Web Application Programming

• Simple HTML is ok for “static pages”
  – When there’s no user input and no processing
• But “real” web apps may do many other things
  – May receive input from users on the client side
  – May need to retrieve data from a database
  – May perform computations
  – The HTML they return to browsers will change depending on input and results
  – Client side is easy, but restricted
    • Just use ordinary HTML
    • Or scripts that run on the client side
      – e.g., JavaScript or VBscript
  – What about server side?
Form Tags and the Server Side

- The heart of most real web apps that accept input is the HTML Form tag: `<form> … </form>
- Some fields (lots of them):
  - `<input type="text" … />`  
    - Browser renders this tag as a textbox input field
  - `<input type="submit" … />`  
    - Browser renders this as a push button
    - When clicked, Form is submitted to the Web Server
    - Textbox input values are also submitted to the Server
    - If there’s no method attribute or if form contains a method="get" tag:
      » Browser sends an HTTP GET command to server with user input appended (e.g., user enters 2 & 3 for text fields named op1 & op2):
        GET /calc.html?op1=2&op2=3 HTTP/1.1
    - If the form has a method="post" attribute:
      » Form is submitted with an HTTP POST command with user input in the body of the HTTP request

Postback

- When user input from an HTML Form is submitted back to the server, a “postback” has occurred
  - Look at http://localhost/calc.html
    - “View” | “Source” to see html
    - Click “=” & look in browser address bar to see GET postback data
- The Server should respond to the postback by extracting the user input and generating html to display the data and the results
- An important reality: HTML is “stateless”
  - A page stores no information about its contents from one invocation to another
  - So server side code must be running to extract the user input and generate a new web page that displays the desired result
    - … and restore the original data if needed and if it is to be visible
Server Response in calc.html Form

– Calc Form allows user to enter two numbers to be added
– Pressing “=” button submits numbers to server
– Original numbers and sum should be returned to browser
– Server should generate something like the following HTML in response to user entering 2 and 3 and clicking the “=” button:
  
  ```html
  <html>
  <body>
  <form>
  <input type="text" name="op1" value="2" />
  +
  <input type="text" name="op2" value="3" />
  <input type="submit" value=" = " />
  5
  </form>
  </body>
  </html>
  ```

– Note: generating repeat input values gives illusion user is seeing one Web page when really we’re seeing two pages in succession

Generating the Server Response

• One way:
  – Use the Common Gateway Interface (CGI)
    • A low-level programmatic interface between web servers and applications that run on Web servers
    • A server-side program script that reads inputs, computes, and writes http responses back to browser
    • Usually written in Perl, but can be done in other languages (C)
    • Hard to use, slow, and has security issues
    • Not used much any more except on UNIX-based Web servers
Programming Web Apps Using ASP

- Mix HTML & server-side scripts in a single .asp file
  - Scripts usually written in VBScript or JavaScript
    - Interpreted, so it can be slow
  - Make it easy to write code that generates html content dynamically
- When an ASP page is requested, the page is parsed by the Server and any scripts it contains are executed
  - ASP Request object accesses input
  - ASP Response object writes HTML to the HTTP response
  - The following example uses VBScript code between `<%` and `%>` tags to check incoming requests for inputs named op1 & op2
    - VB script converts them to integers, adds them, converts result to a string, and writes string to http response using Response.Write()
  - Note the HTML returned (“View” | “Source”)
- ASP provides an easy way to dynamically generate HTML on Web servers

Calc.asp Example Program

```html
<%@ Language = "VBScript" %>

<html>
<body>
<form>
  <input type="text" name="op1" value="<%= Request ("op1") %>">
  +
  <input type="text" name="op2" value="<%= Request ("op2") %>">
  <input type = "submit" value="= ">
  <% 
  If Request ("op1") < > "" And Request ("op2") < > "" Then
    a = CInt (Request("op1"))
    b = CInt (Request("op2"))
    Response.Write (CStr (a + b))
  End If
  %>
</form>
</body>
</html>
```
Problems with ASP

• ASP is a good solution for doing server-side processing of HTML Form input and dynamically generating HTML
  – Higher level of abstraction than CGI
  – Also integrates seamlessly with ADO data bases
• But it has some problems
  – Interpreted scripts means slow execution
  – ASP has no true encapsulation model
    • Can’t build reusable controls that encapsulate complex rendering and behavior logic
    • No event model as for Windows Forms
• ASP.NET – the new Microsoft solution

ASP.NET and Web Forms

• Web Forms are built from a combination of HTML, scripts, and server controls
  – Some examples: Button, TextBox, Label, DropDownList
  – Defined in classes in System.Web.UI.WebControls
• Object oriented
  – Whenever a Web page with server control objects is requested:
    • ASP.NET tells each object to render itself into HTML
    • HTML returned by controls is included in the HTTP response
    • Scripts (with event handlers) are executed as in ASP
ASP.NET Controls

- **Server Control** tag HTML general format:
  ```html
  <asp:Control properties event-handler="handler-ftn" RunAt="server" />
  ```
  - Button Control example:
    ```html
    <asp:Button Text=" = " OnClick="OnAdd" RunAt="server" />
    ```
    - Text=" = " Text property (= sign is displayed on button)
    - OnClick="OnAdd" Wires OnAdd event handler to button’s Click event
    - RunAt="server" attribute
      - Signals ASP.NET is to execute the tag rather than treat as static HTML
      - Must be used with every tag that ASP.NET is to process

- **Server Control script**
  - Specify language and content of event handlers
  - Following example script’s Click handler reads Text properties of TextBoxes ("op1" & "op2") and converts them to integers
  - Result is converted to a string & put into “Sum” Label’s Text property

- **Example calc.aspx (coded manually)**
  - Put it into \Inetpub\wwwroot IIS root virtual directory
    - IIS must be running on the computer
  - Run locally by typing http://localhost/Calc.aspx

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**Calc.aspx**

```html
<html>
<body>
<form runat="server">
  <asp:TextBox ID="op1" RunAt="server" />
  +
  <asp:TextBox ID="op2" RunAt="server" />
  <asp:Button Text=" = " OnClick="OnAdd" RunAt="server" />
  <asp:Label ID="Sum" RunAt="server" />
</form>
</body>
</html>
```

```c#
<script language="C#" RunAt="server">
void OnAdd (Object sender, EventArgs e)
{
  int a = int.Parse(op1.Text);
  int b = int.Parse(op2.Text);
  Sum.Text = (a + b).ToString();
}
</script>
```
**HTML Returned by calc.aspx**

```html
<html>
<body>
<form name="_ctl0" method="post" action="calc.aspx" id="_ctl0">
<input type="hidden" name="__VIEWSTATE" value="dDwxOTE0NDY4ODE2O3Q8O2w8aTwxPjs+O2w8dDw7bDxpPDc+Oz47bDx0PHA8cDxsPFRleHQ7PjtsPDU7Pj47Pjs7Pjs+Pjss+dBISuMwmkqCcHr+yOoms28nF+A0=" />
<input name="op1" type="text" value="2" id="op1" />
+ 
<input name="op2" type="text" value="3" id="op2" />
<input type="submit" name="_ctl1" value=" = " />
<span id="Sum">5</span>
</form>
</body>
</html>
```

**What Has ASP.NET Done?**

- (Look at “View” | “Source” after entering data and clicking “=”)
- ASP.NET has:
  - Turned TextBox controls into `<input type="text">` form tags
  - Turned Button control into `<input type="submit">` form tag
  - Turned Label control into `<span>` (formatting) form tag
- The controls project a user interface by rendering themselves into HTML
What Happened?

• User clicks “=” button
  – Form is posted back to the server
  – ASP.NET notifies the Button object and the Button responds by firing a Click event on the Server
  – ASP.NET then calls the OnAdd() handler
    • (We write this)
  – In calc.aspx, it computes the sum, converts it to a string, and puts it in the Sum label’s Text property
  – ASP.NET then renders the result into an HTML page
  – Since Sum.Text is now a non-null string, output of the Sum label control includes that string inserted between <span> tags
  – Page is returned to the browser

__VIEWSTATE Tag

• Mechanism ASP.NET uses to round-trip data from client to server back to client
• Recall HTML is stateless
  – Nothing is remembered when a new page replaces the old one
  – So how do we determine if the state changed?
  – View State
    • A place where controls can store their state in a way that it remains valid from one request to the next
    • Especially useful for controls that fire change events
  – View State is transmitted to the client in a hidden control and transmitted back to the server with the Form’s postback data
    • VIEWSTATE tag contains all data encoded so that ASP.NET can detect changes to the page and fire change events
Using VS Designer to Create Web Forms

- **“File”** | **“New”** | **“Web Site”** | **“ASP.NET WebSite”**
  - Language: Visual C#
  - Location possibilities:
    - **File System** for a local Web Form that cannot be served to other machines
      - Browse to a parent directory and enter a Directory name
      - Physical directory of project files: C:\ParentDirectory\DirectoryName
        » URL will be: http://localhost:PortAddress/ParentDirectory/DirectoryName
        » PortAddress will be assigned by Visual Web Developer
    - **HTTP** means IIS will be used to serve the page from a virtual directory
      - Project files will be in physical directory C:\Inetpub\wwwroot\DirectoryName
        » The URL will be http://localhost/DirectoryName/FormName (from same machine)
        » http://HostMachineName/DirectoryName/FormName (from another machine)
  - In either case .sln solution file will be in a separate new directory:
    - C:\My Documents\Visual Studio 2005\Projects\DirectoryName
  - Two source files generated: default.aspx and default.aspx.cs
    - Separates the HTML from the C# code script
    - Called code-behind programming

- In Solution Explorer, right click on the default.aspx file to rename it
  - Also change the class name in the .aspx.cs file
  - Also change name after Inherits= in first line of the .aspx file so it is the same as the new name (without file extensions)
- Drag and drop server controls from the tool box
- Set properties, add event handlers as for Windows Forms applications
- Edit the skeleton code generated by the Designer
- Start the Web application
  - Debug | Start Without debugging
  - In a “File System” project the Visual Web Developer Web server is started
    • There’s an icon on the task bar
      - When double clicked a bubble msg appears giving the physical and logical address of the Web server and the port the server is listening to
Validation Web Controls

- Determine whether data in another control is in correct format
  - Provide a mechanism for validating user input on the client
- Validation is performed on the server side
- To use: attach validation control to an input control and set an error message
  - At run time, when user inputs data, the error message is displayed if the validation rule is violated

Some Validation Controls

<table>
<thead>
<tr>
<th>Control</th>
<th>Purpose</th>
<th>Properties to Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>RequiredFieldValidator</td>
<td>User must enter something in field</td>
<td>ControlToValidate, ErrorMessage</td>
</tr>
<tr>
<td>CompareValidator</td>
<td>Compare value in field to another value</td>
<td>ControlToValidate, ControlToCompare or ValueToCompare, Type, ErrorMessage</td>
</tr>
<tr>
<td>RangeValidator</td>
<td>Makes sure input value falls in specified range</td>
<td>ControlToValidate, Minimum Value, Maximum Value, Type, ErrorMessage</td>
</tr>
<tr>
<td>RegularExpressionValidator</td>
<td>Validates against a regular expression such as required number of digits or a formatted value (e.g., SS #)</td>
<td>ControlToValidate, ValidationExpression, ErrorMessage</td>
</tr>
<tr>
<td>ValidationSummary</td>
<td>Displays a summary of all messages from other validation controls</td>
<td>Display Mode</td>
</tr>
</tbody>
</table>

- These controls are in the Designer tool box and can be dragged over
- TestWeb Example: Using a RequiredFieldValidator
Using a Virtual Directory

• If you don’t want to clutter up the Inetpub\wwwroot directory on the target computer, put your program into a virtual directory

• Creating a Virtual Directory on target machine
  – “Start” | “Control Panel” | “Administrative Tools”
  – Start “Internet Information Services”
    • In left pane expand the Local Computer\Web Sites folder
    • Select Default Web Site
    • From “Action” menu item
      – “New” | “Virtual Directory”
      – Starts the Virtual Directory Creation Wizard
        » Type in an alias name for the directory
        » Enter or browse to the path of the desired directory
        » Click “Next” and “Finish”

• To run the app, type URL address into browser:
  http://machine-name/alias-name/pgm-folder/pgm-name.aspx