCs : System.Web.UI.Page
{
    protected void Page_Init(object sender, EventArgs e)
    {
        SqlDataSource sqlDs = new SqlDataSource();
        sqlDs.ConnectionString =
            ConfigurationManager.ConnectionStrings[
            "NorthwindConnectionString"].ToString();
        sqlDs.ID = "SqlDataSource1";
        sqlDs.SelectCommandType = SqlDataSourceCommandType.Text;
        sqlDs.SelectCommand = "SELECT * FROM [products]";
        sqlDs.DataSourceMode = SqlDataSourceMode.DataReader;
        this.Controls.Add(sqlDs);
    }

    protected void Page_Load(object sender, EventArgs e)
    {
        GridView1.DataSourceID = "SqlDataSource1";
    }
}
```

Working with data source controls in code is less common than working with them in markup. Declaring your data source in markup is very straightforward;, the attributes you define in markup are the same as the properties you set in code. Therefore, the majority of this lesson assumes that you are working with markup only, and will not provide examples in code.

Using Parameters

The SqlDataSource control can also be configured to use parameters for Select, Insert, Update, Filter, and Delete commands. This is done by defining parameters inside your SQL statements by using the @ param syntax. You then map parameter values to these parameter definitions by using parameter declarations.

As an example, suppose that you are creating a SqlDataSource control to return products based on their category ID. The category ID will be passed to the page as a value from the query string. You can define this parameter inside the SelectParameters collection as a QueryStringParameter. The following shows the markup of this example.

```
<asp:SqlDataSource
    ID="SqlDataSource1"
    runat="server"
    ConnectionString="<%$ ConnectionStrings:NorthwindConnectionString %>"
    SelectCommandType="Text"
    SelectCommand="SELECT * FROM [products] WHERE CategoryID=@CategoryId"
    DataSourceMode="DataSet">
    <SelectParameters>
        <asp:QueryStringParameter
            Name="CategoryId"
            QueryStringField="catId"
            Type="Int16" />
    </SelectParameters>
</asp:SqlDataSource>
```

You can then bind this control to a GridView (or similar control). When the page is accessed, the data is filtered based on the query string parameter. The following shows an example Uniform Resource Locator (URL) for this call:

```
http://localhost:5652/DataSourceSamples/Products.aspx?catId=2
```

You use the same method for defining InsertParameters, UpdateParameters, and DeleteParameters. These parameters are mapped to the respective InsertCommand, UpdateCommand, and DeleteCommand commands. Controls such as GridView and DetailsView work to trigger update, insert, and delete actions and, in doing so, pass parameter values to the appropriate command. This is similar to what was demonstrated previously in the ObjectDataSource section.

Filtering Data with SqlDataSource

As with the ObjectDataSource control, you can also filter data inside a SqlDataSource control. Again, the data must be a DataSet because the filter is applied to the ADO.NET DataColumn or DataView.RowFilter property.

To define a filter, you set the FilterExpression attribute to a valid filter. This filter will be applied after the data is retrieved from the database. You can also use FilterParameters to map values from the page to the filter expression by defining a filter expression that contains parameter mappings as numbers enclosed in braces. You then add the appropriate filter parameters.

The following code shows an example of a SqlDataSource control that first selects all products from the database. It then applies a FilterExpression to show only those products that have been discontinued.

```
<asp:SqlDataSource
    ID="SqlDataSource1"
    runat="server"
    ConnectionString="<%$ ConnectionStrings:NorthwindConnectionString %>"
    SelectCommandType="Text"
    SelectCommand="SELECT * FROM [products]"
    DataSourceMode="DataSet"
    FilterExpression="Discontinued=true">
</asp:SqlDataSource>
```

Caching SqlDataSource Data

As with ObjectDataSource, you can also configure a SqlDataSource control to be cached by the server. When doing so, however, you must set the DataSourceMode property to DataSet. DataReader sources cannot be cached, because they would hold open a connection to the server.

You indicate the caching of a SqlDataSource control the same way you would an ObjectDataSource control: by setting the EnableCaching and CacheDuration attributes. The following shows an example.

```
<asp:SqlDataSource
    ID="SqlDataSource1"
    runat="server"
    ConnectionString="<%$ ConnectionStrings:NorthwindConnectionString %>"
    SelectCommandType="Text"
    SelectCommand="SELECT * FROM [products]"
    DataSourceMode="DataSet"
    EnableCaching="True"
    CacheDuration="30">
</asp:SqlDataSource>
```

Working with Access Data Files and AccessDataSource Controls

The AccessDataSource control is meant to connect to and work with Microsoft Access file-based databases (.mdb files). This control is very similar to the SqlDataSource control. In fact, it derives from the SqlDataSource class. Therefore, you can expect to work with the AccessDataSource control in a very similar manner when passing parameters, caching, filtering data, and calling Access stored procedures.

NOTE **THE NEW ACCESS DATABASE ENGINE**

The Access database engine has been changed in recent versions from Microsoft Jet to one based on SQL Server. The AccessDataSource control is used to work with Jet-based databases. These can be identified by the .mdf file extension. Newer Access files have the .accdb extension. You can connect to these database files by using the SqlDataSource control (not the AccessDataSource control).

One of the main differences between the AccessDataSource control and the SqlDataSource control is how they connect to the database. The AccessDataSource control replaces the SqlDataSource.ConnectionString property with the DataFile property. You pass a path to a database file to this property to define a connection to an Access database. The following markup shows how you configure the AccessDataSource control to connect to an .mdb file in the App_Data folder.

```
<asp:AccessDataSource
    ID="AccessDataSource1" runat="server"
    DataFile="~/App_Data/AccessNorthwind.mdb"
    SelectCommand="SELECT * FROM [Products]">
</asp:AccessDataSource>
```

The code inside this data source control uses the ADO.NET System.Data.OleDb provider for connecting to an Access data file. Of course, this code is abstracted for you by the control itself. You need only define the markup to begin accessing and working with data in the Access file.

NOTE **CONFIGURING ACCESS TO A FILE-BASED DATABASE**

To ensure that the webpage has access to this file, configure the ASP.NET process identity to allow file-based access to the .mdb file.

Connecting to an Entity Model by Using EntityDataSource

The EntityDataSource control works much like the SqlDataSource control. However, the SqlDataSource control is tied to a specific database model, whereas the EntityDataSource control works with an Entity Data Model that gets mapped to an actual data store (see Chapter 11, "Connecting to and Querying Data with LINQ," for more information on creating and working with Entity Framework's Entity Data Model).

You configure the EntityDataSource control to provide a connection to the entity model's underlying data store, which is done through the ConnectionString property. This value is set to a named entity model connection string that uses the System.Data.EntityClient provider. The connection string is generated and stored in the Web.config file when you set up your entity model (EDMX file).

You can then indicate an EntitySetName to point to the data you want to select and expose through the data source control. This entity set is a named collection of data in your model. Alternatively, you can use the CommandText attribute to define a custom LINQ query to define your selection (more on this later in this section).

The following markup shows an example. This assumes that an entity model named NorthwindEntities has been created. Notice the connection string reference. This string is stored in the Web.config file. Also, notice that the EntitySetName is set to Orders. This is used to establish a default entity set and will return all orders in the data store. Finally, the results are bound to a GridView control for display.

```
<asp:EntityDataSource ID="EntityDataSource1"
    runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EnableFlattening="False"
    EntitySetName="Orders">
</asp:EntityDataSource>

<asp:GridView ID="GridView1" runat="server"
    DataSourceID="EntityDataSource1">
</asp:GridView>
```

Selecting Data to Return

You saw in the previous example that you can return the entire collection for an entity by using the EntitySetName attribute. The EntityDataSource allows you to get more specific with your selection. You can do so through the Select attribute. You define a string in this attribute that will be passed to ObjectQuery<T>. In this way, you can write LINQ to Entities code against the data source for the Select, Where, and Order By attributes.

For example, suppose you want to return only specific fields from the OrderDetails collection in an entity model. You might also want to rename some of these fields and even generate a field based on a calculation. As with a LINQ to Entities query, you can specify a Select statement that will do just that. Recall from Chapter 11 that this is called a *projection*, because you are projecting the results into a collection of a new, anonymous type. The following markup shows an example.

```
<asp:EntityDataSource ID="EntityDataSource1"
    runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EnableFlattening="False"
    EntitySetName="OrderDetails"
    Select="it.OrderId as Id, it.UnitPrice, it.Quantity, it.UnitPrice * it.Quantity as
  LineItemTotal">
</asp:EntityDataSource>
```

SPECIFYING A CUSTOM QUERY

You can specify an entire query (and not just the Select) by using the CommandText property of the EntityDataSource. In this case, you need not set the EntitySetName. The query will indicate the data to select. This query is written as an Entity SQL expression, which uses different syntax than LINQ for Entities. The following markup shows an example (line breaks in the CommandText property are added for clarity.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    CommandText =
    "Select o.OrderId as Id, o.UnitPrice, o.Quantity,
            o.UnitPrice * o.Quantity as LineItemTotal
     from OrderDetails as o
     where o.Discount > 0
  order by o.ProductId">
</asp:EntityDataSource>
```

Note that you can write the same query by using the independent Select, Where, and OrderBy properties of the EntityDataSource control. You will see more on this in upcoming sections.

SPECIFYING OBJECTS TO RETURN

You can specify that additional object collections be returned in the result (in addition to the collection being queried). These additional objects are added to your collection by using the Include attribute. These objects should exist as a navigation property in the entity data model. For example, the following markup returns all Orders. For each order object, the results will also include the OrderDetails collection.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EntitySetName="Orders"
    Include="OrderDetails">
</asp:EntityDataSource>
```

Ordering Results

You can use the OrderBy property of the EntityDataSource control to specify an order by statement that will be passed to ObjectQuery<T>. The following markup shows an example of ordering the OrderDetails entity by ProductId.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EntitySetName="OrderDetails"
    OrderBy="it.ProductId">
</asp:EntityDataSource>
```

Filtering Data

You can use the Where property of the EntityDataSource control to specify a Where statement that will be passed to ObjectQuery<T> without modification. The following markup shows an example of filtering orders for only those that have a discount applied.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EntitySetName="OrderDetails"
    OrderBy="it.ProductId"
    Where="it.Discount > 0">
</asp:EntityDataSource>
```

Defining Parameters

The EntityDataSource control allows you to define several parameters that can be used with the @ paramName syntax inside various properties, including Select, Where, and CommandText. These ParameterCollection objects include CommandParameters, DeleteParameters, OrderByParameters, SelectParameters, UpdateParameters, and WhereParameters.

Each of these parameter collections might contain an ASP.NET parameter control such as ControlParameter, FormParameter, QueryStringParameter, CookieParameter, and similar parameters. This allows you to pass values from your website dynamically to the EntityDataSource control.

As an example, suppose you want to filter orders based on their value. You might ask a user to enter a value into a TextBox control. You could then create a <ControlParameter/> in the WhereParameters collection of an EntityDataSource control to map the TextBox.Text field to the Where clause. The following is an example; the parameter is defined as @ OrderValue, which aligns with the parameter name, OrderValue.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EntitySetName="OrderDetails"
    OrderBy="it.ProductId"
    Where="(it.Quantity * it.UnitPrice) > @OrderValue">
    <WhereParameters>
    <asp:ControlParameter
        ControlID="TextBoxValue" Name="OrderValue"
        DbType="Int32" PropertyName="Text"
        DefaultValue="0" />
    </WhereParameters>
</asp:EntityDataSource>

Enter an order value on which to filter:<br />
<asp:TextBox ID="TextBoxValue" runat="server"></asp:TextBox>
<asp:Button ID="ButtonUpdate" runat="server" Text="Button" />

<asp:GridView ID="GridView1" runat="server"
    DataSourceID="EntityDataSource1">
</asp:GridView>
```

Note that you can set the AutoGenerateWhereClause or AutoGenerateOrderByClause attributes to true if you want to have the EntityDataSource control automatically map a parameter to a field in the results. The parameter and field must have the same name for this to work.

Paging, Sorting, Editing, and Updating Data

The EntityDataSource control supports a few additional attributes that you can use to enable specific scenarios. These attributes include AutoPage, AutoSort, EnableInsert, EnableUpdate, and EnableDelete. These are all Boolean properties that, if set to true, will enable these features for your EntityDataSource. Of course, the features are provided by the underlying entity model; they then need to be exposed via a visible control such as a GridView.

The following markup shows an example of both a fully enabled EntityDataSource control and a GridView control that leverages all of these features. A user can access this page and view, sort, edit, update, and delete data.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntities"
    DefaultContainerName="NorthwndEntities"
    EntitySetName="OrderDetails"
    AutoPage="true"
    AutoSort="true"
    EnableDelete="true"
    EnableInsert="true"
    EnableUpdate="true">
</asp:EntityDataSource>

<asp:GridView ID="GridView1" runat="server"
    DataSourceID="EntityDataSource1"
    AllowPaging="True"
    AllowSorting="True">
    <Columns>
        <asp:CommandField
            ShowDeleteButton="True"
            ShowEditButton="True"
            ShowSelectButton="True" />
    </Columns>
</asp:GridView>
```

Connecting to XML Data by Using XmlDataSource

The XmlDataSource control provides a means to create a binding connection between controls on your page and an XML file. The XmlDataSource control is best used when you want to bind to XML data that is represented as hierarchical. In these cases, the outer elements of the XML represent data records. The child elements can themselves be subrecords related to the outer records. In addition, the child elements and attributes of these outer "record" elements are typically bound to as fields. You can think of these fields as columns of data on the record. Due to this hierarchical nature, the XmlDataSource control is typically bound to controls that show data in a hierarchical manner, such as the TreeView control. However, XmlDataSource controls can be used to display data in tabular formats, too.

You configure the XmlDataSource control at design time to point to an XML file. XML data in your project is typically stored in your project's App_Data folder. To bind to a file, you set the DataFile attribute on the data source control to point to the path of the XML file. The following code shows an example of defining an XmlDataSource control that points to a file containing product data.

```
<asp:XmlDataSource
    ID="XmlDataSource1"
    runat="server"
    DataFile="~/App_Data/products.xml" >
</asp:XmlDataSource>
```

You can also bind directly to a string value that represents XML. The XmlDataSource class provides the Data property for connecting to a string value in your code-behind page.

Transforming XML with the XmlDataSource Control

You can use the XmlDataSource control to define an Extensible Stylesheet Language (XSL) transformation to change the shape and content of your XML data. You do so by setting the TransformFile attribute to a valid XSL file. The XSL file will be applied to your XML data after your XML is loaded into memory and before the XML is bound for output.

As an example, consider the following XML file that defines a set of products across varied categories.

```xml
<?xml version="1.0" standalone="yes"?>
<Products>
    <Product>
        <Category>Beverages</Category>
        <Name>Chai</Name>
        <QuantityPerUnit>10 boxes x 20 bags</QuantityPerUnit>
        <UnitPrice>18.0000</UnitPrice>
    </Product>
    <Product>
        <Category>Condiments</Category>
        <Name>Aniseed Syrup</Name>
        <QuantityPerUnit>12 - 550 ml bottles</QuantityPerUnit>
        <UnitPrice>10.0000</UnitPrice>
    </Product>
    <Product>
        <Category>Condiments</Category>
        <Name>Chef Anton's Cajun Seasoning</Name>
        <QuantityPerUnit>48 - 6 oz jars</QuantityPerUnit>
        <UnitPrice>22.0000</UnitPrice>
    </Product>
    <Product>
        <Category>Produce</Category>
        <Name>Uncle Bob's Organic Dried Pears</Name>
        <QuantityPerUnit>12 - 1 lb pkgs.</QuantityPerUnit>
        <UnitPrice>30.0000</UnitPrice>
    </Product>
    <Product>
        <Category>Beverages</Category>
        <Name>Guaraná Fantástica</Name>
        <QuantityPerUnit>12 - 355 ml cans</QuantityPerUnit>
        <UnitPrice>4.5000</UnitPrice>
    </Product>
    <Product>
        <Category>Beverages</Category>
        <Name>Sasquatch Ale</Name>
        <QuantityPerUnit>24 - 12 oz bottles</QuantityPerUnit>
        <UnitPrice>14.0000</UnitPrice>
    </Product>
    <Product>
        <Category>Beverages</Category>
        <Name>Steeleye Stout</Name>
        <QuantityPerUnit>24 - 12 oz bottles</QuantityPerUnit>
        <UnitPrice>18.0000</UnitPrice>
    </Product>
</Products>
```

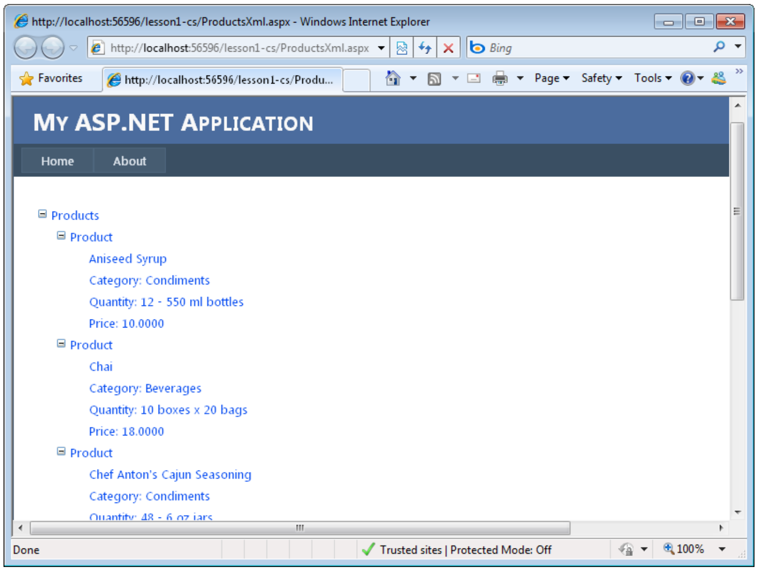
Suppose that you have to transform this data by first sorting it and then adding descriptive text to each field to help a user when viewing the data in a TreeView control. In this case, you can write an XSL transform file. The following code represents an example.

```
<xsl:stylesheet version="1.0"
    xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
    <xsl:template match="Products">
        <Products>
            <xsl:for-each select="Product">
                <xsl:sort select="Name" order="ascending" />
                <Product>
                    <Name>
                        <xsl:value-of select="Name"/>
                    </Name>
                    <Category>
                        <xsl:text>Category: </xsl:text>
                        <xsl:value-of select="Category"/>
                    </Category>
                    <QuantityPerUnit>
                        <xsl:text>Quantity: </xsl:text>
                        <xsl:value-of select="QuantityPerUnit"/>
                    </QuantityPerUnit>
                    <UnitPrice>
                        <xsl:text>Price: </xsl:text>
                        <xsl:value-of select="UnitPrice"/>
                    </UnitPrice>
                </Product>
            </xsl:for-each>
        </Products>
    </xsl:template>
</xsl:stylesheet>
```

Next, you set the TransformFile attribute of the XmlDataSource control to point to the XSL file. The following shows an example of how the configured data source control would look in your markup, followed by an example of how the XmlDataSource control is bound to a TreeView control in markup.

```
<asp:XmlDataSource
    ID="XmlDataSource1"
    runat="server"
    DataFile="~/App_Data/products.xml"
    TransformFile="~/App_Data/ProductTransform.xsl" >
</asp:XmlDataSource>

<asp:TreeView
    id="TreeView1"
    runat="server"
    DataSourceID="XmlDataSource1">
    <DataBindings>
        <asp:TreeNodeBinding DataMember="Name" TextField="#InnerText" />
        <asp:TreeNodeBinding DataMember="Category" TextField="#InnerText" />
        <asp:TreeNodeBinding DataMember="QuantityPerUnit" TextField="#InnerText" />
        <asp:TreeNodeBinding DataMember="UnitPrice" TextField="#InnerText" />
    </DataBindings>
</asp:TreeView>
```

When the page is rendered, ASP.NET loads the XML file into memory. It then applies the XSL file to the XML data. Finally, the result is bound to the TreeView and embedded in the HTTP response. Figure 12-4 shows this data as it would look in a browser window. Notice that the data is sorted and the additional descriptive text has been added to several nodes.


http://localhost:56596/lesson1-cs/ProductsXml.aspx - Windows Internet Explorer
Favorites
Page
Safety
Tools
MY ASP.NET APPLICATION
Home
About
Done
Trusted sites | Protected Mode: Off
100%

```
⊟ Products
  ⊟ Product
      Aniseed Syrup
      Category: Condiments
      Quantity: 12 - 550 ml bottles
      Price: 10.0000
  ⊟ Product
      Chai
      Category: Beverages
      Quantity: 10 boxes x 20 bags
      Price: 18.0000
  ⊟ Product
      Chef Anton's Cajun Seasoning
      Category: Condiments
      Quantity: 48 - 6 oz jars
```

FIGURE 12-4 The transformed file displayed in a browser window.

Filtering XML with the XmlDataSource Control

The XmlDataSource control also allows you to set a data filter to define a subset of your XML. This is done via the XPath attribute. You set this attribute to a valid XPath expression that represents a filter expression. For example, to retrieve a subset of the product data in the XML file defined in the previous section, you could set the XPath attribute as in the following markup.

```
<asp:XmlDataSource
    ID="XmlDataSource1"
    runat="server"
    DataFile="~/App_Data/products.xml"
    TransformFile="~/App_Data/ProductTransform.xsl"
    XPath="/Products/Product[Category='Category: Beverages']" >
</asp:XmlDataSource>
```

In this example, the data is filtered for only those products with a category value set to "Beverages." Notice that the value is actually set to "Category: Beverages." This is because the XPath expression is applied following any XSL transformations. Recall that in the previous example, the "Category: " text was added to data. Therefore, you have to account for it in the XPath expression.

NOTE **INSERTING, DELETING, MODIFYING, AND SAVING XML DATA**

The XmlDataSource control is typically used to read XML data. Unlike many of the other data source controls, it does not provide automatic attributes for inserting, deleting, updating, and saving XML data. Instead, you have to write your own custom code if you require this behavior.

Connecting to LINQ-Based Data by Using LinqDataSource

You can use the LinqDataSource control to easily connect to data supplied by any data source that represents a collection of data. This includes lists, arrays, LINQ to SQL objects, and more. In this way, it is the most flexible data source control and typically requires the least amount of supporting code.

The LinqDataSource control uses the ContextTypeName attribute to define the database context of your LINQ-based data. This attribute can be set to point to the name of the class that represents your database context. As an example, suppose you have created a DBML DataContext file to represent the Northwind database by using LINQ to SQL (see Chapter 11). This file would include the NorthwindDataContext class, which represents the tables in your database. The following markup shows how you would connect to this class by using the LinqDataSource control.

```
<asp:LinqDataSource
    ID="LinqDataSource1"
    runat="server"
    ContextTypeName="NorthwindDataContext"
    EnableDelete="True"
    EnableInsert="True"
    EnableUpdate="True"
    OrderBy="CompanyName"
    TableName="Suppliers"
    Where="Country == @Country">
    <WhereParameters>
        <asp:QueryStringParameter
            DefaultValue="USA"
            Name="Country"
            QueryStringField="country"
            Type="String" />
    </WhereParameters>
</asp:LinqDataSource>
```

The LinqDataSource control is similar to other data source controls. It allows you to define parameters, indicate sorting, enable paging, and more. However, its LINQ-style declarative syntax makes it unique. Consider the preceding markup. Notice that the TableName attribute is set to Suppliers. You then use attributes to define a query that indicates both a Where clause and an OrderBy clause. The Where clause uses the WhereParameters parameter, which represents a query string that filters the data based on the value of country on the query string.

You can use LINQ language constructs in the markup of your LinqDataSource control. For example, by default, if no Select attribute is specified, the data source will return all fields in the collection. However, you can use a LINQ expression to indicate a new anonymous type. You can even create calculated fields as you would with any Select statement in a LINQ query. The following markup shows an example. Notice that the Location field is made up of three different fields from the data source.

```
<asp:LinqDataSource ID="LinqDataSource1" runat="server"
    ContextTypeName="NorthwindDataContext"
    EntityTypeName=""
    TableName="Suppliers"
    Where="Country == @Country"
    Select="new(SupplierId As Id,
                CompanyName As Name,
                Address + ' ' + City  + ' ' + PostalCode As Location)">
    <WhereParameters>
        <asp:QueryStringParameter DefaultValue="USA" Name="Country"
            QueryStringField="country" Type="String" />
    </WhereParameters>
</asp:LinqDataSource>
```

You can also bind a LinqDataSource control to a data-bound control, as you would with any other data source. You can set values on the LinqDataSource to indicate whether to allow deleting, inserting, and updating of data. The data-bound control will then work with the LinqDataSource as appropriate.

Connecting to Site Navigation Data by Using SiteMapDataSource

The SiteMapDataSource control is used to connect to site navigation data for your website. The data for this control is defined in a special XML file called a web.sitemap. You can define one sitemap file in the root of your website. The file includes information about the pages in your site and their hierarchy. It also includes page names, navigational information, and a description of each page. It is meant as a central place for managing the navigational data of your site; it is used by controls such as Menu and TreeView to allow users to easily navigate your application.

As an example, suppose that the following web.sitemap file is defined at the root of your web application.

```
<?xml version="1.0" encoding="utf-8" ?>
<siteMap xmlns="http://schemas.microsoft.com/AspNet/SiteMap-File-1.0" >
    <siteMapNode url="" title="Home" description="">
        <siteMapNode url="products.aspx" title="Products" description="">
            <siteMapNode url="productDetails.aspx"
                title="Product Details" description="" />
        </siteMapNode>
        <siteMapNode url="services.aspx" title="Services" description="" />
        <siteMapNode url="locations.aspx" title="Locations" description="" />
        <siteMapNode url="about.aspx" title="About Us" description="" />
    </siteMapNode>
</siteMap>
```

You can connect to this data by using a SiteMapDataSource control. You simply add the control to your page. You cannot configure it to point to a specific file. Instead, it automatically picks up the web.sitemap file defined at the root of your web application. The following markup shows an example. You bind to this data the same way you bind to the other data source controls. The following code also demonstrates binding to a Menu control.

```
<asp:SiteMapDataSource
    ID="SiteMapDataSource1"
    runat="server" />

<asp:Menu ID="Menu1"
    runat="server"
    DataSourceID="SiteMapDataSource1">
</asp:Menu>
```

The result of this binding is shown in Figure 12-5.

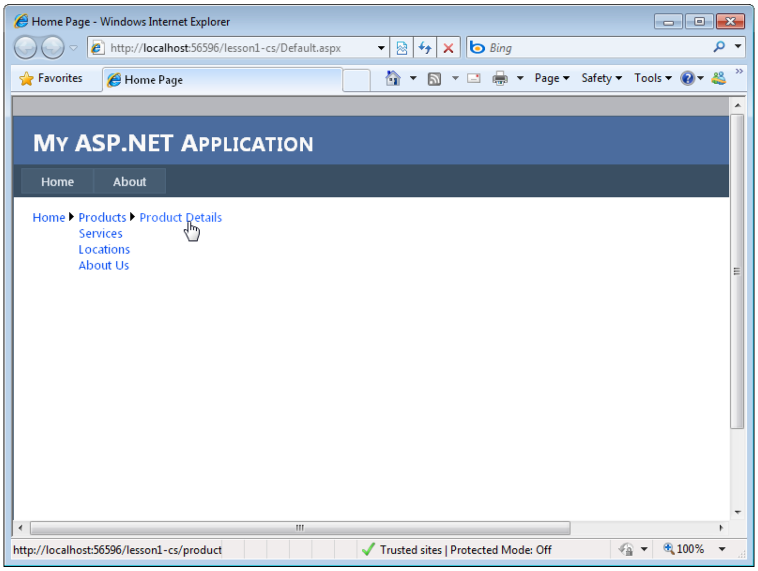

Home Page - Windows Internet Explorer
http://localhost:56596/lesson1-cs/Default.aspx
Bing
Favorites
Home Page
Page
Safety
Tools
MY ASP.NET APPLICATION
Home
About
Home
Products
Product Details
Services
Locations
About Us
http://localhost:56596/lesson1-cs/product
Trusted sites | Protected Mode: Off
100%

FIGURE 12-5 The site map data bound to a Menu control and displayed in a browser.

Filtering the Data Shown in the SiteMapDataSource

Sometimes, you might want to display only a portion of the data in your sitemap data file. The SiteMapDataSource control provides a couple of attributes that you can use to control the data that is provided to a visual control for display. The first, StartingNodeUrl, is used to indicate the node in the sitemap file that should be used as the root of the data source.

As an example, consider the sitemap file discussed previously. Suppose you need to display only the Products node and its subnodes. You can do so by setting the SiteMapDataSource control's StartingNodeUrl property to product.aspx, as shown in the following sample markup.

```
<asp:SiteMapDataSource
    ID="SiteMapDataSource1"
    runat="server"
    StartingNodeUrl="products.aspx" />
```

You can also use the ShowStartingNode attribute to indicate whether to display the node where the SiteMapDataSource control is set to start. You set this value to false if you want to hide the starting node. This property works with the other properties of the SiteMapDataSource control, such as StartingNodeUrl.

You might find that you want your navigation controls to display navigation data based on the current active page in the browser. You can do so by setting the StartFromCurrentNode attribute to true. This evaluates the name of the current page, finds it in the sitemap, and uses it as the start node for any bound controls on that page. This setting is especially useful if you embed your navigation and SiteMapDataSource controls inside a master page.

Finally, the StartingNodeOffset attribute is used to move the starting node up or down the sitemap data tree. You set the value to a negative number to move the start node up the tree from its current evaluated position. A positive number moves it deeper into the tree hierarchy.

Quick Check

1. **Which attribute of the SqlDataSource control do you use to define a connection to the database?**
2. **How do you define an ObjectDataSource to connect to a business object?**
3. **Which attribute of the LinqDataSource control do you use to indicate the O/R class used for connecting to and working with LINQ-based data?**
4. **Which attribute of the EntityDataSource control do you set to indicate a default entity set for your control to expose?**

Quick Check Answers

1. **You use the ConnectionString attribute.**
2. **You use the TypeName attribute.**
3. **You use the ContextTypeName attribute.**
4. **You use the EntitySetName attribute.**

PRACTICE Using a Data Source Control on a Webpage

In this practice, you work with Visual Studio to create a website to work with an EntityDataSource control that exposes data from the Northwind database.

ON THE COMPANION MEDIA

If you encounter a problem completing an exercise, you can find the completed projects in the samples installed from this book's companion CD. For more information about the project files and other content on the CD, see "Using the Companion Media" in this book's Introduction.

EXERCISE 1 Creating the Website and Defining the Entity Model

In this exercise, you create a new website and define the Entity Model.

1. Open Visual Studio and create a new website called **DataSourceLab** by using your preferred programming language.
2. Add the northwnd.mdf file to your App_Data directory. You can copy the file from the sample files installed from this book's CD.
3. Add a new ADO.NET Entity Data Model to your website. Name this model **Northwind.edmx**. When prompted, allow Visual Studio to add the model to the App_Code directory.
4. Using the Entity Data Model Wizard, select Generate from database on the first step and click Next.
5. On the next page, select the northwnd.mdf data file. Make sure to select the check box to save the connection string in the Web.config file. Name this connection string **NorthwndEntitiesCnn** and click Next.
6. On the next page, select the Customers, Order Details, and Orders tables. Make sure that both check boxes are selected, and set the Model Namespace to **NorthwndModel**. Click Finish to complete the wizard and generate your database model.
7. Rename items in the model to better identify them. First, select the Order_Detail entity in the model, right-click it, and choose Rename. Rename the entity to **OrderDetail**. Then select the Order_Details navigation property from the Order entity and rename it to **OrderDetails**.
8. Save and close the model.

EXERCISE 2 Binding to the EntityDataSource Control

In this exercise, you create a webpage that defines an EntityDataSource that will be used to work with the entity model created in the previous exercise.

1. Continue editing the project you created in the previous exercise. Alternatively, you can open the completed Lesson 1, Exercise 1 project in the samples installed from the CD.
2. Open the Default.aspx page. Set the title over the grid (<h2>) to **Customers**, and delete the default markup content. In Design view, drag an EntityDataSource control onto the page from the Data tab of the Toolbox. This control will be used to expose a list of customers in the database.
3. Click the smart tag in the upper-right corner of the EntityDataSource control to open the EntityDataSource Tasks list. Select Configure Data Source to open the Configure Data Source Wizard.
   a. On the first page of the wizard, from the Named Connection list, select NorthwndEntitiesCnn.
   b. On the second page of the wizard, select the Customers EntitySetName. Set the Select fields to CustomerID, CompanyName, City, Region, Country, and Phone.
   c. Finish the wizard, and switch to Source view for your page. Edit the EntityDataSource markup to include AutoPage and AutoSort. Also, include an OrderBy statement to order the results by CompanyName (you can do so inside markup or use the Properties window). Your markup should look similar to the following.

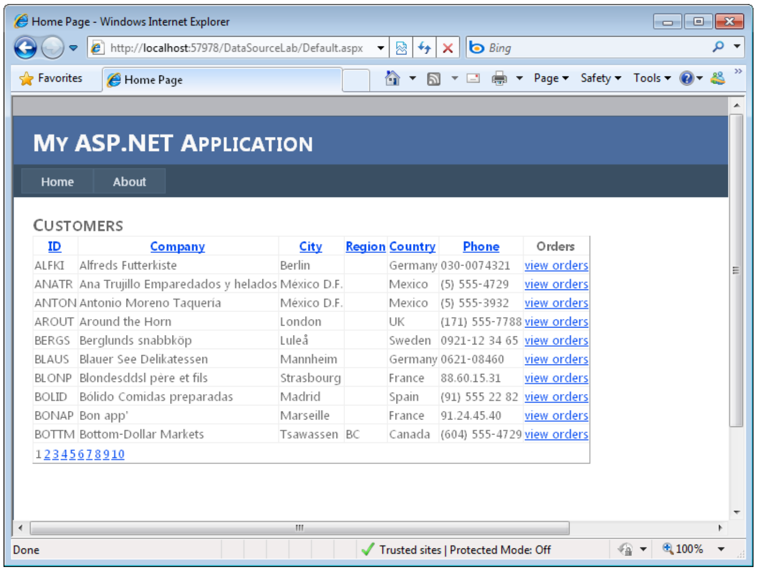
```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=NorthwndEntitiesCnn"
    DefaultContainerName="NorthwndEntitiesCnn"
    EnableFlattening="False"
    EntitySetName="Customers"
    AutoPage="true"
    AutoSort="true
    OrderBy="it.CompanyName"
    Select="it.[CustomerID], it.[CompanyName], it.[City], it.[Region],
  it.[Country], it.[Phone]">
</asp:EntityDataSource>
```

4. Add a GridView control to the page. Set the DataSourceID property to point to the EntityDataSource created previously.
5. Define bound columns and change the HeaderText for each field in the result set.
6. Enable AllowPaging and AllowSorting.
7. Add a HyperLinkField to the GridView to call orders.aspx and pass the customer ID as a query string parameter.

Your GridView markup should look as follows.

```
<asp:GridView ID="GridViewCustomers" runat="server" AllowPaging="True"
    AllowSorting="True" AutoGenerateColumns="False"
    DataSourceID="EntityDataSource1">
    <Columns>
        <asp:BoundField DataField="CustomerID" HeaderText="ID"
            ReadOnly="True" SortExpression="CustomerID" />
        <asp:BoundField DataField="CompanyName" HeaderText="Company"
            ReadOnly="True" SortExpression="CompanyName" />
        <asp:BoundField DataField="City" HeaderText="City"
            ReadOnly="True" SortExpression="City" />
        <asp:BoundField DataField="Region" HeaderText="Region"
            ReadOnly="True" SortExpression="Region" />
        <asp:BoundField DataField="Country" HeaderText="Country"
            ReadOnly="True" SortExpression="Country" />
        <asp:BoundField DataField="Phone" HeaderText="Phone"
            ReadOnly="True" SortExpression="Phone" />
        <asp:HyperLinkField DataNavigateUrlFields="CustomerID"
            DataNavigateUrlFormatString="orders.aspx?custId={0}"
            HeaderText="Orders" Text="view orders" />
    </Columns>
</asp:GridView>
```

8. Run the page. Your page should look similar to that shown in Figure 12-6.


Home Page - Windows Internet Explorer
http://localhost:57978/DataSourceLab/Default.aspx
Bing
Favorites
Home Page
Page
Safety
Tools
MY ASP.NET APPLICATION
Home
About
Done
Trusted sites | Protected Mode: Off
100%

CUSTOMERS

ID	Company	City	Region	Country	Phone	Orders
ALFKI	Alfreds Futterkiste	Berlin		Germany	030-0074321	view orders
ANATR	Ana Trujillo Emparedados y helados	México D.F.		Mexico	(5) 555-4729	view orders
ANTON	Antonio Moreno Taquería	México D.F.		Mexico	(5) 555-3932	view orders
AROUT	Around the Horn	London		UK	(171) 555-7788	view orders
BERGS	Berglunds snabbköp	Luleå		Sweden	0921-12 34 65	view orders
BLAUS	Blauer See Delikatessen	Mannheim		Germany	0621-08460	view orders
BLONP	Blondesddsl père et fils	Strasbourg		France	88.60.15.31	view orders
BOLID	Bólido Comidas preparadas	Madrid		Spain	(91) 555 22 82	view orders
BONAP	Bon app'	Marseille		France	91.24.45.40	view orders
BOTTM	Bottom-Dollar Markets	Tsawassen	BC	Canada	(604) 555-4729	view orders

1 2 3 4 5 6 7 8 9 10

FIGURE 12-6 The EntityDataSource control bound to a GridView.

9. Add an Orders.aspx page to your site.

10. Add an EntityDataSource control to the page. Set attributes to connect to the Customers entity. Define a Where clause to select a customer by a specific ID. Set the ID as a QueryStringParameter. Finally, indicate that the results should include the customer's Orders collection. The following markup shows an example.

```
<asp:EntityDataSource ID="EntityDataSourceCust" runat="server"
    ConnectionString="name=NorthwndEntitiesCnn"
    DefaultContainerName="NorthwndEntitiesCnn"
    EnableFlattening="False"
    EntitySetName="Customers"
    Where="it.CustomerID=@custId"
    Include="Orders">
    <WhereParameters>
    <asp:QueryStringParameter
        QueryStringField="custId"
        Name="custId"
        DbType="String"/>
    </WhereParameters>
</asp:EntityDataSource>
```

11. Next, add a DetailsView control to the page and name it **DetailsViewCust**. In Design view, use the smart tag to set the data source to the EntityDataSource set previously. Select Refresh Schema from the same smart tag task list to generate columns bound to the data source.

12. Add a GridView control under the DetailsView and name it **GridViewOrders**. This will be used to show custom orders. You cannot, at present, bind this to the included collections of the EntityDataSource by using markup. Instead, you must write some code.

13. Add an event handler for the DetailsViewCust DataBound event. This event fires when the DetailsView control has been bound to data. You can use it to pull the bound Customer from the control and use its Orders collection for the GridView control. Your code should read as follows.

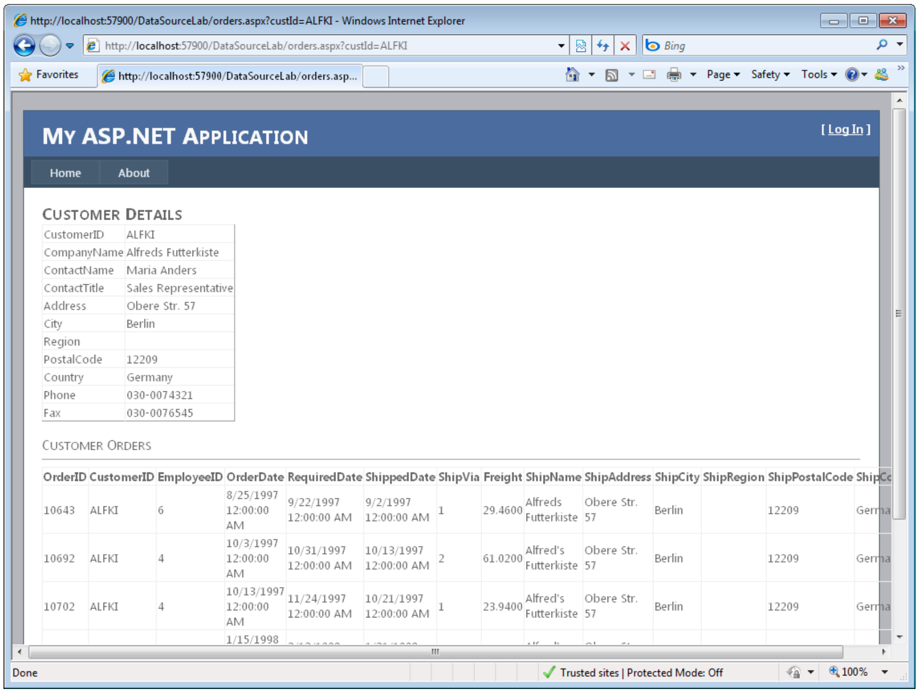
Sample of Visual Basic Code

```
Protected Sub DetailsViewCust_DataBound( _
    ByVal sender As Object, ByVal e As System.EventArgs) _
    Handles DetailsViewCust.DataBound

    Dim cust As NorthwndModel.Customer =
        CType(DetailsViewCust.DataItem, NorthwndModel.Customer)

    Me.GridViewOrders.DataSource = cust.Orders
    Me.GridViewOrders.DataBind()

End Sub
```

Sample of C# Code

```
protected void DetailsViewCust_DataBound(object sender, EventArgs e)
{
    NorthwndModel.Customer cust =
        (NorthwndModel.Customer)DetailsViewCust.DataItem;
    this.GridViewOrders.DataSource = cust.Orders;
    this.GridViewOrders.DataBind();
}
```

14. Run the application. Select different customers. Click the view orders link and view the results. You should see something similar to the screen shown in Figure 12-7.



http://localhost:57900/DataSourceLab/orders.aspx?custId=ALFKI - Windows Internet Explorer

My ASP.NET Application

Customer Details

CustomerID	ALFKI
CompanyName	Alfreds Futterkiste
ContactName	Maria Anders
ContactTitle	Sales Representative
Address	Obere Str. 57
City	Berlin
Region	
PostalCode	12209
Country	Germany
Phone	030-0074321
Fax	030-0076545

Customer Orders

OrderID	CustomerID	EmployeeID	OrderDate	RequiredDate	ShippedDate	ShipVia	Freight	ShipName	ShipAddress	ShipCity	ShipRegion	ShipPostalCode	ShipCo
10643	ALFKI	6	8/25/1997 12:00:00 AM	9/22/1997 12:00:00 AM	9/2/1997 12:00:00 AM	1	29.4600	Alfreds Futterkiste	Obere Str. 57	Berlin		12209	Germa
10692	ALFKI	4	10/3/1997 12:00:00 AM	10/31/1997 12:00:00 AM	10/13/1997 12:00:00 AM	2	61.0200	Alfred's Futterkiste	Obere Str. 57	Berlin		12209	Germa
10702	ALFKI	4	10/13/1997 12:00:00 AM	11/24/1997 12:00:00 AM	10/21/1997 12:00:00 AM	1	23.9400	Alfred's Futterkiste	Obere Str. 57	Berlin		12209	Germa
			1/15/1998										

Done | Trusted sites | Protected Mode: Off | 100%

FIGURE 12-7 The orders.aspx page has two controls that are bound to two different collections exposed by the same EntityDataSource control.

Lesson Summary

- ASP.NET provides several data source controls (LinqDataSource, ObjectDataSource, SqlDataSource, AccessDataSource, EntityDataSource, XmlDataSource, and SiteMapDataSource) that allow you to easily work with various types of data. These controls allow you to bind to data by using data-bound web server controls.
- You can pass parameters to most data source controls. A parameter can be bound to a value in a cookie, in the session, in a form field, in the query string, or in a similar object.
- Many of the data source controls allow you to cache data. Those that do include the ObjectDataSource, SqlDataSource, and AccessDataSource controls.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 1, "Connecting to Data with Data Source Controls." The questions are also available on the companion CD in a practice test, if you prefer to review them in electronic form.

NOTE **ANSWERS**

Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You have a data context map for your SQL Server database defined inside a class file. You need to connect to this data by using a data source control. Which data source control should you use?
   - **A.** ObjectDataSource
   - **B.** SqlDataSource
   - **C.** SiteMapDataSource
   - **D.** LinqDataSource
2. You are using an ObjectDataSource control to connect to a business object. Which attributes of the control must you set to return data for the data source? (Choose all that apply.)
   - **A.** TypeName
   - **B.** SelectMethod
   - **C.** DataSourceId
   - **D.** SelectParameters
3. You want to apply caching to your data source control to increase your scalability for frequently used data. You want to set the cache to expire every 60 seconds. Which attributes of your data source control should you set to do so? (Choose all that apply.)
   - **A.** CacheTimeout
   - **B.** CacheDuration
   - **C.** EnableCaching
   - **D.** DisableCaching
4. You are using an EntityDataSource control on your page. You need to write a custom query that uses a parameter in the Where clause. What actions should you take? (Choose all that apply.)
   - **A.** Set the command by using the EntitySetName property.
   - **B.** Set the command by using the CommandText property.
   - **C.** Add a WhereParameters section to the EntityDataSource control markup.
   - **D.** Name the parameter by using the @ ParamName construct inside the Where parameter definition.

Lesson 2: Working with Data-Bound Web Server Controls

Lesson 1 showed you how to connect to various data sources by using the data source controls. After it has been accessed, the data needs to be displayed to users so that they can interact with it. ASP.NET provides a large set of controls for doing so. These controls are referred to as *data-bound controls*. Data-bound controls are controls that provide web-based UI output (HTML and JavaScript) and also bind to data on the server.

This lesson presents an overview of data binding in ASP.NET. It then presents the many data-bound controls found inside ASP.NET.

After this lesson, you will be able to:

- Understand the basics of how data-bound controls operate.
- Use simple data-bound controls such as DropDownList, ListBox, CheckBoxList, RadioButtonList, and BulletedList.
- Use composite data-bound controls such as GridView, DetailsView, FormView, DataList, Repeater, ListView, DataPager, and Chart.
- Use hierarchical data-bound controls such as TreeView and Menu.
- Use the data visualization control, Chart.

Estimated lesson time: 60 minutes

Introducing Data-Bound Controls

The data-bound controls in ASP.NET can be classified as simple, composite, hierarchical, or visualization controls. Simple data-bound controls are the controls that inherit from ListControl. Composite data-bound controls are classes that inherit from CompositeDataBoundControl, such as GridView, DetailsView, FormsView, and similar controls. Hierarchical data-bound controls are the Menu and TreeView controls. Finally, the Chart control is a data visualization control that inherits directly from DataBoundControl.

The Microsoft .NET Framework provides several base classes that are used to provide common properties and behavior for the concrete data-bound controls. These classes form the basis of many of the data-bound controls. In this way, all of the data-bound controls work in a similar manner. Figure 12-8 shows the hierarchy of the base classes used for data-bound controls in ASP.NET.

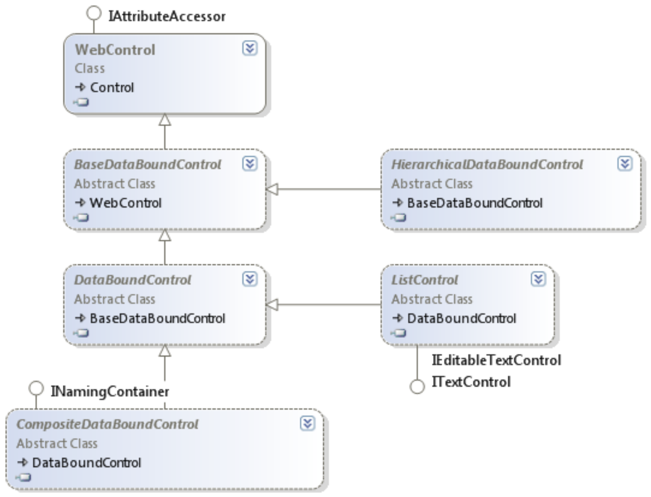


FIGURE 12-8 The base data-bound class hierarchy.

The BaseDataBoundControl is the first control in the hierarchy (inheriting from WebControl). This class contains the DataSource and DataSourceID properties used in data binding. The DataSource property gets or sets the object that the data-bound control uses to retrieve its data items. This property is most often used when binding to data in code, and it was the default binding property in early versions of ASP.NET. However, the DataSourceID property was introduced later to provide a declarative means of binding to data. You use the DataSourceID property to get or set the ID of a data source control that contains the source of the data, such as the data source controls discussed in Lesson 1. You typically set either the DataSource or the DataSourceID property (not both). If both properties are set, the DataSourceID takes precedence.

You can bind a data-bound web control to any data that implements IEnumerable, IListSource, IDataSource, or IHierarchicalDatasource. The data-bound control will automatically connect to the data source at run time by calling the DataBind method (which also raises the DataBound event). You can also call this method yourself in code to force a rebinding of data to the control.

The next control in Figure 12-8, HierarchicalDataBoundControl, inherits from the BaseDataBoundControl. It is the parent class for 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, ListControl, and Chart. These classes are the parent classes to controls that display tabular data such as the GridView and DropDownList controls. 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.

Mapping Fields to Templates

Templated binding can be used on controls that support templates. A *template control* is a control that has no default UI. The control simply provides the mechanism for binding to data. The developer supplies the UI 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 support templates include GridView, DetailsView, and FormView, among others. A typical control might 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 template; if it is implemented, every other row is rendered with this template.
- **SelectedItemTemplate** This is an optional template; if implemented, the template is used to render a row that has been selected.
- **SeparatorTemplate** This is an optional template that defines the markup used to indicate the separation of items from alternate items.
- **EditItemTemplate** This is an optional 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.

Some of the upcoming examples look at defining these templates for specific controls. For the most part, this process is similar regardless of the control with which you are working.

Using the DataBinder Class

In addition to automatically binding data with data-bound controls, you sometimes will need to have more granular control over which fields get bound to which controls on your page. For this, ASP.NET provides the DataBinder class. This class can be used to define code inside your script that controls how a data source is bound.

The DataBinder class provides the static Eval method to help bind data in this manner. The Eval method uses reflection to perform a lookup of a 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 field. This makes writing data binding syntax on your page an easy task. For example, the following shows binding to the Vin property of a Car object:

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

The Eval method also provides an overloaded method that allows a format string to be assigned as part of the data binding. As an example, if you were to bind to a field called Price, you can modify the display of this field by providing currency formatting, as shown here.

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

The Eval method is great for one-way (or read-only) data binding. However, it does not support read-write data binding and thus cannot be used for insert and edit scenarios. The Bind method of the DataBinder class, however, can be used for two-way data binding. This makes Bind preferable when you need to edit or insert records.

Just like the Eval method, the Bind method has two overloads: one without a format and one with the format parameter. The code for the Bind method looks the same as that for the Eval method. However, the Bind method does not work with all bound controls. It only works with controls that support read, insert, update, and delete scenarios, such as GridView, DetailsView, and FormView.

Simple Data-Bound Controls

Several controls in ASP.NET provide basic, list-based data binding. These controls are not meant to work with pages of data or provide elaborate editing scenarios. Instead, they allow you to provide a list of data items with which a user can operate. Figure 12-9 shows these simple data-bound controls, including their common base class, ListControl.

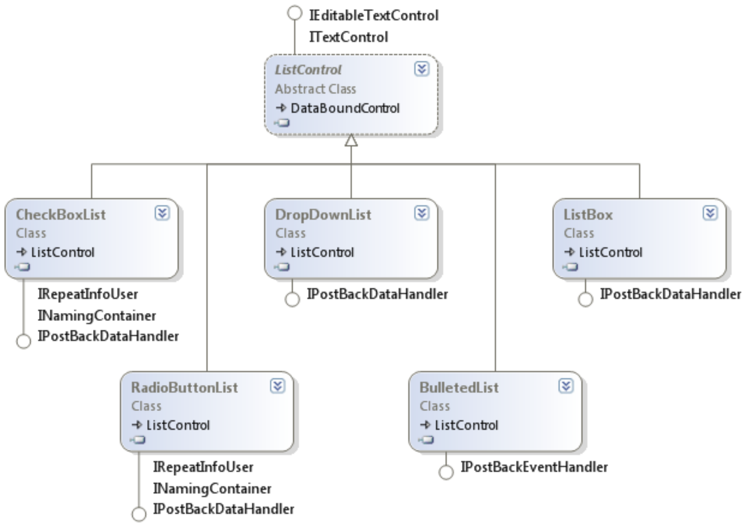


FIGURE 12-9 The ListControl class hierarchy.

The ListControl class is an abstract base class that provides common functionality for the classes that derive from it. This functionality includes an Items collection, which is a collection of ListItem data objects. Each ListItem object contains a Text property that is displayed to the user and a Value property that is posted back to the web server.

You can add items to the ListItems collection in code or declaratively in markup. You can also bind data to the controls that inherit from ListControl by setting the DataSource property (or the DataMember property if the source data has more than one table). You can also declaratively data-bind a ListControl-derived object by setting the DataSourceID property to the ID of a valid data source control on your page.

You can also choose the fields in your results that you will bind to the ListItem.Text and ListItem.Value properties. You can do so in code or through declarative markup by using the DataTextField and DataValueField properties, respectively. The text displayed for each item in the list control can also be formatted by setting the DataTextFormatString property. As an example, the following shows the declarative syntax for a ListBox bound to a SqlDataSource that provides the Northwind shipper table data.

```
<asp:ListBox
    ID="ListBox1"
    runat="server"
    DataSourceID="SqlDataSource1"
    DataTextField="CompanyName"
    DataValueField="ShipperID">
</asp:ListBox>
```

The SelectedIndex property lets you get or set the index of the selected item in the ListControl. By 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 contains the property called AppendDataBoundItems, which 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 ListControl also provides the SelectedIndexChanged event, which is raised when the selection in the list control changes between posts to the server. Recall that you need to set a control's AutoPostback property to true if you intend it to post back to the server for this type of event.

The DropDownList Control

The DropDownList control is used to display a list of items to users to allow them to make a single selection. The Items collection contains the child ListItem objects that are displayed in the DropDownList control. To determine the item that the user has selected, you can retrieve the SelectedValue, SelectedItem, or SelectedIndex property.

In the following example, a DropDownList control is bound to a SqlDataSource control that returns data from the Territories database table in the Northwind database. Notice that the DataTextField and DataValueField attributes are set to fields in the database table.

```
<asp:DropDownList runat="server" Width="250px"
    ID="DropDownList1"
    DataSourceID="SqlDataSource1"
    DataTextField="TerritoryDescription"
    DataValueField="TerritoryID" >
</asp:DropDownList>
```

Suppose that this page also contains a button with an event that captures the selected item from the DropDownList and displays it on a label. This button control's event code might look as follows.

Sample of Visual Basic Code

```
Label1.Text = "You selected TerritoryID: " & DropDownList1.SelectedValue
```

Sample of C# Code

```
Label1.Text = "You selected TerritoryID: " + DropDownList1.SelectedValue;
```

When the page is run and the user makes a selection in the DropDownList control and then clicks the button, the results are displayed in the label.

The ListBox Control

The ListBox control is used to select and display items from a longer list rather than one at a time as done in the DropDownList. With the ListBox control, users can see more data at once. You can also configure the control to allow the selection of a single item or multiple items. To do so, you set the SelectionMode property. The ListBox control also has the Rows property, which is used to specify the number of items displayed on the screen. The following shows an example of a ListBox that is set to allow multiple selections and show up to 13 rows.

```
<asp:ListBox runat="server" Height="225px" Width="275px"
    ID="ListBox1"
    Rows="13"
    DataSourceID="SqlDataSource1"
    DataTextField="TerritoryDescription"
    DataValueField="TerritoryID"
    SelectionMode="Multiple">
</asp:ListBox>
```

The Items collection contains the collection of ListItem objects in the ListBox control. To determine which items the user has selected, you can enumerate the ListItem objects in the Items collection by examining the Selected value for each ListItem element. The following code shows an example of processing the selected items and displaying them inside a Label control.

Sample of Visual Basic Code

```
For Each i As ListItem In ListBox1.Items
    If i.Selected Then
        Label1.Text = Label1.Text & "You selected TerritoryID: " & i.Value & "<br />"
    End If
Next
```

Sample of C# Code

```
foreach (ListItem i in ListBox1.Items)
{
    if(i.Selected)
        Label1.Text = Label1.Text + "You selected TerritoryID: " + i.Value + "<br />";
}
```

The CheckBoxList and RadioButtonList Controls

The CheckBoxList and RadioButtonList controls are very similar. Both are used to display lists of items to users to allow them to make selections but use a check box or button to make the selection. The RadioButtonList control is used to make a single selection. The CheckBoxList control allows users to make multiple selections.

These controls contain a RepeatColumns property that is used to indicate the number of columns to be displayed horizontally. In addition, the RepeatDirection can be set to Horizontal or Vertical (the default) to indicate whether the data should be rendered across by rows or down by columns.

The following shows a CheckBoxList control configured to work with the Territory data and show data across five columns.

```
<asp:CheckBoxList runat="server"
    ID="CheckBoxList1"
    DataSourceID="SqlDataSource1"
    DataTextField="TerritoryDescription"
    DataValueField="TerritoryID" RepeatColumns="5">
</asp:CheckBoxList>
```

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

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. This control renders as either bulleted or numbered, depending on the BulletStyle property.

If the control is set to render as bulleted, you can select the bullet style to Disc, Circle, or Square. Note that the BulletStyle settings are not compatible with all browsers. A custom image can also be displayed instead of the bullet.

If the BulletedList control is set to render numbered, you can set the BulletStyle to LowerAlpha, UpperAlpha, LowerRoman, and UpperRoman fields. You can also set the FirstBulletNumber property to specify the starting number for the sequence.

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.

The following example shows a data-bound BulletedList control. The control is bound to a data source control that selects the Shippers table data from the Northwind database.

```
<asp:BulletedList runat="server"
    ID="BulletedList1"
    DataSourceID="SqlDataSource1"
    DataTextField="CompanyName"
    DataValueField="ShipperID" BulletStyle="Circle">
</asp:BulletedList>
```

Composite Data-Bound Controls

There are several data-bound controls that use other ASP.NET controls to display bound data to the user. For this reason, these controls are referred to as *composite data-bound controls*. These controls inherit from the CompositeDataBoundControl base class. This class implements the INamingContainer interface, which means that an inheritor of this class is a naming container for child controls.

The classes that inherit from CompositeDataBoundControl directly are FormView, DetailsView, and GridView, as shown in Figure 12-10. These controls are covered in this section, along with the related ListView, DataPager, Repeater, Chart, and DataList data-bound controls.

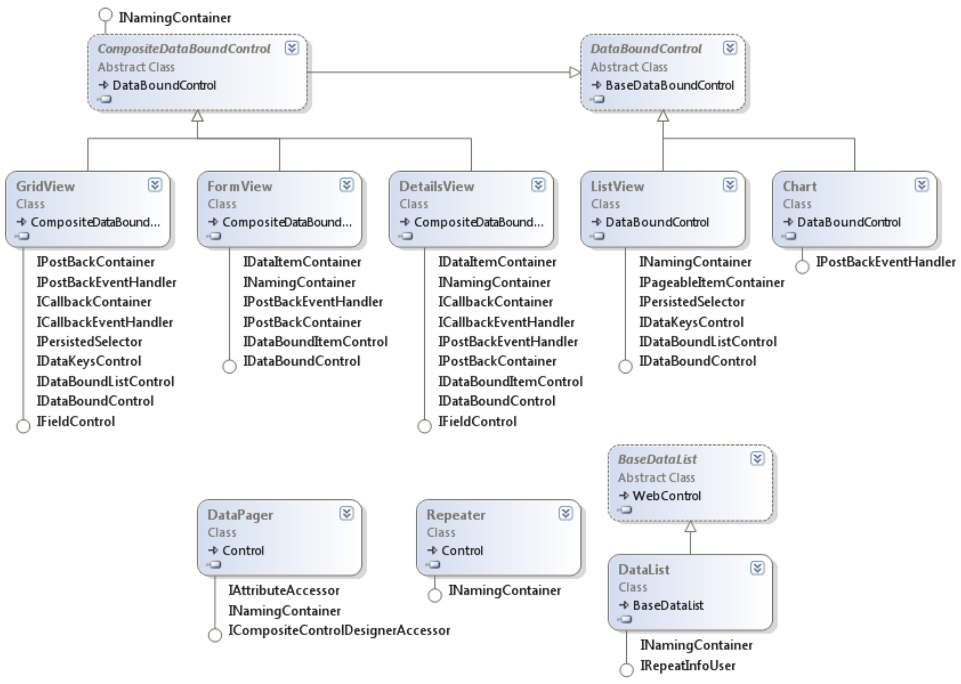
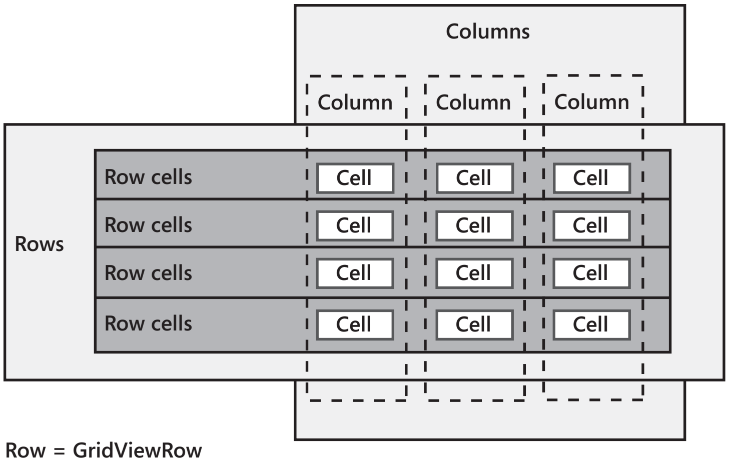


FIGURE 12-10 The CompositeDataBoundControl classes (and related controls).

The GridView Control

The GridView control is used to display data in a tabular format (rows and columns). The control renders in the browser as an HTML table. The GridView control makes it easy to configure features such as paging, sorting, and editing data without having to write much code.

The basic structure of the GridView is shown in Figure 12-11. The GridView control consists 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. This property is a collection of DataControlFieldCell objects.



Row = GridViewRow
Column = DataControlField
Cell = DataControlFieldCell

FIGURE 12-11 The basic GridView control structure.

Although the GridViewRow object holds the collection of cells, each DataControlField (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 12-12. 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 by using the InitializeCell method. The DataControlField class hierarchy shows the different column types that are available in a GridView control.

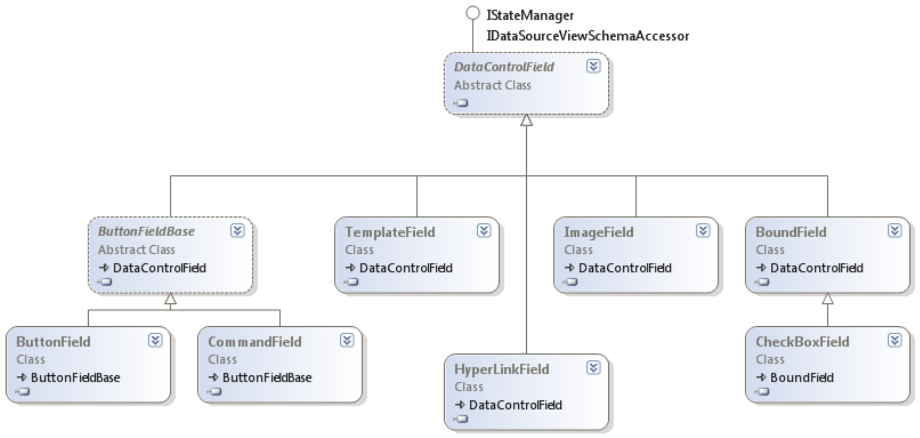


FIGURE 12-12 The DataControlField class hierarchy.

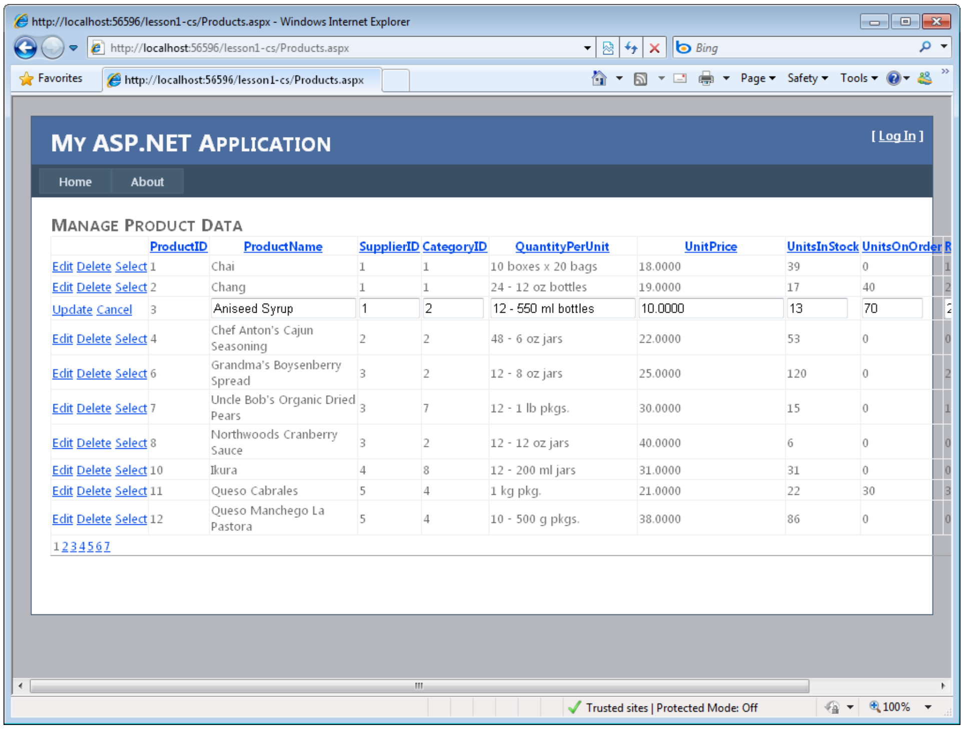
USING STYLES TO FORMAT THE GRIDVIEW CONTROL

You use styles to format the GridView. There are several styles available for you to manage, including an overall GridViewStyle and a HeaderStyle, FooterStyle, RowStyle, AlternatingRowStyle, SelectedRowStyle, EditRowStyle, and more. You can set these styles declaratively at design time. In addition, the RowCreated and RowDataBound events can also be used to control the style programmatically. In 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, before the data is available. 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 that 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" numbers red, but only when an item is shipped more than once per month).

As an example, consider a page that contains a SqlDataSource control bound to the Products table in the Northwind database. Suppose that this data source control provides SQL statements for selecting, updating, inserting, and deleting data. You can use this data source control to configure a GridView control that allows for this editing. The following markup shows an example of how the GridView would look in Source view.

```
<asp:GridView ID="GridView1" runat="server"
    AllowPaging="True"
    AllowSorting="True"
    AutoGenerateColumns="False"
    DataKeyNames="ProductID"
    DataSourceID="SqlDataSource1">
    <Columns>
        <asp:CommandField ShowDeleteButton="True" ShowEditButton="True"
            ShowSelectButton="True" />
        <asp:BoundField DataField="ProductID" HeaderText="ProductID"
            InsertVisible="False" ReadOnly="True" SortExpression="ProductID" />
        <asp:BoundField DataField="ProductName" HeaderText="ProductName"
            SortExpression="ProductName" />
        <asp:BoundField DataField="SupplierID" HeaderText="SupplierID"
            SortExpression="SupplierID" />
        <asp:BoundField DataField="CategoryID" HeaderText="CategoryID"
            SortExpression="CategoryID" />
        <asp:BoundField DataField="QuantityPerUnit" HeaderText="QuantityPerUnit"
            SortExpression="QuantityPerUnit" />
        <asp:BoundField DataField="UnitPrice" HeaderText="UnitPrice"
            SortExpression="UnitPrice" />
        <asp:BoundField DataField="UnitsInStock" HeaderText="UnitsInStock"
            SortExpression="UnitsInStock" />
        <asp:BoundField DataField="UnitsOnOrder" HeaderText="UnitsOnOrder"
            SortExpression="UnitsOnOrder" />
        <asp:BoundField DataField="ReorderLevel" HeaderText="ReorderLevel"
            SortExpression="ReorderLevel" />
        <asp:CheckBoxField DataField="Discontinued" HeaderText="Discontinued"
            SortExpression="Discontinued" />
    </Columns>
</asp:GridView>
```

Notice the Columns collection in the markup. Each column is defined along with the DataField and the text to be displayed as the column header (HeaderText). When this webpage is executed and displayed, each row is shown to the user along with action buttons for editing, deleting, and selecting the row. A user can click the Edit link on one of the rows to place the row into edit mode. Figure 12-13 shows an example.


http://localhost:56596/lesson1-cs/Products.aspx - Windows Internet Explorer
http://localhost:56596/lesson1-cs/Products.aspx
Bing
Favorites
http://localhost:56596/lesson1-cs/Products.aspx
Page
Safety
Tools
My ASP.NET Application
[Log In]
Home
About
Trusted sites | Protected Mode: Off
100%

Manage Product Data

	ProductID	ProductName	SupplierID	CategoryID	QuantityPerUnit	UnitPrice	UnitsInStock	UnitsOnOrder	R
Edit Delete Select	1	Chai	1	1	10 boxes x 20 bags	18.0000	39	0	1
Edit Delete Select	2	Chang	1	1	24 - 12 oz bottles	19.0000	17	40	2
Update Cancel	3	Aniseed Syrup	1	2	12 - 550 ml bottles	10.0000	13	70	2
Edit Delete Select	4	Chef Anton's Cajun Seasoning	2	2	48 - 6 oz jars	22.0000	53	0	0
Edit Delete Select	6	Grandma's Boysenberry Spread	3	2	12 - 8 oz jars	25.0000	120	0	2
Edit Delete Select	7	Uncle Bob's Organic Dried Pears	3	7	12 - 1 lb pkgs.	30.0000	15	0	1
Edit Delete Select	8	Northwoods Cranberry Sauce	3	2	12 - 12 oz jars	40.0000	6	0	0
Edit Delete Select	10	Ikura	4	8	12 - 200 ml jars	31.0000	31	0	0
Edit Delete Select	11	Queso Cabrales	5	4	1 kg pkg.	21.0000	22	30	3
Edit Delete Select	12	Queso Manchego La Pastora	5	4	10 - 500 g pkgs.	38.0000	86	0	0

1 2 3 4 5 6 7

FIGURE 12-13 The GridView control showing a row in edit mode.

The DetailsView Control

The DetailsView control is used to display the values of one record at a time from a data source in an HTML table. 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. However, 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 master-detail form.

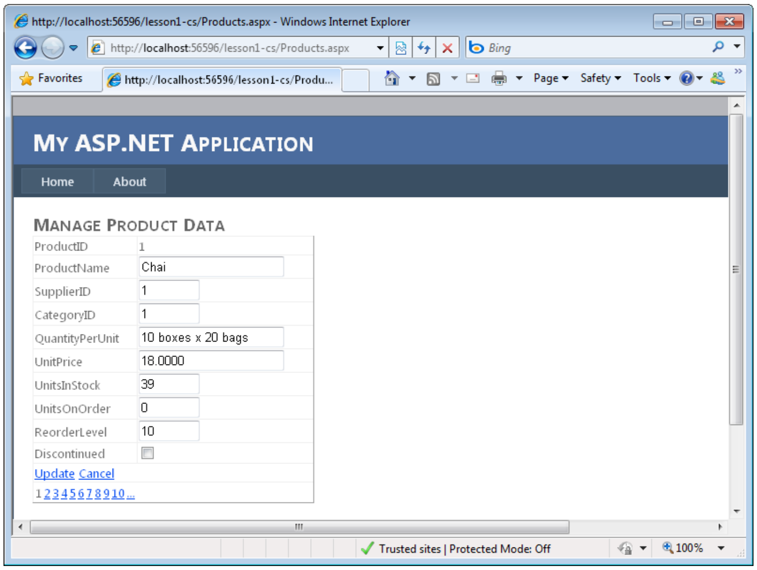
The DetailsView control does not directly support sorting, whereas the GridView control does. However, you can use the DataSource control, as discussed in Lesson 1, to manage data sorting. You should also note that the GridView does not automatically support inserting new records, whereas the DetailsView does support this feature.

The DetailsView supports the same formatting options that are available with the GridView control. You can format the DetailsView control by using the HeaderStyle, RowStyle, AlternatingRowStyle, CommandRowStyle, FooterStyle, PagerStyle, and EmptyDataRowStyle properties.

As an example, again consider a page that has a SqlDataSource control used for defining selection, insertion, updates, and deletion of product data in the Northwind database. You can configure a DetailsView to show this product data as pages and allow users to edit this data, insert new records, and delete existing ones. The following markup shows an example.

```
<asp:DetailsView runat="server" Width="300px"
    ID="DetailsView1"
    AllowPaging="True"
    AutoGenerateRows="False"
    DataKeyNames="ProductID"
    DataSourceID="SqlDataSource1">
    <Fields>
        <asp:BoundField DataField="ProductID" HeaderText="ProductID"
            InsertVisible="False" ReadOnly="True" SortExpression="ProductID" />
        <asp:BoundField DataField="ProductName" HeaderText="ProductName"
            SortExpression="ProductName" />
        <asp:BoundField DataField="SupplierID" HeaderText="SupplierID"
            SortExpression="SupplierID" />
        <asp:BoundField DataField="CategoryID" HeaderText="CategoryID"
            SortExpression="CategoryID" />
        <asp:BoundField DataField="QuantityPerUnit" HeaderText="QuantityPerUnit"
            SortExpression="QuantityPerUnit" />
        <asp:BoundField DataField="UnitPrice" HeaderText="UnitPrice"
            SortExpression="UnitPrice" />
        <asp:BoundField DataField="UnitsInStock" HeaderText="UnitsInStock"
            SortExpression="UnitsInStock" />
        <asp:BoundField DataField="UnitsOnOrder" HeaderText="UnitsOnOrder"
            SortExpression="UnitsOnOrder" />
        <asp:BoundField DataField="ReorderLevel" HeaderText="ReorderLevel"
            SortExpression="ReorderLevel" />
        <asp:CheckBoxField DataField="Discontinued" HeaderText="Discontinued"
            SortExpression="Discontinued" />
        <asp:CommandField ShowDeleteButton="True" ShowEditButton="True"
            ShowInsertButton="True" />
    </Fields>
</asp:DetailsView>
```

Notice that each column in the data table is set inside the Fields collection. The DataField attribute maps to the name of the column in the data source. The HeaderText property is used as the label that describes the data field. When the page is executed and displayed, the DetailsView shows Edit, Delete, and New buttons. When users click the Edit button, they are taken to edit mode for the selected record, as shown in Figure 12-14.


http://localhost:56596/lesson1-cs/Products.aspx - Windows Internet Explorer

MY ASP.NET APPLICATION

Home About

MANAGE PRODUCT DATA

ProductID	1
ProductName	Chai
SupplierID	1
CategoryID	1
QuantityPerUnit	10 boxes x 20 bags
UnitPrice	18.0000
UnitsInStock	39
UnitsOnOrder	0
ReorderLevel	10
Discontinued	☐
Update Cancel	
1 2 3 4 5 6 7 8 9 10 ...	

Trusted sites | Protected Mode: Off

FIGURE 12-14 The DetailsView control in edit mode after the user has clicked the Edit button.

The FormView Control

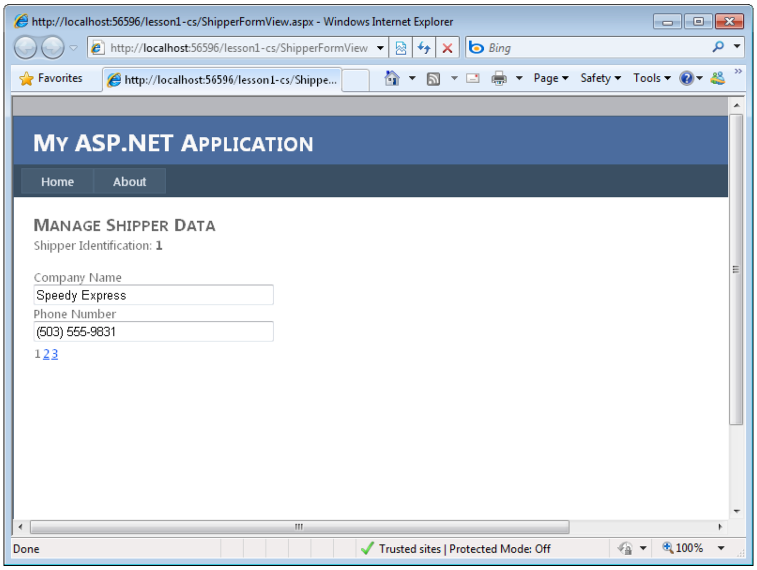
Like DetailsView, the FormView control is used to display a single record from a data source. However, the FormView control does not automatically display the data in a predefined HTML table. Instead, it allows developers to create templates that define how the data should be displayed. You can define different templates for viewing, editing, and updating records. Creating your own templates gives you the greatest flexibility in controlling how data is displayed.

The FormView contains the following template definitions: ItemTemplate, EditItemTemplate, InsertItemTemplate, EmptyDataTemplate, FooterTemplate, HeaderTemplate, and PagerTemplate. You define a template by placing markup inside it and adding binding code within this markup. You then set the appropriate mode of the FormView control to switch to the specified template.

As an example, consider a page that defines a data source control for selecting the shipper data from the Northwind database. You can configure a FormView control to work with this data. For display, you can define the ItemTemplate. Here you set the controls and HTML used to lay out this data. You use the binding syntax (Eval and Bind) to connect data from the SqlDataSource to the FormView. The markup on the next page shows an example.

```
<asp:FormView runat="server"
    ID="FormView1"
    AllowPaging="True"
    DataSourceID="SqlDataSource1">
    <ItemTemplate>
        Shipper Identification:
        <asp:Label runat="server" Font-Bold="True"
            ID="Label1"
            Text='<%# Eval("ShipperID") %>'>
        </asp:Label>
        <br />
        <br />
        Company Name<br />
        <asp:TextBox runat="server" Width="250px"
            ID="TextBox1"
            Text='<%# Bind("CompanyName") %>'>
        </asp:TextBox>
        <br />
        Phone Number<br />
        <asp:TextBox runat="server" Width="250px"
            ID="TextBox2"
            Text='<%# Bind("Phone") %>'>
        </asp:TextBox>
    </ItemTemplate>
</asp:FormView>
```

When you run the page, the custom template is used with the FormView to display data as defined. Figure 12-15 shows the results in a browser window.


http://localhost:56596/lesson1-cs/ShipperFormView.aspx - Windows Internet Explorer

MY ASP.NET APPLICATION

MANAGE SHIPPER DATA

Shipper Identification: **1**

Company Name

Speedy Express

Phone Number

(503) 555-9831

1 2 3

Done | Trusted sites | Protected Mode: Off | 100%

FIGURE 12-15 The FormView control showing the ItemTemplate in a browser.

The Repeater Control

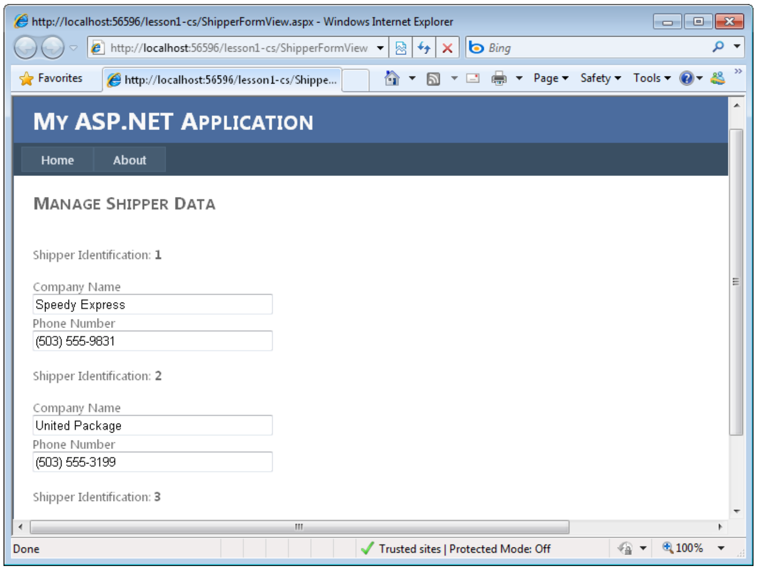
The Repeater control also uses templates to define custom binding. However, it does not show data as individual records. Instead, it repeats the data rows as you specify in your template. This allows you to create a single row of data and have it repeat across your page.

The Repeater control is a read-only template. That is, it supports only the ItemTemplate. It does not implicitly support editing, insertion, and deletion. You should consider one of the other controls if you need this functionality, otherwise you will have to code this yourself for the Repeater control.

The following markup is similar to that for the FormView control example. It displays shipper data from the Northwind database as bound to a Label and two TextBox controls.

```
<asp:Repeater runat="server"
    ID="Repeater1"
    DataSourceID="SqlDataSource1">
    <ItemTemplate>
        <br /><br />
        Shipper Identification:
        <asp:Label runat="server" Font-Bold="True"
            ID="Label1"
            Text='<%# Eval("ShipperID") %>'>
        </asp:Label>
        <br />
        <br />
        Company Name<br />
        <asp:TextBox runat="server" Width="250px"
            ID="TextBox1"
            Text='<%# Bind("CompanyName") %>'>
        </asp:TextBox>
        <br />
        Phone Number<br />
        <asp:TextBox runat="server" Width="250px"
            ID="TextBox2"
            Text='<%# Bind("Phone") %>'>
        </asp:TextBox>
    </ItemTemplate>
</asp:Repeater>
```

When this data is displayed, however, it is repeated down the page. Figure 12-16 shows the results in a browser window.


http://localhost:56596/lesson1-cs/ShipperFormView.aspx - Windows Internet Explorer
Favorites
Page
Safety
Tools
My ASP.NET Application
Home
About
Done
Trusted sites | Protected Mode: Off
100%

MANAGE SHIPPER DATA

Shipper Identification: 1

Company Name
Speedy Express
Phone Number
(503) 555-9831

Shipper Identification: 2

Company Name
United Package
Phone Number
(503) 555-3199

Shipper Identification: 3

FIGURE 12-16 The Repeater control showing the ItemTemplate in a browser.

The ListView Control

The ListView control also uses templates for the display of data. However, it supports many additional templates that allow for more scenarios when working with your data. These templates include the LayoutTemplate, which allows you to indicate an overall layout inside of which rows of your data will be displayed. The rows themselves are defined with the ItemTemplate. At run time, rows are placed within the LayoutTemplate placeholder identified by a control that has its ID attribute set to itemPlaceholder.

Another template is the GroupTemplate, which allows you to define groups of data. You can then set the GroupItemCount value to indicate the number of items in a group, and you can set the control to lay out groups of data and allow users to page through them.

The ItemSeparatorTemplate allows you to define content that should be placed between rows of items. This allows you to put graphic separators or other data between rows.

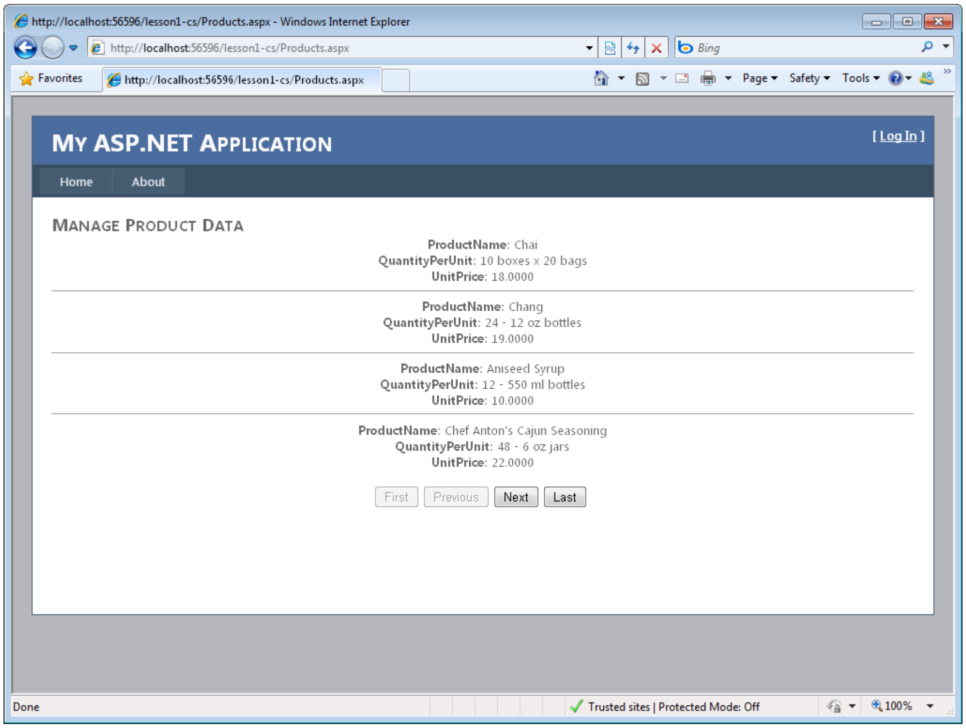
The ListView control (unlike DataList and Repeater) also implicitly supports the ability to edit, insert, and delete data by using a data source control. You can define individual templates for each of these scenarios. You can then change the mode of the ListView control through a server-side call and thus invoke the template for the user.

As an example, consider a page that includes a data source control that exposes the Product table from the Northwind database. You can create a ListView control to work with this data. The following markup shows such an example. In this example, a LayoutTemplate defines a <div> tag that includes the itemPlaceholder setting. The ItemTemplate is then defined by a <div> tag. At run time, each row will be added as a <div> tag in the placeholder.

```
<asp:ListView runat="server"
    ID="ListView1"
    DataKeyNames="ProductID"
    DataSourceID="SqlDataSource1">
    <LayoutTemplate>
        <div id="itemPlaceholder" runat="server"></div>
        <br />
        <div style="text-align: center">
            <asp:DataPager ID="DataPager1" runat="server" PageSize="4">
                <Fields>
                    <asp:NextPreviousPagerField
                        ButtonType="Button"
                        ShowFirstPageButton="True"
                        ShowLastPageButton="True" />
                </Fields>
            </asp:DataPager>
        </div>
    </LayoutTemplate>
    <ItemTemplate>
        <div style="text-align: center">
            <b>ProductName:</b>
            <asp:Label ID="ProductNameLabel" runat="server"
                Text='<%# Eval("ProductName") %>' />
            <br />
            <b>QuantityPerUnit:</b>
            <asp:Label ID="QuantityPerUnitLabel" runat="server"
                Text='<%# Eval("QuantityPerUnit") %>' />
            <br />
            <b>UnitPrice:</b>
            <asp:Label ID="UnitPriceLabel" runat="server"
                Text='<%# Eval("UnitPrice") %>' />
            <br />
        </div>
    </ItemTemplate>
    <ItemSeparatorTemplate>
        <hr />
    </ItemSeparatorTemplate>
</asp:ListView>
```

Notice also that the ListView control uses the ASP.NET DataPager control. This control allows you to provide custom data pagers for your data lists. Here the control is embedded at the end of the LayoutTemplate. The ListView control automatically uses the DataPager to move the user through data.

Finally, notice the use of the ItemSeparatorTemplate. This is used to put a horizontal rule between data rows. Figure 12-17 shows the results in a browser window.


http://localhost:56596/lesson1-cs/Products.aspx - Windows Internet Explorer
Bing
Favorites
Page
Safety
Tools
MY ASP.NET APPLICATION
[Log In]
Home
About
Done
Trusted sites | Protected Mode: Off
100%

MANAGE PRODUCT DATA

ProductName: Chai
QuantityPerUnit: 10 boxes x 20 bags
UnitPrice: 18.0000

ProductName: Chang
QuantityPerUnit: 24 - 12 oz bottles
UnitPrice: 19.0000

ProductName: Aniseed Syrup
QuantityPerUnit: 12 - 550 ml bottles
UnitPrice: 10.0000

ProductName: Chef Anton's Cajun Seasoning
QuantityPerUnit: 48 - 6 oz jars
UnitPrice: 22.0000

First Previous Next Last

FIGURE 12-17 The ListView control rendered in the browser.

The Chart Control

The Chart control allows you to display data by using chart visualization. You bind a data source to this control much like you do for the other data-bound controls. The big difference is that you then indicate fields from the data source that should be bound to an axis or data series in a chart.

There are more than 25 different chart types for displaying data. When the chart control runs on the server, it generate a graphic file (which is a PNG file by default, but you can change this setting) and then sends this to the browser as part of the response.

There are hundreds of properties you can set to define your chart and how it displays data. The chart definition typically includes the Series and ChartAreas elements. A Series represents a group of data to be shown on a chart. A Series element has a ChartType that defines the visualization of the data (choices are Bar, Area, Bubble, Line, Column, Pie, Radar, Range, and many more). A ChartArea element is used to indicate specifics about areas on your chart, such as an x and y axis. Here you can set intervals, formatting, and related visual items.

As an example, suppose you have the following SqlDataSource control that exposes sales by region.

```
<asp:SqlDataSource ID="SqlDataSource1" runat="server"
    ConnectionString="<%$ ConnectionStrings:NorthwindConnectionString %>"
    SelectCommand="SELECT SUM([Order Details].UnitPrice * [Order Details].Quantity) AS
Total, Orders.ShipCountry FROM Orders INNER JOIN [Order Details] ON Orders.OrderID =
[Order Details].OrderID GROUP BY Orders.ShipCountry Order By Total"></asp:SqlDataSource>
```

You could then bind this to a Chart control to display each country and the total sales for that country. The following markup shows an example.

```
<asp:Chart ID="Chart1" runat="server"
    DataSourceID="SqlDataSource1"
    Width="702px" Height="581px">
    <Series>
        <asp:Series Name="Series1"
            XValueMember="ShipCountry"
            YValueMembers="Total"
            ChartType=" "Bar"
            XValueType="String"
            IsValueShownAsLabel="True"
            LabelBackColor="White"
            LabelFormat="{c}">
            <SmartLabelStyle CalloutBackColor="White" />
        </asp:Series>
    </Series>
    <ChartAreas>
        <asp:ChartArea Name="ChartArea1">
            <AxisY>
                <LabelStyle Format="{c}" />
            </AxisY>
            <AxisX Interval="1">
            </AxisX>
        </asp:ChartArea>
    </ChartAreas>
</asp:Chart>
```

Running this page will produce results similar to those shown in Figure 12-18.

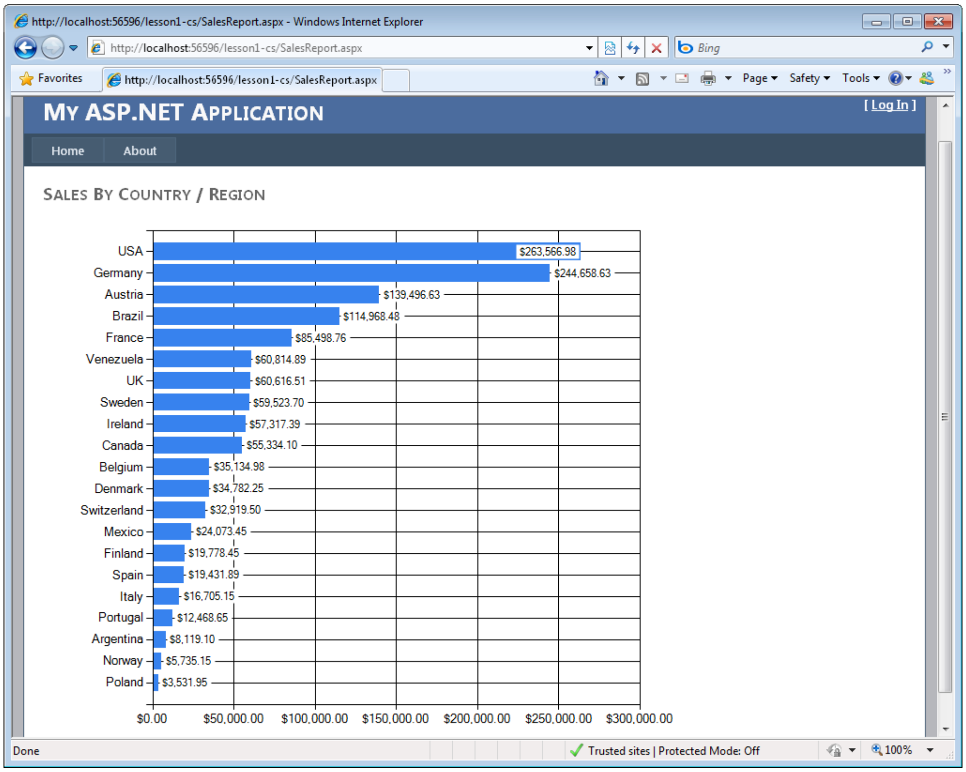


FIGURE 12-18 The Chart control rendered in the browser.

The DataList Control

The DataList control works like the Repeater control. It repeats data for each row in your data set, and it displays this data according to your defined template. However, it lays out the data defined in the template within various HTML structures. This includes options for horizontal or vertical layout, and it also allows you to set how the data should be repeated, as flow or table layout.

The DataList control does not automatically use a data source control to edit data. Instead, it provides command events in which you can write your own code for these scenarios. To enable these events, you add a Button control to one of the templates and set the button's CommandName property to the edit, delete, update, or cancel keyword. The appropriate event is then raised by the DataList control.

The following markup shows an example of a DataList control configured to show product data from the Northwind database. This control's RepeatDirection is set to show data vertically by using a RepeatLayout of flow. The product data is bound to the DataList control inside the ItemTemplate code.

```
<asp:DataList runat="server"
    DataSourceID="SqlDataSource1"
    RepeatDirection="Vertical"
    ID="DataList1"
    RepeatLayout="flow">
    <ItemTemplate>
        <asp:Label ID="Label1" runat="server"
            Text='<%# Eval("ProductName") %>'
            Font-Bold="True">
        </asp:Label>
        <asp:Label ID="Label2" runat="server"
            Text='<%# Eval("UnitPrice", "{0:C}") %>'>
        </asp:Label>
        <br />
    </ItemTemplate>
</asp:DataList>
```

Hierarchical Data-Bound Controls

The HierarchicalDataBoundControl control serves as a base class for controls that render data in a hierarchical fashion. The classes that inherit from HierarchicalDataBoundControl are TreeView and Menu, as shown in Figure 12-19.

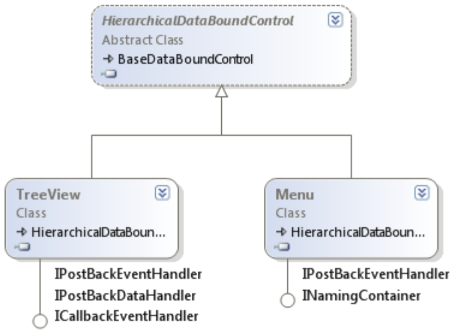


FIGURE 12-19 The HierarchicalDataBoundControl class hierarchy.

The TreeView Control

The TreeView control 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. Each entry in the tree is called a *node*. 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.

You can programmatically access and control the properties of the TreeView control. The TreeView can also be populated via client-side script by using modern browsers. In addition, nodes can be displayed as either plaintext or hyperlinks, and you can opt to display a check box next to each node.

Each node 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 both 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 without being forced to have a single root node.

The TreeNode has a Text property that is populated with the data that is to be displayed. The TreeNode also has a Value property that is used to store the data that is posted back to the web server.

You can configure a node 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, and clicking the node simply selects it. If the NavigateUrl property is not set to an empty string, the node is a navigation node, and clicking it navigates to the location specified by the NavigateUrl property.

POPULATING THE TREEVIEW CONTROL

The TreeView control can be populated by using static data or by using data binding. 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 <TreeNode> elements within the <Nodes> element. Each <TreeNode> has properties that you can set by adding attributes to the <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 automatically 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 binding criteria and the data item property to display in the node. This is useful when binding to XML elements when you are interested in binding to an attribute of the element.

Assume that you want to use a TreeView control to display customer data from a file called Customers.xml, which contains a list of customers, their orders and invoices, and the items for each order. This data is stored in a hierarchical format in the XML file. The Customers.xml file looks like the following.

```
<?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 webpage and configured. The following shows the markup for the TreeView control.

```
<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>
```

In this example, the configuration is kept to a minimum, but configuration is required to display information that is more important than the XML element name, such as the customer's name instead of the XML element name (Customer). The following code is added to the code-behind page to simply display the value of the selected node.

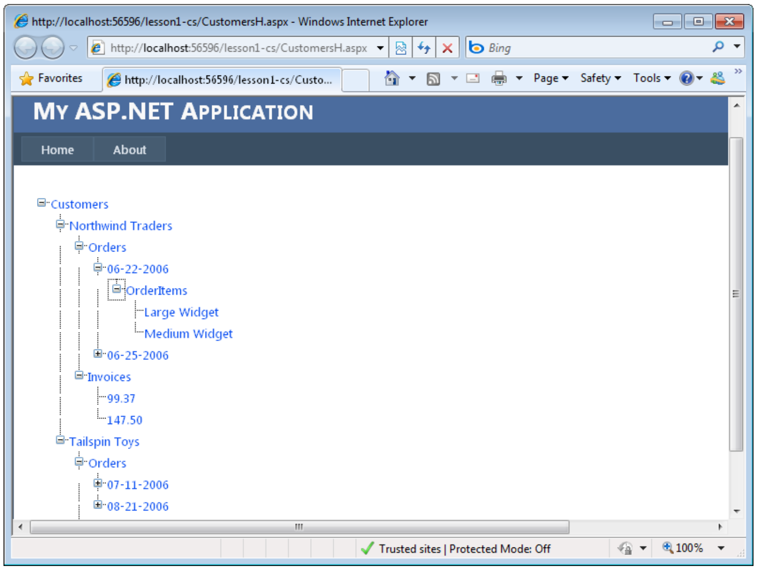
Sample of Visual Basic Code

```
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
```

Sample of C# Code

```
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 webpage is displayed, the Customers node is visible. You can also click the plus (+) sign to expand the nodes, as shown in Figure 12-20.


http://localhost:56596/lesson1-cs/CustomersH.aspx - Windows Internet Explorer
Bing
Favorites
Page
Safety
Tools
MY ASP.NET APPLICATION
Home
About
Trusted sites | Protected Mode: Off
100%

Customers
Northwind Traders
Orders
06-22-2006
OrderItems
Large Widget
Medium Widget
06-25-2006
Invoices
99.37
147.50
Tailspin Toys
Orders
07-11-2006
08-21-2006

FIGURE 12-20 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 website.

The Menu control can be populated by using static data or by using data binding. 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 <MenuItem> elements within the <Items> element. Each <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.

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 calling the DataBind method.

The Menu control contains a DataBindings property that is a collection of MenuItemBinding objects that define the binding between a data item and the menu item it is binding to in a Menu control. You can specify the binding criteria and the data item properties to display in the items. This is useful when binding to XML elements when you are interested in binding to an attribute of the element.

Assume that you want to use a Menu control to display menu data from a file called MenuItems.xml, which contains a list of the menu items to be displayed. The data is stored in a hierarchical format in the XML file. The MenuItems.xml file looks like the following.

```
<?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 webpage. The XmlDataSource is configured to use the XML file. The Menu control is configured to use the XmlDataSource. The following is the webpage markup.

```
<asp:Menu runat="server"
    ID="Menu1"
    DataSourceID="XmlDataSource1"
    OnMenuItemClick="Menu1_MenuItemClick">
</asp:Menu>
```

In this example, showing the root MenuItems element in the XML file is not desirable, so an XPath expression is supplied to retrieve the elements that exist under the root MenuItems element. The following code is added to the code-behind page to simply display the ValuePath property of the selected MenuItem. When the webpage is displayed, the Menu appears and you can point to a menu item to see its child menu items.

Sample of Visual Basic Code

```
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
```

Sample of C# Code

```
public partial class Menu_Control : System.Web.UI.Page
{
    protected void Menu1_MenuItemClick(object sender, MenuEventArgs e)
    {
        Label1.Text = e.Item.ValuePath;
    }
}
```

✓ 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 two-way data binding?
3. What GUI object can provide a data source that allows you to connect middle-tier objects to data-bound controls?

Quick Check Answers

1. You should call the DataBind method.
2. The Bind method is used to perform two-way data binding.
3. The ObjectDataSource control can provide a data source that allows you to connect middle-tier objects to data-bound controls.

PRACTICE Using the GridView and DetailsView Controls

In this practice, you use the GridView and DetailsView data-bound controls together to create a master-detail page.

ON THE COMPANION MEDIA

If you encounter a problem completing an exercise, you can find the completed projects in the samples installed from this book's companion CD. For more information about the project files and other content on the CD, see "Using the Companion Media" in this book's Introduction.

EXERCISE Creating the Website, Adding Controls to the Page, and Configuring the Controls

In this exercise, you create a new website and add the database and data source control. You then add the data-bound controls and configure them accordingly.

1. Open Visual Studio and create a new website called **UsingDataBoundControls** by using your preferred programming language.
2. Add the northwnd.mdf file to your App_Data directory. You can copy the file from the samples installed from the CD.
3. Open Default.aspx. Delete the default content on the page. Add a SqlDataSource control to the page from the Toolbox; name it **SqlDataSourceReadList**. This control will read data for display by the GridView control.
4. In Design view of the Default.aspx page, click the smart tag in the upper-right corner of the SqlDataSource control to launch the Configure Data Source Wizard.
   a. On the first page, set the connection to the northwnd.mdf file in the App_Data directory and click Next.
   b. When prompted, save the connection string as **ConnectionStringNorthwind**, and then click Next again.
   c. On the Configure Select Statement page, select the Customers table from the Name list box. Select the CustomerID, CompanyName, ContactName, City, Country, and Phone fields. Click Next, and then click Finish to close the wizard.

   Your SqlDataSource markup should look similar to the following.

```
<asp:SqlDataSource ID="SqlDataSource1" runat="server"
    ConnectionString="<%$ ConnectionStrings:ConnectionStringNorthwind %>"
    SelectCommand="SELECT [CustomerID], [CompanyName], [ContactName], [City],
  [Country], [Phone] FROM [Customers]">
</asp:SqlDataSource>
```

5. Drag a GridView control onto the Default.aspx page. Using either Design or Source view, configure the GridView control as follows:
   - Set the DataSourceId to SqlDataSourceReadList, created previously.
   - Set Enable Paging (AllowPaging property) to true.
   - Set Enable Sorting (AllowSorting property) to true.
   - Set AutoGenerateColumns to false.
   - Configure the CustomerID, CompanyName, ContactName, City, Country, and Phone fields to be displayed.
   - Add a CommandField to allow a user to select a row of data (you can do so in Design view by clicking Enable Selection).

Your markup should look similar to the following.

```
<asp:GridView ID="GridView1" runat="server"
    AllowPaging="True" AllowSorting="True"
    AutoGenerateColumns="False"
    DataKeyNames="CustomerID"
    DataSourceID="SqlDataSource1"
    width="700px">
    <Columns>
        <asp:CommandField ShowSelectButton="True" />
        <asp:BoundField DataField="CustomerID" HeaderText="ID"
            ReadOnly="True" SortExpression="CustomerID" />
        <asp:BoundField DataField="CompanyName" HeaderText="Company"
            SortExpression="CompanyName" />
        <asp:BoundField DataField="ContactName" HeaderText="Contact"
            SortExpression="ContactName" />
        <asp:BoundField DataField="City" HeaderText="City"
            SortExpression="City" />
        <asp:BoundField DataField="Country" HeaderText="Country"
            SortExpression="Country" />
        <asp:BoundField DataField="Phone" HeaderText="Phone"
            SortExpression="Phone" />
    </Columns>
</asp:GridView>
```

6. If you want, select the GridView in Design view and click the AutoFormat link on the task pane (from the smart tag). Select Professional or another formatting option.
7. Run the website; you should be able to page through data, sort data, and select a row.
8. Next, add another SqlDataSource control to the Default.aspx page; name it **SqlDataSourceUpdate**. Configure this control as before, by using the Configure Data Source Wizard.
    a. On the first page, select ConnectionStringNorthwind and click Next.
    b. The next step is to configure the SELECT statement to pick up the CustomerID parameter from the selected row on the GridView control. On the Configure The Select Statement page, select the Customers table. This time, select each field in the table. Then click the Where button to launch the Add WHERE Clause dialog box. Set the column to CustomerID. Set the Operator to = (the equal sign). Set the Source to Control. Under Parameter Properties, set the Control ID to GridView1. Click the Add button, and then click OK to close the dialog box.
    c. Click the Advanced button. In the Advanced Sql Generation Options dialog box, select the Generate INSERT, UPDATE, And DELETE Statements option. Click OK to close this dialog box. Click Next, and then click Finish to close the wizard.

Your SqlDataSource control's markup should look as follows.

```
<asp:SqlDataSource ID="SqlDataSourceUpdate" runat="server"
    ConnectionString="<%$ ConnectionStrings:ConnectionStringNorthwind %>"
    DeleteCommand="DELETE FROM [Customers] WHERE [CustomerID] = @CustomerID"
    InsertCommand="INSERT INTO [Customers] ([CustomerID], [CompanyName],
  [ContactName], [ContactTitle], [Address], [City], [Region], [PostalCode],
  [Country], [Phone], [Fax]) VALUES (@CustomerID, @CompanyName, @ContactName,
  @ContactTitle, @Address, @City, @Region, @PostalCode, @Country, @Phone, @Fax)"
    SelectCommand="SELECT [CustomerID], [CompanyName], [ContactName],
[ContactTitle],
  [Address], [City], [Region], [PostalCode], [Country], [Phone], [Fax] FROM
  [Customers] WHERE ([CustomerID] = @CustomerID)"
    UpdateCommand="UPDATE [Customers] SET [CompanyName] = @CompanyName,
  [ContactName] = @ContactName, [ContactTitle] = @ContactTitle, [Address] =
    @Address,
  [City] = @City, [Region] = @Region, [PostalCode] = @PostalCode, [Country] =
  @Country, [Phone] = @Phone, [Fax] = @Fax WHERE [CustomerID] = @CustomerID">
    <DeleteParameters>
        <asp:Parameter Name="CustomerID" Type="String" />
    </DeleteParameters>
    <InsertParameters>
        <asp:Parameter Name="CustomerID" Type="String" />
        <asp:Parameter Name="CompanyName" Type="String" />
        <asp:Parameter Name="ContactName" Type="String" />
        <asp:Parameter Name="ContactTitle" Type="String" />
        <asp:Parameter Name="Address" Type="String" />
        <asp:Parameter Name="City" Type="String" />
        <asp:Parameter Name="Region" Type="String" />
        <asp:Parameter Name="PostalCode" Type="String" />
        <asp:Parameter Name="Country" Type="String" />
        <asp:Parameter Name="Phone" Type="String" />
        <asp:Parameter Name="Fax" Type="String" />
    </InsertParameters>
    <SelectParameters>
        <asp:ControlParameter ControlID="GridView1" Name="CustomerID"
            PropertyName="SelectedValue" Type="String" />
    </SelectParameters>
    <UpdateParameters>
        <asp:Parameter Name="CompanyName" Type="String" />
        <asp:Parameter Name="ContactName" Type="String" />
        <asp:Parameter Name="ContactTitle" Type="String" />
        <asp:Parameter Name="Address" Type="String" />
        <asp:Parameter Name="City" Type="String" />
        <asp:Parameter Name="Region" Type="String" />
        <asp:Parameter Name="PostalCode" Type="String" />
        <asp:Parameter Name="Country" Type="String" />
        <asp:Parameter Name="Phone" Type="String" />
        <asp:Parameter Name="Fax" Type="String" />
        <asp:Parameter Name="CustomerID" Type="String" />
    </UpdateParameters>
</asp:SqlDataSource>
```

9. Add a DetailsView control to the page; place it under the GridView control.

10. Switch to Design view and configure the DetailsView control by using the smart tag and related task list.
11. Set the control's data source to SqlDataSourceUpdate.
12. Enable inserting and editing. (Deleting requires management of a foreign key constraint, so leave that cleared for this example.)
13. Click Edit Templates from the task list of the DetailsView control.
14. Select the EmptyData Template from the Display list in the task list.
15. In the template, type **No customer is currently selected**.
16. Add a LinkButton control to the template. Set the LinkButton control's CausesValidation property to false (from the Properties pane). Set its CommandName property to **New**, and set its Text property to **New**.
17. In the DetailView Tasks window, click End Template Editing.

    Your DetailsView markup should look as follows.

```
<asp:DetailsView ID="DetailsView1" runat="server" Height="50px" Width="125px"
    AutoGenerateRows="False" DataKeyNames="CustomerID"
    DataSourceID="SqlDataSourceUpdate">
    <EmptyDataTemplate>
        <b>No customer is currently selected<br />
        <asp:LinkButton ID="LinkButton1" runat="server"
            CausesValidation="False"
            CommandName="New">New</asp:LinkButton>
        </b>
    </EmptyDataTemplate>
    <Fields>
        <asp:BoundField DataField="CustomerID" HeaderText="ID"
            ReadOnly="True" SortExpression="CustomerID" />
        <asp:BoundField DataField="CompanyName" HeaderText="Company"
            SortExpression="CompanyName" />
        <asp:BoundField DataField="ContactName" HeaderText="Contact"
            SortExpression="ContactName" />
        <asp:BoundField DataField="ContactTitle" HeaderText="Contact Title"
            SortExpression="ContactTitle" />
        <asp:BoundField DataField="Address" HeaderText="Address"
            SortExpression="Address" />
        <asp:BoundField DataField="City" HeaderText="City"
            SortExpression="City" />
        <asp:BoundField DataField="Region" HeaderText="Region"
            SortExpression="Region" />
        <asp:BoundField DataField="PostalCode" HeaderText="Postal Code"
            SortExpression="PostalCode" />
        <asp:BoundField DataField="Country" HeaderText="Country"
            SortExpression="Country" />
        <asp:BoundField DataField="Phone" HeaderText="Phone"
            SortExpression="Phone" />
        <asp:BoundField DataField="Fax" HeaderText="Fax"
            SortExpression="Fax" />
        <asp:CommandField ShowEditButton="True"
            ShowInsertButton="True" />
    </Fields>
</asp:DetailsView>
```

18. If you want, select the DetailsView control in Design view and click the AutoFormat link in the task pane (from the smart tag). Select Professional or another formatting option.

19. Next, add code to update the GridView when a record has been inserted or edited in the DetailsView control. To do so, add event handlers for both the ItemUpdated and ItemInserted events of the DetailsView control. Inside each event, rebind the GridView control. The following code shows an example.

Sample of Visual Basic Code

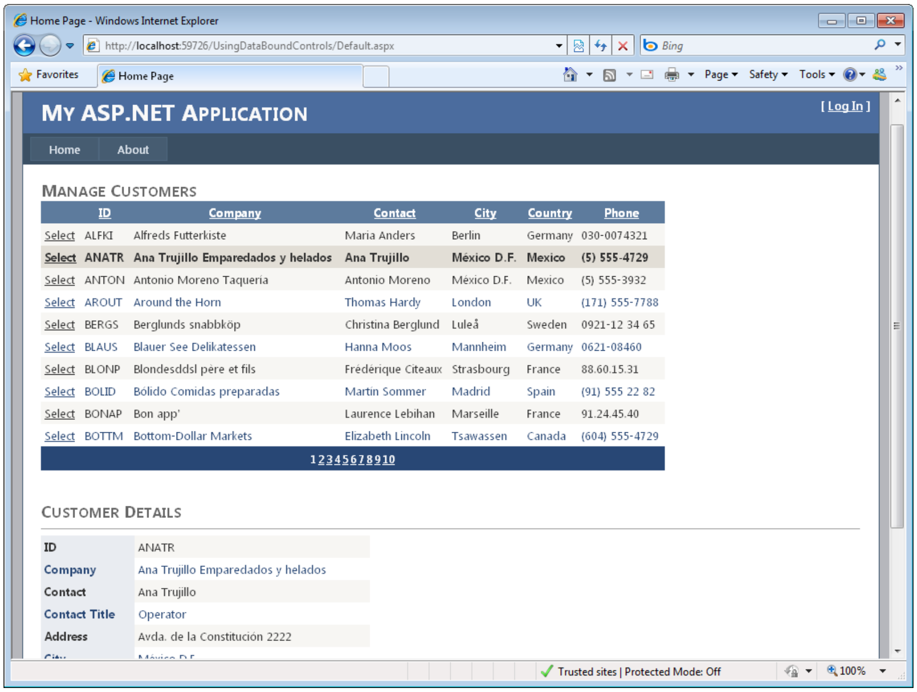
```
Protected Sub DetailsView1_ItemInserted(ByVal sender As Object, _
  ByVal e As System.Web.UI.WebControls.DetailsViewInsertedEventArgs) _
  Handles DetailsView1.ItemInserted

  GridView1.DataBind()

End Sub

Protected Sub DetailsView1_ItemUpdated(ByVal sender As Object, _
  ByVal e As System.Web.UI.WebControls.DetailsViewUpdatedEventArgs) _
  Handles DetailsView1.ItemUpdated

  GridView1.DataBind()

End Sub
```

Sample of C# Code

```
protected void DetailsView1_ItemUpdated(object sender,
    DetailsViewUpdatedEventArgs e)
{
    GridView1.DataBind();
}

protected void DetailsView1_ItemInserted(object sender,
    DetailsViewInsertedEventArgs e)
{
    GridView1.DataBind();
}
```

20. Add a title to the top of the page for **Manage Customers**. Add another title for **Customer Details**.

21. Run the webpage. Notice that the empty DetailsView control allows you to add a new record. Select a row from the GridView. Notice that it appears in the DetailsView section, as shown in Figure 12-21. Click the Edit link (which will appear when a row is selected in the GridView), and then edit a record.


Home Page - Windows Internet Explorer

http://localhost:59726/UsingDataBoundControls/Default.aspx

MY ASP.NET APPLICATION

[Log In]

Home About

MANAGE CUSTOMERS

	ID	Company	Contact	City	Country	Phone
Select	ALFKI	Alfreds Futterkiste	Maria Anders	Berlin	Germany	030-0074321
Select	**ANATR**	**Ana Trujillo Emparedados y helados**	**Ana Trujillo**	**México D.F.**	**Mexico**	**(5) 555-4729**
Select	ANTON	Antonio Moreno Taquería	Antonio Moreno	México D.F.	Mexico	(5) 555-3932
Select	AROUT	Around the Horn	Thomas Hardy	London	UK	(171) 555-7788
Select	BERGS	Berglunds snabbköp	Christina Berglund	Luleå	Sweden	0921-12 34 65
Select	BLAUS	Blauer See Delikatessen	Hanna Moos	Mannheim	Germany	0621-08460
Select	BLONP	Blondesddsl père et fils	Frédérique Citeaux	Strasbourg	France	88.60.15.31
Select	BOLID	Bólido Comidas preparadas	Martín Sommer	Madrid	Spain	(91) 555 22 82
Select	BONAP	Bon app'	Laurence Lebihan	Marseille	France	91.24.45.40
Select	BOTTM	Bottom-Dollar Markets	Elizabeth Lincoln	Tsawassen	Canada	(604) 555-4729

1 2 3 4 5 6 7 8 9 10

CUSTOMER DETAILS

ID	ANATR
Company	Ana Trujillo Emparedados y helados
Contact	Ana Trujillo
Contact Title	Operator
Address	Avda. de la Constitución 2222

Trusted sites | Protected Mode: Off 100%

FIGURE 12-21 The master-detail form shown in the browser window.

Lesson Summary

- Simple data-bound controls consist of controls that inherit from the ListControl, such as DropDownList, ListBox, CheckBoxList, BulletedList, and RadioButtonList. For these controls, you set the DataTextField to the name of the column that contains the data you want to display to the user. You set the DataValueField to the column that contains the value or values you want to return to the server for a selected item.
- Composite data-bound controls consist of the GridView, DetailsView, FormView, Repeater, ListView, and DataList controls. The GridView and DetailsView controls show data as tables. The other controls allow you to define templates for laying out your data.
- Hierarchical data-bound controls consist of the Menu and TreeView controls. These controls are used for displaying data that contains parent-child relationships.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 2, "Working with Data-Bound Web Server Controls." The questions are also available on the companion CD in a practice test, if you prefer to review them in electronic form.

NOTE **ANSWERS**

Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You are creating a data-bound CheckBoxList control that allows a user to select options for configuring a vehicle. When the data is displayed to the user, you want the OptionName column to display. When the data is posted back to the server, you need the OptionId column value for all selected items. Which of the following attribute definitions would you set? (Choose all that apply.)
   - **A.** DataTextField=OptionId
   - **B.** DataTextField=OptionName
   - **C.** DataValueField=OptionId
   - **D.** DataValueField=OptionName
2. You want to display a list of suppliers on a webpage. The supplier list must display 10 suppliers at a time, and you require the ability to edit individual suppliers. Which web control is the best choice for this scenario? (Choose all that apply.)
   - **A.** The DetailsView control
   - **B.** The Repeater control
   - **C.** The GridView control
   - **D.** The ListView control
3. You want to display a list of parts in a master-detail scenario so that users can select a part number from a list that takes a minimum amount of space on the webpage. When the part is selected, a DetailsView control displays all the information about the part and allows users to edit the part. Which web control is the best choice to display the part number list for this scenario?
   - **A.** The DropDownList control
   - **B.** The RadioButtonList control
   - **C.** The FormView control
   - **D.** The TextBox control

Lesson 3: Working with ASP.NET Dynamic Data

ASP.NET Dynamic Data is a set of user interface templates and controls for creating data-driven websites. You attach a data context to a Dynamic Data MetaModel object and can then work with that data to read, filter, insert, update, and delete. Dynamic Data does not generate code specific to a particular data schema. Rather, it is a series of extensible templates that can work with any LINQ to SQL, Entity Framework, or custom data context. If you need to customize a template to change the way data is displayed or behaves, you can do so by following the conventions of ASP.NET Dynamic Data.

This lesson helps you get started with using ASP.NET Dynamic Data to either create a new website or add these capabilities to an existing one. The lesson covers creating the scaffolding for using Dynamic Data and customizing the technology, including creating custom routes, fields, pages, and business logic.

After this lesson, you will be able to:

- Create the scaffolding for using Dynamic Data against a data context.
- Create custom routing, field templates, page templates, and business logic.
- Add Dynamic Data scaffolding and/or features to an existing website.

Estimated lesson time: 40 minutes

REAL WORLD

Mike Snell

I have personally written a number of custom web store fronts using ASP and ASP.NET. In each case, most of the work actually involved creating screens to allow administrators to manage the data in the site. This meant adding and editing products, orders, customer information, sales, and more. Dynamic Data would have cut what was weeks (often months) of work down to days.

Getting Started with Dynamic Data Websites

ASP.NET Dynamic Data works at run time to extract information from your data context and apply that information to template pages for handling CRUD operations against your data source. Recall that a data context is created by using LINQ to SQL or LINQ to Entities (see Chapter 11 for more details).

Dynamic Data uses the information from your model, such as table relationships and field data types, to create meaningful pages. For example, if you are showing data in a list, Dynamic Data will use foreign-key relationships to allow you to filter that data (into product categories, for example). It will also allow you to link to related data from a specified data record (such as customer orders). In addition, fields will be shown based on their underlying data type, and when users update or insert data, validation rules will be enforced based on the model.

To start creating a new website with Dynamic Data, you typically follow these steps:

1. Create a scaffold site that includes the default presentation layer templates used by ASP.NET Dynamic Data.
2. Define a data context that represents your data source and model by using either LINQ to SQL, LINQ to Entities, or a custom model.
3. Register your data context with the website's MetaModel instance inside the Global.asax file.
4. Customize the URL routing, page and field templates, business logic, and validation in the website. (This step is optional.)

You will walk through each of these steps in the upcoming sections.

Creating a Dynamic Data Website

You can create a new ASP.NET Dynamic Data website or add Dynamic Data features to an existing site. This section covers the former; you will see how to add these features to existing sites later in the lesson.

Visual Studio ships with two ASP.NET Dynamic Data project templates: ASP.NET Dynamic Data Entities Web Site and ASP.NET Dynamic Data LINQ to SQL Web Site. The first is used to create sites that use the Entity Framework as the data context; the second is for sites that connect to a LINQ to SQL data context. You must choose between the two, because the templates only support a single data context in a site (as it is defined within the application's Global.asax file).

Figure 12-22 shows the structure of a newly created Dynamic Data website. Note that you do not select a data source when you create the website. Instead, you can connect to a data source as a later step. The website only contains templates that use your data context information at run time. The next section covers this website structure in detail.

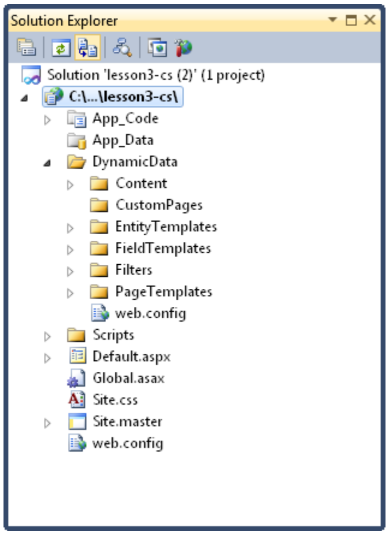


FIGURE 12-22 The structure of an ASP.NET Dynamic Data website.

DYNAMIC DATA WEBSITE STRUCTURE

The Dynamic Data website contains the DynamicData folder and several files in the root of the site. You will look at the contents of the DynamicData folder soon. First, the files in the root of the site are listed here, along with a brief description of each:

- **Default.aspx** This file is used to display all tables in the data context. It includes a GridView control that is bound to the MetaModel.VisibleTables collection. The MetaModel is exposed through an application variable (from the Global.asax file) called DefaultModel. It is referenced as follows:

  ```
  ASP.global_asax.DefaultModel.VisibleTables.
  ```

- **Global.asax** This file contains code that is run for application events, including Application_Start. Dynamic Data uses this file to call RegisterRoutes at Application_Start. This method connects your data context to a meta-model and uses ASP.NET routing to handle page requests for tables and actions (such as List, Details, Edit, and Insert).
- **Site.css** This file represents a style sheet used by the master page and related page templates. You can customize this style sheet to change the look of your Dynamic Data site.
- **Site.master** This is the master page for the Dynamic Data site. By default, it defines navigation for the site, a ScriptManager control, and the main ContentPlaceHolder control. The Site.master page is used by the page templates.
- **Web.config** This is a less verbose version of the Web.config file that is created for standard ASP.NET websites.

The DynamicData folder contains several subfolders and another Web.config file. The Web.config file registers an HTTP handler for System.Web.HttpNotFoundHandler. The folders and their naming convention define a pattern that is used by Dynamic Data to route requests accordingly. Each folder is listed here, along with a brief description of its contents:

- **Content** This folder contains content used by Dynamic Data, including images for the pager control and a custom GridViewPager user control.
- **CustomPages** By default, this folder is empty. You use this folder if you need to create custom templates for displaying or editing data. The convention is to create a new folder under CustomPages with the name of the item in your data model that you want to customize (such as Customers). You then typically copy a page template (from the PageTemplates directory) to this new folder, customize it, and save it. The Dynamic Data routing will look in this CustomPages folder first for items that are named with this convention (and thus use those instead of the default templates).
- **EntityTemplates** This folder contains user controls that are used by the page templates for displaying and editing data. These user controls include Default.ascx, Default_Edit.ascx, and Default_Insert.ascx.
- **FieldTemplates** This folder contains a set of user controls (ASCX files) that define the UI for displaying table fields in either a view or edit mode. There are user controls based on the type of data being worked with, including Boolean, DateTime, Text, Url, Decimal, Email, and more. These fields are rendered based on the data type in the data context or on additional attributes that you add to extend the meta-model. You can also create custom field templates to display or edit data with other controls (including third-party controls).
- **Filters** This folder contains user controls to define the UI that is used to filter data that is displayed in a list. These controls include Boolean.ascx, Enumeration.ascx, and ForeignKey.ascx.
- **PageTemplates** This folder contains the default templates for working with data. These template pages can show a table in a list (List.aspx), allow you to create a new record (Insert.aspx), edit an existing record (Edit.aspx), view the details of a record (Details.aspx), and show a list of data and a selected record's details on the same page (ListDetails.aspx).

Defining a Data Context

You create a data context by adding either a LINQ to SQL Classes (DBML) file or an ADO.NET Entity Data Model (EDMX) file to your project (see Chapter 11 for more details). You can also create a custom model through code.

As an example, suppose that the Northwind database is in the App_Data directory of your site. You can then create a LINQ to SQL DBML file based on tables found inside this database. Figure 12-23 shows an example.

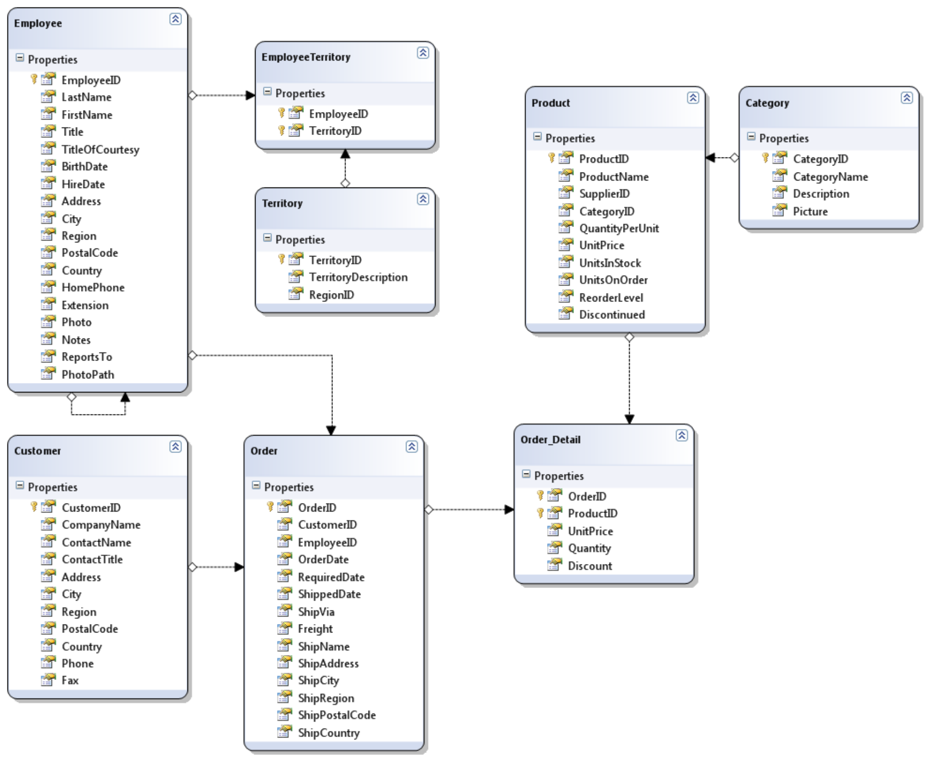


FIGURE 12-23 An example LINQ to SQL DBML model.

Registering Your Data Context with the MetaModel

The next step is to register your data context with System.Web.DynamicData.MetaModel. The MetaModel defines the connectivity or mapping between the scaffold templates and your data layer.

You register your data context inside the Global.asax file. Here you will notice that, at the top of the file, the MetaModel is actually defined as a private application variable and exposed as a read-only property. The following code shows an example.

Sample of Visual Basic Code

```
Private Shared s_defaultModel As New MetaModel
Public Shared ReadOnly Property DefaultModel() As MetaModel
    Get
        Return s_defaultModel
    End Get
End Property
```

Sample of C# Code

```
private static MetaModel s_defaultModel = new MetaModel();
public static MetaModel DefaultModel {
    get {
        return s_defaultModel;
    }
}
```

Further down in the file, notice that the RegisterRoutes method is called at application start. The following code shows an example.

Sample of Visual Basic Code

```
Private Sub Application_Start(ByVal sender As Object, ByVal e As EventArgs)
    RegisterRoutes(RouteTable.Routes)
End Sub
```

Sample of C# Code

```
void Application_Start(object sender, EventArgs e) {
    RegisterRoutes(RouteTable.Routes);
}
```

The RegisterRoutes method is used to connect your data source to the MetaModel. You do so through the DefaultModel.RegisterContext method and pass the type name of your data context. You might also want to set the ScaffoldAllTables property to true to make sure that the site will return all tables in the data context by default. The following code shows an example of registering the NorthwindDataContext LINQ to SQL object with the MetaModel.

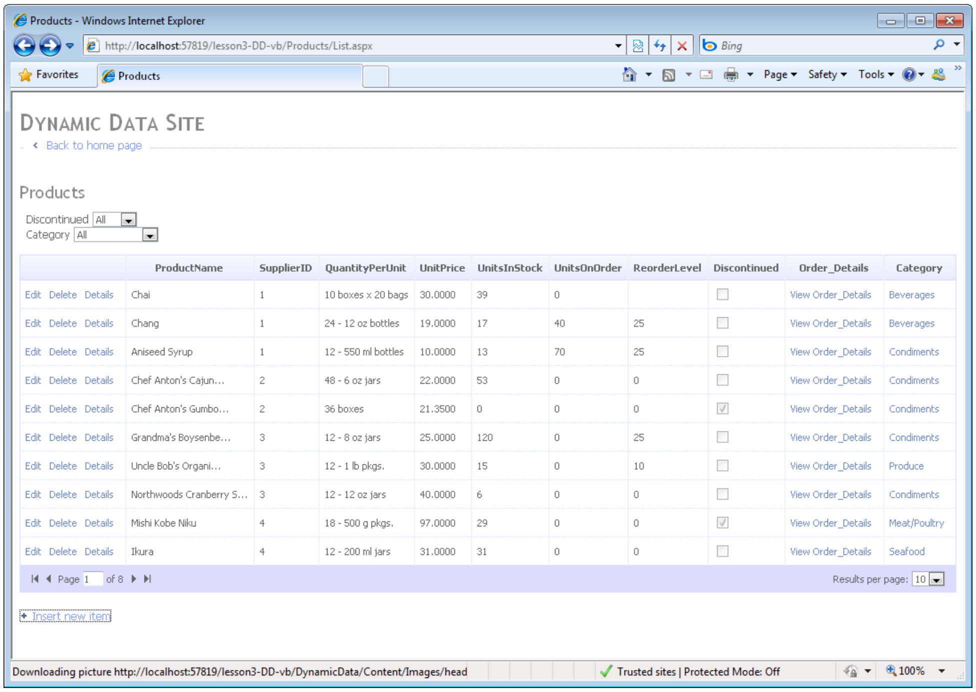
Sample of Visual Basic Code

```
Public Shared Sub RegisterRoutes(ByVal routes As RouteCollection)

    DefaultModel.RegisterContext( _
        GetType(NorthwindDataContext), New ContextConfiguration() _
        With {.ScaffoldAllTables = True})

    routes.Add(New DynamicDataRoute("{table}/{action}.aspx") With {
    .Constraints = New RouteValueDictionary(New _
        With {.Action = "List|Details|Edit|Insert"}),
    .Model = DefaultModel})

End Sub
```

Sample of C# Code

```
public static void RegisterRoutes(RouteCollection routes) {

    DefaultModel.RegisterContext(typeof(NorthwindDataContext),
        new ContextConfiguration() { ScaffoldAllTables = true });

    routes.Add(new DynamicDataRoute("{table}/{action}.aspx") {
        Constraints = new RouteValueDictionary(
            new { action = "List|Details|Edit|Insert" }),
        Model = DefaultModel
    });
}
```

That is all that is required to create a basic Dynamic Data website. You can now run the site and view, edit, insert, and delete data by using the template user interface. Figure 12-24 shows an example of the Products table in a web browser. Notice the URL, Products/List.aspx. This table/action convention is defined in the routing. It simply indicates that the List.aspx template page should be called and the Product data should be displayed from the model.


Products - Windows Internet Explorer

http://localhost:57819/lesson3-DD-vb/Products/List.aspx

DYNAMIC DATA SITE

Back to home page

Products

Discontinued All

Category All

	ProductName	SupplierID	QuantityPerUnit	UnitPrice	UnitsInStock	UnitsOnOrder	ReorderLevel	Discontinued	Order_Details	Category
Edit Delete Details	Chai	1	10 boxes x 20 bags	30.0000	39	0		☐	View Order_Details	Beverages
Edit Delete Details	Chang	1	24 - 12 oz bottles	19.0000	17	40	25	☐	View Order_Details	Beverages
Edit Delete Details	Aniseed Syrup	1	12 - 550 ml bottles	10.0000	13	70	25	☐	View Order_Details	Condiments
Edit Delete Details	Chef Anton's Cajun…	2	48 - 6 oz jars	22.0000	53	0	0	☐	View Order_Details	Condiments
Edit Delete Details	Chef Anton's Gumbo…	2	36 boxes	21.3500	0	0	0	☑	View Order_Details	Condiments
Edit Delete Details	Grandma's Boysenbe…	3	12 - 8 oz jars	25.0000	120	0	25	☐	View Order_Details	Condiments
Edit Delete Details	Uncle Bob's Organi…	3	12 - 1 lb pkgs.	30.0000	15	0	10	☐	View Order_Details	Produce
Edit Delete Details	Northwoods Cranberry S…	3	12 - 12 oz jars	40.0000	6	0	0	☐	View Order_Details	Condiments
Edit Delete Details	Mishi Kobe Niku	4	18 - 500 g pkgs.	97.0000	29	0	0	☑	View Order_Details	Meat/Poultry
Edit Delete Details	Ikura	4	12 - 200 ml jars	31.0000	31	0	0	☐	View Order_Details	Seafood

Page 1 of 8 Results per page: 10

Insert new item

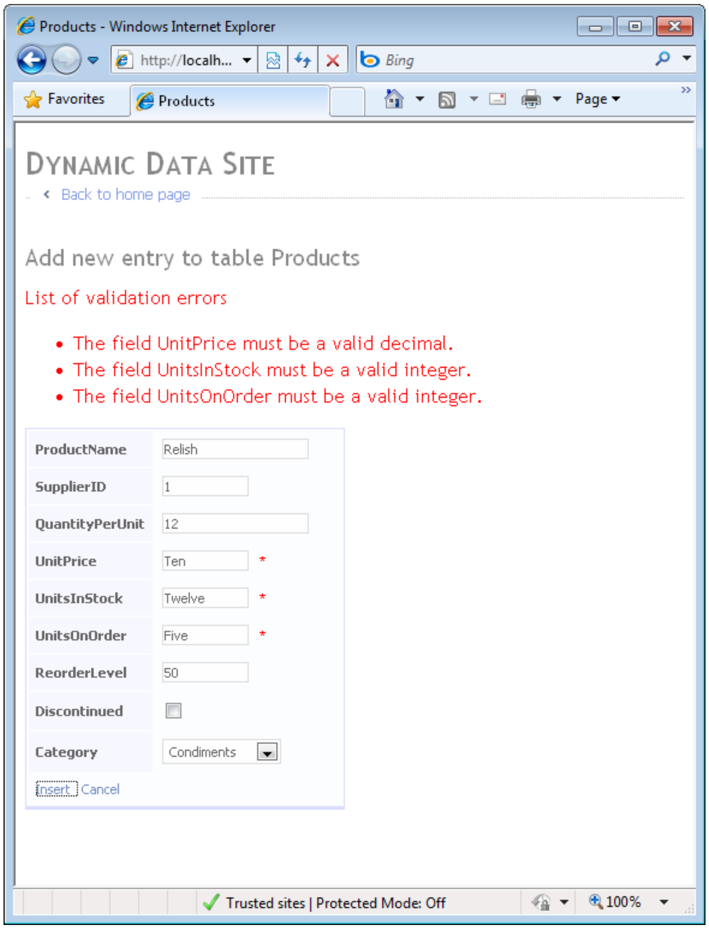
Downloading picture http://localhost:57819/lesson3-DD-vb/DynamicData/Content/Images/head

Trusted sites | Protected Mode: Off 100%

FIGURE 12-24 An example LINQ to SQL DBML model.

Notice also the default filters created for this list. The Discontinued filter is based on a Boolean field in the data. The Category filter is based on the relationship between Product and Category. In fact, relational IDs won't be displayed in the table, but related data will be. You can see that this was possible for the Category, because it exposed the CategoryName field. However, this was not possible for SupplierID because this table does not include a SupplierName field.

You can also see that the form allows you to page the data; select how many rows to show in a page; edit, delete, and view the details of an item; insert a new item; and connect to data related to a particular row (View Order_Details). Figure 12-25 shows an example of inserting a product. Notice that here you again get the Category drop-down list. You can also see that default data validation is being used. The validation is based on stored data types.



DYNAMIC DATA SITE

Back to home page

Add new entry to table Products

List of validation errors

- The field UnitPrice must be a valid decimal.
- The field UnitsInStock must be a valid integer.
- The field UnitsOnOrder must be a valid integer.

ProductName	Relish
SupplierID	1
QuantityPerUnit	12
UnitPrice	Ten *
UnitsInStock	Twelve *
UnitsOnOrder	Five *
ReorderLevel	50
Discontinued	☐
Category	Condiments

Insert Cancel

FIGURE 12-25 Automatic data validation in insert mode.

This site behavior is the default behavior with the template scaffolding. You can see that there was no code or customization done to this site. In upcoming sections, you will see how to customize the routing, create new page and field templates, and add custom business logic to validate data.

The Dynamic Data Classes

ASP.NET Dynamic Data relies on several classes inside the System.Web.DynamicData namespace. These classes include controls for defining custom field user controls, managing the routing, and using Dynamic Data inside a webpage. The MetaModel classes are found in the System.Data.Linq.Mapping namespace. Figure 12-26 shows some of the key classes used by Dynamic Data. Many of these classes will be discussed in upcoming sections.

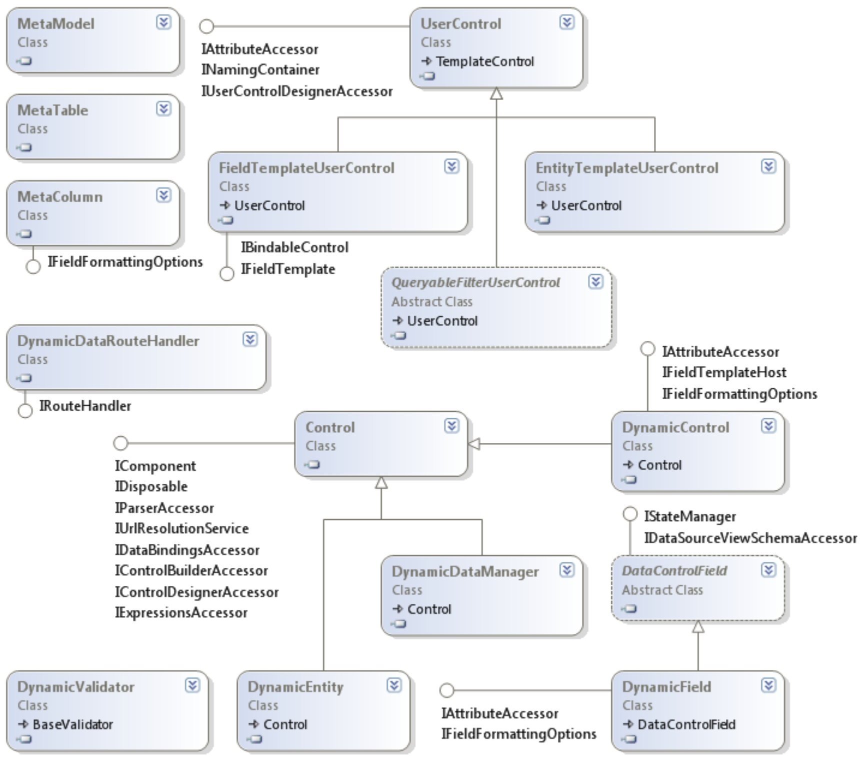


FIGURE 12-26 Some of the key classes related to ASP.NET Dynamic Data.

Extending and Customizing Dynamic Data

ASP.NET Dynamic Data is fully extensible. You can customize how fields are edited, how data is displayed, the look of the pages, the URL routing, data validation, and more. You can create customizations to existing templates that will be applied to all data elements. You can also create new, entity-specific templates for customizations that are specific to a particular entity. This section walks you through common customizations you might want to make when using ASP.NET Dynamic Data.

Defining Custom Routing

Dynamic Data uses the same routing features from System.Web.Routing that are used by ASP.NET model-view-controller (MVC) (see Chapter 14, “Creating Websites with ASP.NET MVC 2”). This routing engine maps intelligent Uniform Resource Identifiers (URIs) that are defined based on user actions to actual pages in your site, which makes the URIs easier to understand for users and search engines.

For example, Dynamic Data exposes the List.aspx, Edit.aspx, Insert.aspx, and Details.aspx page templates for working with data. These pages are called by the routing engine based on the user's action: List, Edit, Details, or Insert. A DynamicDataRoute class is created and added to the RouteTable.Routes collection inside the Global.asax file. This DynamicDataRoute indicates that a URI should be mapped as *table/action*.aspx. The following shows the code from the Global.asax file that does this.

Sample of Visual Basic Code

```
routes.Add(New DynamicDataRoute("{table}/{action}.aspx") With {
    .Constraints = New RouteValueDictionary( _
    New With {.Action = "List|Details|Edit|Insert"}), .Model = DefaultModel})
```

Sample of C# Code

```
routes.Add(new DynamicDataRoute("{table}/{action}.aspx") {
    Constraints = new RouteValueDictionary(
    new { action = "List|Details|Edit|Insert" }), Model = DefaultModel
```

This code ensures that a call to http://mysite/products/Edit.aspx?ProductID=1 will be routed to the /DynamicData/PageTemplates/Edit.aspx page. When accessed, the page will know the right table to edit (Products) and right record to edit (ProductID=1).

EDITING THE URI STRUCTURE

You can customize this routing by editing this code. For example, you might want to change the structure of the URL or even add a custom action. You can switch the table and action in the route definition to read {action}/{table}.aspx and get the same results but a different URL. New requests will be made as http://mysite/Edit/Products.aspx?ProductID=1. In this case, the table is used for the ASPX page name, and the action precedes the table name.

EDITING THE ROUTE TABLE TO SHOW A LIST AND DETAILS ON THE SAME PAGE

The Dynamic Data page templates include the ListDetails.aspx file. This page supports viewing a table in a list and selecting an item from the list to view its details. You can also edit the item or delete it, and you can insert a new item into the list by using this page. However, by default, requests are not routed to this page. You can change this behavior by removing the existing routing and adding entries for the action's List and Details that both point to the ListDetails.aspx page. The following code shows an example.

Sample of Visual Basic Code

```
routes.Add(New DynamicDataRoute("{table}/ListDetails.aspx") With {
    .Action = PageAction.List,
    .ViewName = "ListDetails",
    .Model = DefaultModel})

routes.Add(New DynamicDataRoute("{table}/ListDetails.aspx") With {
    .Action = PageAction.Details,
    .ViewName = "ListDetails",
    .Model = DefaultModel})
```

Sample of C# Code

```
routes.Add(new DynamicDataRoute("{table}/ListDetails.aspx")
{
    Action = PageAction.List,
    ViewName = "ListDetails",
    Model = DefaultModel
});

routes.Add(new DynamicDataRoute("{table}/ListDetails.aspx")
{
    Action = PageAction.Details,
    ViewName = "ListDetails",
    Model = DefaultModel
});
```

The result is that all calls to view a record's details or show a table in a list will be routed to the ListDetails.aspx page. From there, users can do everything they need to with the data. Note that ListDetails.aspx also handles inline editing in the GridView control.

CREATING A CUSTOM ROUTE TO A SPECIFIC PAGE

ASP.NET Dynamic Data can already route to custom pages you create. You simply need to follow the conventions already set up. You do not need to add custom routes. Instead, you create a new folder in the CustomPages folder and name this new folder with the name of an entity from your model. You then place appropriate action pages inside this folder (List.aspx, Edit.aspx, Insert.aspx, and so on). The default routing will look for pages in CustomPage first. You will walk through an example of creating a custom template page in an upcoming section.

Adding Metadata to Your Data Context

The classes in your data context are partial classes that include partial methods. This allows you to add to these classes and their methods outside the generated code. Doing so ensures that your changes are not overwritten if the model's code gets regenerated when the database changes.

You create partial classes so that you can add metadata that defines how your fields are to be displayed and validated (see "Creating Custom Field Templates," later in this lesson). You can also add custom business logic inside a partial method (see "Adding Custom Validation," also later in this lesson).

To start, you simply add a class to the App_Code directory and give it the same name as the class in your data context. Of course, you mark this class as partial. You then create a related metadata class (typically added to the same file). You can name this class by using the *Entity*Metadata convention.

Inside this metadata class, you redefine the properties contained in your data context class (but as simple object types, because the underlying type already has strongly typed properties). You then mark your partial class with the MetadataType attribute from the System.ComponentModel.DataAnnotations namespace. This attribute should pass the metadata class type as a parameter.

You can then add attributes to your metadata class to change how your fields are rendered by Dynamic Data. As an example, if you want to exclude a field from display, you can add the ScaffoldColumn attribute and pass in false. Additionally, if you want to format a value for display, you can use the DisplayFormat attribute. This attribute allows you to indicate whether to only format the value when it is displayed or also when it is being edited. You can also use the Display attribute to change the name of a column.

The following shows an example from the Products entity partial class and metadata class. Notice the use of ScaffoldColumn, Display, and DisplayFormat.

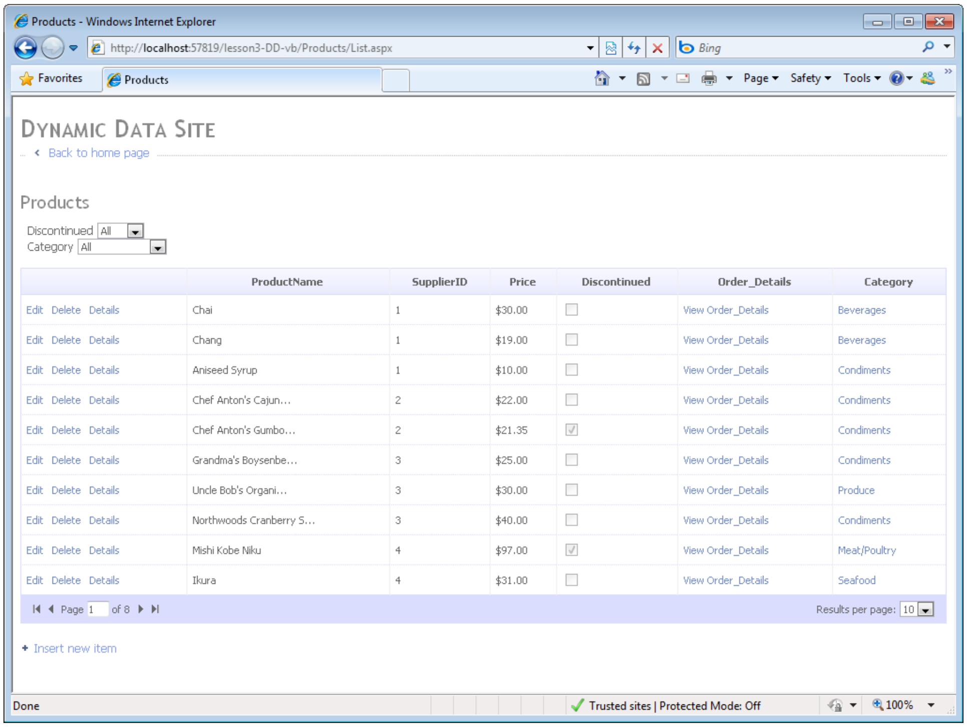
Sample of Visual Basic Code

```
Imports Microsoft.VisualBasic
Imports System.ComponentModel.DataAnnotations

<MetadataType(GetType(ProductMetadata))> _
Partial Public Class Product

End Class

Public Class ProductMetadata

    Public Property ProductID As Object
    Public Property ProductName As Object
    Public Property SupplierID As Object
    Public Property CategoryID As Object

    <ScaffoldColumn(False)> _
    Public Property QuantityPerUnit As Object

    <DisplayFormat(ApplyFormatInEditMode:=False,
        DataFormatString:="{0:c}")> _
    <Display(Name:="Price")> _
    Public Property UnitPrice As Object

    <ScaffoldColumn(False)> _
    Public Property UnitsInStock As Object

    <ScaffoldColumn(False)> _
    Public Property UnitsOnOrder As Object

    <ScaffoldColumn(False)> _
    Public Property ReorderLevel As Object

    Public Property Discontinued As Object

End Class
```

Sample of C# Code

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.ComponentModel.DataAnnotations;

[MetadataType(typeof(ProductMetadata))]
public partial class Product
{
}

public class ProductMetadata
{
    public object ProductID { get; set; }
    public object ProductName { get; set; }
    public object SupplierID { get; set; }
    public object CategoryID { get; set; }

    [ScaffoldColumn(false)]
    public object QuantityPerUnit { get; set; }

    [DisplayFormat(ApplyFormatInEditMode=false,
        DataFormatString="{0:c}")]
    [Display(Name = "Price")]
    public object UnitPrice { get; set; }

    [ScaffoldColumn(false)]
    public object UnitsInStock { get; set; }

    [ScaffoldColumn(false)]
    public object UnitsOnOrder { get; set; }

    [ScaffoldColumn(false)]
    public object ReorderLevel { get; set; }

    public object Discontinued { get; set; }
}
```

When you run the application, this metadata is added to the Product class. Dynamic Data then picks up on this metadata and displays your fields accordingly. Figure 12-27 shows the results in a browser. Notice the missing fields, formatted UnitPrice column, and changed name.


Products - Windows Internet Explorer
http://localhost:57819/lesson3-DD-vb/Products/List.aspx
Bing
Favorites
Products
Page ▾ Safety ▾ Tools ▾
Done
Trusted sites | Protected Mode: Off
100%

DYNAMIC DATA SITE

‹ Back to home page

Products

Discontinued All

Category All

	ProductName	SupplierID	Price	Discontinued	Order_Details	Category
Edit Delete Details	Chai	1	$30.00	☐	View Order_Details	Beverages
Edit Delete Details	Chang	1	$19.00	☐	View Order_Details	Beverages
Edit Delete Details	Aniseed Syrup	1	$10.00	☐	View Order_Details	Condiments
Edit Delete Details	Chef Anton's Cajun...	2	$22.00	☐	View Order_Details	Condiments
Edit Delete Details	Chef Anton's Gumbo...	2	$21.35	✓	View Order_Details	Condiments
Edit Delete Details	Grandma's Boysenbe...	3	$25.00	☐	View Order_Details	Condiments
Edit Delete Details	Uncle Bob's Organi...	3	$30.00	☐	View Order_Details	Produce
Edit Delete Details	Northwoods Cranberry S...	3	$40.00	☐	View Order_Details	Condiments
Edit Delete Details	Mishi Kobe Niku	4	$97.00	✓	View Order_Details	Meat/Poultry
Edit Delete Details	Ikura	4	$31.00	☐	View Order_Details	Seafood

Page 1 of 8 Results per page: 10

+ Insert new item

FIGURE 12-27 Using metadata and partial classes to indicate field display options.

There are many additional annotations you can add to your metadata from the System.ComponentModel.DataAnnotations namespace. You will see some of these in the upcoming sections. Table 12-1 provides a partial list of these classes (note that all are attribute classes).

TABLE 12-1 Commonly Used Metadata Annotation Classes

CLASS	DESCRIPTION
Association	Used to mark a property as a data relationship, such as a foreign key.
CustomValidation	Used to indicate a custom validation method to use for validating a property.
DataType	Used to indicate the data type to associate with the field.
Display	Allows you to indicate many things about the display of a field, including its order and its name.
DisplayFormat	Allows you to change how the data in a field is displayed. You can apply the formatting to affect only the view mode (and not the edit mode) if you want.
Editable	Used to indicate whether a property can be edited.
EnumDataType	Allows you to set an enum data type for a property.

CLASS	DESCRIPTION
Key	Allows you to set one or more properties as unique keys for a collection of objects.
MetadataType	Used to set the metadata class to associate with a type from your data context.
Range	Allows you to add a numeric range constraint to a property. You can also set an error message to be shown if the range is not valid.
RegularExpression	Used to add a regular expression constraint to a property.
Required	Used to indicate that a property is required when inserting or editing.
ScaffoldColumn	Indicates whether the column should be part of the scaffold (shown).
ScaffoldTable	Indicates whether an entire table should be part of the scaffold (shown).
StringLength	Allows you to set a constraint on a property based on the specified minimum and maximum number of characters for a property.
UIHint	Used to specify a custom field user control that should be used to display the property.

Adding Custom Validation

You can see from Table 12-1 that you can use attributes to mark your metadata with specific constraints. These constraints will then be enforced by Dynamic Data, and ASP.NET validation controls will be rendered and invoked.

The validation attributes include Range, StringLength, Required, and RegularExpression (among others). You use these controls to enforce additional constraints on your data. For example, suppose you want to add the Range validator to the ReorderLevel property to indicate that users can only reorder stock in quantities of 1 to 144 units. You could do so with the following code.

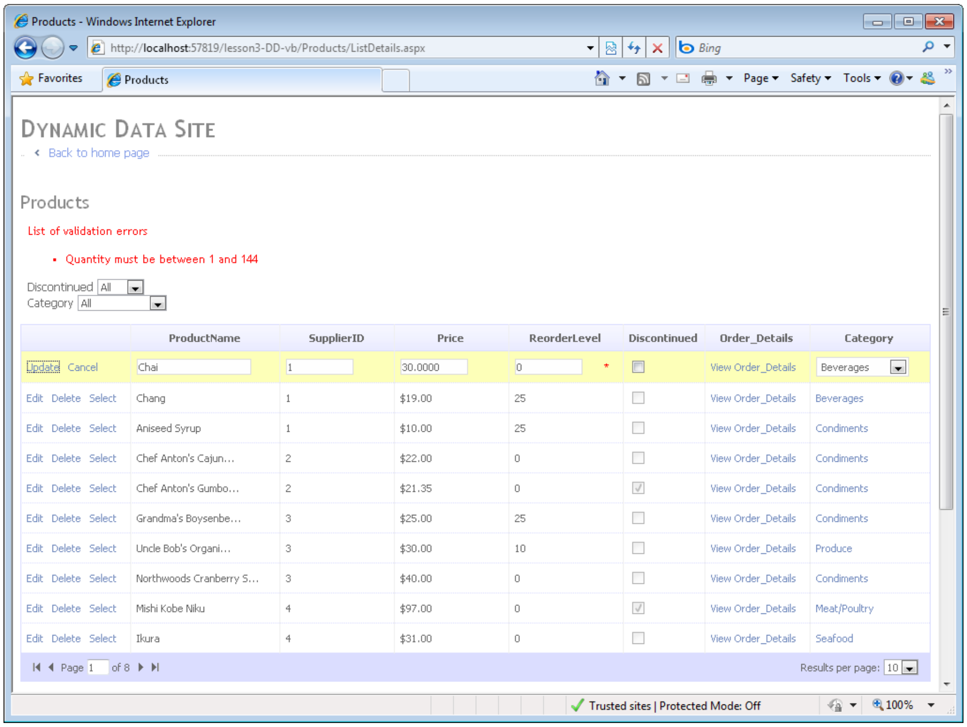
Sample of Visual Basic Code

```
<Range(1, 144, ErrorMessage:="Quantity must be between 1 and 144")> _
Public Property ReorderLevel As Object
```

Sample of C# Code

```
[Range(1, 144, ErrorMessage = "Quantity must be between 1 and 144")]
public object ReorderLevel { get; set; }
```

This business logic is then processed by Dynamic Data. You can see the results of a row edit in Figure 12-28. Here the user set the ReorderLevel to a value that is out of range (0). You can follow this same construct for other validation attributes, including StringLength and Required. Of course, you can apply more than one attribute to any property.


Products - Windows Internet Explorer

http://localhost:57819/lesson3-DD-vb/Products/ListDetails.aspx

DYNAMIC DATA SITE

‹ Back to home page

Products

List of validation errors

- Quantity must be between 1 and 144

Discontinued All

Category All

	ProductName	SupplierID	Price	ReorderLevel	Discontinued	Order_Details	Category
Update Cancel	Chai	1	30.0000	0 *	☐	View Order_Details	Beverages
Edit Delete Select	Chang	1	$19.00	25	☐	View Order_Details	Beverages
Edit Delete Select	Aniseed Syrup	1	$10.00	25	☐	View Order_Details	Condiments
Edit Delete Select	Chef Anton's Cajun…	2	$22.00	0	☐	View Order_Details	Condiments
Edit Delete Select	Chef Anton's Gumbo…	2	$21.35	0	✓	View Order_Details	Condiments
Edit Delete Select	Grandma's Boysenbe…	3	$25.00	25	☐	View Order_Details	Condiments
Edit Delete Select	Uncle Bob's Organi…	3	$30.00	10	☐	View Order_Details	Produce
Edit Delete Select	Northwoods Cranberry S…	3	$40.00	0	☐	View Order_Details	Condiments
Edit Delete Select	Mishi Kobe Niku	4	$97.00	0	✓	View Order_Details	Meat/Poultry
Edit Delete Select	Ikura	4	$31.00	0	☐	View Order_Details	Seafood

Page 1 of 8 Results per page: 10

Trusted sites | Protected Mode: Off 100%

FIGURE 12-28 The Range constraint running in a browser window.

CUSTOM VALIDATION WITH PARTIAL METHODS

The data content model includes partial methods that allow you to add custom code that will be added to the method when the partial class is assembled. In fact, you can see these partial methods inside the Extensibility Method Definitions region of the generated code for a LINQ to SQL model. There are partial methods for OnChanging and OnChanged for each property in the data context. This means that the Product table has an OnUnitPriceChanging and OnUnitPriceChanged partial method. In fact, when you type "partial" into your partial class, Visual Studio's IntelliSense provides you with a list of all partial methods that you can extend.

You can use these partial methods to write customized validation rules. Remember, your partial class is an instance of the actual class representing the entity. Therefore, you have access to all fields on the record. The OnChanging partial method is also passed the value to which the property is being changed. You can use these fields and this value to write custom business logic. If you encounter an error, you throw a ValidationException from System.ComponentModel.DataAnnotations. Dynamic Data will present the exception to the user as an ASP.NET validation error.

As an example, suppose you want to write custom business logic that processes when the Product.UnitPrice is being changed. This logic might prevent a user from lowering the price of an object if there are items still in stock and the product has not been discontinued. You would add this code to the Product partial class as follows.

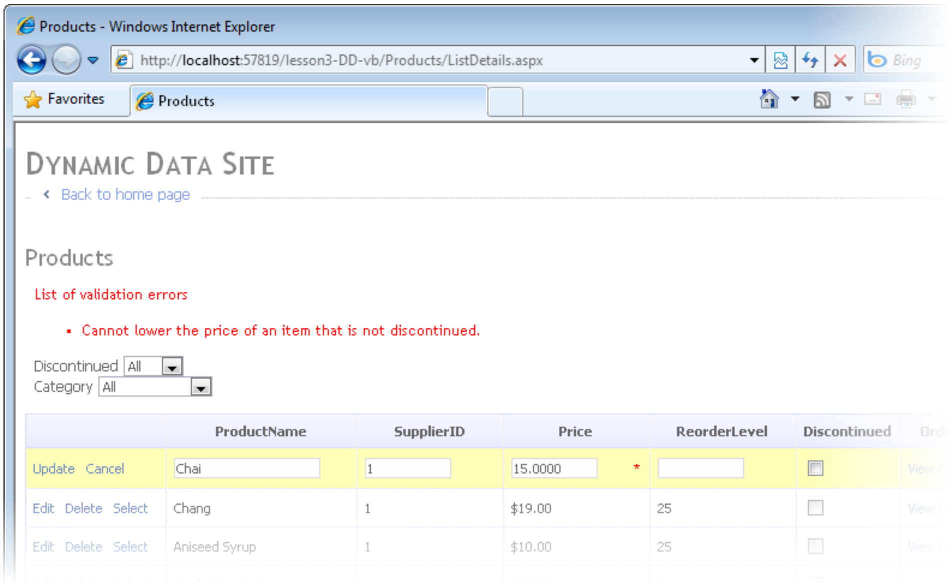
Sample of Visual Basic Code

```
Private Sub OnUnitPriceChanging(ByVal value As System.Nullable(Of Decimal))

    'rule: can only lower the price if product is discontinued
    If (Me.UnitsInStock > 0 And Me.UnitPrice > value) _
        And (Me.Discontinued = False) Then

        Throw New ValidationException( _
            "Cannot lower the price of an item that is not discontinued.")

    End If

End Sub
```

Sample of C# Code

```
partial void OnUnitPriceChanging(decimal? value)
{
    //rule: can only lower the price if product is discontinued
    if ((this.UnitsInStock > 0 && this.UnitPrice > value)
        && (this.Discontinued == false))
    {
        throw new ValidationException(
            "Cannot lower the price of an item that is not discontinued.");
    }
}
```

Figure 12-29 shows an example of this logic processing. Notice that the validation message is shown as part of the validation summary controls in ASP.NET.


Products - Windows Internet Explorer
http://localhost:57819/lesson3-DD-vb/Products/ListDetails.aspx
Bing
Favorites
Products

DYNAMIC DATA SITE

‹ Back to home page

Products

List of validation errors

- Cannot lower the price of an item that is not discontinued.

Discontinued All
Category All

	ProductName	SupplierID	Price	ReorderLevel	Discontinued	Ord
Update Cancel	Chai	1	15.0000 *		☐	View
Edit Delete Select	Chang	1	$19.00	25	☐	View
Edit Delete Select	Aniseed Syrup	1	$10.00	25	☐	View

FIGURE 12-29 The custom business logic being processed in the browser.

Creating Custom Field Templates

Recall that the Dynamic Data templates include the FieldTemplates folder. Inside this folder is a set of user controls that inherit from FieldTemplateUserControl. These controls are used to render the appearance and functionality of your data context properties when they are displayed on a details or edit page (or page section).

Field template controls are named as either display controls or edit controls for a specific data type and functionality. For example, the controls used to render DateTime values are DateTime.ascx and DateTime_Edit.ascx. The former is simply a Literal control that is used when a DateTime value is rendered for display. The edit version includes a TextBox, a RequiredFieldValidator, a RegularExpressionValidator, a DynamicValidator, and a CustomValidator control. This composite user control is used whenever a DateTime value is displayed for editing.

You can edit the field template controls or create new ones in order to provide additional behavior in your website. Edits to an existing control will apply to all uses of that control within your website. When you create a new control, you use metadata to specify which properties in your data model use the new control. You will look at both examples next.

CUSTOMIZING AN EXISTING FIELD TEMPLATE

You can customize an existing field template user control as you would any other user control. This means adding client-side script, changing the appearance, and modifying the processing logic.

For example, you could modify the code-behind file for each of the core edit pages (Text_Edit.ascx, DataTime_Edit.ascx, Decimal_Edit.ascx, Integer_Edit.ascx, and MultilineText_Edit.ascx) to change the background color of the control if a different background color is required. To do so, you would add code to the OnDataBinding event. At this point, the SetupValidator methods have already run and any validation controls, including the RequiredFieldValidator, will already be set as either enabled or disabled. You could then add the following code to this event to set the background color accordingly.

Sample of Visual Basic Code

```
Protected Overrides Sub OnDataBinding(ByVal e As System.EventArgs)

    MyBase.OnDataBinding(e)
    If Me.RequiredFieldValidator1.Enabled = True Then
        TextBox1.BackColor = System.Drawing.Color.SandyBrown
    End If

End Sub
```

Sample of C# Code

```
protected override void OnDataBinding(EventArgs e)
{
    base.OnDataBinding(e);
    if (this.RequiredFieldValidator1.Enabled == true)
        TextBox1.BackColor = System.Drawing.Color.SandyBrown;
}
```

You can then add the RequiredAttribute class to any properties in your metadata class that you want to be required. When the control is rendered, Dynamic Data will mark the edit versions for these properties with the color if they are required fields.

CREATING A NEW FIELD TEMPLATE CONTROL

You can create your own custom field template user controls. You can do so by copying an existing user control in Dynamic Data/FieldTemplates or by selecting the Dynamic Data Field template from the Add New Item dialog box.

When you use the Dynamic Data Field item template, Visual Studio will actually generate two controls: one for display (ControlName.ascx) and one for editing (ControlName_Edit.ascx). The display version by default is just a Literal control. The edit version will include a TextBox control and the various validation controls used by DynamicData, some of which were shown in Table 12-1. You can then customize these controls to your needs.

As an example, suppose you want to create a new user control to allow users to use a Calendar control when picking a date in edit mode. To do so, you can add a new Dynamic Data Field to your project named CalendarPicker.ascx. Again, this will create two controls. You can leave the display version as is. You might then modify the markup in the CalendarPicker_Edit.ascx control to use a Calendar control, as follows.

```
<%@ Control Language="VB" CodeFile="CalendarPicker_Edit.ascx.vb"
    Inherits="DynamicData_FieldTemplates_CalendarPicker_EditField" %>

<asp:Calendar ID="Calendar1" runat="server"
    CssClass="DDTextBox"></asp:Calendar>
```

You would then add code to the code-behind page for the control to set the value of the Calendar control when data binding occurs. This code might look as follows.

Sample of Visual Basic Code

```
Protected Overrides Sub OnDataBinding(ByVal e As System.EventArgs)
    MyBase.OnDataBinding(e)
    Dim dte As DateTime = DateTime.Parse(Me.FieldValue)
    Calendar1.SelectedDate = dte
    Calendar1.VisibleDate = dte
End Sub
```

Sample of C# Code

```
protected override void OnDataBinding(EventArgs e)
{
    base.OnDataBinding(e);
    DateTime dte = DateTime.Parse(this.FieldValue.ToString());
    Calendar1.SelectedDate = dte;
    Calendar1.VisibleDate = dte;
}
```

The last step is to mark your metadata properties to indicate that they should use this new control. You do so with the UIHint attribute. You pass the name of your control to this attribute. Dynamic Data will then find your control and use it for all display and edits (including GridView edits) that involve this field. As an example, the following metadata marks the HireDate and BirthDate properties of the Employee class to use the custom CalendarPicker control.

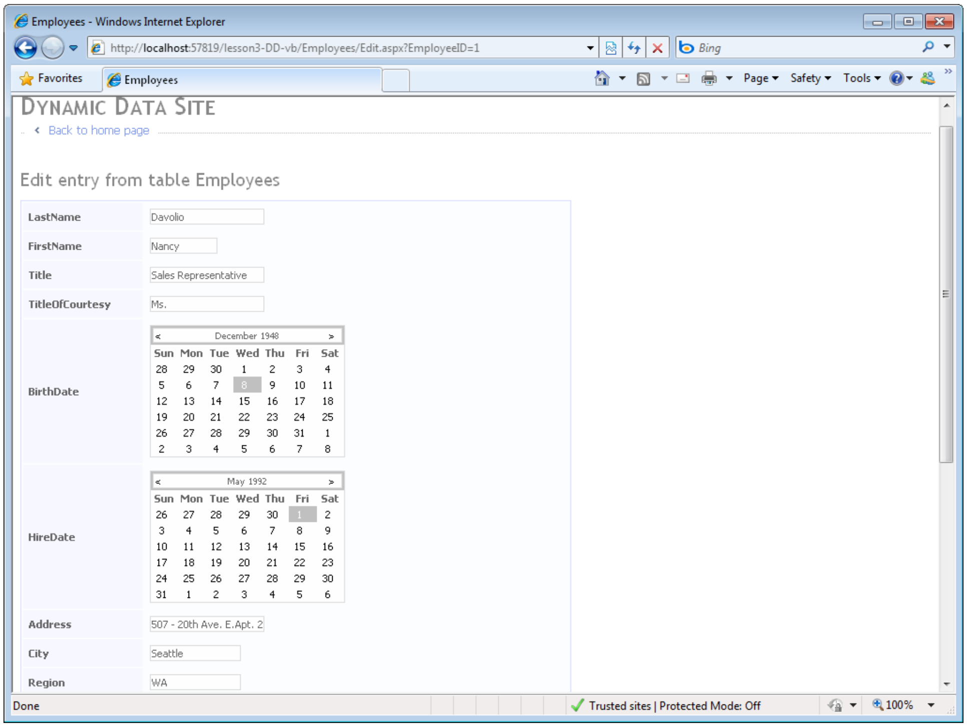
Sample of Visual Basic Code

```
<MetadataType(GetType(EmployeeMetadata))> _
Partial Public Class Employee

End Class

Public Class EmployeeMetadata

    <UIHint("CalendarPicker")> _
    Public Property HireDate As Object

    <UIHint("CalendarPicker")> _
    Public Property BirthDate As Object

End Class
```

Sample of C# Code

```
[MetadataType(typeof(EmployeeMetadata))]
public partial class Employee
{
}

public class EmployeeMetadata
{
    [UIHint("CalendarPicker")]
    public object HireDate { get; set; }

    [UIHint("CalendarPicker")]
    public object BirthDate { get; set; }
}
```

Figure 12-30 shows the control in use on a webpage.


Employees - Windows Internet Explorer
Favorites
Employees
Bing
Page
Safety
Tools
Done
Trusted sites | Protected Mode: Off
100%

http://localhost:57819/lesson3-DD-vb/Employees/Edit.aspx?EmployeeID=1

DYNAMIC DATA SITE

‹ Back to home page

Edit entry from table Employees

LastName	Davolio
FirstName	Nancy
Title	Sales Representative
TitleOfCourtesy	Ms.
BirthDate	
HireDate	
Address	507 - 20th Ave. E.Apt. 2
City	Seattle
Region	WA

BirthDate: < December 1948 >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
28	29	30	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	31	1
2	3	4	5	6	7	8

HireDate: < May 1992 >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
26	27	28	29	30	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
31	1	2	3	4	5	6

FIGURE 12-30 The custom field template being used in the browser.

Creating Custom Page Templates

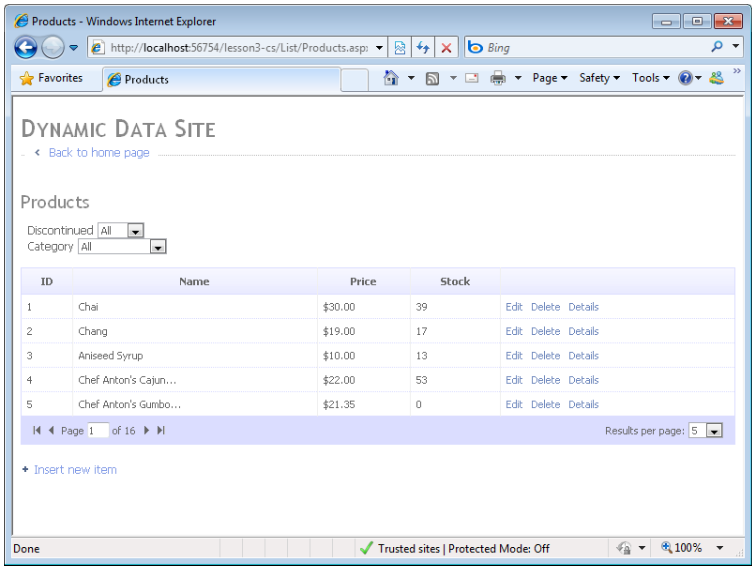
Recall that the Dynamic Data templates are not specific to an object in your data context. Rather, they are generic templates that get information about the data they display from your data context at run time. You can customize how these templates display your data by using a metadata partial class and the data annotation attributes. However, you might find scenarios in which you need to create an entity-specific version of a page to control exactly how that entity is rendered to the browser. In this case, you need to create a custom page template.

Custom page templates are specific to a single entity in your data context. You create them by first creating a new folder inside the CustomPages folder. This folder should have the same name as your entity object. To create custom pages for working with products, for example, you would create a Products folder inside CustomPages. You then copy one or more of the page templates from the PageTemplates directory into your new folder. The Dynamic Data routing will look first in the CustomPages/EntityName folders for action pages such as Edit.aspx, Insert.aspx, and List.aspx. If the file it is looking for is there, it will use this custom page for display. If not, it will use the default action page inside the PageTemplates directory.

As an example, suppose you want to create a custom version of the List.aspx page for use with Products. You would create a Products folder in CustomPages. You would then copy the List.aspx page to that folder. You can then open this page and edit the markup and code-behind accordingly. A common edit is to bind the GridView control more tightly with the specific product. You can do so by setting the AutoGenerateColumns property to false. You can then add a series of DynamicField properties to represent your bound data. The following markup shows an example.

```
<asp:GridView ID="GridView1" runat="server"
    DataSourceID="GridDataSource" EnablePersistedSelection="true"
    AllowPaging="True" AllowSorting="True" CssClass="DDGridView"
    RowStyle-CssClass="td" HeaderStyle-CssClass="th" CellPadding="6"
    AutoGenerateColumns="false">
    <Columns>
        <asp:DynamicField DataField="ProductID" HeaderText="ID" />
        <asp:DynamicField DataField="ProductName" HeaderText="Name" />
        <asp:DynamicField DataField="UnitPrice" HeaderText="Price" />
        <asp:DynamicField DataField="UnitsInStock" HeaderText="Stock" />
        <asp:TemplateField>
            <ItemTemplate>
                <asp:DynamicHyperLink runat="server" Action="Edit" Text="Edit"/>
                &nbsp;<asp:LinkButton runat="server"
                CommandName="Delete" Text="Delete" OnClientClick=
                    'return confirm("Are you sure you want to delete this item?");'/>
                &nbsp;<asp:DynamicHyperLink runat="server" Text="Details" />
            </ItemTemplate>
        </asp:TemplateField>
    </Columns>
    <PagerStyle CssClass="DDFooter"/>
    <PagerTemplate>
        <asp:GridViewPager runat="server" />
    </PagerTemplate>
    <EmptyDataTemplate>
        There are currently no items in this table.
    </EmptyDataTemplate>
</asp:GridView>
```

Figure 12-31 shows this custom page running in a browser.


Products - Windows Internet Explorer

http://localhost:56754/lesson3-cs/List/Products.aspx

DYNAMIC DATA SITE

Back to home page

Products

Discontinued All

Category All

ID	Name	Price	Stock	
1	Chai	$30.00	39	Edit Delete Details
2	Chang	$19.00	17	Edit Delete Details
3	Aniseed Syrup	$10.00	13	Edit Delete Details
4	Chef Anton's Cajun…	$22.00	53	Edit Delete Details
5	Chef Anton's Gumbo…	$21.35	0	Edit Delete Details

Page 1 of 16 Results per page: 5

Insert new item

Done Trusted sites | Protected Mode: Off 100%

FIGURE 12-31 The custom page template being displayed in the browser.

Using Dynamic Controls in Existing Sites

You can use the features of Dynamic Data in existing sites. For example, you can add the full scaffolding and connect to a data context for CRUD operations, and you can create custom webpages (or customize existing ones) to take advantage of the lower code, lower markup solution that Dynamic Data offers.

Adding Dynamic Data Scaffolding to an Existing Website

You can add Dynamic Data scaffolding to an existing website. To do so, you must have a data context defined in your site (or you must create one). Remember, Dynamic Data works with either LINQ to SQL classes, the ADO.NET Entity Framework, or a custom data context.

You then edit the Global.asax file to register your context and enable custom routing. This code can be copied from the Global.asax file for a blank Dynamic Data site. Refer back to "Getting Started with Dynamic Data Websites" earlier in this lesson for details.

Finally, you copy the DynamicData folder from a blank Dynamic Data site into your existing site. You can then make customizations and use Dynamic Data features as discussed in prior sections.

Enabling Dynamic Data Inside a Webpage

You can use Dynamic Data inside completely custom webpages that do not use the scaffolding or routing common to Dynamic Data. For this scenario, you can create pages that use data-bound controls such as GridView, DetailsView, ListView, and FormView, and use Dynamic Data for displaying, editing, and validating data. In this case, you get the default behavior of Dynamic Data, including data validation. You can then customize this behavior by adding more information to your meta-model as described previously.

As an example, suppose you have a standard ASP.NET website (not one built with the Dynamic Data template). Suppose that this site has an ADO.NET Entity Data Model for working with the Northwind database.

You can then add an EntityDataSource control to the Default.aspx page for the site. This control can be set to use the entity model for selecting, inserting, updating, and deleting. Recall that you set EntitySetName to indicate the entity used by the data source. The following markup shows an example.

```
<asp:EntityDataSource ID="EntityDataSource1" runat="server"
    ConnectionString="name=northwndEntities"
    DefaultContainerName="northwndEntities" EnableDelete="True"
    EnableFlattening="False" EnableInsert="True" EnableUpdate="True"
    EntitySetName="Products">
</asp:EntityDataSource>
```

Next, you can add a data display control to the page. In this example, assume you add a GridView to the page. You would then configure this control to auto-generate columns and enable editing. The following markup shows an example.

```
<asp:GridView ID="GridView1" runat="server"
    DataSourceID="EntityDataSource1"
    AllowPaging="True" AllowSorting="True"
    AutoGenerateColumns="true">
    <Columns>
        <asp:CommandField ShowEditButton="True" />
    </Columns>
</asp:GridView>
```

The final step is to add code to the Page_Init event to enable the Dynamic Data. The following code shows an example.

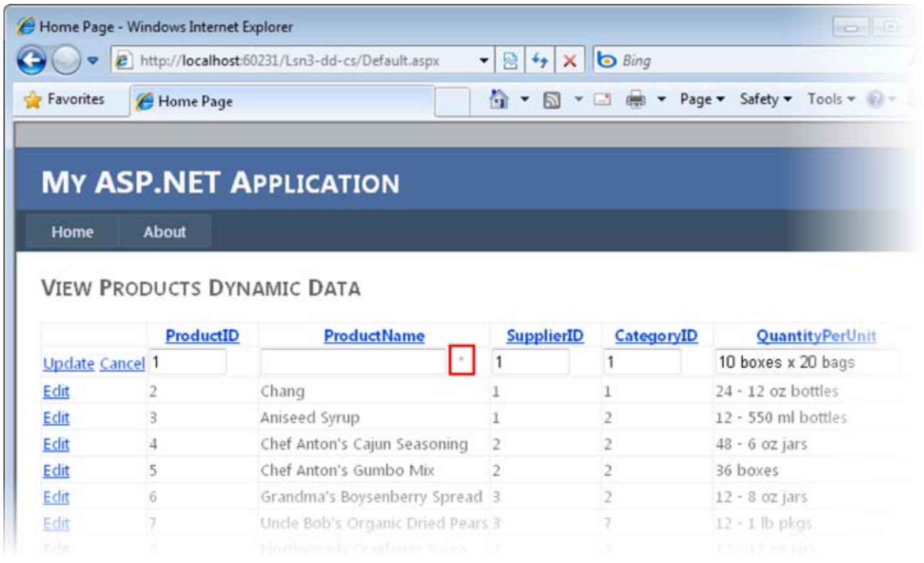
Sample of Visual Basic Code

```
Protected Sub Page_Load1(ByVal sender As Object, _
    ByVal e As System.EventArgs) Handles Me.Load

    GridView1.EnableDynamicData(GetType(northwndModel.Product));

End Sub
```

Sample of C# Code

```
protected void Page_Init()
{
    GridView1.EnableDynamicData(typeof(northwndModel.Product));
}
```

Figure 12-32 shows the results. Notice that the attempt to edit the first record failed. You can see the asterisk next to the ProductName field. This is because this field cannot be blank, as defined in the model. You can further customize this page to use even more features from Dynamic Data.


Home Page - Windows Internet Explorer
http://localhost:60231/Lsn3-dd-cs/Default.aspx
Bing
Favorites
Home Page
Page
Safety
Tools
Home
About

MY ASP.NET APPLICATION

VIEW PRODUCTS DYNAMIC DATA

	ProductID	ProductName	SupplierID	CategoryID	QuantityPerUnit
Update Cancel	1	*	1	1	10 boxes x 20 bags
Edit	2	Chang	1	1	24 - 12 oz bottles
Edit	3	Aniseed Syrup	1	2	12 - 550 ml bottles
Edit	4	Chef Anton's Cajun Seasoning	2	2	48 - 6 oz jars
Edit	5	Chef Anton's Gumbo Mix	2	2	36 boxes
Edit	6	Grandma's Boysenberry Spread	3	2	12 - 8 oz jars
Edit	7	Uncle Bob's Organic Dried Pears	3	7	12 - 1 lb pkgs.

FIGURE 12-32 Dynamic Data being used on a standard webpage.

Quick Check

1. What data models can you use with Dynamic Data?
2. Where do you register your data model with the site's MetaModel?
3. Which of the data annotation classes would you use to define metadata to change the display format of a property?

Quick Check Answers

1. Dynamic data must use a data model based on DataContext or ObjectContext. This includes LINQ to SQL classes and ADO.NET Entity Framework models.
2. You register your data context inside the Global.asax file.
3. You would use the DisplayFormatAttribute.

PRACTICE Creating a Dynamic Data Website

In this practice, you create a Dynamic Data website and edit the default routing.

ON THE COMPANION MEDIA

If you encounter a problem completing an exercise, you can find the completed projects in the samples installed from this book's companion CD. For more information about the project files and other content on the CD, see "Using the Companion Media" in this book's Introduction.

EXERCISE Creating a Dynamic Data Website and an Entity Model

In this exercise, you create a new Dynamic Data website, add a database to the site, and define an Entity Data Model. You then configure the site to work with the model and customize the routing.

1. Open Visual Studio and create a new ASP.NET Dynamic Data Entities Web Site. Name the site **DynamicDataLab**. Select your preferred programming language.
2. Add the northwnd.mdf file to your App_Data directory. You can copy the file from the samples installed from the CD.
3. Add an ADO.NET Entity Data Model to your site. Name the model **Northwind.edmx**. When prompted, allow Visual Studio to add this to your App_Code directory. Use the Entity Data Model Wizard to connect to all tables in the database; use the default settings throughout the wizard.
4. Open the Global.asax file. Inside RegisterRoutes, uncomment the line that calls RegisterContext. Change this code to register your new entity model and set ScaffoldAllTables to true. Your code should look as follows.

   Sample of Visual Basic Code

   ```
   'VB
   DefaultModel.RegisterContext(GetType(northwndModel.northwndEntities), _
       New ContextConfiguration() With {.ScaffoldAllTables = True})
   ```

   Sample of C# Code

   ```
   DefaultModel.RegisterContext(typeof(northwndModel.northwndEntities),
       new ContextConfiguration() { ScaffoldAllTables = true });
   ```

5. Run the application and view the results. Select Products. Click to edit a product. Notice the URL routing. On the product editing page, clear the name field and click update. Notice the validation that is displayed.

6. Return to the Global.asax file to enable routing to ListDetails.aspx. This page allows you to edit a row directly in the GridView as well as in a DetailsView on the same page. To enable row editing, comment out the routes.Add call for {table}/{action}. Then uncomment both routes.Add calls at the bottom of the method. Notice that these routes indicate that the List and Details actions should route to ListDetails.aspx. This page handles all other actions inline with the page.
7. Rerun the site. Select the Products table. Notice the new URL. Click the Edit link for a product in the GridView control. Notice the inline editing and data validation.

Lesson Summary

- There are two Dynamic Data website templates in ASP.NET: one for working with the Entity Framework and one for working with LINQ to SQL models. Both create a set of page and field template files inside the DynamicData folder. Both allow you to connect your data context to the site inside the Global.asax file.
- You can use the System.Web.Routing inside the Global.asax file to indicate how your Dynamic Data site maps entity requests and actions formatted in a URI to page templates.
- You use partial classes to extend the metadata of your data context. This metadata includes attributes from the DataAnnotations namespace that define display formatting properties and validation rules.
- You can write additions to the OnChanging partial methods from your data context model to extend individual properties to include additional business logic.
- You can create custom field templates that change how properties are displayed and edited. These field templates inherit from FieldTemplateUserControl. You apply a custom field template as metadata to a property in your partial entity class by using the UIHintAttribute.
- You can create custom page templates that are entity specific inside the CustomPages folder. You add a folder with the same name as your entity. You then define custom action pages such as List.aspx and Edit.aspx.
- You can use the EnableDynamicData method of the data view controls (such as GridView) to add Dynamic Data features to existing websites that do not contain the standard scaffolding.

Lesson Review

You can use the following questions to test your knowledge of the information in Lesson 3, "Working with ASP.NET Dynamic Data." The questions are also available on the companion CD in a practice test, if you prefer to review them in electronic form.

NOTE **ANSWERS**

Answers to these questions and explanations of why each answer choice is correct or incorrect are located in the "Answers" section at the end of the book.

1. You need to add metadata to your data context object, Invoice, in order to change how invoices are handled by Dynamic Data. Which actions should you take? (Choose all that apply.)
   - **A.** Create a new partial class called Invoice in the App_Code directory.
   - **B.** Create a new class called InvoiceAnnotations in the App_Code directory.
   - **C.** Decorate the Invoice class with the MetadataTypeAttribute class.
   - **D.** Decorate the InvoiceAnnotations class with the ScaffoldTableAttribute class.
2. You have defined a custom field template user control for changing the way an Invoice number is edited. You want to apply this control to the Invoice.Number property. Which data annotation attribute class would you use to do so?
   - **A.** MetadataType
   - **B.** Display
   - **C.** Editable
   - **D.** UIHint
3. You want to implement custom business logic that should run when the InvoiceNumber property is modified. What actions should you take? (Choose all that apply.)
   - **A.** Add a CustomValidator control to the DynamicData/FieldTemplates/Integer_Edit.asax file. Set this control to process custom logic to validate an invoice number.
   - **B.** Extend the OnInvoiceNumberChanged partial method inside the Invoice partial class to include additional validation logic.
   - **C.** Extend the OnInvoiceNumberChanging partial method inside the Invoice partial class to include additional validation logic.
   - **D.** If the logic fails, throw a ValidationException instance.

Case Scenarios

In the following case scenarios, you apply what you've learned in this chapter. If you have difficulty completing this work, review the material in this chapter before beginning the next chapter. You can find answers to these questions in the "Answers" section at the end of this book.

Case Scenario 1: Choosing Data Source Controls

You are a developer at Contoso, Ltd, a car insurance company. You have been asked to write an application that allows a customer service agent to provide an insurance quote to a customer over the phone. However, there are many factors that go into pricing the insurance policy. Each of these factors contains data from different sources. This data is displayed to the agent for selection. Based on his or her selection, a price is generated.

You identify most of the data sources as follows:

- **Location premium markup data** Provided as XML from a web service.
- **Year, make, and model rates** Provided inside a SQL Server database.
- **Driver history** Provided through an XML web service.
- **Existing customer information** Provided through a shared customer object to which the application has a reference.

Thinking about how you will access the data, answer the following questions:

1. Which data source control would you use for accessing the data returned by the location and driver history web services? How would you configure the data source control to receive this data?
2. Which data source control would you use for accessing the year, make, and model rate data?
3. How would you access the data provided by the customer object?

Case Scenario 2: Implementing a Master-Detail Solution

You are a developer who is creating a webpage for displaying customers and their orders in a master-detail scenario. The top of the webpage will provide a list of customers that contains the customer numbers and names. The bottom of the webpage will provide a list of the orders containing the order numbers, the order dates, the order amounts, and the ship dates. The orders will be displayed for the customer that is selected.

Thinking about how you will display your data, answer the following questions:

1. What controls would you use to display the customer and orders?
2. If you want to use this webpage to add customers and orders, what are some ways that you can provide this functionality?

Case Scenario 3: Adding ASP.NET Dynamic Data to a Website

You are a developer working on an existing website. There are several core tables in the database that users cannot edit. This is becoming a problem, because maintenance is needed. You have been asked to quickly enable this editing for some of these tables not already exposed by the functionality of your website.

Answer the following questions about how you would enable this functionality using Dynamic Data.

1. How can you add Dynamic Data scaffolding to this existing site?
2. How would you indicate which tables to expose through Dynamic Data?

Suggested Practices

To help you successfully master the exam objectives presented in this chapter, complete the following tasks.

Create Pages by Using Each of the Controls

For this task, you should complete Practice 1 for the data source controls. Practice 2 should be completed for additional use of the data-bound web controls. If attempting Practice 2, you should complete Practice 1 first. Practice 3 provides experience with using the insert, update, and delete parts of a data source control.

- **Practice 1** Create a new website and add a new page for each of the data source controls in this chapter, especially those not defined in the practice for Lesson 1. Configure these controls to access data.
- **Practice 2** Add the ability to display the data defined in the pages in Practice 1. For each data source, select a different display control. Use the Menu control for XML data. Also, be sure to define a layout control that uses templates.
- **Practice 3** Return to the practice for Lesson 1. Edit the site to enable customer editing.

Create a Master-Detail Solution by Using the Data-Bound Server Controls

This practice gives you experience with using data-bound server controls.

- Create a new website that uses a domain familiar to you, such as customers and orders, owners and vehicles, employees and sick days, or albums and songs. Add a webpage that is configurable as a master-detail page to provide access to related data.

Work with Dynamic Data Websites

For this task, you should complete Practices 1 and 2 to gain experience creating custom field and page templates. Complete Practice 3 for experience with using Dynamic Data outside a Dynamic Data website.

- **Practice 1** Return to the practice from Lesson 3. Create a custom field template for selecting dates. Use the CalendarPicker example from the chapter. Apply this control to date values in the site.
- **Practice 2** Return to the practice from Lesson 3. Create a custom page template for displaying only portions of an Employee object.
- **Practice 3** Create a new, standard ASP.NET website. Define a data context connected to a database. Enable Dynamic Data for a single page within the site (without adding the scaffolding support).

Take a Practice Test

The practice tests on this book's companion CD offer many options. For example, you can test yourself on just the lesson review questions in this chapter, or you can test yourself on all the 70-515 certification exam objectives. You can set up the test so it closely simulates the experience of taking a certification exam, or you can set it up in study mode so you can look at the correct answers and explanations after you answer each question.

MORE INFO **PRACTICE TESTS**

For details about all the practice test options available, see the "How to Use the Practice Tests" section in this book's Introduction.