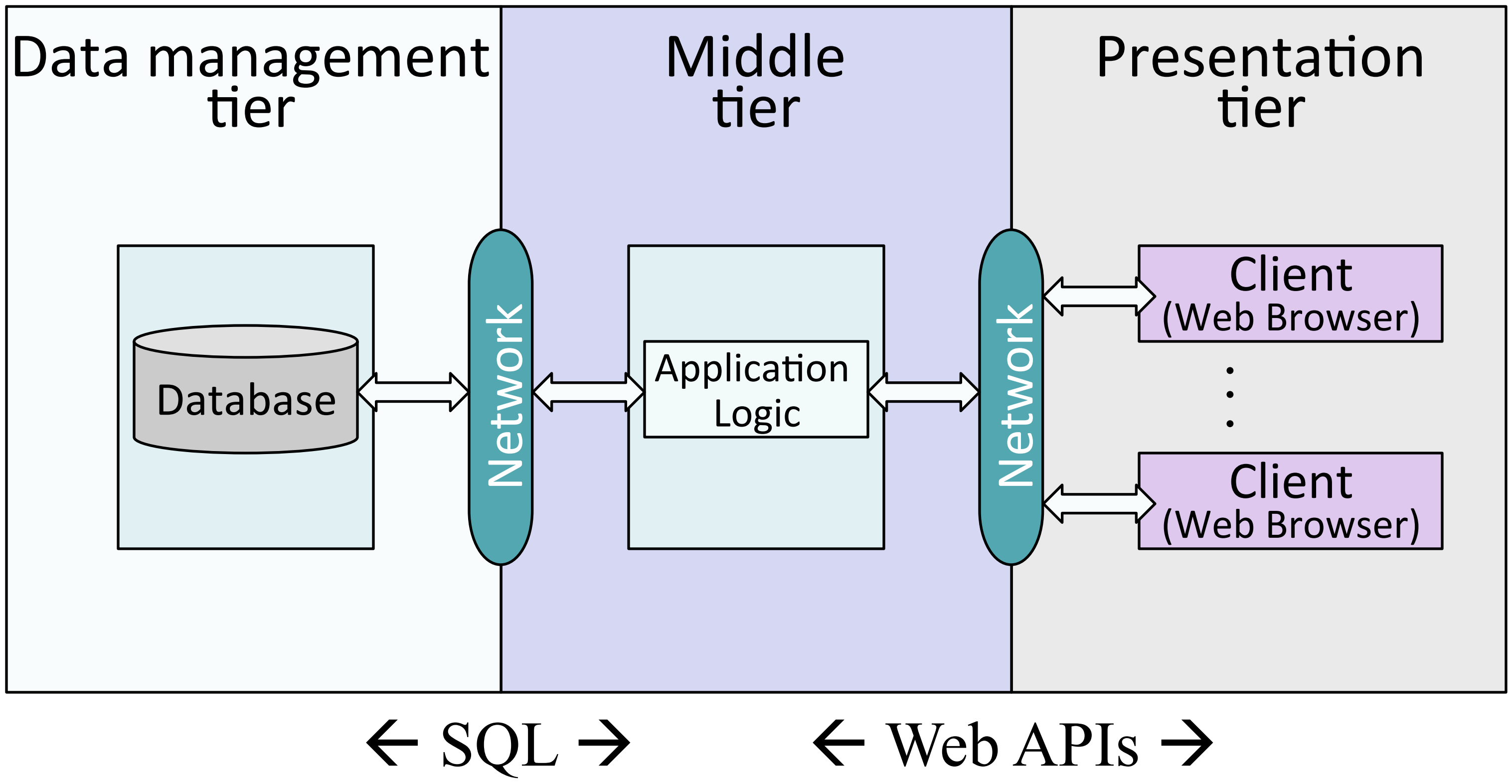
Databases and Internet Applications

Part 2

Chapter 7.5-7.9

Had there been no horses.

Review: Three-Tier Architecture



Lecture Overview

- Internet Concepts
- Web data formats
  - HTML, XML, DTDs
- Introduction to three-tier architectures
- The presentation layer
  - HTML forms; HTTP Get and POST, URL encoding; Javascript; Stylesheets. XSLT
- The middle tier
  - CGI, application servers, Servlets, JavaServerPages, passing arguments, maintaining state (cookies)

Overview of the Presentation Tier

- Recall: Functionality of the presentation tier
  - Primary user interface
  - Needs to adapt to different display devices (PC, PDA, smart phone, voice access?)
  - Simple functionality, such as field validity checking
- We will cover:
  - HTML Forms: How to pass data to the middle tier
  - JavaScript: Programmable functionality at the presentation tier (e.g., form checking, simple animations)
  - Style sheets: Present the same webpage with customized formatting for clients with different capabilities.

HTML Forms

- Common way to *communicate data* from client to middle tier
- General format of a *form*:

```
<FORM  ACTION="page.jsp"  METHOD="GET" NAME="LoginForm">
…
</FORM>
```

- Inside an HTML form,
  - We have form elements that allow the user to enter information in a form
  - We can use any HTML tags

Attributes of Form Tag

```
<FORM  ACTION="page.jsp"   METHOD="GET" NAME="LoginForm">
…
</FORM>
```

- ACTION: Specifies URI of the page to which the form contents are submitted (if absent, URI of current page is used)

  → the page provides logic for processing input from the form.

- METHOD: Specifies HTTP GET or POST method for form submission (GET arguments are part of the URI, POST arguments are part of the request)

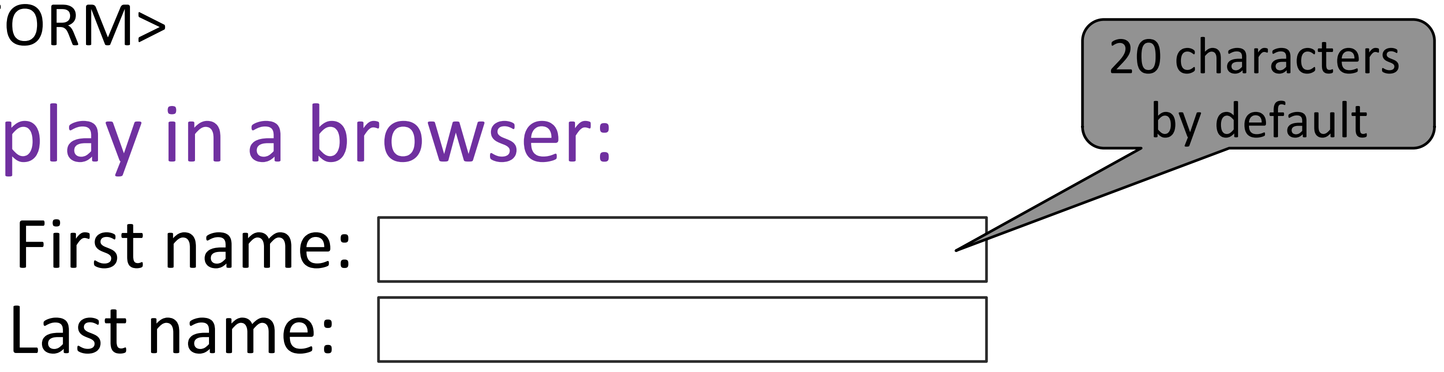
- NAME: Name of the form; can be used in client-side scripts to refer to the form (more on this later)

Form Element - Example 1

- INPUT is the most used form tag:

```
<FORM>
First name:
<INPUT TYPE="text" NAME="firstname">
<br>
Last name:
<INPUT TYPE="text" NAME="lastname">
</FORM>
```

- Display in a browser:



Form Element - Example 2

- Using radio buttons:

```
<FORM>
<INPUT TYPE="radio" NAME="status" VALUE="U" checked />
   Undergraduate<br>
<INPUT TYPE="radio" NAME="status" VALUE="G" />
   Graduate
</FORM>
```

- Display in a browser:

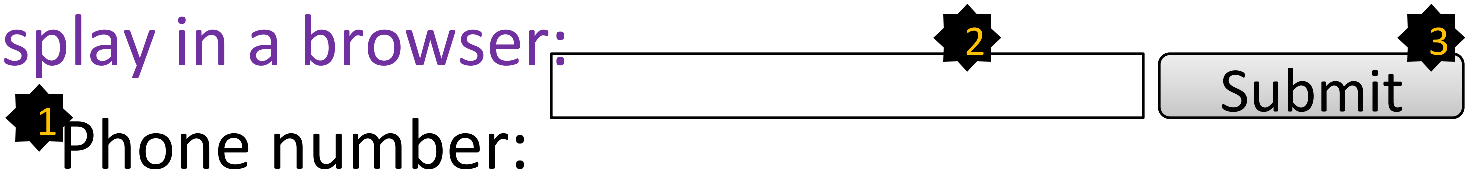
◉ Undergraduate
○ Graduate

Form Element - Example 3

- Using Submit botton:

```
  <FORM ACTION=“phone.jsp” METHOD=“GET”
1    NAME=“Phone”>
2 Phone number:
3 <INPUT TYPE=“text” NAME=“phonenum”>
  <INPUT TYPE=“submit” VALUE=“Submit”>
  </FORM>
```

- Display in a browser:



- When “Submit” button is clicked, the content of the form is sent to the page called phone.jsp on the server
- The page named action needs to be a program, script, or page that will process the user input

INPUT - General Format

<INPUT TYPE="text" NAME="username" VALUE="Joe">

text: a text input field

password: a text field where the entered characters are displayed as stars

reset: a button that resets all input fields

submit: a button that sends the values in the form to the server

- Specifies the symbolic name for this element
- Used to identify the associated input when sent to the middle tier

- Specifies default value for text or password fields
- For submit or reset buttons, it sets the label of the button

Three Types of User Input

- INPUT tag
  - *button*, *checkbox*, *file*, *hidden*, *image*, in addition to password, radio, reset, submit, text
- TEXTAREA tag
  - A multi-line box for text entry with ROWS, and COLS attributes to set the size
- SELECT tag
  - Choose one of multiple choices via a drop-down list or some other GUI element
  - Block enclosing OPTION tags; returns "value" of selected one

Passing Arguments

Two methods for submitting HTML Form data to the Web server:

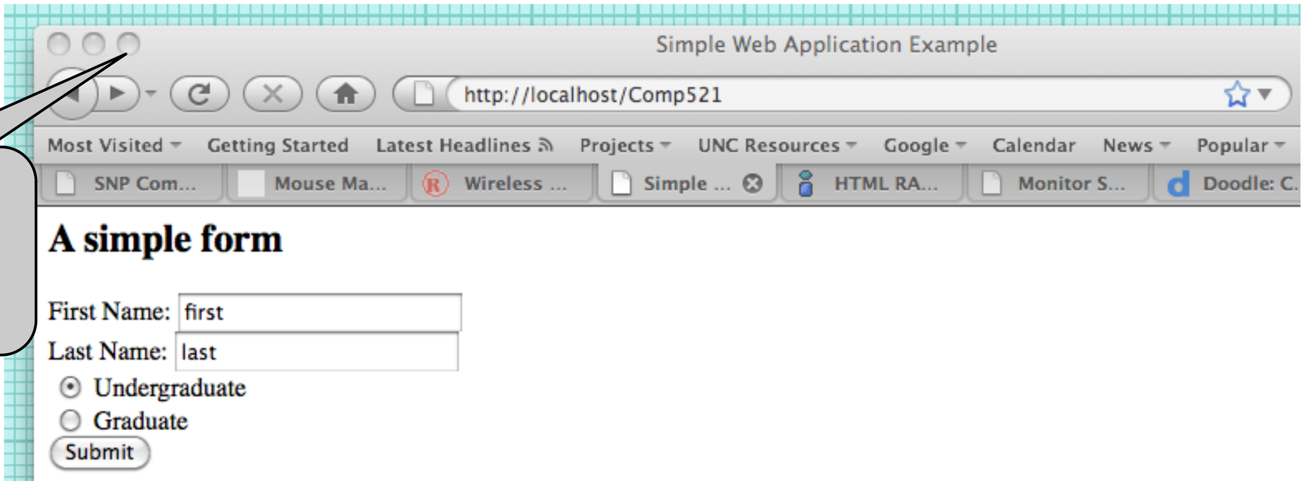
❖GET:

- The contents of the form are assembled into a query URI (i.e., Middle tier request URI actually contains data from the form)
- The form contents are directly visible to the user as the constructed URI
- The users can bookmark the page with the constructed URI

❖POST:

- The contents of the form are encoded as in the GET method, but the they are sent as a separate data block in the request
- The form contents are sent inside the *HTTP request message body* and are not visible to the user

GET



Simple Web Application Example

http://localhost/Comp521

A simple form

First Name: first

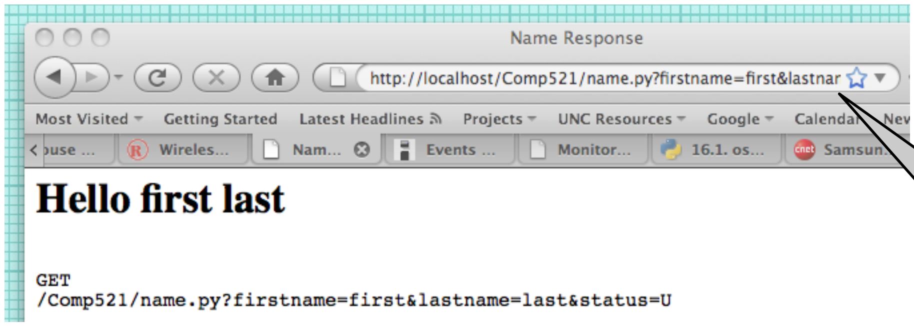
Last Name: last

(●) Undergraduate

( ) Graduate

Submit

Before clicking on "Submit"



Name Response

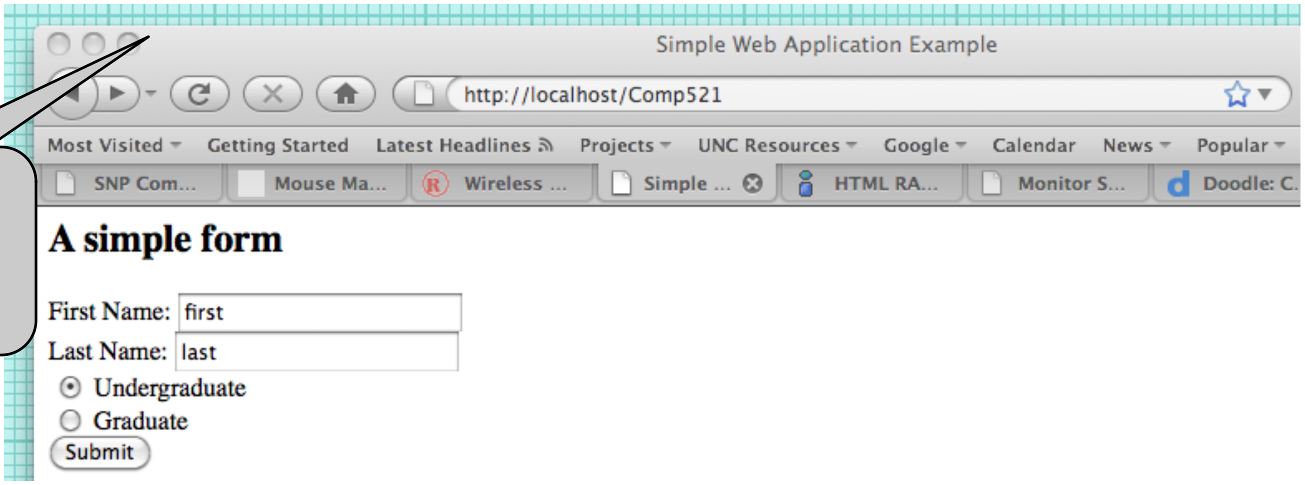
http://localhost/Comp521/name.py?firstname=first&lastnar

Hello first last

```
GET
/Comp521/name.py?firstname=first&lastname=last&status=U
```

After clicking on "Submit"

POST



Before clicking on "Submit"

A simple form

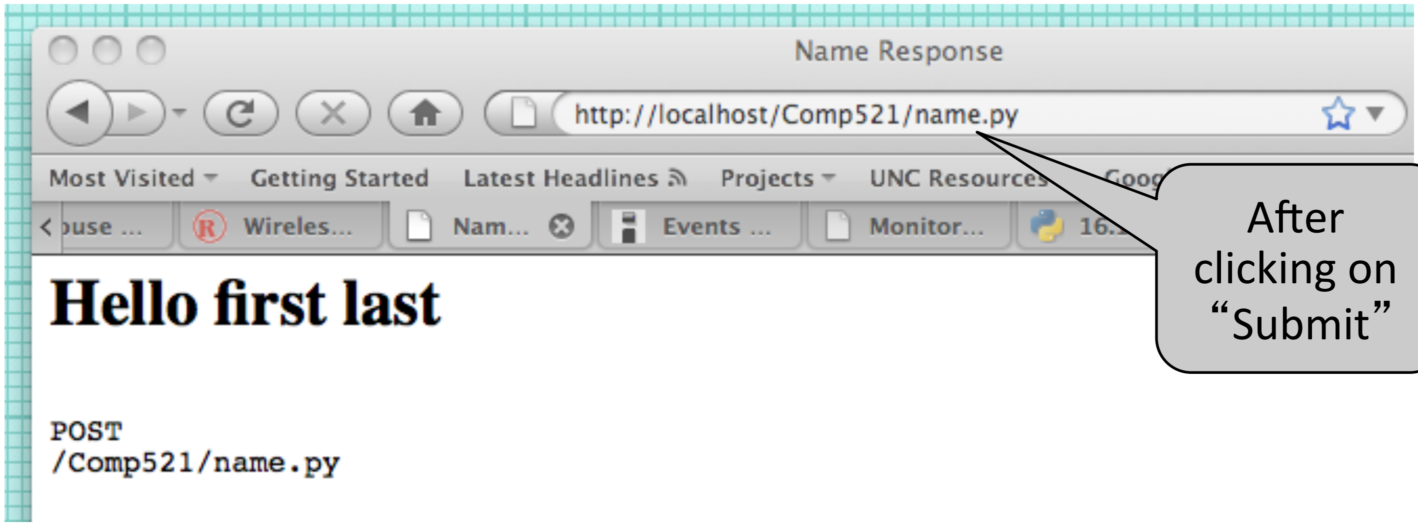
First Name: first

Last Name: last

[✓ Undergraduate]

Graduate

Submit

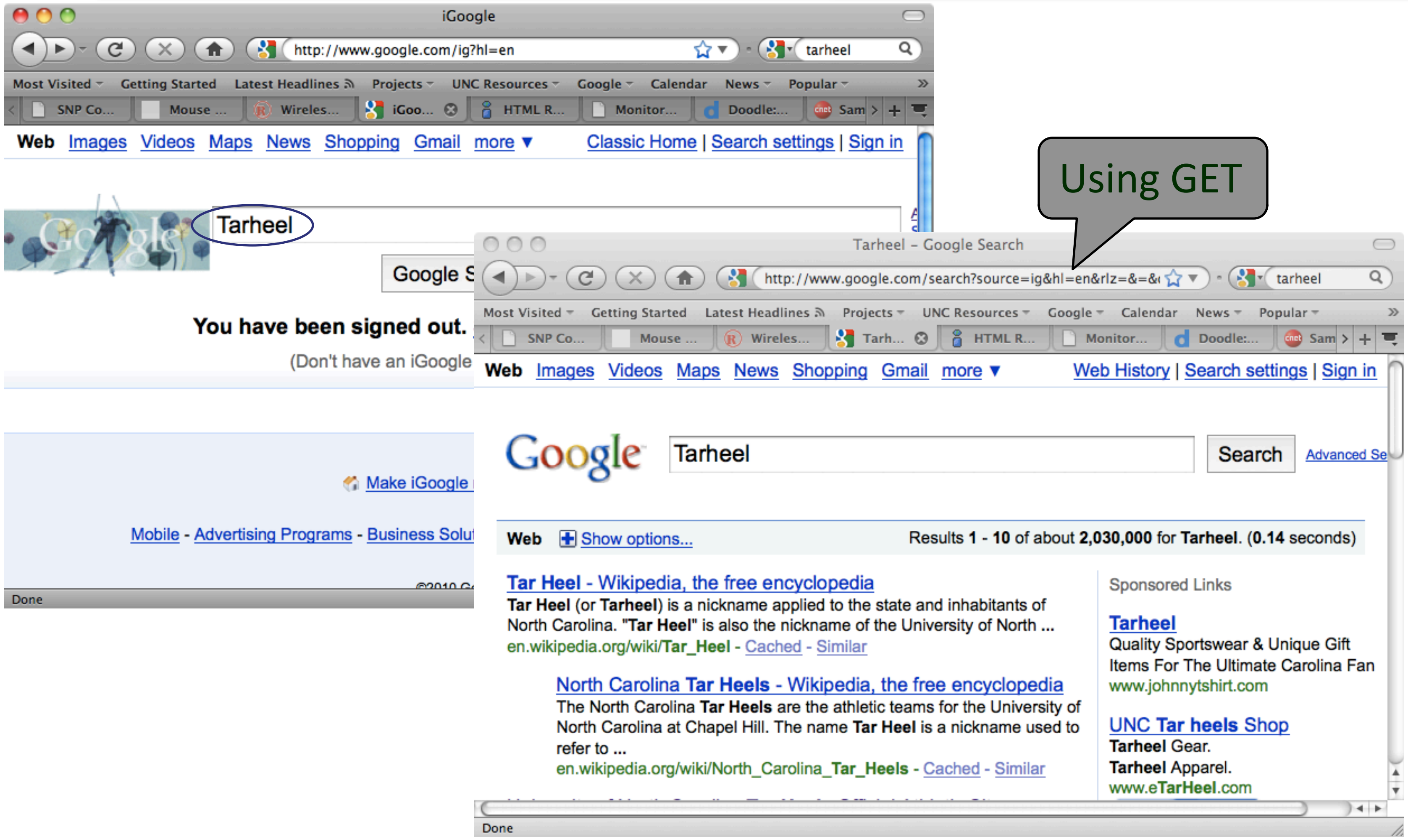


After clicking on "Submit"

Hello first last

```
POST
/Comp521/name.py
```

Example: Google Search



iGoogle
http://www.google.com/ig?hl=en
tarheel
Most Visited Getting Started Latest Headlines Projects UNC Resources Google Calendar News Popular
Web Images Videos Maps News Shopping Gmail more
Classic Home | Search settings | Sign in
Tarheel
Google S
Make iGoogle
Mobile - Advertising Programs - Business Solut
Done
Using GET
Tarheel – Google Search
http://www.google.com/search?source=ig&hl=en&rlz=&=&
Web History | Search settings | Sign in
Search
Advanced Se
Done

You have been signed out.

(Don't have an iGoogle

Web Show options... Results 1 - 10 of about 2,030,000 for Tarheel. (0.14 seconds)

Tar Heel - Wikipedia, the free encyclopedia
Tar Heel (or Tarheel) is a nickname applied to the state and inhabitants of North Carolina. "Tar Heel" is also the nickname of the University of North ...
en.wikipedia.org/wiki/Tar_Heel - Cached - Similar

North Carolina Tar Heels - Wikipedia, the free encyclopedia
The North Carolina Tar Heels are the athletic teams for the University of North Carolina at Chapel Hill. The name Tar Heel is a nickname used to refer to ...
en.wikipedia.org/wiki/North_Carolina_Tar_Heels - Cached - Similar

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Encoded URI

Only shown for GET method

action?name1=value1&name2=value2&name3=value3

The action is the URI specified in the ACTION attribute of the FORM tag

'name=value' pairs are the user inputs from the INPUT fields in the form

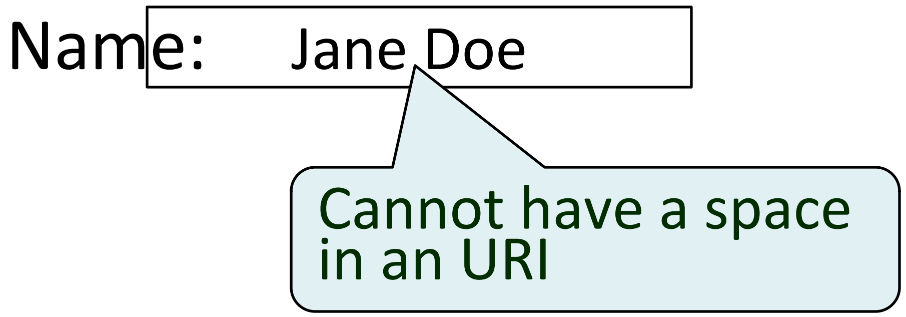
Example:

page.py?username=John+Doe&password=secret

'+' represents a space character

HTTP GET: Encoding Form Fields

- Form fields can contain general ASCII characters that cannot appear in an URI (e.g., space character)


Name: Jane Doe

Cannot have a space in an URI

- A special encoding convention converts such field values into "URI-compatible" characters:

HTTP GET: Encoding Form Fields

❖ Overview of the encoding convention :

1. Converts all spaces to the "+" character
2. Glue (name,value)-pairs from the form INPUT tags together with "&" to form the URI

```
page.py?coursename=Database+Systems&CourseID=Comp521
```

First INPUT

Second INPUT

3. Convert all "special" characters to %xyz, were xyz is the ASCII code of the character. Special characters include &, =, +, %, etc.

Clientside Scripting

- JavaScript is an interpreted scripting language
  - A JavaScript is a program added to a Web page.
  - It runs at the client tier to add functionality to the presentation
- Sample applications:
  - Browser Detection: Detect browser type and load browser-specific page.
  - Form validation: Validate form input fields (e.g., an email address contains '@'), or if all required fields have input data.
  - Browser control: Open new windows (e.g., pop-up ads)

JavaScript: SCRIPT Tags

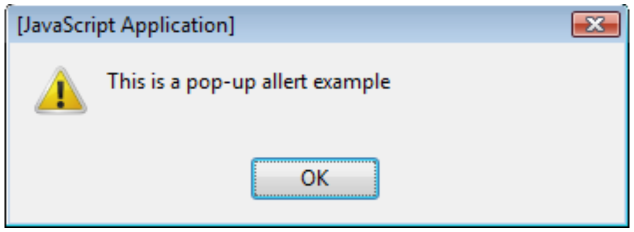
- A JavaScript is usually embedded inside the HTML with the <SCRIPT> … </SCRIPT> tag.
- <SCRIPT> tag has several attributes:
  - LANGUAGE: indicates language of the script (such as JavaScript)
  - SRC: Specifies the external file with the script code
- Example:

```
<SCRIPT LANGUAGE="JavaScript" SRC="validate.js">
   </SCRIPT>
```

JavaScript without SRC Attribute

- If <SCRIPT> tag does not have an SRC attribute, then the JavaScript code is enclosed within the tag of the HTML file.
- Example: Create a pop-up box with a message

```
<SCRIPT LANGUAGE="JavaScript">
<!-- alert("This is a pop-up alert example")
//-->
</SCRIPT>
```


[JavaScript Application]

This is a pop-up allert example

- Two different commenting styles
  - <!-- marks the start of an HTML comment
  - // marks the start of a JavaScript comment
  - <!-- indicates the following JavaScript code should be ignored by the HTML processor
  - // comment is used to comment out the HTML "-- >" comment as it is interpreted otherwise

Two Different Commenting Styles

- "//…" is used for single-line comments
- "/* … */ " is used for multi-line comments

JavaScript Basics

- Variables:
  - numbers, boolean values, strings, …
  - Variables do not have a fixed type, but implicitly have the type of the data to which they have been assigned
- Assignments: =, +=, …
- Comparison operators: <,>,…
- Boolean operators: && for logical AND, || for logical OR, ! for negation
- Statements
  - if (condition) {statements;} else {statements;}
  - Loops: for-loop, do-while, and while-loop
- Functions with return values

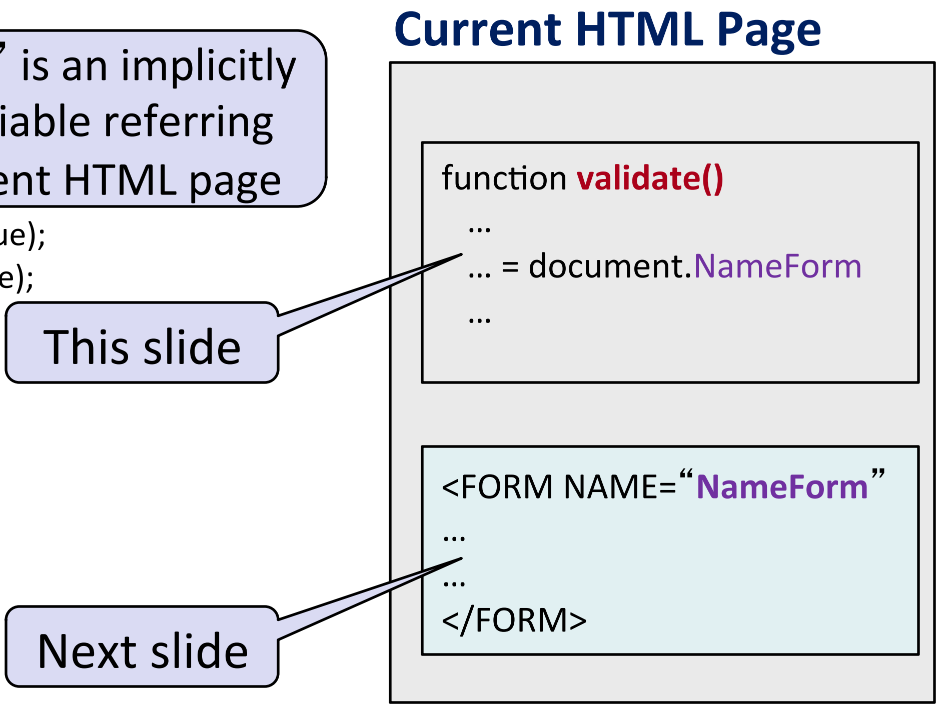
  function funcname(arg1, …, argk) {statements;}

A Complete Example

```
<script language="JavaScript">
<!--
function strip(strval) {
   while (strval.charAt(0) == ' ') {
       strval = strval.substr(1);
   }
   while ((strval.length > 0) && (strval.charAt(strval.length - 1) == ' ')) {
       strval = strval.substr(0, strval.length - 1);
   }
   return strval;
}

function validate() {
   var first = strip(document.NameForm.firstname.value);
   var last = strip(document.NameForm.lastname.value);
   if ((first == "") || (last == "")) {
       alert('A First and Last name are required');
       return false;
     } else {
       document.NameForm.firstname.value = first
       document.NameForm.lastname.value = last
       return true;
     }
}
//-->
</script>
```

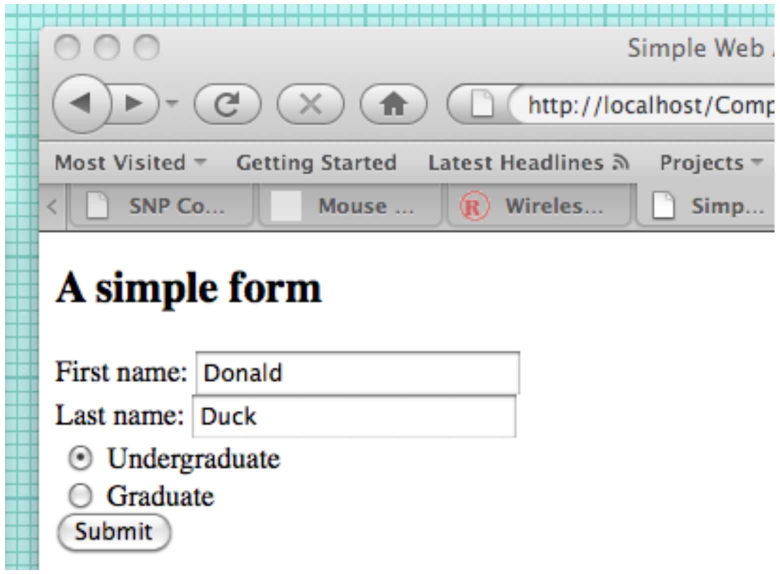
"document" is an implicitly defined variable referring to the current HTML page



A Complete Example – Cont'd

```
<h2>A simple form</h2>
<form action="name.py"
    onsubmit="return validate()"
    method="get"
    name="NameForm">
First name: <input type="text" name="firstname"><br>
Last name: <input type="text" name="lastname"><br>
<input type="radio"
    name=status value="U" checked>
    Undergraduate<br>
<input type="radio"
    name=status value="G">
    Graduate<br>
<input type="submit"
    value="Submit">
</form>
```

The form contents are submitted to server if function returns true



A simple form

First name: Donald
Last name: Duck
(●) Undergraduate
( ) Graduate
Submit

Event Handlers

```
<FORM NAME = “LoginForm” METHOD=“POST”
        ACTION=“TableOfContents.jsp”
        onSubmit=“return testLoginEmpty()”>
```

- An event handler is a function that is called if an event happens on an object in a webpage
- onSubmit() is an event handler, which is called if the submit button is pressed
- If the event handler returns true, then the form contents are submitted to the server
- Others OnFocus(), OnBlur(), onKeyDown(), etc..

Style Sheets

- We need different ways of displaying the same information to clients with different displays
  - Using different font sizes or colors to provide better contrast on a black-and-white screen
  - Rearranging objects on the page to accommodate small screens
  - Highlighting different information to focus on some important part of the page
- A style sheet is a method to adapt the same document contents to different presentation formats
  - It tells a Web browser how to translate the data into a presentation that is suitable for the client’s display

Style Sheets

- Idea: Separate display from contents, and adapt display to different presentation formats
- Two aspects:
  - Document transformations to decide what parts of the document to display and in what order
  - Document rendering to decide how each part of the document is displayed
- Two stylesheet languages
  - Cascading style sheets (CSS): For HTML documents
  - Extensible stylesheet language (XSL): For XML documents

CSS: Cascading Style Sheets

- Styles are normally stored in style sheets, which are files that contain style definitions. They define how to display HTML documents.
- Many HTML documents (e.g., all in a website) can refer to the same CSS
  - Can change format of a website by changing a single file (i.e., separation of content from presentation)
- Example: Include the following line into an HTML file to link to the external CSS style sheet.

```
<LINK REL="style sheet" TYPE="text/css" HREF="books.css"/>
```

Relationship between current document and linked document

The type of the linked document

Location of the linked document

CSS: Example

<LINK REL="style sheet" TYPE="text/css" HREF="books.css"/>

The books.css file:

```
BODY {BACKGROUND-COLOR: yellow}
H1 {FONT-SIZE: 36pt}
H3 {COLOR: blue}
P {MARGIN-LEFT: 50px;  COLOR: red}
```

Same effect as:
<BODY BACKGROUND-COLOR="YELLOW">

- Each line consists of three parts: selector {property: value}
  - Selector: Tag whose format is defined
  - Property: Tag's attribute whose value is set
  - Value: value of the attribute
- Multiple properties for the same selector are separated by semicolons

XSL

- Language for expressing style sheets
  - More at: http://www.w3.org/Style/XSL/
- Three components
  - XSLT: XSL Transformation language
    - Can transform one document to another
    - More at http://www.w3.org/TR/xslt
  - XPath: XML Path Language
    - Selects parts of an XML document
    - More at http://www.w3.org/TR/xpath
  - XSL Formatting Objects
    - Formats the output of an XSL transformation
    - More at http://www.w3.org/TR/xsl/

Lecture Overview

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- Introduction to three-tier architectures
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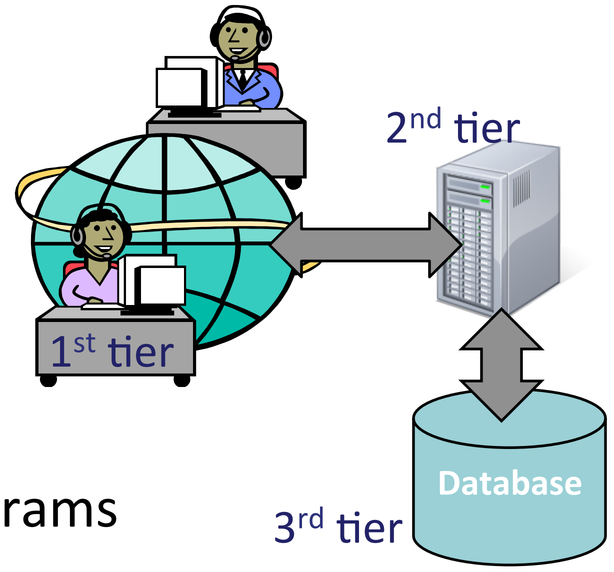
  - HTML forms; HTTP Get and POST, URL encoding; Javascript; Stylesheets. XSLT
- The middle tier
  - CGI, application servers, Servlets, JavaServerPages, passing arguments, maintaining state (cookies)

Review of the Middle Tier

- Recall: Functionality of the middle tier
  - Encodes business logic
  - Connects to database system(s)
  - Accepts input from the presentation tier
  - Generates output for the presentation tier

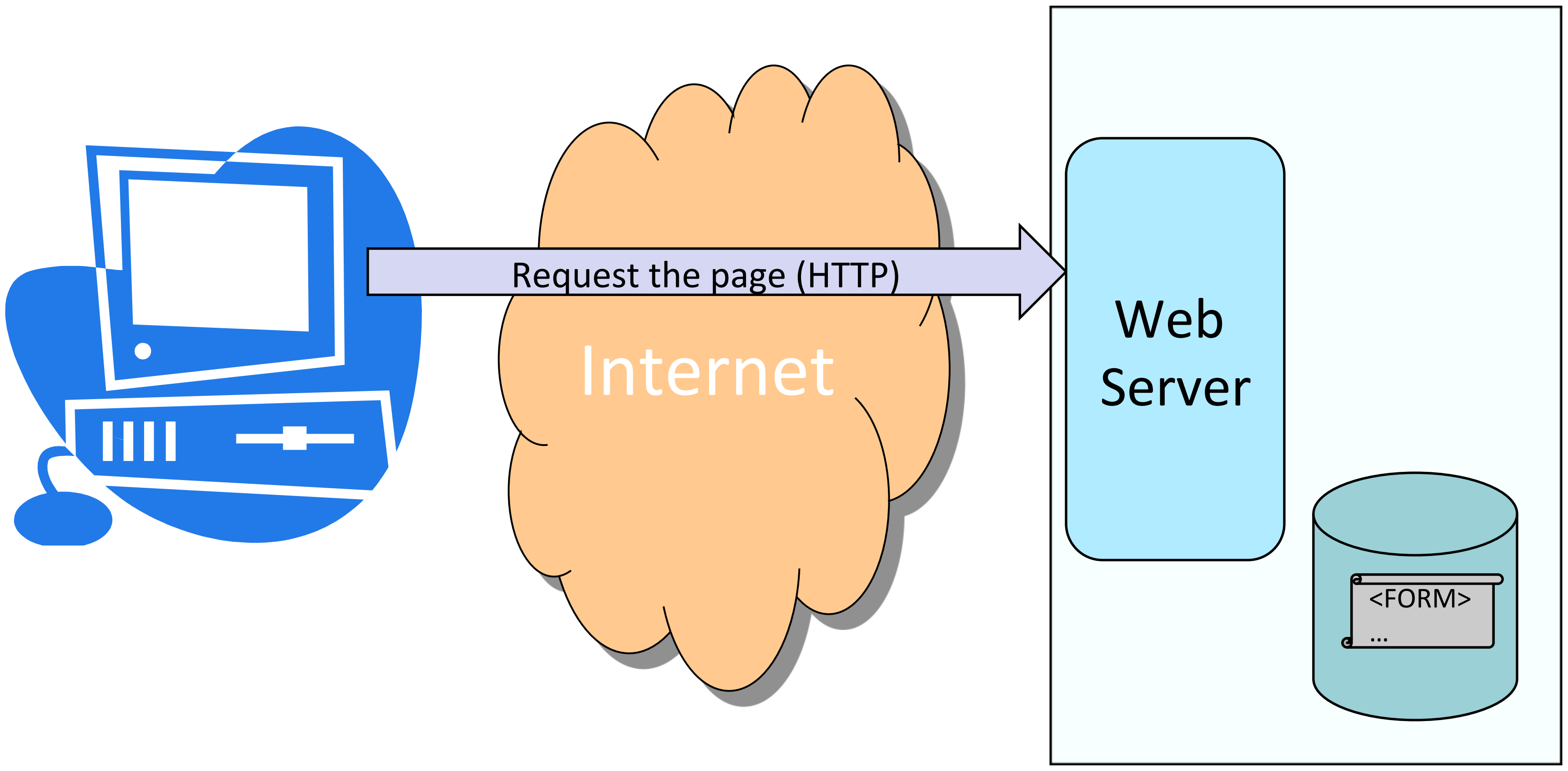


- We will cover
  - **CGI**: Protocol for passing arguments to programs running at the middle tier
  - **Application servers**: Runtime environment at the middle tier
  - **Servlets**: Java programs at the middle tier
  - **JavaServerPages**: Java scripts at the middle tier
  - Maintaining state: How to maintain state at the middle tier. Main focus: **Cookies**.

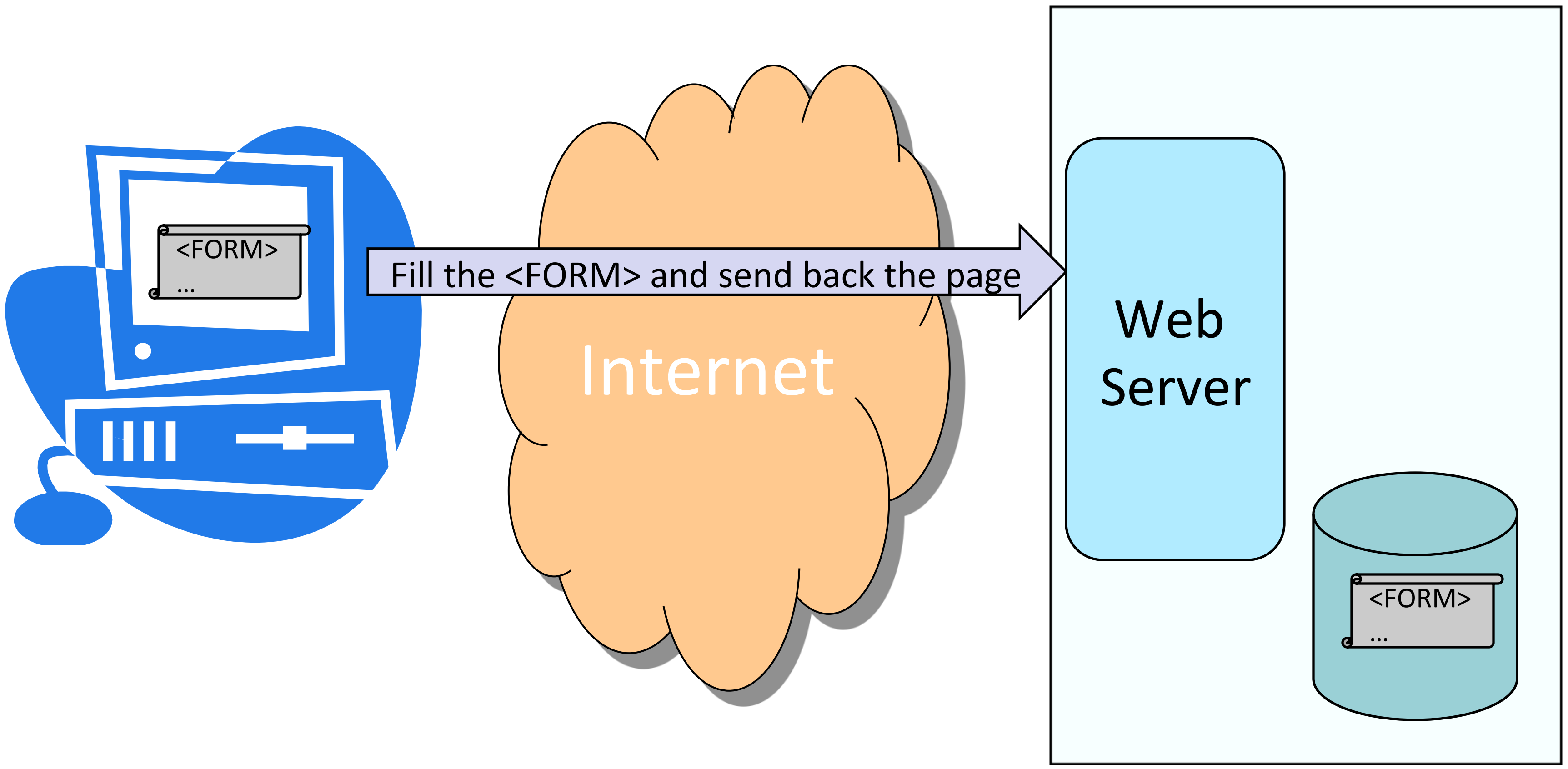
CGI: Common Gateway Interface

- Goal: Transmit arguments from HTML forms to application programs running at the middle tier
- Details of the actual CGI protocol unimportant → libraries implement high-level interfaces (enable application programs to get arguments from the HTML form)
- Disadvantages:
  - The application program is invoked as a new process at every invocation (remedy: FastCGI)
  - No resource sharing between application programs (e.g., database connections)
  - Remedy: Application servers

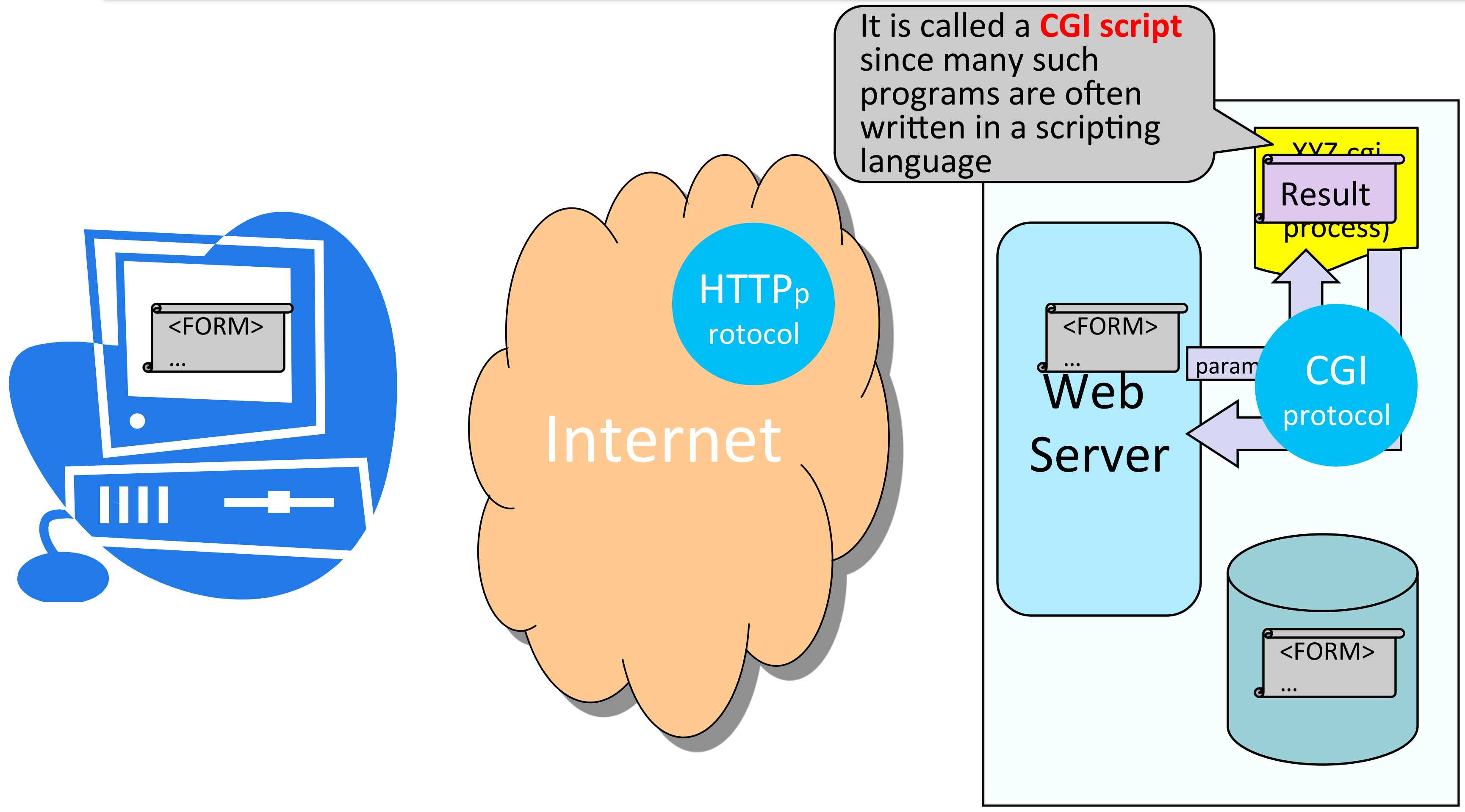
CGI Illustration: Request the Page



CGI Illustration: Send Back the page



CGI Illustration: Process <FORM>


It is called a **CGI script** since many such programs are often written in a scripting language
<FORM>
…
HTTPp
rotocol
Internet
XYZ.cgi
Result
process)
<FORM>
…
param
Web
Server
CGI
protocol
<FORM>
…

Review: HTTP Responses

The HTTP response message has three parts:

- status line, e.g., “HTTP/1.1 200 OK” (The request succeeded and the object is in the body of the message.)
- several header lines

```
Date: Mon, 04 Mar 2002 12:00:00 GMT
Server: Apache/1.3.0 (Linux)
Last-Modified: Mon, 01 Mar 2002 09:23:24 GMT
Content-Length: 1024
Content-Type: text/html
```

- body of the message (which contains the requested object)

CGI: Example

- Python can be used for CGI scripting
- Provides libraries supporting high-level interfaces to the CGI protocol

Example Python code:

Include the standard library CGI

Arguments from CGI

Extract arguments from the HTML form

Dynamically construct the Webpage

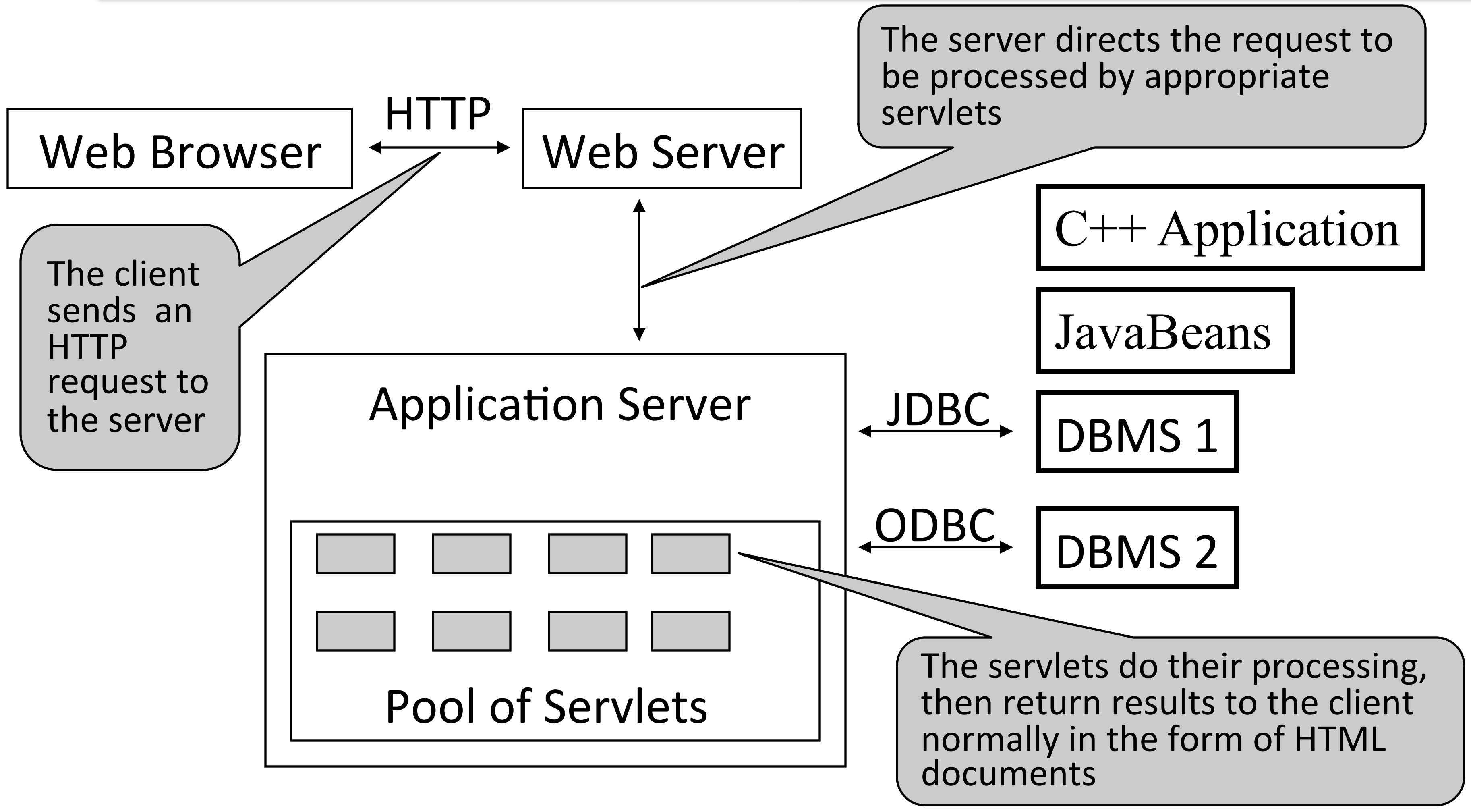
```
#!/usr/bin/python
import cgi
import cgitb   # provides nice debugging info
cgitb.enable()
import os
pageStart = """
<html><head><title>Name Response</title></head>
<body><h1>Hello %s %s</h1><pre>"""
pageEnd = """</pre></body></html>"""

if __name__ == '__main__':
   form = cgi.FieldStorage()
   first = form["firstname"].value
   last = form["lastname"].value
   print "Content-type: text/html\n\n"
   print pageStart % (first, last)
   print os.environ['REQUEST_METHOD']
   print os.environ['REQUEST_URI']
   print pageEnd
```

Application Servers

- The application program is invoked using the CGI protocol. Each page request results in the creation of a new process
  - Does not scale well with a large number of requests.
  - Generally only has 60-90 secs to complete
- Way to avoid the process creation overhead:
  - Application server maintains a pool of threads or processes and uses them to execute requests
  - Application server also provides other functionality
    - Enable access to heterogeneous data sources (e.g., by providing JDBC drivers.)
    - Provide APIs for session management

Application Server: Process Structure


Web Browser
HTTP
Web Server
The server directs the request to be processed by appropriate servlets
The client sends an HTTP request to the server
C++ Application
JavaBeans
Application Server
JDBC
DBMS 1
ODBC
DBMS 2
Pool of Servlets
The servlets do their processing, then return results to the client normally in the form of HTML documents

What is a Servlet ?

- Servlets are Java's answer to CGI programming
- Servlet is a Java class used to extend the capabilities of servers that host applications
- In most cases, servlets extend the specific HttpServlet class for Web servers that communicate with clients via HTTP
- HttpServlet class provides methods such as
  - doGet (for HTTP GET) and doPost (for HTTP POST) to receive arguments from HTML forms, and
  - sending output back to the client via HTTP

A Servlet Template

This simple servlet just outputs two words "Hello World"

```
import java.io.*;
import java.servlet.*;
import java.servlet.http.*;

public class ServetTemplate extends HttpServlet {
    public void doGet(HTTPServletRequest  request,
                                           HTTPServletResponse  response)
                        throws SerletExpection, IOException {
        PrintWriter out=response.getWriter();
            out.println("Hello World");     // sends content to browser
    }
}
```

request object is used to read HTML form data

response object is used to specify: (1) the response status code, and (2) headers of the HTTP response

Uses 'out' to compose content that is returned to the client

Servlets: A Complete Example

```
public class ReadUserName extends HttpServlet {
      public void doGet(            HttpServletRequest request,
                                    HttpSevletResponse response)
                  throws ServletException, IOException {
            reponse.setContentType("text/html");
            PrintWriter out=response.getWriter();
            out.println("<HTML><BODY>\n <UL> \n" +
                        "<LI>" + request.getParameter("userid") + "\n" +
                        "<LI>" + request.getParameter("password") + "\n" +
                        "<UL>\n<BODY></HTML>");
      }
      public void doPost(           HttpServletRequest request,
                                    HttpSevletResponse response)
            throws ServletException, IOException {
            doGet(request,response);
      }
}
```

Servlet dynamically generates HTML

Servlet Life Cycle

- Servlet container is the intermediary between the Web server and the servlets in the container
- When a request arrives from the Web server:
  - If an instance of the servlet does not exist, the container
    - Loads the servlet class
    - Creates an instance of the servlet class
    - Initializes the servlet instance (i.e., places it into service)
  - Container calls service() method to allow the servlet to respond to the request. Two objects are passed:
    - The HttpServletRequest object contains the client's HTTP request information, and
    - The HttpServletResponse encapsulates the servlet's response
- Servlet container calls the destroy method before removing a servlet from service (e.g., to free memory)

Java Server Pages (JSP)

- Servlets
  - Generate HTML by writing it to the "PrintWriter" object
  - Code first, webpage second
- JavaServer Pages
  - Written in HTML, Servlet-like code embedded in the HTML
  - Webpage first, code second
  - They are usually compiled into a Servlet

JavaServer Pages

- Change the file extensions to ".jsp" instead of ".html"
- Embed Java expressions in JSP pages by putting them between <%= and %>

  The time is now <%= date %>
- Embed block of Java code (called scriplet) between <% and %>
- There are a number of useful predefined objects for scriplet:
  - The variable out can be used to generate HTML

    ```
    <%   java.util.Date  date = new  java.util.Date();   %>
     The time is now
    <%   out.println( String.valueOf( date ));    %>
    ```
  - request is another useful variable

    request.getParameter("username"): returns value of the requested parameter

JavaServer Pages: Example

```
<html>
<head><title>Welcome to B&N</title></head>
<body>
   <h1>Welcome back!</h1>
   <% String name="NewUser";
        if (request.getParameter("username") != null) {
                name=request.getParameter("username");
        }
   %>
   You are logged on as user <%=name%>
   <p>
</body>
</html>
```

- Placing java code between <% and %>
- The block of code is known as scriptlet
- This makes it possible to generate dynamic HTML pages

Maintaining State

HTTP is stateless

- Advantages
  - Easy to use: don't need anything
  - Great for static-information applications
  - Requires no extra memory space
- Disadvantages
  - No record of previous requests means
    - No shopping baskets
    - No user logins
    - No custom or dynamic content
    - Security is more difficult to implement

Application State

- Server-side state
  - Information is stored in a database, or in the application layer's local memory
- Client-side state
  - Information is stored on the client's computer in the form of a cookie
- Hidden state
  - Information is hidden within dynamically created web pages

Server-Side State

Many types of Server side state:

1. Store information in a database
   - Data will be safe in the database
   - BUT: requires a database access to query or update the information
2. Use application layer's local memory
   - Can map the user's IP address to some state
   - BUT: this information is volatile and takes up lots of server main memory

Server-Side State

- Should use Server-side state maintenance for information that needs to persist
  - Old customer orders
  - “Click trails” of a user’s movement through a site
  - Permanent choices a user makes

Client-side State: Cookies

- Cookies are textual information a Web server sends to a browser, and that browser returns unchanged when sending HTTP requests to the Web server later
  - Can be disabled by the client.
  - Are wrongfully perceived as "dangerous," and therefore will scare away potential site visitors if asked to enable cookies
    - Cookies are never interpreted or executed
      → cannot be used to insert virus
    - Browser generally accept 20 cookies per site and 300 cookies total → cannot be used to fill up someone's disk or launch other denial of service attacks
- A cookie is a collection of (Name, Value) pairs

Client State: Cookies

- Advantages
  - Easy to use in Java Servlets / JSP
  - Provide a simple way to persist non-essential data on the client (in the browser cache) even after the browser is closed
- Disadvantages
  - Limit of 4 KB of information (not bad for most applications)
  - Users can (and often will) disable them
- Should use cookies to store interactive state
  - The current user's login information
  - The current shopping basket
  - Any non-permanent choices the user has made

Creating A Cookie

```
Cookie myCookie =
  new Cookie("username", "jeffd");
response.addCookie(myCookie);
```

Create a new cookie object with the specified (name, value) pair

Add the cookie to the response header, i.e., send cookie to client

You can create a cookie at any time

Cookie – Another Example

```
Cookie myCookie = new Cookie(“username”, “jeffd”);
Cookie.setDomain(www.bookstore.com);
                        // Web site that receives this cookie
Cookie.setSecure(false):               // no SSL required
Cookie.setMaxAge(60*60*24*31)    // one month lifetime
response.addCookie(myCookie);      // add cookie to
                                      response object
```

Cookie - How it works

- We create a cookie through the Java or Python Cookie class in the middle tier application code
- The cookie is added to the **response** object within the java servlet to be sent to the client
- Once a cookie is received, the client' s Web browser appends it to all HTTP requests it sends to this site, until the cookie expires

Reading Cookies from the Client

Look for the cookie with name ‘username’

```
Cookie[]   cookies = request.getCookies();    // returns an array of cookies
String   theUser;
for(int i=0; i<cookies.length; i++) {
  Cookie   cookie = cookies[i];
  if(cookie.getName().equals(“username”))
      theUser = cookie.getValue();
}
// at this point theUser == “username”
```

Hidden State

- Often users will disable cookies
- You can “hide” data in two places:
  - Hidden input fields within a form
  - Using the path information
- Requires no “storage” of information because the state information is passed inside of each web page

Hidden State: Hidden Fields

- Declare hidden fields within a form:
  - <input type=‘hidden’ name=‘user’ value=‘username’ />
- Users will not see this information (unless they view the HTML source)
- Typically used when we have variables we want to pass from one form to another without making the user to re-type the information over and over again
  - We can use this feature to maintain state, e.g., remember the user in order to update the shopping cart

Hidden State:

Using Extra Path Information

- The middle tier can embed an identifier, as extra path information, within a document's URL
- As a user traverse through the site, the dynamically generated html pages can pass the identifier from document to document
- Thus, we can track the documents requested by the user

Hidden State:

Using Extra Path Information

- Path information is stored in the URL request:

  http://server.com/index.htm?user=jeffd

- Can separate 'fields' with an & character:

  index.htm?user=jeffd&preference=pepsi

- There are mechanisms to parse this field in Java. Check out the

  javax.servlet.http.HttpUtils parserQueryString

  method.

Multiple state methods

Typically all methods of state maintenance are used:

- User logs in and this information is stored in a cookie
- User issues a query which is stored in the path information
- User places an item in a shopping basket cookie
- User purchases items and credit-card information is stored/retrieved from a database
- User leaves a click-stream which is kept in a log on the web server (which can later be analyzed)

"Web 2.0" – more current methods

- "Single Web Page" applications are the norm now – much like Google's gmail. Rich JavaScript builds a user interface, xmlHttpRequest object in JavaScript is used to move XML back and forth to the web server(s).
- Numerous JavaScript toolkits for building web pages that act like full-fledged desktop applications – JQuery is dominant. http://jquery.com/
- Smartphone applications can be built entirely in HTML5 and JavaScript – combination of JQuery and Apache Cordova hides complexity, makes cross-platform development reasonable. http://cordova.apache.org/

Web 2.0 on the Server Side

- CGI is on the ropes, various servlet-like methods have won the war.
- "node.js" – lets you write entire middle tier in JavaScript, and even includes its own web server. http://nodejs.org/
- php – simple scripting language for server-side work. http://php.net/
- Ruby On Rails – great for building web pages that look a lot like business data reporting. http://rubyonrails.org/
- Commercial vendors would love to sell you full stack "solutions" – IBM's Websphere, Oracle WebLogic, etc.

Summary

We covered:

- Internet Concepts (URIs, HTTP)
- Web data formats
  - HTML, XML, DTDs
- Three-tier architectures
- The presentation layer
  - HTML forms, Javascript, Stylesheets.
- The middle tier
  - CGI, application servers, Servlets, JavaServer Pages, maintaining state (cookies)