Recommended reading:

Core SERVLETS and JAVASERVER by Marty Hall, Sun Microsystems Press/Prentice Hall PTR Book, ISBN 0-13-089340-4

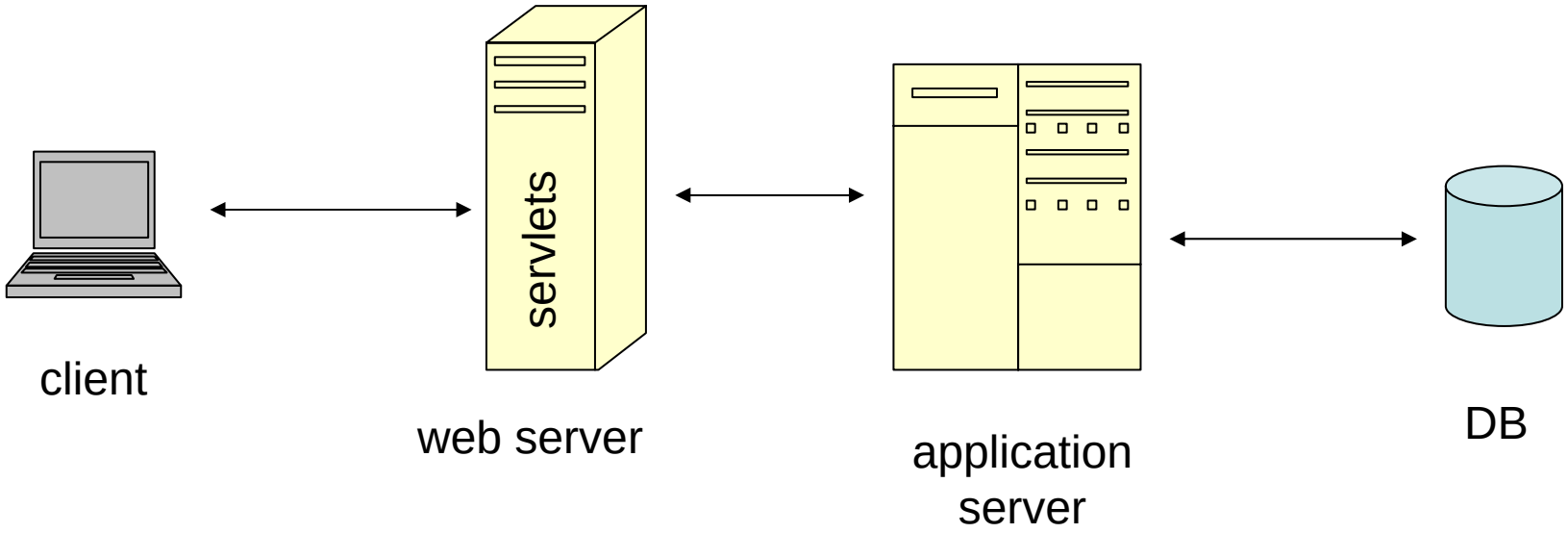
These handouts are adapted from Hall's notes.

A Servlet's Job

- A servlet can be regarded as a Java program residing on a web server.
- Servlets are used to generate web pages dynamically.
- Read explicit data sent by client (form data)
- Read implicit data sent by client (request headers)
- Generate the results
- Send the explicit data back to client (HTML)
- Send the implicit data to client (status codes and response headers)

Response from the web server

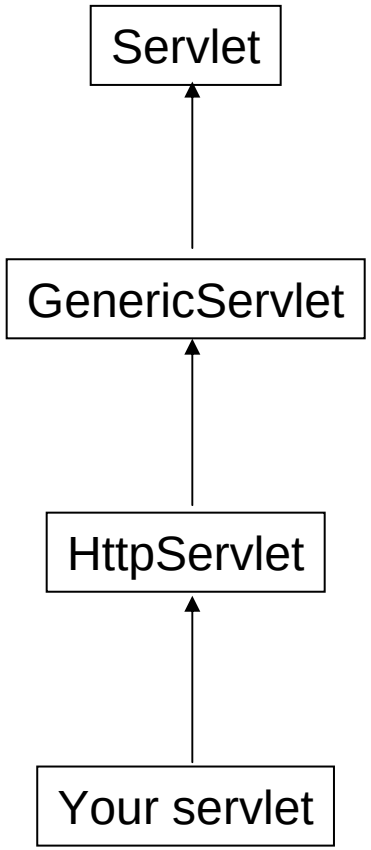
- The response from a web server consists of
  - a status line
    - HTTP/1.1 200 OK
  - Some response headers
    - Content-Type: text/html
    - Date: Sun, 17 Feb 2008 23:11:38 GMT
  - The document.
    - <HTML><BODY>Hello World </BODY></HTML>


servlets
client
web server
application
server
DB

Why Build Web Pages Dynamically?

- The Web page is based on data submitted by the user
  - results page from search engines and DB queries
- The Web page is derived from data that changes frequently
  - a weather report or stock price

Servlet Classes

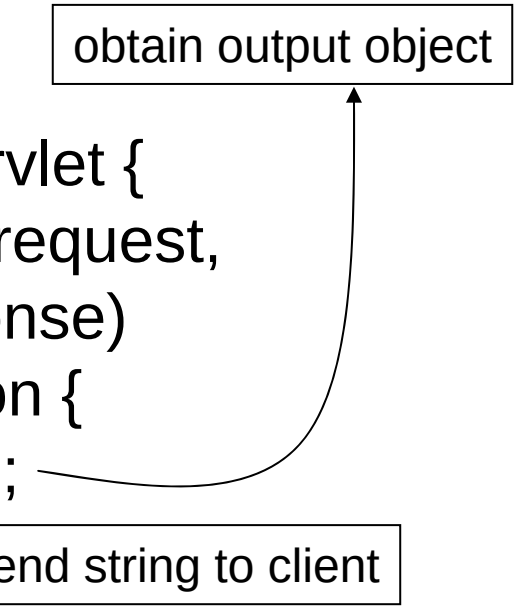


Commonly used servlet methods

- Class HttpServlet includes some methods for handling the corresponding HTTP request methods.
  - doGet() , doPost(), doHead() etc.
- In your servlets, you need to overwrite these methods to make the servlets behave according to your requirements.

First Servlet

```
package examples;
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;

public class HelloWorld extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    PrintWriter out = response.getWriter();
    out.println("Hello World!");
  }
}
```



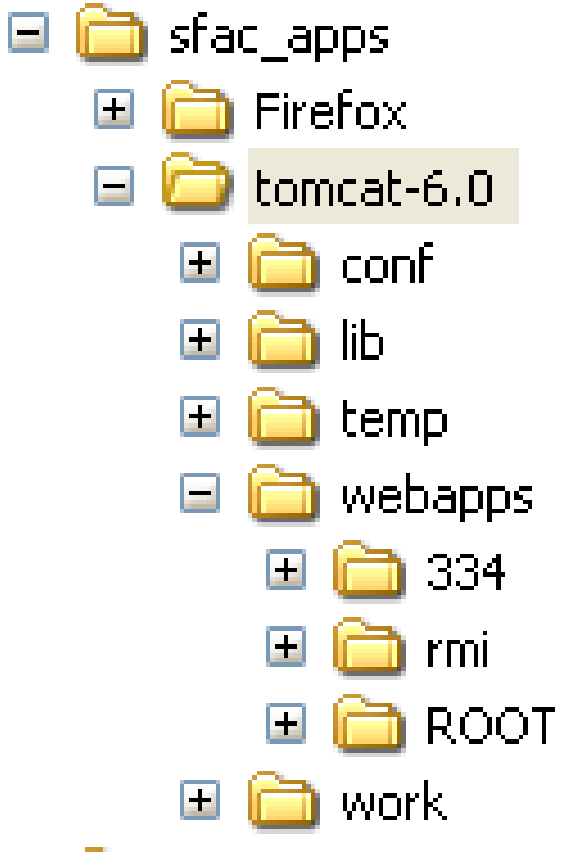
Creating, Deploying and Executing Servlet/JSP in Tomcat 6

- Tomcat 6 is the official reference implementation of the Servlet 2.5 and JavaServer Pages 2.1 specifications.
- It can be used as a small stand-alone server for testing servlets and JSP pages.
- Tomcat is free from http://tomcat.apache.org/
- There are many versions of Tomcat. The version that we use in 334 is Tomcat 6.

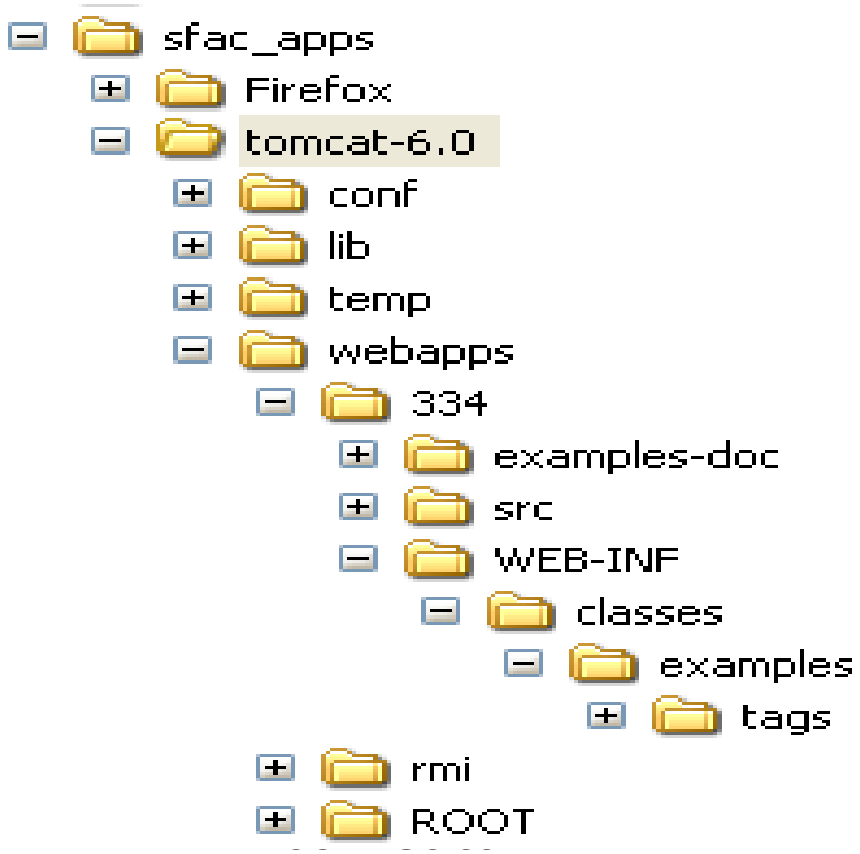
Setup Environment on Windows

- After installing Tomcat, you need to set up some environment variables.
- JAVA_HOME should be set to the directory where J2SE is installed.
  - e.g. set JAVA_HOME =d:\jdk
  - In Windos XP, use “control panel” → “system”. Then, click “Advanced” tab → “Environment Variables” button. Then, use “New” or “Edit” button to set the variable.
- CLASSPATH should also be extended to include the jar file which contains the servlet and jsp package.
  - e.g. set CLASSPATH=.;C:\apache-tomcat-6.0\common\lib\servlet-api.jar;C:\apache-tomcat-6.0\common\lib\jsp-api.jar;%CLASSPATH%
  - or, use “control panel” → “system” in Windows XP as above.

- download rmi-class.zip file from http://www.cs.auckland.ac.nz/compsci334s1t/resources/rmi-classes.zip
- unpack the file and store it at H:\sfac_apps\tomcat-6.0\webapps



- You can download the servlet and jsp examples from 334 web site and unpack them under webapps directory of the Tomcat directory.
- After unpacking, in the lab your directory under webapps should be as below

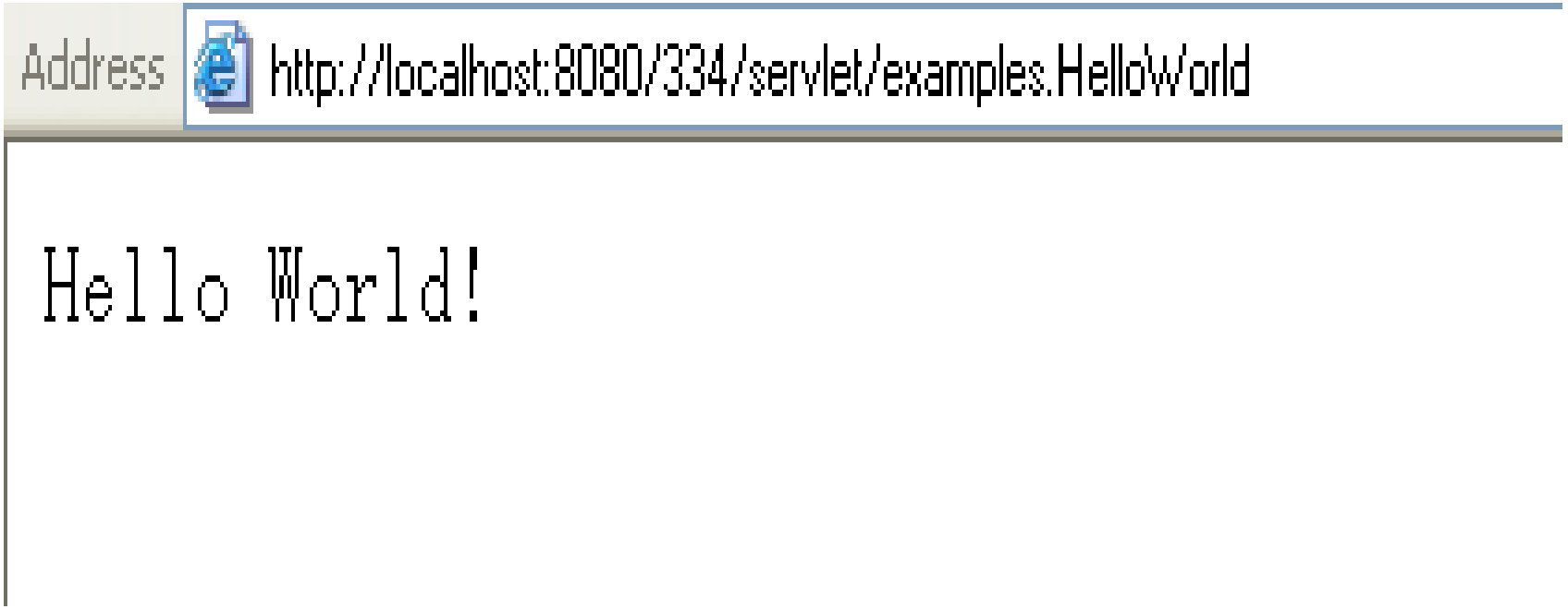


- Type http://localhost:8080/334/, the page below is shown.
- Clicking the program description link, e.g. Hello World, will activate the corresponding program and show the outputs of the program.
- Clicking the source link next to a program description link will display the source code of the program.
- The sources code of the programs can be found in folder 'webapps/334/src/'
- The class files of the program are stored in folder 'webapps/334/WEB-INF/classes/examples/
- The html files are in folder 'webapps/334/examples-doc'

- You can create your own directory under webapps to store your own servlet and jsp.
- Your directory must contain a WEB-INF directory. Under WEB-INF, you must have a web.xml file.
  - copy the web.xml file in 334/WEB-INF
- Under WEB-INF, you must have a “classes” directory where all your servlets are stored.

Compiling and Invoking HelloWorld

- Place source code HelloWorld.java in directory examples.
- Compile HelloWorld.java
  - javac HelloWorld.java
- Start Tomcat
  - Tomcat listens to http request on port 8080
- Send request
  - http://localhost:8080/334/servlet/examples.HelloWorld


Address
http://localhost:8080/334/servlet/examples.HelloWorld
Hello World!

add the following to web.xml

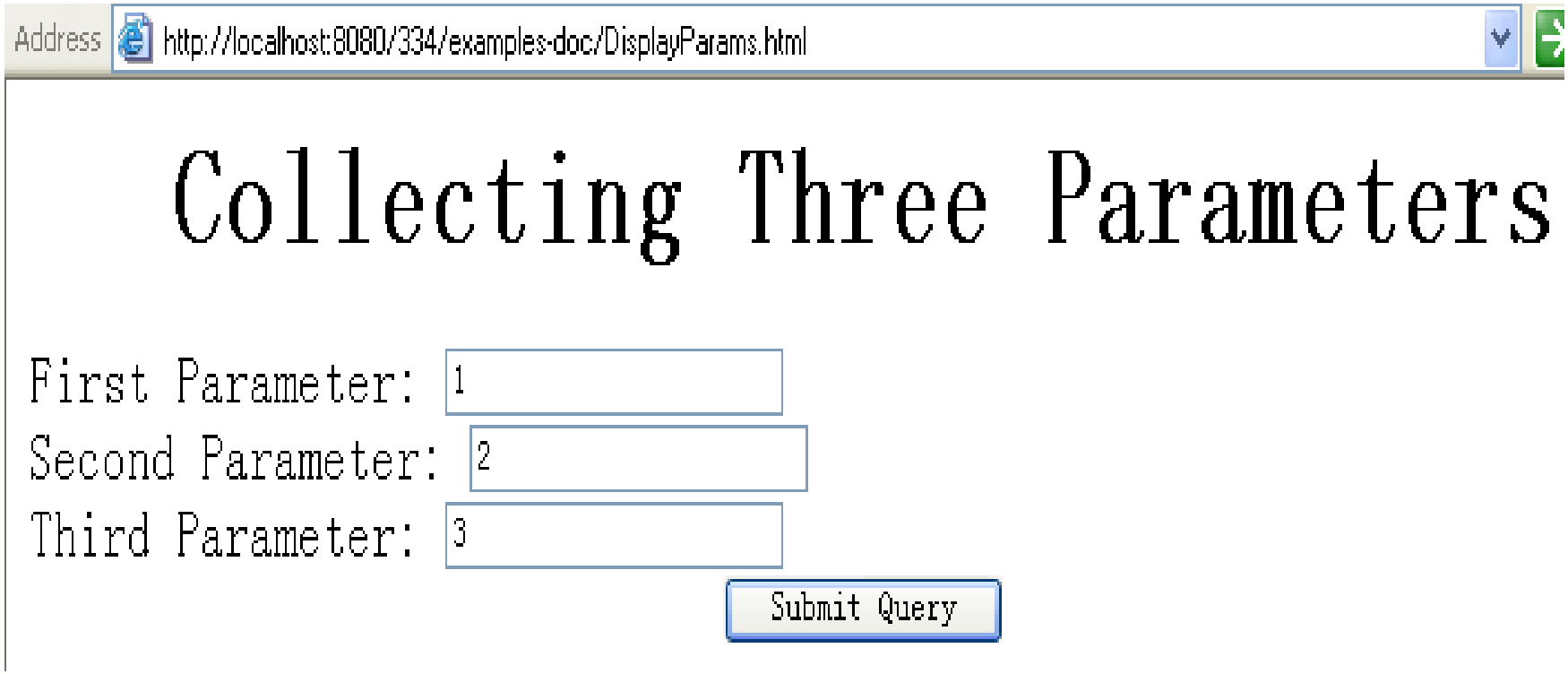
```
<servlet>
    <servlet-name>HelloWorld</servlet-name>
    <servlet-class>examples.HelloWorld</servlet-class>
</servlet>
<servlet-mapping>
    <servlet-name>HelloWorld</servlet-name>
    <url-pattern>/servlet/examples.HelloWorld</url-pattern>
</servlet-mapping>
```

Packaging Servlets

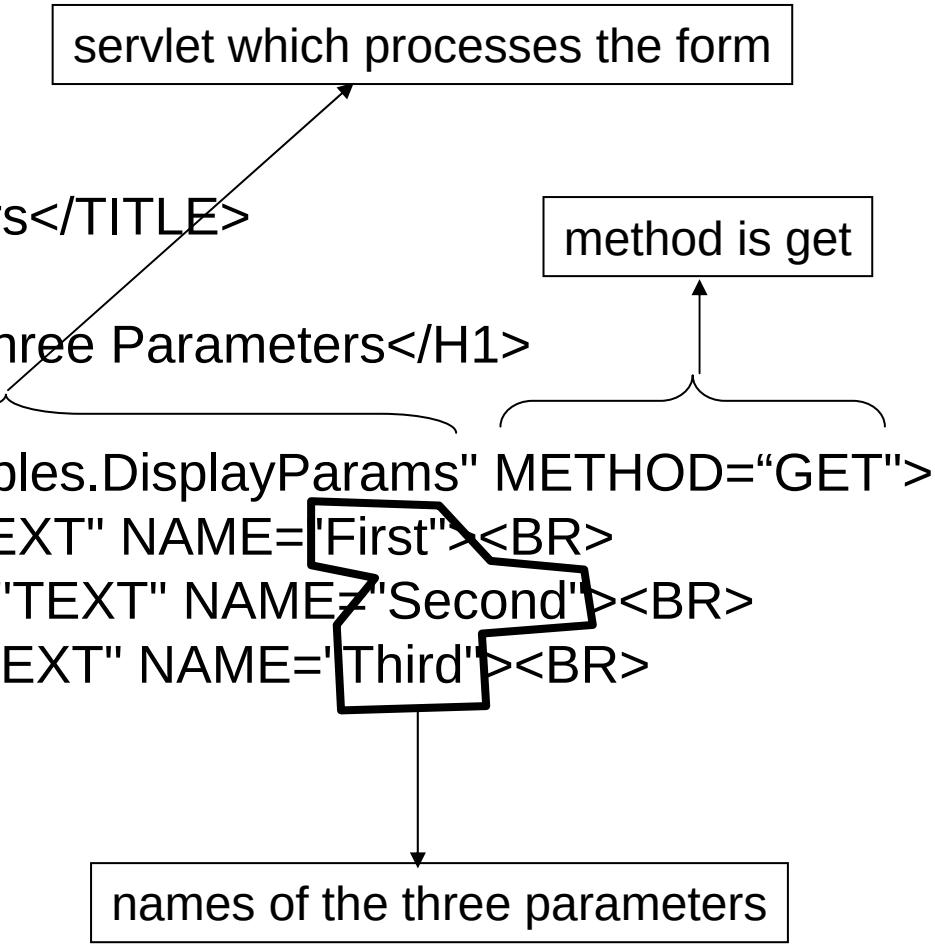
- Move the files to a subdirectory that matches the intended package name
  - For example, HelloWorld.java under examples
  - “examples” is a subdirectory under “classes”
- Insert a package statement in the class file
  - package examples;
- Include package name in URL
  - http://localhost:8080/334/servlet/examples.HelloWorld

Handling the Client Request

- Chapter 19, 4, 5 and 6 of *Core SERVLETS and JAVASERVER*
- A form for user to fill in three parameters
- When the “submit query” button is clicked, the form is sent back to the server.
- Servlet “DisplayParams” is used to process the form.
  - retrieve the values entered by the user
  - generate a page which shows the three values entered by the user


Address
http://localhost:8080/334/examples-doc/DisplayParams.html
Collecting Three Parameters
First Parameter:
1
Second Parameter:
2
Third Parameter:
3
Submit Query

```
<HTML>
<HEAD>
  <TITLE>Collecting Three Parameters</TITLE>
</HEAD>
<H1 ALIGN="CENTER">Collecting Three Parameters</H1>

<FORM ACTION="/334/servlet/examples.DisplayParams" METHOD="GET">
  First Parameter:  <INPUT TYPE="TEXT" NAME="First"><BR>
  Second Parameter: <INPUT TYPE="TEXT" NAME="Second"><BR>
  Third Parameter:  <INPUT TYPE="TEXT" NAME="Third"><BR>
  <CENTER>
    <INPUT TYPE="SUBMIT">
  </CENTER>
</FORM>

</BODY>
</HTML>
```



Three Parameters

- First: 1
- Second: 2
- Third: 3

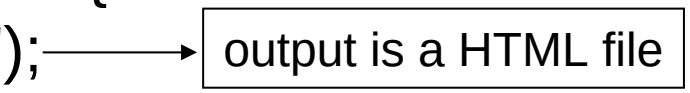
Response in HTML

```
<HTML>
<TITLE>Display Three Parameters</TITLE>
<BODY>
<H1 ALIGN=CENTER> Three Parameters </H1>
<UL>
  <LI><B>First</B>: 1
  <LI><B>Second</B>: 2
  <LI><B>Third</B>: 3
</UL>
</BODY></HTML>
```

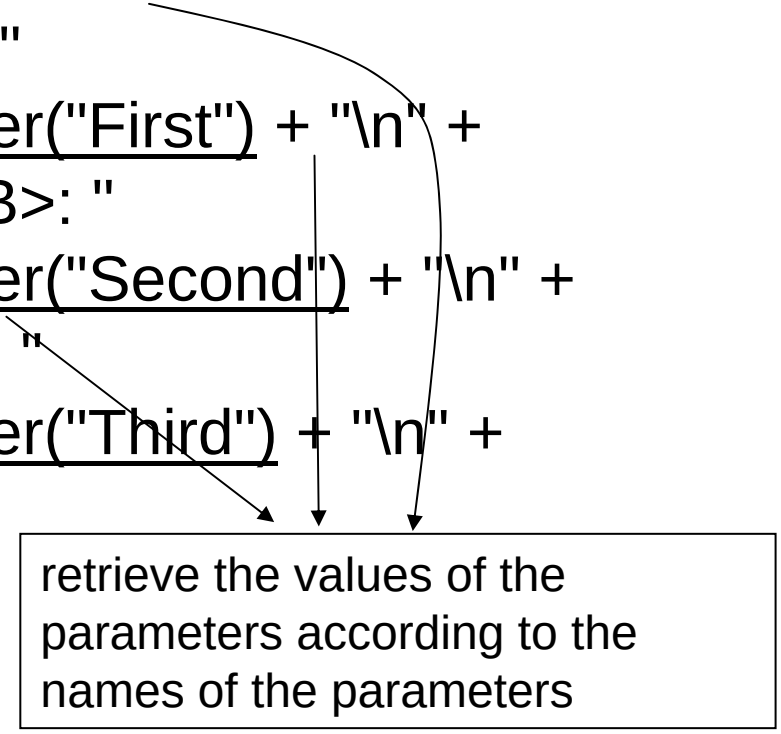
Reading Form Data In Servlets

- request.getParameter("name")
  - Returns the value of first occurrence of name in query string
  - Returns null if no such parameter is in query data
- request.getParameterValues("name")
  - Returns an array of the values of all occurrences of name in query string
  - Returns null if no such parameter is in query
- request.getParameterNames()
  - Returns Enumeration of request params

```
package examples;

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

public class DisplayParams extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
```

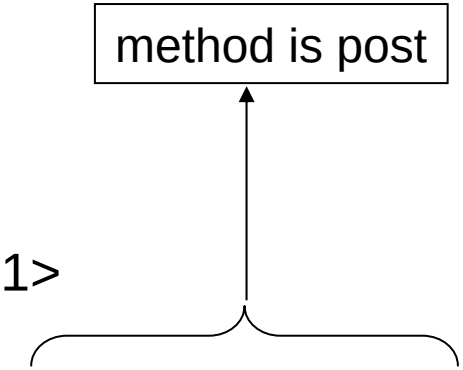


```
out.println(“<HTML>”+
            “<TITLE>Display Three Parameters</TITLE>\n" +
            “<BODY>”+
            "<H1 ALIGN=CENTER> Three Parameters </H1>\n" +
            "<UL>\n" +
            "  <LI><B> First </B>: "
            + request.getParameter("First") + "\n" +
            "  <LI><B> Second </B>: "
            + request.getParameter("Second") + "\n" +
            "  <LI><B> Third </B>: "
            + request.getParameter("Third") + "\n" +
            "</UL>\n" +
            "</BODY></HTML>");
  }
}
```



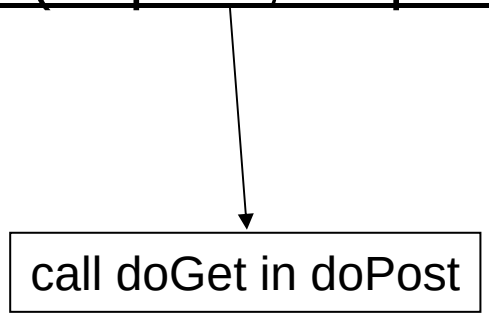
What if the method is “POST”

```
<HTML>
<HEAD>
  <TITLE>Collecting Three Parameters</TITLE>
</HEAD>
<H1 ALIGN="CENTER">Collecting Three Parameters</H1>

<FORM ACTION="/334/servlet/examples.DisplayParams" METHOD="POST">
  First Parameter:  <INPUT TYPE="TEXT" NAME="First"><BR>
  Second Parameter: <INPUT TYPE="TEXT" NAME="Second"><BR>
  Third Parameter:  <INPUT TYPE="TEXT" NAME="Third"><BR>
  <CENTER>
    <INPUT TYPE="SUBMIT">
  </CENTER>
</FORM>

</BODY>
</HTML>
```



If you process the post method in the same way as the get method, you can simply call the doGet method in doPost.

```
public void doPost(HttpServletRequest request,
                   HttpServletResponse response)
    throws ServletException, IOException {
        doGet(request, response);
}
```



- POST are used to send a large amount of information
- You might want to use a loop to enumerate through the parameters rather than list each one by hand
  - Use method request.getParameterNames()
  - the order of the returned parameters is unspecified

```
public void doPost(HttpServletRequest request,
                   HttpServletResponse response)
            throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    out.println("<HTML><TITLE>Display Parameters</TITLE>" +
                "<BODY>"+
                "<H1 ALIGN=CENTER> Parameters </H1>\n" +
                "<UL>\n");
    Enumeration paramNames = request.getParameterNames();
    while (paramNames.hasMoreElements()) {
        String paramName = (String)paramNames.nextElement();
        out.println("<LI><B>"+paramName+"</B>:"
                    +request.getParameter(paramName));
     }
    out.println("</UL>\n" + "</BODY></HTML>");
}
```

get the names of all the parameters

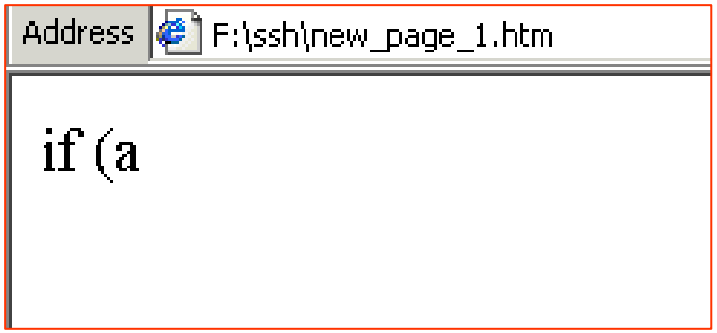
retrieve and display the value of each parameter

Parameters

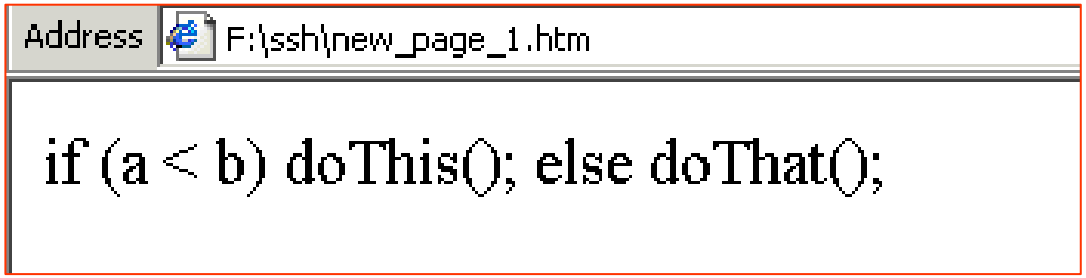
- Second: 2
- First: 1
- Third: 3

Filtering Strings for HTML-Specific Characters

- HTML files contain some special characters, e.g. <, >, &, etc., which are used as directives in HTML.
- If we want to display a character which is the same as a special HTML character, to make sure that resulting page can be displayed correctly, we need to substitute the character as a sequence of other characters.
  - < → “<”, > → “>”, & → “&”




```
<html>
<body>
if (a<b)
      doThis();
else
      doThat();
</body>
</html>
```




```
<html>
<body>
if (a &amp;lt; b)
            doThis();
else
            doThat();
</body>
</html>
```

```
public static String filter(String input) {
  StringBuffer filtered = new StringBuffer(input.length());
  char c;
  for(int i=0; i<input.length(); i++) {
    c = input.charAt(i);
    if (c == '<') {
      filtered.append("&lt;");
    } else if (c == '>') {
      filtered.append("&gt;");
    } else if (c == '"') {
      filtered.append("&quot;");
    } else if (c == '&') {
      filtered.append("&amp;");
    } else {
      filtered.append(c);
    }
  }
  return(filtered.toString());
}
```

This method checks each character in the input string. It replaces “<“ with “<”, etc.

Common HTTP 1.1 Request Headers

- Accept
  - Indicates MIME types browser can handle
- Accept-Encoding
  - Indicates encodings (e.g., gzip or compress) browser can handle.
- Authorization
  - User identification for password-protected pages.
- Connection
  - Persistent connections mean that the server can reuse the same socket over again for requests very close together from the same client (e.g., the images associated with a page)

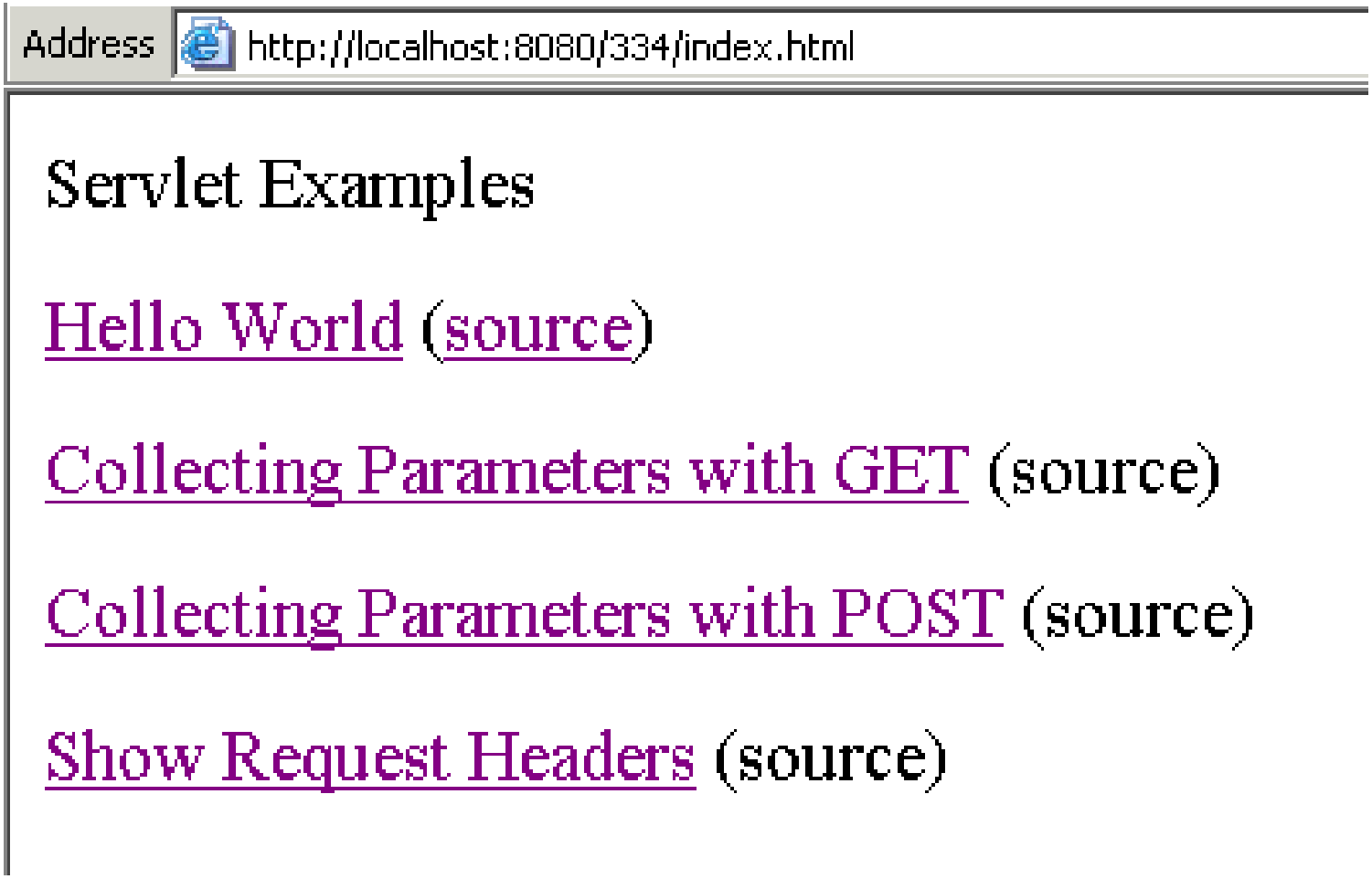
- Cookie
  - Gives cookies previously sent to client.
- Host
  - Indicates host given in original URL
- If-Modified-Since
  - Indicates client wants page only if it has been changed after specified date
- Referer
  - URL of referring Web page
  - Useful for tracking traffic; logged by many servers
- User-Agent
  - for identifying category of client, e.g. Web browser, cell phone, etc.

Reading Request Headers

- Some time the request headers are important in processing client's requests
  - Compressed page
  - Image formats
- In this example, we want to display the request header being sent in by the browser.

Some Useful Methods

- General
  - getHeader: get the value of a specified request header
  - getHeaderNames: get the names of the request headers sent in by the browser
- Related info
  - getMethod: GET, POST, etc.
  - getRequestURI: part of this requested URL
    - No server name
    - Use getRequestURL if want to see the server name etc
  - getProtocol: HTTP/1.1, HTTP/1.0


Address
http://localhost:8080/334/index.html
Servlet Examples
Hello World (source)
Collecting Parameters with GET (source)
Collecting Parameters with POST (source)
Show Request Headers (source)

Showing Request Headers

Request Method: GET
Request URI: /334/servlet/examples.ShowRequestHeaders
Request Protocol: HTTP/1.1

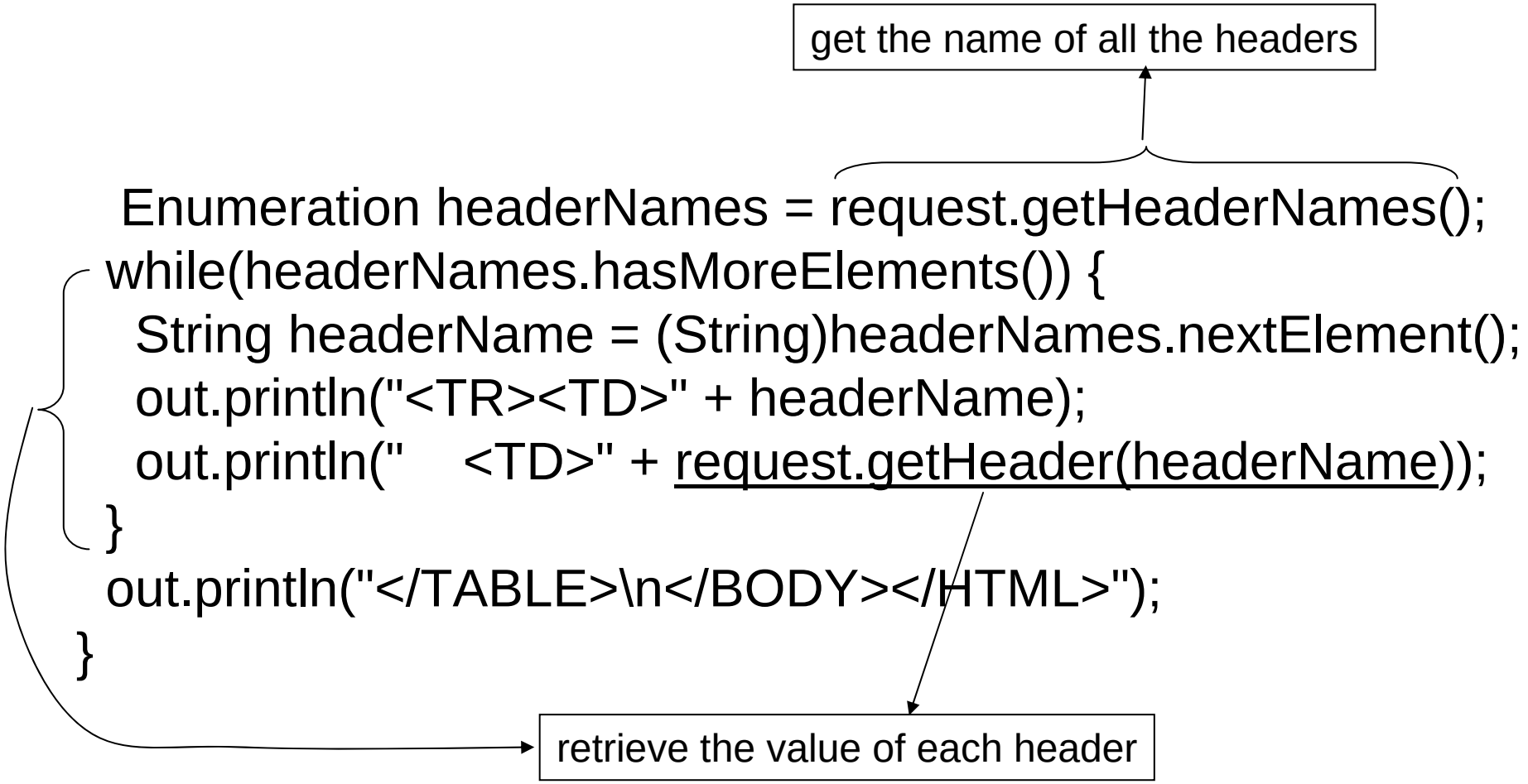
Header Name	Header Value
User-Agent	Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.0)
Accept	image/gif, image/x-xbitmap, image/jpeg, image/pjpeg, application/vnd.ms-powerpoint, application/vnd.ms-excel, application/msword, application/x-shockwave-flash, */*
Host	localhost:8080
Accept-Encoding	gzip, deflate
Accept-Language	en-nz
Referer	http://localhost:8080/334/index.html
Connection	Keep-Alive

```
…
<B>Request Method: </B> xxx <BR>
<B>Request URI: </B> xxx <BR>
<B>Request Protocol: </B> xxx <BR><BR>
<TABLE BORDER=1 ALIGN=CENTER>
<TR>
<TH>Header Name<TH>Header Value
<TR><TD> xxx <TD> xxx
<TR><TD> xxx <TD> xxx
…
</TABLE>
…
```

Use the print/println statement to generate the above html file.

```
public class ShowRequestHeaders extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    out.println("< HTML>< BODY><H1 ALIGN=CENTER> "+
                "Showing Request Headers</H1>\n" +
                "<B>Request Method: </B>" +
                request.getMethod() + "<BR>\n" +
                "<B>Request URI: </B>" +
                request.getRequestURI() + "<BR>\n" +
                "<B>Request Protocol: </B>" +
                request.getProtocol() + "<BR><BR>\n" +
                "<TABLE BORDER=1 ALIGN=CENTER>\n" +
                "<TR>\n" +
                "<TH>Header Name<TH>Header Value");
```

get various information of this request


get the name of all the headers
Enumeration headerNames = request.getHeaderNames();
while(headerNames.hasMoreElements()) {
String headerName = (String)headerNames.nextElement();
out.println("<TR><TD>" + headerName);
out.println(" <TD>" + request.getHeader(headerName));
}
out.println("</TABLE>\n</BODY></HTML>");
}
retrieve the value of each header

Sending Compressed Pages

- Gzipped files are compressed files. They can reduce the download time of long text pages.
- Recent browsers automatically uncompress the files whose “Content-Encoding” header marked as “gzip”.
  - Need to check whether the browser can handle “gzip” file before sending the compressed file to the browser
  - request.getHeader("Accept-Encoding")
- To send a gzipped page, the servlet must use Java’s GZIPOutputStream to generate the page.
  - If send a compressed file, need to tell the browser by setting the response header
  - response.setHeader("Content-Encoding", "gzip");

```
public class EncodedPage extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
    throws ServletException, IOException {
   response.setContentType("text/html");
   String encodings = request.getHeader("Accept-Encoding");
   PrintWriter out;
   if ((encodings != null) &&
       (encodings.indexOf("gzip") != -1)) {
    OutputStream out1 = response.getOutputStream();
    out = new PrintWriter(new GZIPOutputStream(out1), false);
    response.setHeader("Content-Encoding", "gzip");
   } else {
    out = response.getWriter();
   }
```

retrieve header value

check whether header exists

accept gzip format?

output will be in gzip format

```
    out.println("<HTML><BODY>" );
    String line = "Blah, blah, blah, blah, blah. ";
    for(int i=0; i<10000; i++) {
      out.println(line);
    }
    out.println("</BODY></HTML>");
    out.close();
  }
}
```

Redirect pages

- In this example, when a user submits a form containing a search string, servlet SearchEngines processes the form.
  - SearchEngines redirects the search to google.
- Search string must be encoded
  - When browser sends data to the server, the browser replaces the space with “+” and all the other non-alphanumerical characters to “%XY” where XY is the hex value of the ASCII character
  - http://www.google.co.nz/search?q=at+t
    - means containing “at t”: space is represented by “+”
  - what if the search string is “at + t”
    - replace “+” with “%2B”
    - http://www.google.co.nz/search?q=at+%2B+t

- URLEncoder.encode(String s, String enc)
  - Translates a string into application/x-www-form-urlencoded format using a specific encoding scheme
  - UTF-8 for enc

- response.sendRedirect(String url)
  - Redirect a request to the specified url

```
<HTML>
<HEAD>
  <TITLE>Searching the Web</TITLE>
</HEAD>

<H1 ALIGN="CENTER">Searching the Web</H1>

<FORM ACTION="/334/servlet/examples.SearchEngines">
  <CENTER>
    Search String:
    <INPUT TYPE="TEXT" NAME="searchString"><BR>
   </CENTER>
</FORM>

</BODY>
</HTML>
```

- Retrieve the search string entered by the user
  - request.getParameter("searchString");
  - The string is decoded when retrieved
    - “at+%2B+t” → “at + t”
- Check whether the search string exists
  - null: something wrong with the html form
  - searchString.length() == 0: user did not enter a string
  - sendError(int, String)
    - the error status code
    - the descriptive message
- Encode the search string
  - URLEncoder.encode(searchString,”UTF-8”)
- Redirect to google
  - response.sendRedirect(“http://www.google.co.nz/search?q=“+searchString);

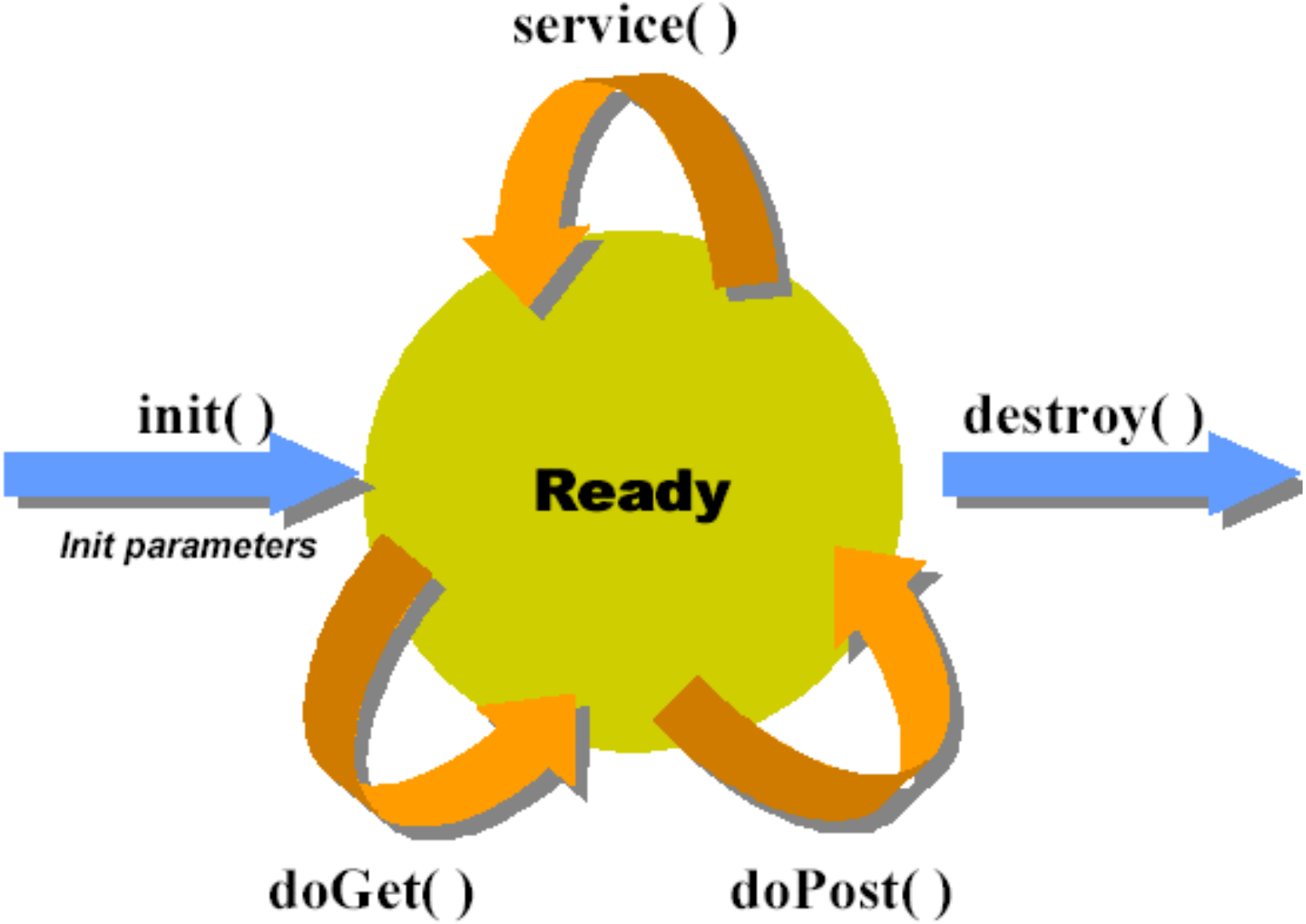
```
public class SearchEngines extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    String searchString = request.getParameter("searchString");
    if ((searchString == null) ||
        (searchString.length() == 0)) {
      response.sendError(response.SC_BAD_REQUEST,
                         "Missing search string.");
      return;
    }
    searchString = URLEncoder.encode(searchString,”UTF-8”);
    response.sendRedirect(“http://www.google.co.nz/search?q=“
                          +searchString);
  }
```

string is decoded when retrieved

search string cannot be empty

encode search string

Servlet Life Cycle

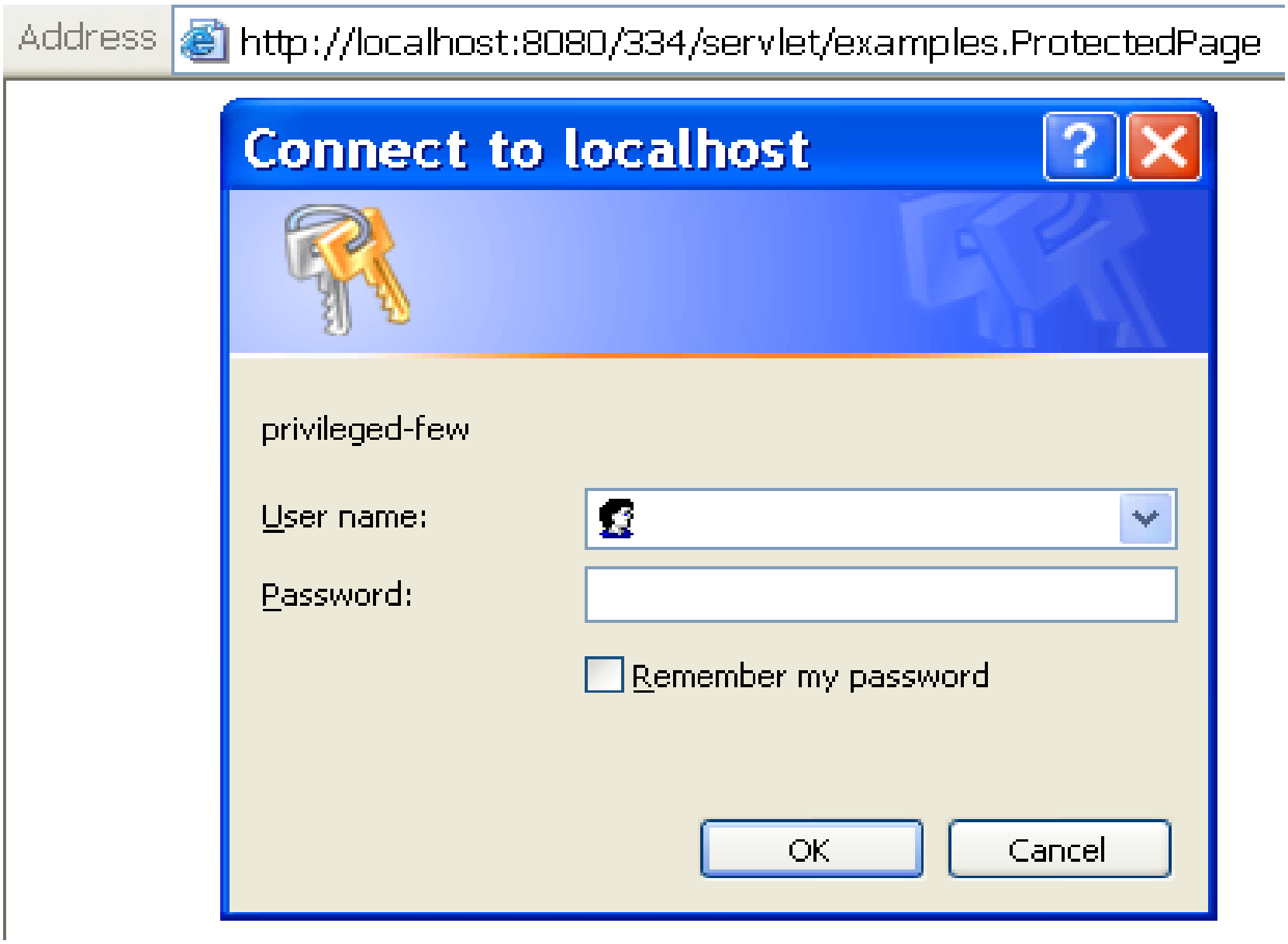


- **Init()**
  - Executed **once** when the servlet is first loaded.
  - Not called for each request.
  - Perform any set-up in this method.
- **Service()**
  - Do not override this method!
- **doGet(), doPost(), doXxx()**
  - Handles GET, POST, etc. requests.
  - Override these to provide desired behavior.
- **Destroy()**
  - Called when server deletes servlet instance.
  - Perform any clean-up, and save data to be read by the next init().

Restricting Access to Web Pages

- Step 1
  - Check whether there is Authorization header in the request.
    - Authorization=Basic bWFydHk6bWFydHlwdw==
  - If not, go to Step 2.
  - If so, skip over word “basic” and reverse the base64 encoding of the remaining part.
    - This results in a string of the form username:password.
    - Check the username and password against some stored information.
    - If it matches, return the page.
    - If not, go to Step 2.

- Step 2
  - Return a 401 (Unauthorized) response code and a header of the following form:
    - WWW-Authenticate: BASIC realm="some-name"
  - The header instructs browser to pop up a dialog box telling the user to enter a name and password, then to reconnect with that username and password embedded in a single base64 string inside the Authorization header.


Address
http://localhost:8080/334/servlet/examples.ProtectedPage
Connect to localhost
privileged-few
User name:
Password:
Remember my password
OK
Cancel

- Set up the passwords for users
  - Done in the init method when the servlet starts

```
public class ProtectedPage extends HttpServlet {
  private Properties passwords;

 public void init(ServletConfig config)
     throws ServletException {
          passwords = new Properties();
          passwords.put("abc001", "micky");
          passwords.put("abc002", "goofy");
  }
```

store UPIs and passwords in a property variable

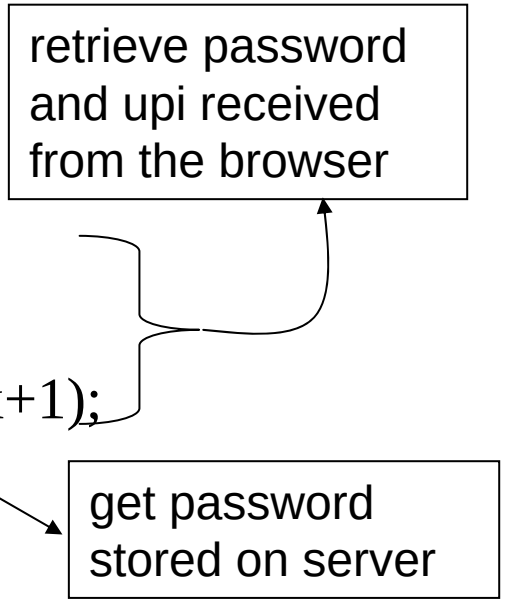
- Obtain the value of the “Authorization” header
  - request.getHeader("Authorization");
- If the “Authorization” header is not empty, retrieve the user name and password
  - String userInfo = authorization.substring(6).trim();
    - Authorization=Basic bWFydHk6bWFydHlwdw==
    - password information starts at position 6 of the header value
  - Decode the BASE64 value to obtain the real value for user name and password
    - BASE64Decoder decoder = new BASE64Decoder();
    - String nameAndPassword = new String(decoder.decodeBuffer(userInfo));
  - Extract the user name and password from the decoded string
    - User name and password are separated by “:”
    - Java String APIs
  - Compare the user name and password with the corresponding ones stored on the server
    - passwords.getProperty(user);

```
public void doGet(HttpServletRequest request,
                  HttpServletResponse response)
    throws ServletException, IOException {
  response.setContentType("text/html");
  PrintWriter out = response.getWriter();
  String authorization = request.getHeader("Authorization");
  if (authorization == null) {
    askForPassword(response);
  } else {
    System.out.println("Authorization="+authorization);
    String userInfo = authorization.substring(6).trim();
    BASE64Decoder decoder = new BASE64Decoder();
    String nameAndPassword =
      new String(decoder.decodeBuffer(userInfo));
```

if no password, ask user provide password

password information starts at position 6 of the header value

decode header value




```
int index = nameAndPassword.indexOf(":");
String user = nameAndPassword.substring(0, index);
String password = nameAndPassword.substring(index+1);
String realPassword = passwords.getProperty(user);

 if ((realPassword != null) &&
         (realPassword.equals(password))) {
       out.println("<HTML><BODY>"+
                 "<H1 ALIGN=CENTER>Welcome to the Protected Page”+
                     “</H1>\n </BODY></HTML>");
     } else {
       askForPassword(response);
     }
   }
 }
```

- If the “Authorization” header is empty
  - Set the response status code
    - response.setStatus(response.SC_UNAUTHORIZED);
  - Ask browser opens a pop-up for entering user name and password
    - response.setHeader("WWW-Authenticate", "BASIC realm=\"privileged-few\"");

```
private void askForPassword(HttpServletResponse response) {
  response.setStatus(response.SC_UNAUTHORIZED); // Ie 401
  response.setHeader("WWW-Authenticate",
                     "BASIC realm=\"privileged-few\"");
}
```

ask browser opens a pop-up for entering user name and password

Some HTTP 1.1 Response Headers

- Chapter 7 of *Core SERVLETS and JAVASERVER*
- Cache-Control
  - public: document is cacheable
  - private: document is for a single user and can only be stored in private caches
  - no-cache: document should never be cached
- Content-Disposition
  - request the browser ask the user to save the response to disk in a file of the given name
  - Content-Disposition: attachment; filename=file-name

- Content-Encoding
  - The way document is encoded.
- Content-Length
  - The number of bytes in the response.
- Content-Type
  - The MIME type of the document being returned.
- Expires
  - The time at which document should be considered out-of-date and thus should no longer be cached.
- Refresh
  - The number of seconds until browser should reload page.

- Set-Cookie
  - The cookies that browser should remember.
- WWW-Authenticate
  - The authorization type and realm needed in Authorization header.

Setting Arbitrary Response Headers

- public void setHeader(String headerName, String headerValue)
  - Sets an arbitrary header
- public void setIntHeader(String name, int headerValue)
  - Prevents need to convert int to String before calling setHeader

Setting Special Response Headers

- setContentType
  - Sets the Content-Type header.
  - text/html, application/msword
- setContentLength
  - Sets the Content-Length header.
- addCookie
  - Adds a value to the Set-Cookie header.

This program requests the browser refreshes its page every 2 seconds.

```
public class Refresh extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
          PrintWriter out = response.getWriter();
          response.setContentType("text/html");
          response.setIntHeader("Refresh", 2);
          out.println("<HTML><BODY>");
          out.println("Current Time is "+(new java.util.Date()));
          out.println("</BODY></HTML>");
  }
}
```

set Refresh header

Handling Cookies

- Chapter 8 of *Core SERVLETS and JAVASERVER*
- Cookies are textual information that a web server sends to a browser.
  - Cookies are used by the web server to record information about the clients.
- When a browser sends a request to a site, it sends the cookies received from the site to the web server.

The Potential of Cookies

- Identifying a user during an e-commerce session
- Avoiding username and password
- Customizing a site
  - user can select the information to be displayed and the server remembers the user's choices
- Targeted advertising
  - advertisements based on user's interests

Problems with Cookies

- The problem is mainly privacy, not security
- Servers can remember your previous actions
- Poorly designed sites store sensitive information like credit card numbers directly in cookie

Sending Cookies to the Client

- Create a Cookie object
  - Call the Cookie constructor with a cookie name and a cookie value, both of which are strings.
  - Cookie c = new Cookie("userID", "a1234");
- Set the maximum age
  - To tell browser to store cookie on disk
  - c.setMaxAge(60*60*24*7); // One week
  - c.setMaxAge(0) tells the browser to delete the cookie
- Place the Cookie into the HTTP response
  - Use response.addCookie

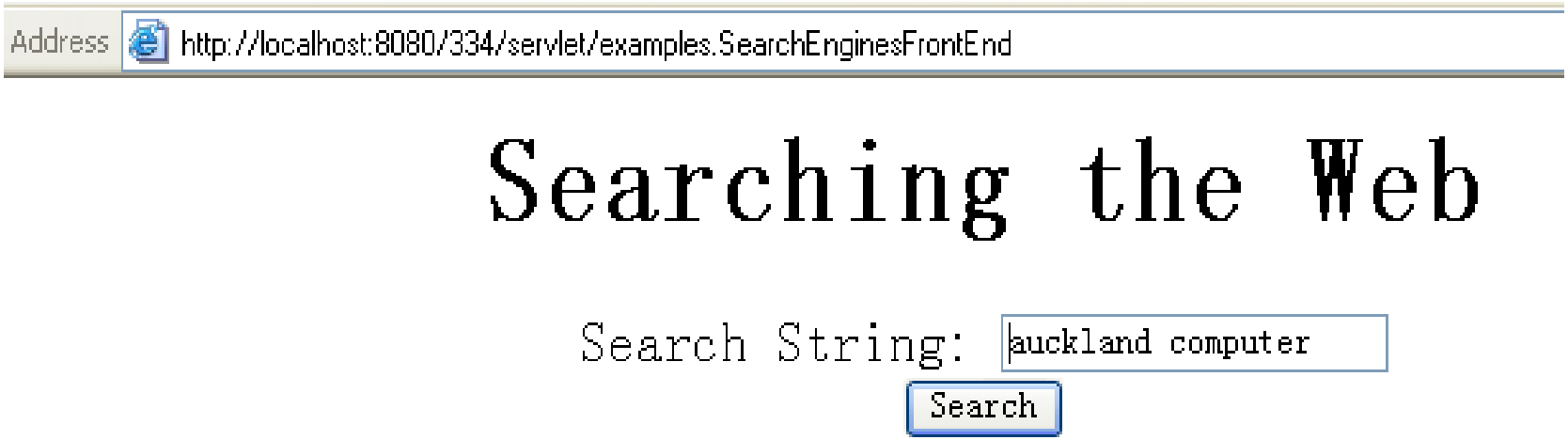
Using Cookie Attributes

- getMaxAge/setMaxAge
  - Gets/sets the cookie expiration time (in seconds). If you fail to set this, cookie applies to current browsing session only.
- getName
  - Gets the cookie name. There is no setName method; you supply name to constructor. For incoming cookie array, you use getName to find the cookie of interest.
- getValue/setValue
  - Gets/sets value associated with cookie. For new cookies, you supply value to constructor, not to setValue. For incoming cookie array, you use getName to find the cookie of interest, then call getValue on the result. If you set the value of an incoming cookie, you still have to send it back out with response.addCookie.

Reading Cookies from the Client

- Call request.getCookies
  - This yields an array of Cookie objects
- Loop down the array, calling getName on each entry until you find the cookie of interest

```
String cookieName = "userID";
Cookie[] cookies = request.getCookies();
if (cookies != null) {
  for(int i=0; i<cookies.length; i++) {
    Cookie cookie = cookies[i];
    if (cookieName.equals(cookie.getName())) {
      doSomethingWith(cookie.getValue());
    }
  }
}
```


Address
http://localhost:8080/334/servlet/examples.SearchEnginesFrontEnd
Searching the Web
Search String:
auckland computer
Search

- In this example, when a user visit servlet SearchEnginesFrontEnd, a form is shown.
  - Generate the form using out.println
- SearchEnginesFrontEnd fills in the “Search String” field with the string typed in by the user when the servlet is visited last time by the user (if any).
  - The search string typed in by the user last time is sent back to the server in a cookie
  - Retrieve the cookie containing the search string
    - request.getCookies()
    - getCookieValue(cookies, "searchString");
- When the “search” button is clicked, servlet “CustomizedSearchEngines” is called to redirect the search to google.

In the doGet method:

```
Cookie[] cookies = request.getCookies();
String searchString = getCookieValue(cookies, "searchString");
if (searchString==null) searchString="";
```

read cookies to find out whether there is any search string from previous visit

if no string found, initialize the string to empty

- Use println to generate the html code of the form
- The ACTION attribute of the FORM tag should be set to "/334/servlet/examples.CustomizedSearchEngines”
  - CustomizedSearchEngines is the servlet which processes the search request
- The VALUE attribute of the INPUT tag should be set to the value of variable searchString
  - The INPUT tag shows the input field
  - "<INPUT TYPE=\"TEXT\" NAME=\"searchString\" VALUE=\""+searchString+"\">
\n"

This method goes through all the cookies returned from the client to find out whether the cookie with the specified name exists

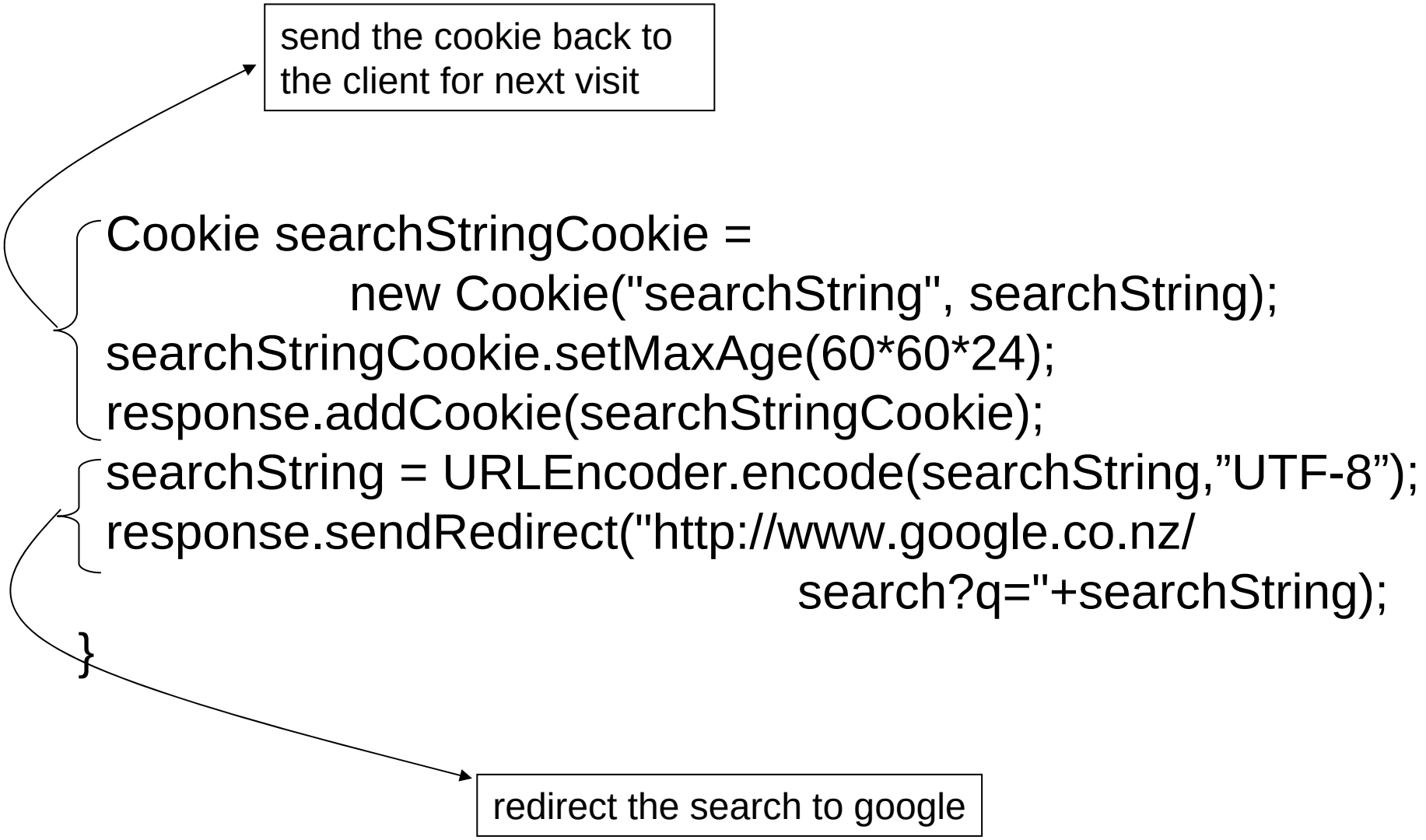
```
public String getCookieValue(Cookie[] cookies, String cookieName) {
    if (cookies != null) {
       for(int i=0; i<cookies.length; i++) {
           Cookie cookie = cookies[i];
           if (cookieName.equals(cookie.getName()))
              return(cookie.getValue());
       }
     }
     return(null);
 }
}
```

CustomizedSearchEngines

- Check the search string
  - Same as the redirecting page example
- Store the newly entered search string in a cookie and return the cookie to the client.
  - Create a cookie
    - Cookie searchStringCookie = new Cookie("searchString", searchString);
  - Set cookie expire time
    - searchStringCookie.setMaxAge(60*60*24);
  - Send cookie back
    - response.addCookie(searchStringCookie);
- Redirect search to google
  - Same as the redirecting page example

```
public class CustomizedSearchEngines extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {

    String searchString = request.getParameter("searchString");
    if ((searchString == null) || (searchString.length() == 0)) {
        response.sendError(response.SC_BAD_REQUEST,
                                          "Missing search string.");
        return;
    }
```

search string cannot be empty


send the cookie back to the client for next visit
Cookie searchStringCookie =
new Cookie("searchString", searchString);
searchStringCookie.setMaxAge(60*60*24);
response.addCookie(searchStringCookie);
searchString = URLEncoder.encode(searchString,”UTF-8”);
response.sendRedirect("http://www.google.co.nz/
search?q="+searchString);
}
redirect the search to google

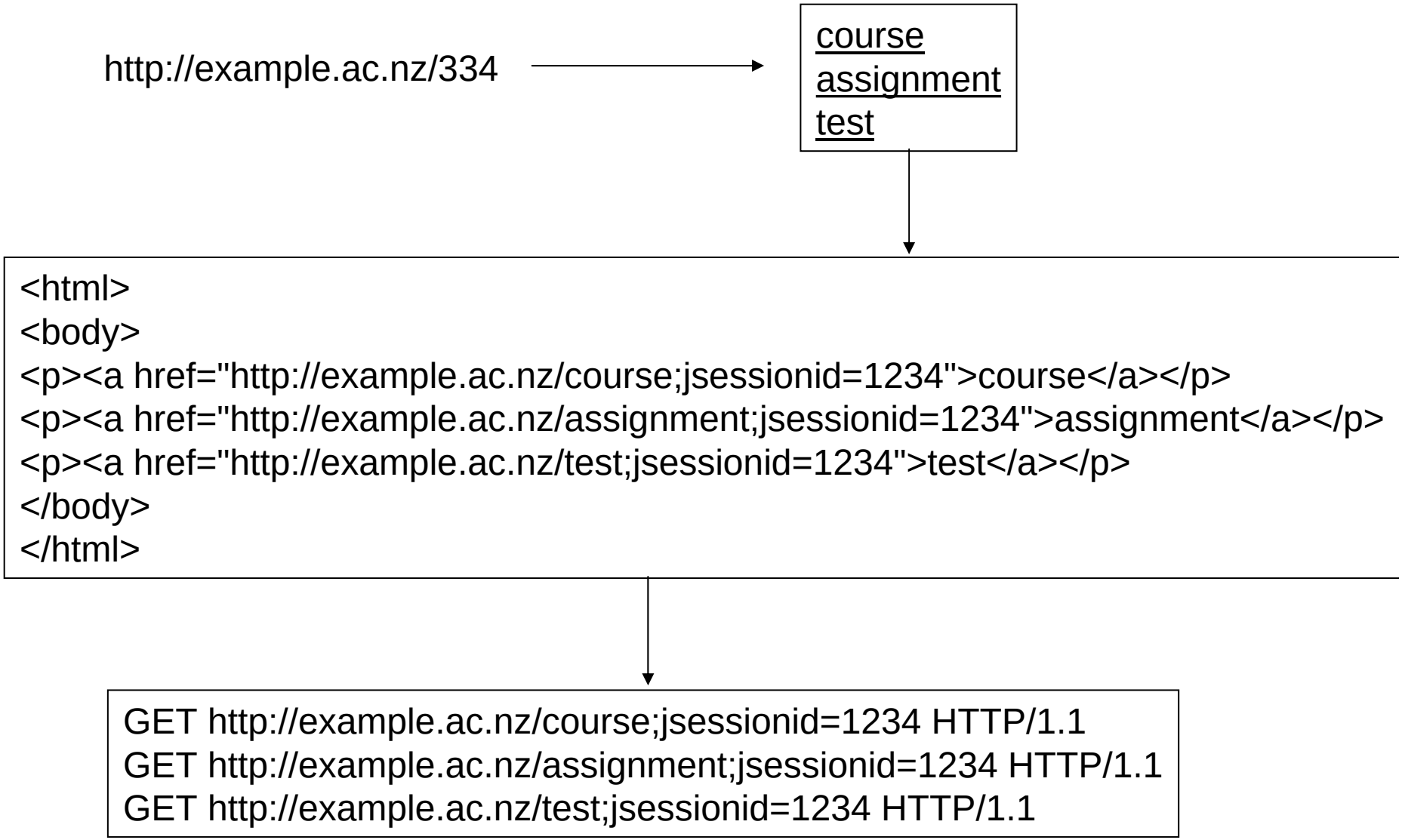
Session Tracking

- Chapter 9 of *Core SERVLETS and JAVASERVER*
- Why session tracking?
  - HTTP protocol is stateless.
  - When doing on-line shopping, a customer might browse many pages and make many orders on different pages.
  - When a customer checks out, we need to find out the orders the customer made while in the shop.

Techniques for session tracking

- Using cookies
  - Send a cookie to the client when the client first visit the site.
  - Whenever the client comes back the same site, the cookie is sent back by the client's browser.
  - Problem
    - Client might disallow cookie

- URL-Rewriting
  - Appends some extra data that identifies the session on the end of each URL that refers to the sever site
    - http://host/path/file.html;session=xyz
  - Server associates that identifier with data it has stored about that session
  - Advantage
    - Works even if cookies are disabled or unsupported
  - Disadvantage
    - Must encode all URLs to include the session information that refer to your own site
    - all pages which contain reference to your site must be generated dynamically


http://example.ac.nz/334
course
assignment
test
<html>
<body>
course
assignment
test
</body>
</html>
GET http://example.ac.nz/course;jsessionid=1234 HTTP/1.1
GET http://example.ac.nz/assignment;jsessionid=1234 HTTP/1.1
GET http://example.ac.nz/test;jsessionid=1234 HTTP/1.1

- Hidden Form Fields
  - <INPUT TYPE="HIDDEN" NAME="session" VALUE="1234">
    - the field is invisible to the user
    - when the form is submitted, the name, i.e. session, and the value, i.e. 1234, are automatically sent to the server
  - when generating form, the servlet needs to generate the hidden field

The Session Tracking API

- Session objects live on the server
- Automatically associated with client via cookies or URL-rewriting
  - Use request.getSession(true) to get either existing or new session
  - Behind the scenes, the system looks at cookie or URL extra info and sees if it matches the key to some previously stored session object. If so, it returns that object. If not, it creates a new one, assigns a cookie or URL info as its key, and returns that new session object.

- Hashtable-like mechanism lets you store arbitrary objects inside session
  - setAttribute stores values
  - getAttribute retrieves values

Session Tracking Basics

- Access the session object
  - Call request.getSession to get HttpSession object
    - This is a hashtable associated with the user
- Look up information associated with a session.
  - Call getAttribute on the HttpSession object, cast the return value to the appropriate type, and check whether the result is null.
- Store information in a session.
  - Use setAttribute with a key and a value.
- Discard session data.
  - Call removeAttribute discards a specific value.
  - Call invalidate to discard an entire session.

- The session object is like a hash table
- setAttribute(String name, Object o)
- getAttribute(String name)
- getAttributeNames()

Session Tracking Basics

```
HttpSession session = request.getSession();
SomeClass value = (SomeClass)session.getAttribute("someID");
if (value == null) {
   value = new SomeClass(...);
   session.setAttribute("someID", value);
}
doSomethingWith(value);
```

What if Server Uses URL Rewriting?

- Encode the URL that links back to the same site as the servlet:
  - Pass URL through response.encodeURL.
    - If server is using cookies, this returns URL unchanged
    - If server is using URL rewriting, this appends the session info to the URL

      String url = "order-page.html";

      url = response.encodeURL(url);

- This example is a simple servlet that shows basic information about the client's session.
- When the client connects, the servlet retrieves the existing session. If there is no session, create a new one.
  - HttpSession session = request.getSession(true);
- The servlet looks for an attribute called accessCount of type Integer.
  - Integer accessCount = (Integer)session.getAttribute("accessCount");
  - accessCount does not exist, use 0 as the number of previous accesses
    - accessCount = new Integer(0);
  - Otherwise, increment the attribute by one
    - accessCount = new Integer(accessCount.intValue() + 1);
  - Store the new value to the session
    - session.setAttribute("accessCount", accessCount);

- Use a table to display various information about the session object
  - Session ID: session.getId()
  - Creation time: session.getCreationTime()
  - Last accessed time: session.getLastAccessedTime()

```
public class ShowSession extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
    throws ServletException, IOException {
   response.setContentType("text/html");
   PrintWriter out = response.getWriter();
   HttpSession session = request.getSession(true);
   String heading;
   Integer accessCount = (Integer)session.getAttribute("accessCount");
   if (accessCount == null) {
    accessCount = new Integer(0);
    heading = "Welcome, Newcomer";
   } else {
    heading = "Welcome Back";
    accessCount = new Integer(accessCount.intValue() + 1);
   }
   session.setAttribute("accessCount", accessCount);
```

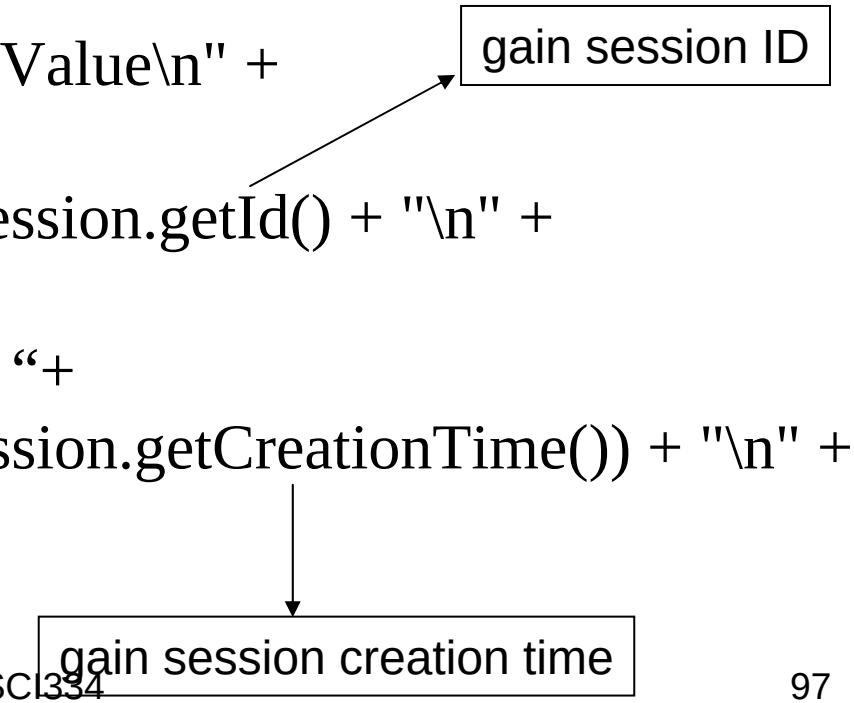
retrieve session

find attribute

initialize the attribute if it does not exist

increment the attribute if it already exists

```
// URL rewirting
String url = response.encodeURL
        ("http://localhost:8080/334/servlet/examples.ShowSession");
 out.println("<HTML><BODY>\n" +
            "<H1 ALIGN=\"CENTER\">" + heading + "</H1>\n" +
            "<H2>Information on Your Session:</H2>\n" +
            "<TABLE BORDER=1 ALIGN=\"CENTER\">\n" +
            "<TR >\n" +
            "  <TH>Info Type <TH>Value\n" +
            "<TR>\n" +
            "  <TD>ID\n <TD>" + session.getId() + "\n" +
            "<TR>\n "+
            “  <TD>Creation Time\n “+
            “  <TD>" + new Date(session.getCreationTime()) + "\n" +
```

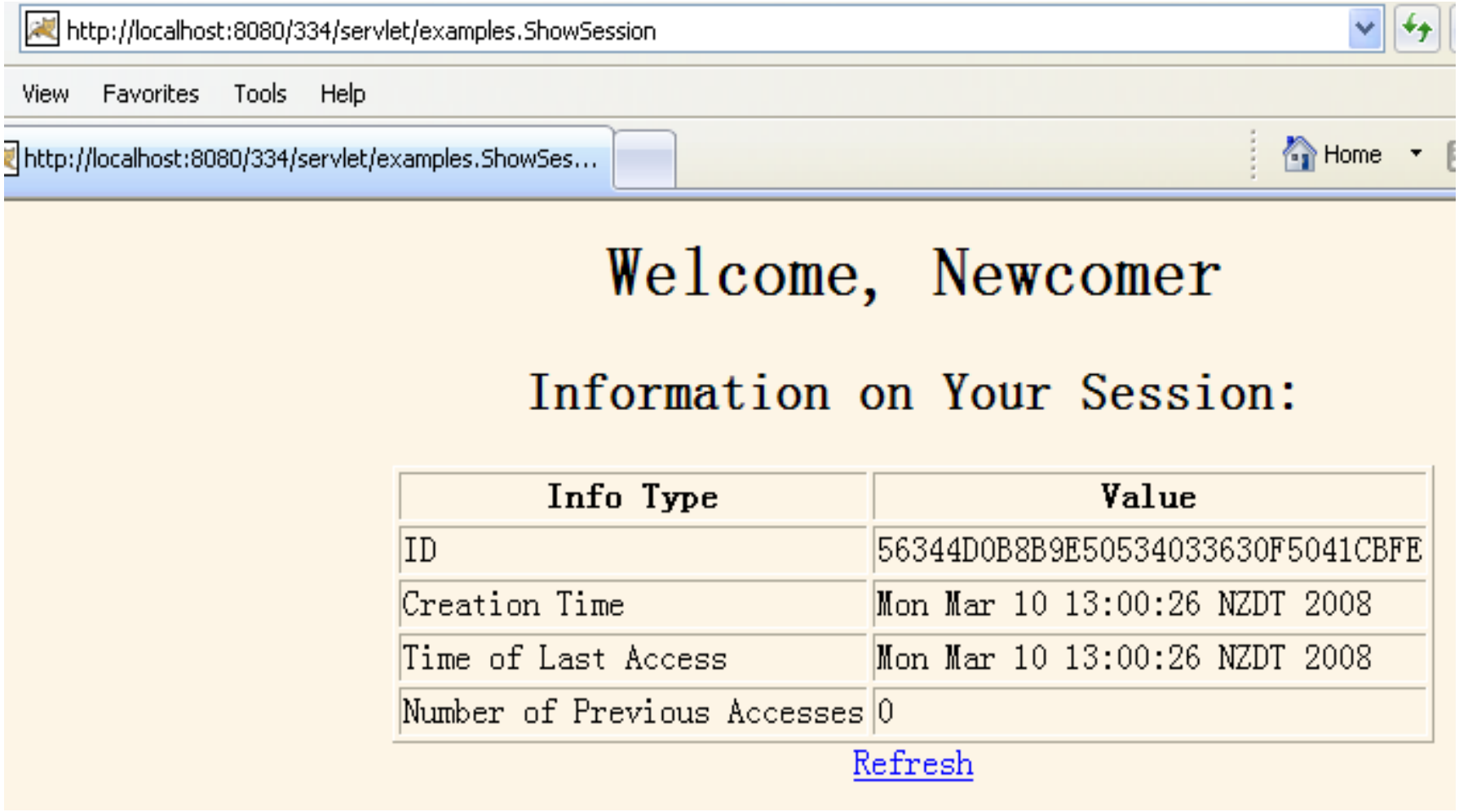


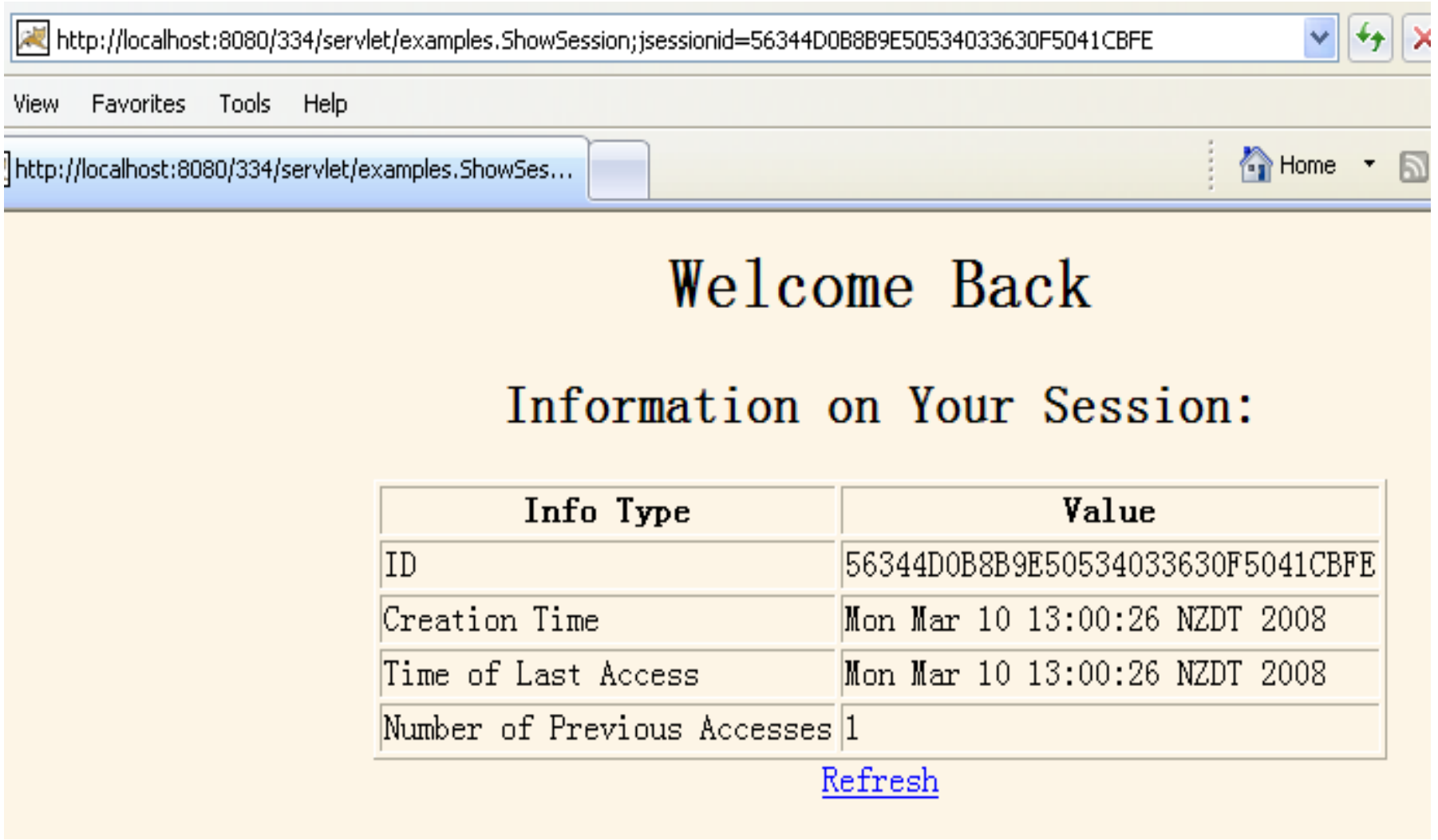
```
    "<TR>\n" +
    "  <TD>Time of Last Access\n" +
    "  <TD>" + new Date(session.getLastAccessedTime()) + "\n" +
    "<TR>\n" +
    "  <TD>Number of Previous Accesses\n" +
    "  <TD>" + accessCount + "\n" +
    "</TABLE>\n" +
     "<CENTER><a href=\"" + url + "\">Refresh</a></CENTER>"+
    "</BODY></HTML>");
}
```

number of previous access

retrieve the time that the session was last sent from client

- To see how URL rewriting works, you need to disable the cookie
- In IE browser, you can add localhost to the "Restricted sites" using "Internet Options" → security. Then, click "Restricted sites" → click the "Sites" button and use the pop up panel to enter the "http://localhost".

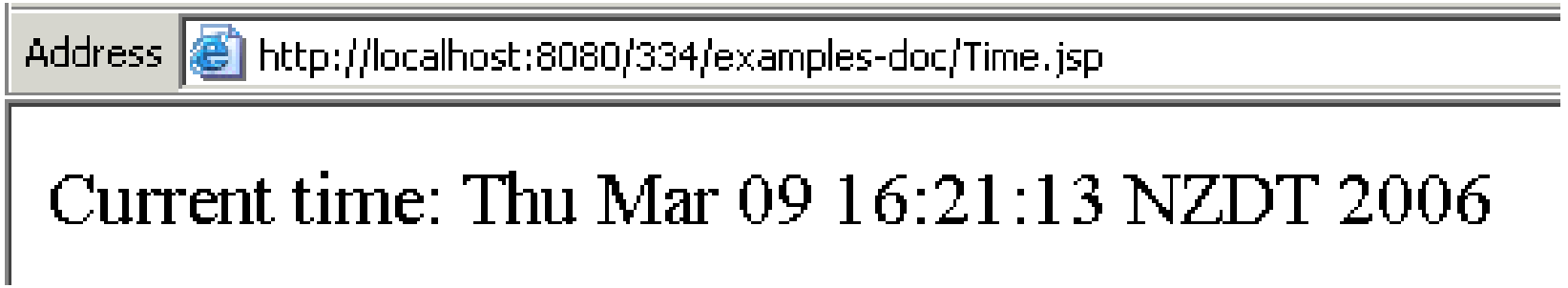

http://localhost:8080/334/servlet/examples.ShowSession
View Favorites Tools Help
http://localhost:8080/334/servlet/examples.ShowSes...
Home
Welcome, Newcomer
Information on Your Session:
Info Type
Value
ID
56344D0B8B9E50534033630F5041CBFE
Creation Time
Mon Mar 10 13:00:26 NZDT 2008
Time of Last Access
Mon Mar 10 13:00:26 NZDT 2008
Number of Previous Accesses
0
Refresh


http://localhost:8080/334/servlet/examples.ShowSession;jsessionid=56344D0B8B9E50534033630F5041CBFE
View Favorites Tools Help
http://localhost:8080/334/servlet/examples.ShowSes...
Home
Welcome Back
Information on Your Session:
Info Type
Value
ID
56344D0B8B9E50534033630F5041CBFE
Creation Time
Mon Mar 10 13:00:26 NZDT 2008
Time of Last Access
Mon Mar 10 13:00:26 NZDT 2008
Number of Previous Accesses
1
Refresh

The Need for JSP

- Chapter 10 and 11 of *Core SERVLETS and JAVASERVER*
- The main drawback of using servlet is that all the HTML text must be generated by println statement.
  - Web page writers must know programming.
- The idea behind JSP
  - A page contains a mixture of Java and HTML code
  - Use regular HTML for most of page
  - Mark Java code with special tags
  - Entire JSP page gets translated into a servlet (once), and servlet is what actually gets invoked (for each request)

```
<HTML>
<BODY>
Current time: <%= new java.util.Date() %>
</BODY>
</HTML>
```



- JSP makes it easier to create and maintain HTML, while still providing full access to servlet code
- JSP pages get translated into servlets the first time the pages are requested
  - Servlet code gets executed. The original JSP page is totally ignored.
  - Page translation does not occur for each request.

Basic Syntax

- HTML Text
  - <H1>Blah</H1>
  - Passed through to client. Really turned into servlet code that looks like
    - out.print("<H1>Blah</H1>");
- JSP Comments
  - <%-- Comment --%>
  - Not sent to client
  - To get <% in output, use <\%

- Expressions
  - <%= Java Expression %>
  - Expression evaluated, converted to String, and placed into HTML page at the place it occurred in JSP page
  - <%= new java.util.Date() %>

JSP/Servlet Correspondence

- **Original JSP**

```
<H1>A Random Number</H1>
<%= Math.random() %>
```

- **Possible resulting servlet code**

```
public void _jspService(HttpServletRequest request,
                        HttpServletResponse response)
    throws ServletException, IOException {
  response.setContentType("text/html");
  HttpSession session = request.getSession(true);
  JspWriter out = response.getWriter();
  out.println("<H1>A Random Number</H1>");
  out.println(Math.random());
  ...
}
```

Predefined Variables

- request
  - The HttpServletRequest
- response
  - The HttpServletResponse
- out
  - The JspWriter used to send output to the client
- session
  - The HttpSession associated with the request

JSP Scriptlets

- A collections of Java code enclosed with <% %>
  - <% Java code %>
  - <%

```
String queryData = request.getQueryString();
out.println("Attached GET data: " + queryData);
```

%>

- Scriplets need not be complete Java expressions
- Complete expressions are usually clearer and easier to maintain.

Example

```
<% if (Math.random() < 0.5) { %>
Have a <B>nice</B> day!
<% } else { %>
Have a <B>lousy</B> day!
<% } %>
```

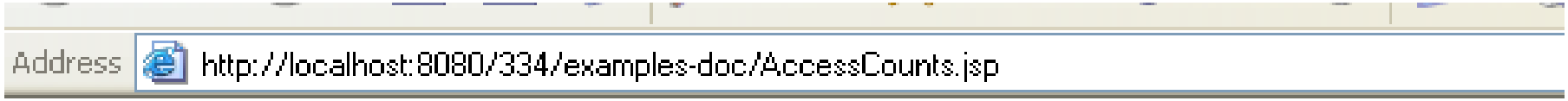
Representative result

```
if (Math.random() < 0.5) {
  out.println("Have a <B>nice</B> day!");
} else {
  out.println("Have a <B>lousy</B> day!");
}
```

JSP Declarations

```
<HTML>
<BODY>
<H1>JSP Declarations</H1>

<%! private int accessCount = 0; %>
<H2>Accesses to page since server reboot:
<%= ++accessCount %></H2>

</BODY>
</HTML>
```

The scope of the declaration is in a JSP file.



JSP Declarations

Accesses to page since server reboot: 1

JSP Declarations

Accesses to page since server reboot: 2

JSP page Directive:

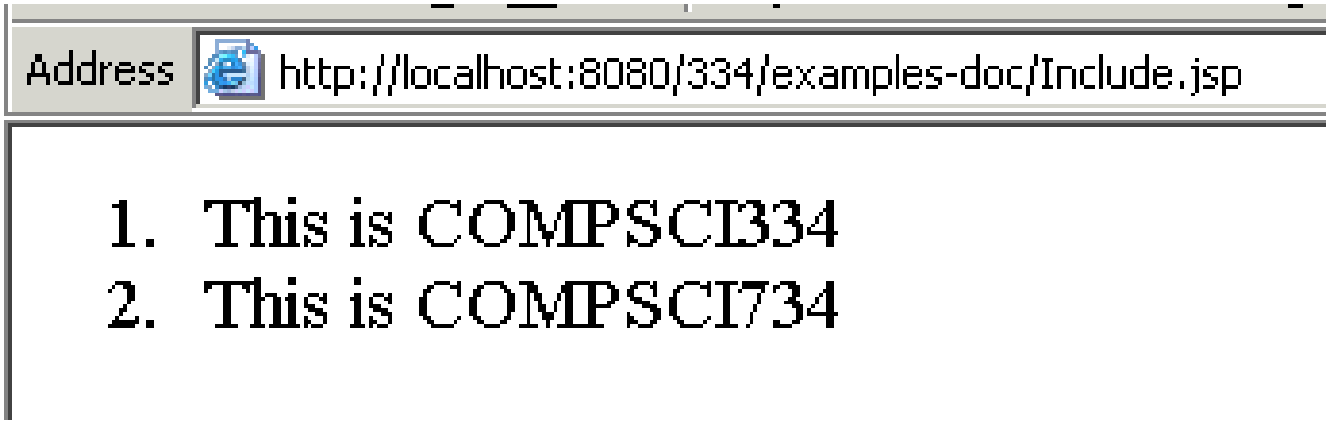
- By default, the servlet imports java.lang.*, javax.servlet.*, javax.servlet.jsp.*, javax.servlet.http.* packages.
  - Different servers might also import various other Java packages.
- To import other packages, the following forms are used:
  - <%@ page import="package.class" %>
  - <%@ page import="package.class1,...,package.classN" %>

```
<HTML>
<BODY>
<%@ page import="java.math.BigInteger" %>
<%! BigInteger bi = new java.math.BigInteger("123456789012345678890"); %>
Number is <%= bi.toString() %>
</BODY>
</HTML>
```

Including Files in JSP Documents

- Chapter 13 of *Core SERVLETS and JAVASERVER*
- To reuse JSP, HTML, or plain text content
- Use jsp:include tag
  - <jsp:include page=“file-name" />
  - <jsp:include page="COMPSCI334.html" />
- Use include directive
  - <%@ include file=“file-name" %>
  - <%@ include file="AccessCount.jsp" %>

```
<HTML>
<BODY>
<OL>
<LI><jsp:include page="COMPSCI334.html" />
<LI><jsp:include page="COMPSCI734.html" />
</OL>
</BODY>
</HTML>
```



```
<%!
private int accessCount = 0;
private String accessHost = null;
%>
<P>
<HR>
This page has been accessed <%= ++accessCount %>
times since server reboot.
<%      if (accessHost != null) { %>
                    It was last accessed from
                    <%= accessHost %>.
<%      }
        accessHost = request.getRemoteHost(); %>
```

JSP file to be included

```
<HTML>
<BODY>
<%@ page import="java.util.Date" %>
Current time: <%= new java.util.Date() %>
<%@ include file="AccessCount.jsp" %>
</BODY>
</HTML>
```

Current time: Thu Apr 10 10:11:22 NZST 2008

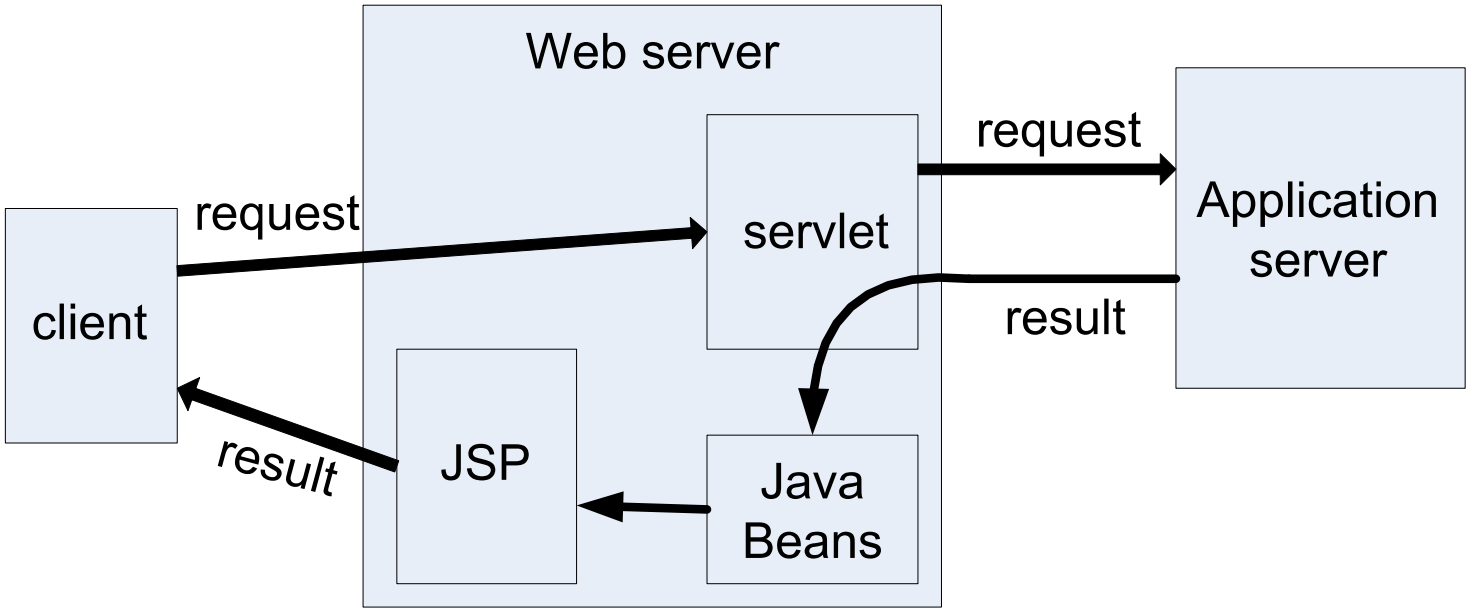
This page has been accessed 1 times since server reboot.

Current time: Thu Apr 10 10:14:06 NZST 2008

This page has been accessed 2 times since server reboot.
It was last accessed from 127.0.0.1.

Using JavaBeans with JSP

- Chapter 14 of *Core SERVLETS and JAVASERVER*
- In JSP pages, we should avoid using complicated programming logic.



What Are Beans?

- Java classes that follow certain conventions
  - Must have a zero-argument (empty) constructor
    - You can satisfy this requirement either by explicitly defining such a constructor or by omitting all constructors
  - Should have no public instance variables (fields)
  - Class variables should be accessed through methods called ge*tXxx* and se*tXxx*
    - If class has method getTitle that returns a String, class is said to have a String *property* named title
    - Boolean properties use is*Xxx* instead of ge*tXxx*

```
package examples;
public class StringBean {
  private String message = "No message specified";
  public String getMessage() {
    return(message);
  }
  public void setMessage(String message) {
    this.message = message;
  }
}
```

- The file should be placed in webapps\334\WEB-INF\classes\examples folder
- Compile the file with
  javac StringBean.java

Basic Bean Use in JSP

- Format
  - <jsp:useBean id="*name*e" class="*package.Class*s" />
  - If an existing bean is to be accessed, it is retrieved. If a bean needs to be created, it is instantiated without explicit Java programming.
- Example
  - <jsp:useBean id=“sb" class=“examples.StringBean " />
  - Same as

    <% examples.StringBean sb = new examples.StringBean ();

    pageContext.setAttribute("sb", sb, PageContext.PAGE_SCOPE);

    %>

Accessing Bean Properties

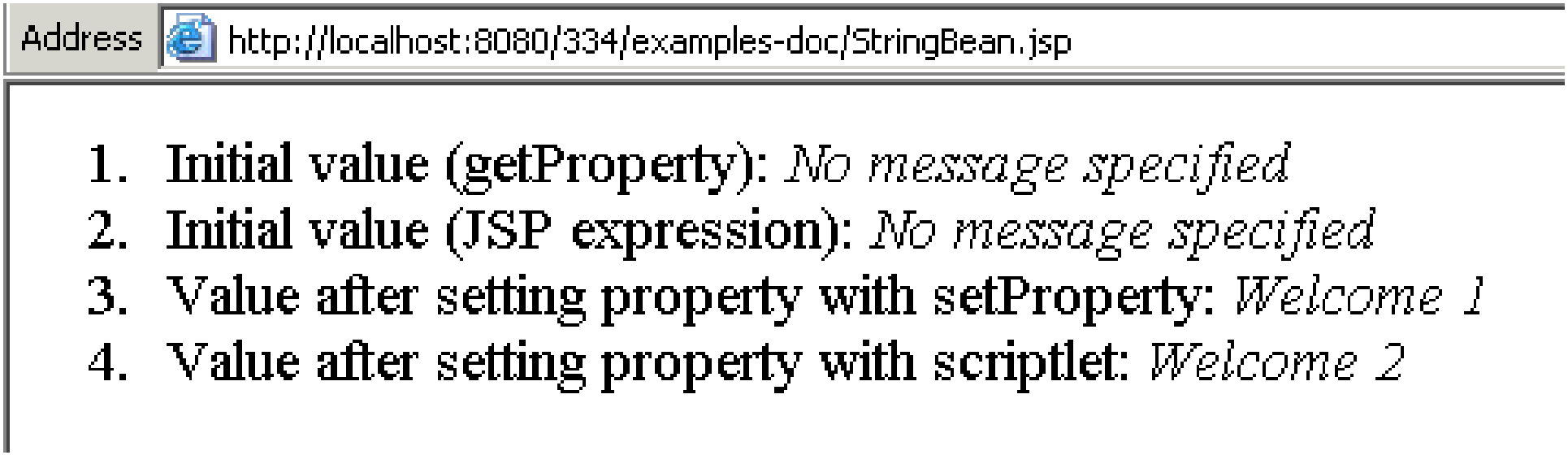
- Format
  - <jsp:getProperty name="*name*e" property="*property*" />
- Example
  - <jsp:getProperty name=“sb" property=“message" />
  - Same as <%= sb.getMessage() %>

Setting Bean Properties:

- Format
  - <jsp:setProperty name="*name*e"
    property="*property*"
    value="*value*e" />
- Example
  - <jsp:setProperty name=“sb"
    property=“message"
    value=“welcome" />
  - Same as <% sb.setMessage(“welcome"); %>

```
<HTML>
<BODY>
<jsp:useBean id="stringBean" class="examples.StringBean" />

<OL>
<LI>Initial value (getProperty):
   <I><jsp:getProperty name="stringBean"
                       property="message" /></I>

<LI>Initial value (JSP expression):
   <I><%= stringBean.getMessage() %></I>
```

```
<LI><jsp:setProperty name="stringBean"
                     property="message"
                     value="Welcome 1" />
   Value after setting property with setProperty:
   <I><jsp:getProperty name="stringBean"
                       property="message" /></I>

<LI><% stringBean.setMessage("Welcome 2"); %>
   Value after setting property with scriptlet:
   <I><%= stringBean.getMessage() %></I>
</OL>

</BODY>
</HTML>
```

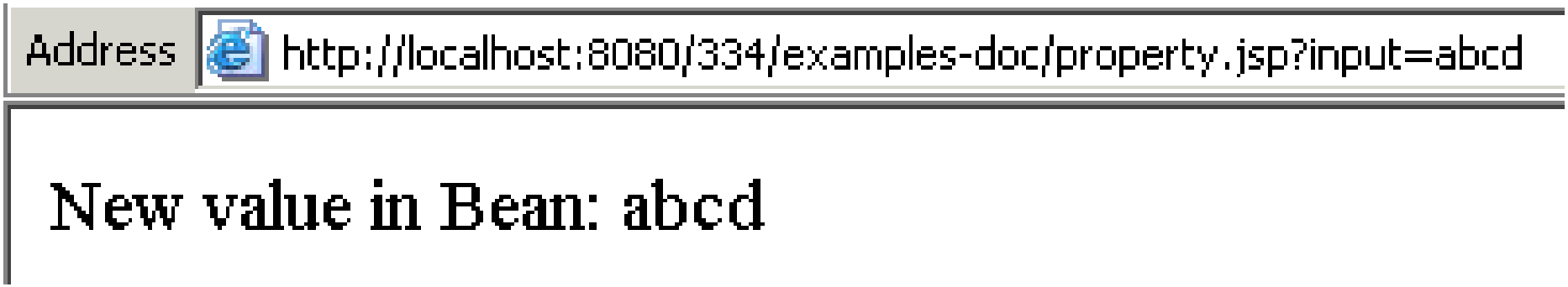

Address
http://localhost:8080/334/examples-doc/StringBean.jsp
1. Initial value (getProperty): No message specified
2. Initial value (JSP expression): No message specified
3. Value after setting property with setProperty: Welcome 1
4. Value after setting property with scriptlet: Welcome 2

Associating Individual Properties with Input Parameters

- Format
  - <jsp:setProperty name=“Bean’s ID"
    property=“Bean’s property"
    param=“form’s parameter name" />
- Example
  - <jsp:setProperty name="stringBean"
    property="message"
    param="input" />

```
<HTML>
<BODY>
<FORM ACTION="property.jsp">
Enter message here: <INPUT TYPE="text" NAME="input"> <BR>
<INPUT TYPE="SUBMIT" VALUE="Submit">
</FORM>
</BODY>
</HTML>
```

```
<HTML>
<BODY>
<jsp:useBean id="stringBean" class="examples.StringBean" />
<jsp:setProperty name="stringBean" property="message" param="input" />
New value in Bean: <jsp:getProperty name="stringBean" property="message" />
</BODY>
</HTML>
```



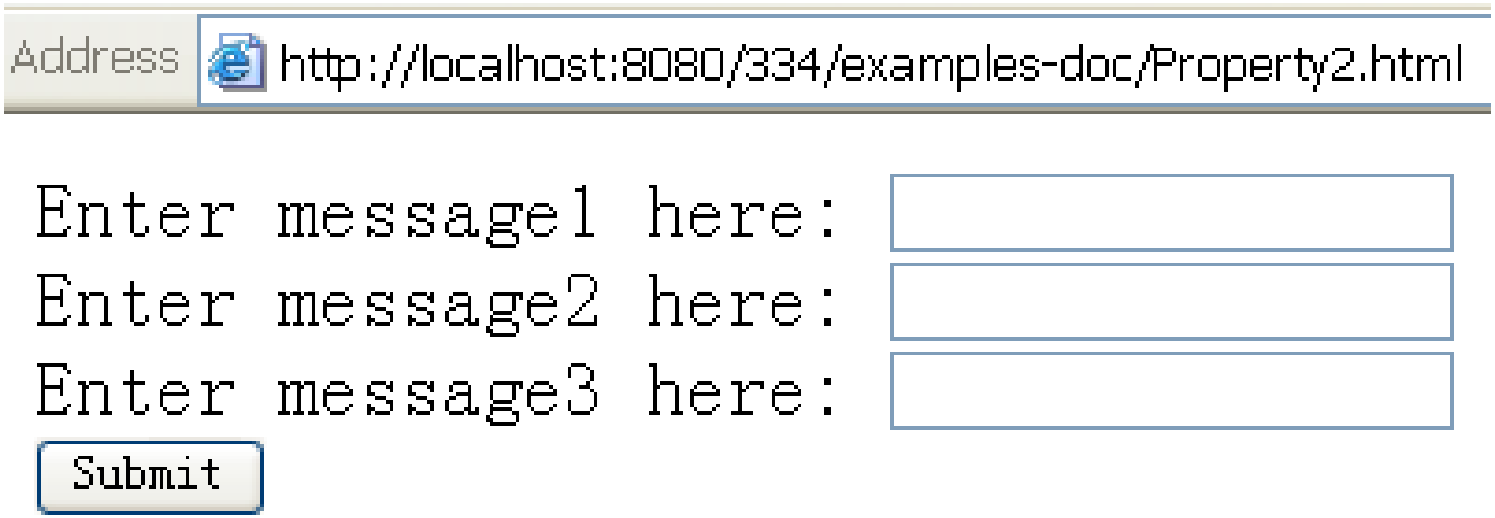
Associating All Properties with Input Parameters

- If the names of the parameters in a form are the same as the names of the properties of a Bean, you can assign the values of the parameters directly to the corresponding properties in the Bean.
  - no action is taken when an input parameter is missing
- Format
  - <jsp:setProperty name=“Bean’s ID" property="*" />

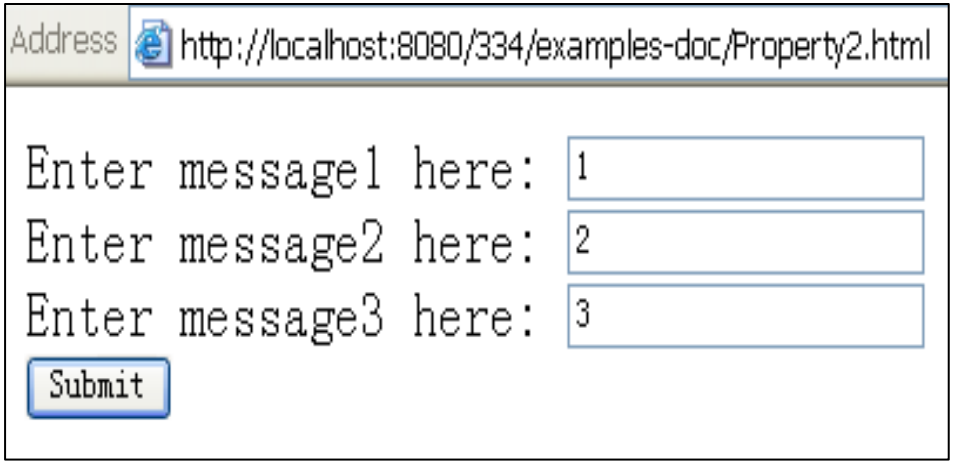
```
public class StringBean2 {
  private String message1 = "No message specified";
  private String message2 = "No message specified";

  public String getMessage1() {
    return(message1);
  }
  public String getMessage2() {
    return(message2);
  }

  public void setMessage1(String message) {
    this.message1 = message;
  }
  public void setMessage2(String message) {
    this.message2 = message;
  }
}
```

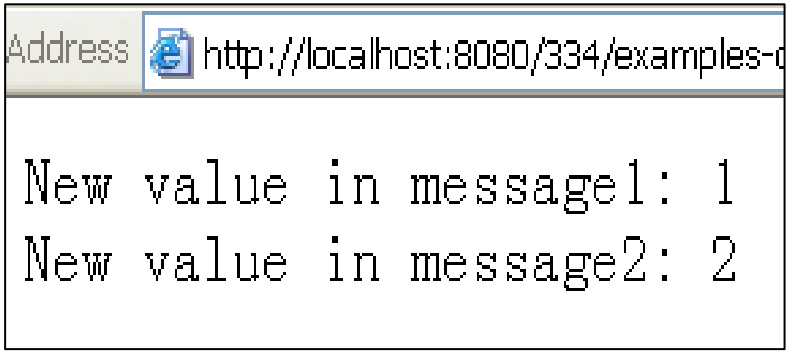
Bean with two properties

```
<HTML>
<BODY>
<FORM ACTION="property2.jsp">
Enter message1 here: <INPUT TYPE="text" NAME="message1" size="20"> <BR>
Enter message2 here: <INPUT TYPE="text" NAME="message2" size="20"> <BR>
Enter message3 here: <INPUT TYPE="text" NAME="message3" size="20"> <BR>
<INPUT TYPE="SUBMIT" VALUE="Submit">
</FORM>
</BODY>
</HTML>
```

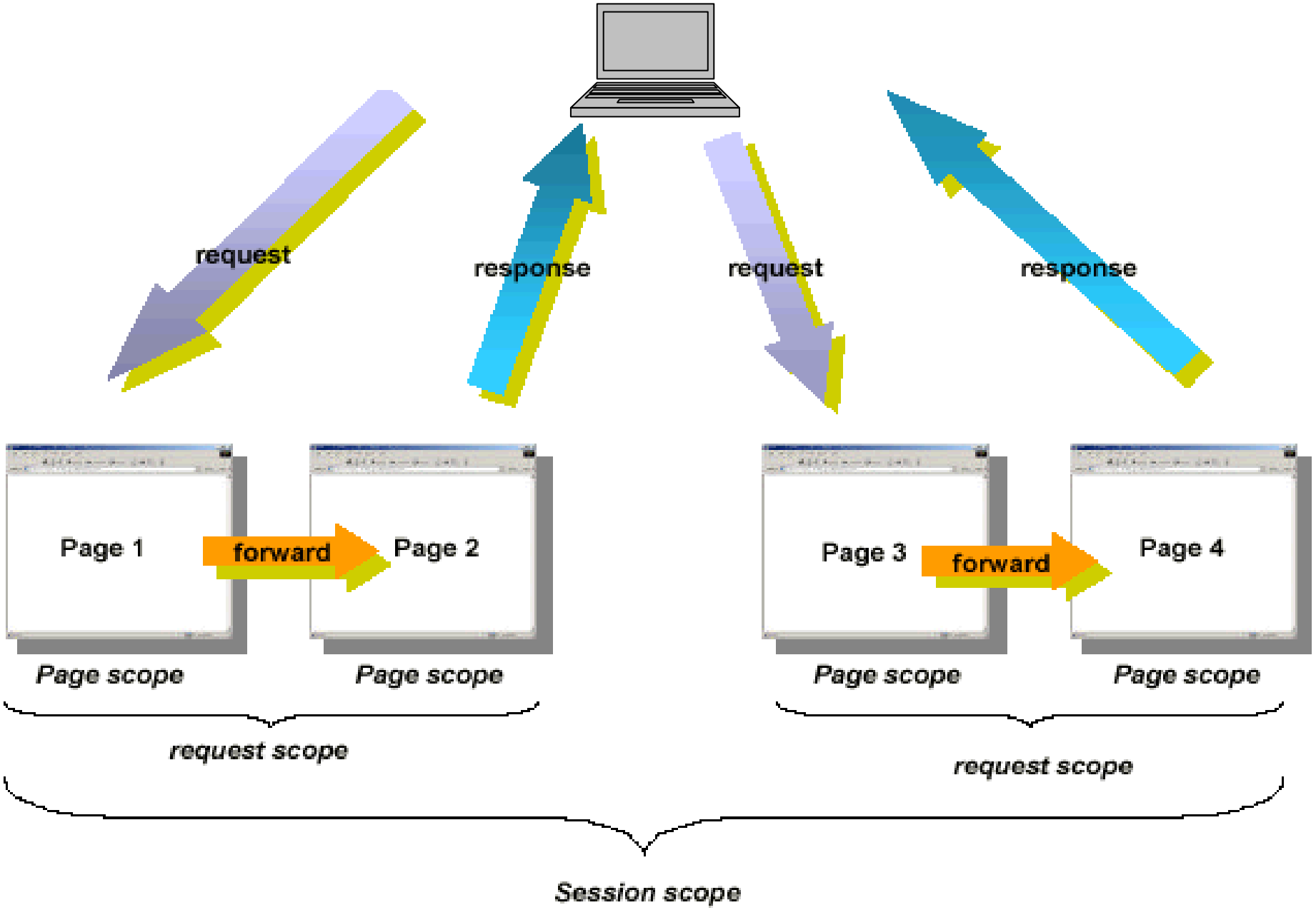


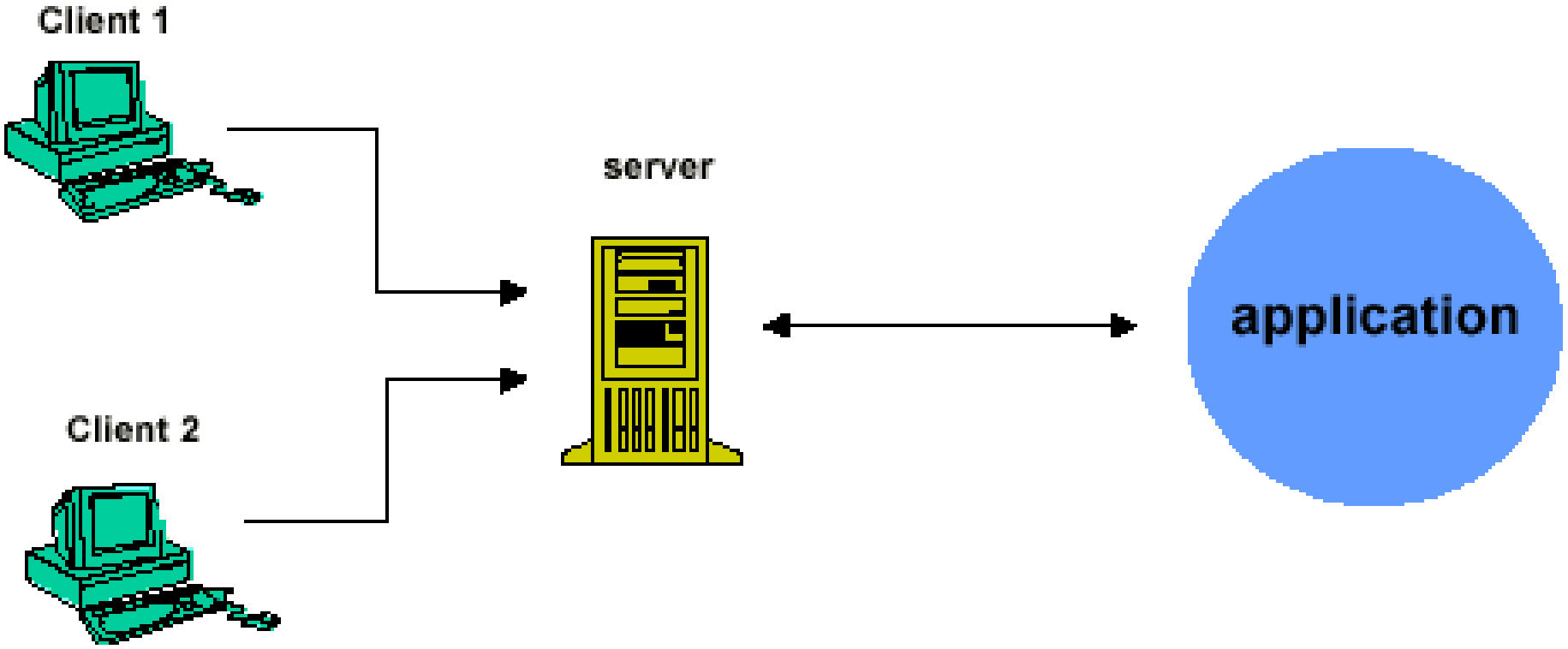
```
<HTML>
<BODY>
<jsp:useBean id="stringBean" class="examples.StringBean2" />
<jsp:setProperty name="stringBean" property="*" />
New value in message1: <jsp:getProperty name="stringBean"
                                        property="message1" /><br>
New value in message2: <jsp:getProperty name="stringBean"
                                        property="message2" />
</BODY>
</HTML>
```





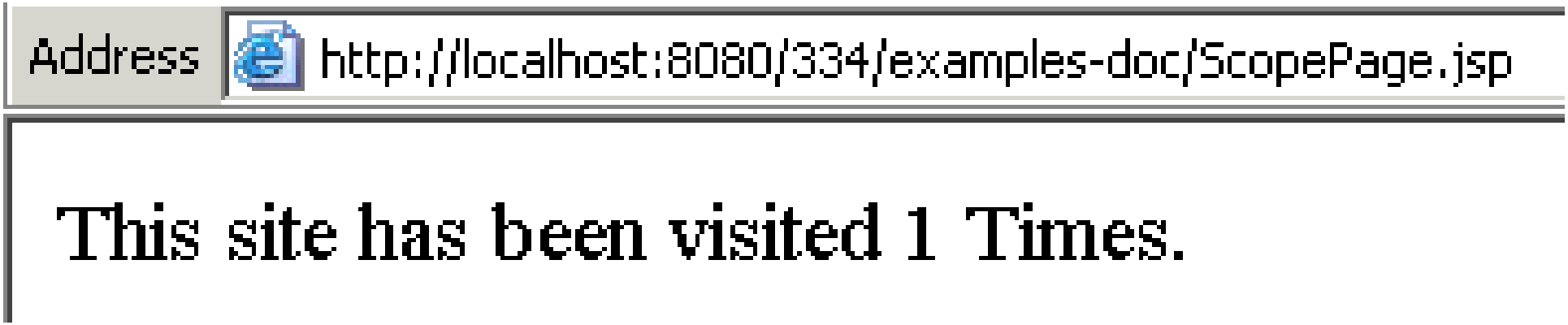
The Scope of JavaBean



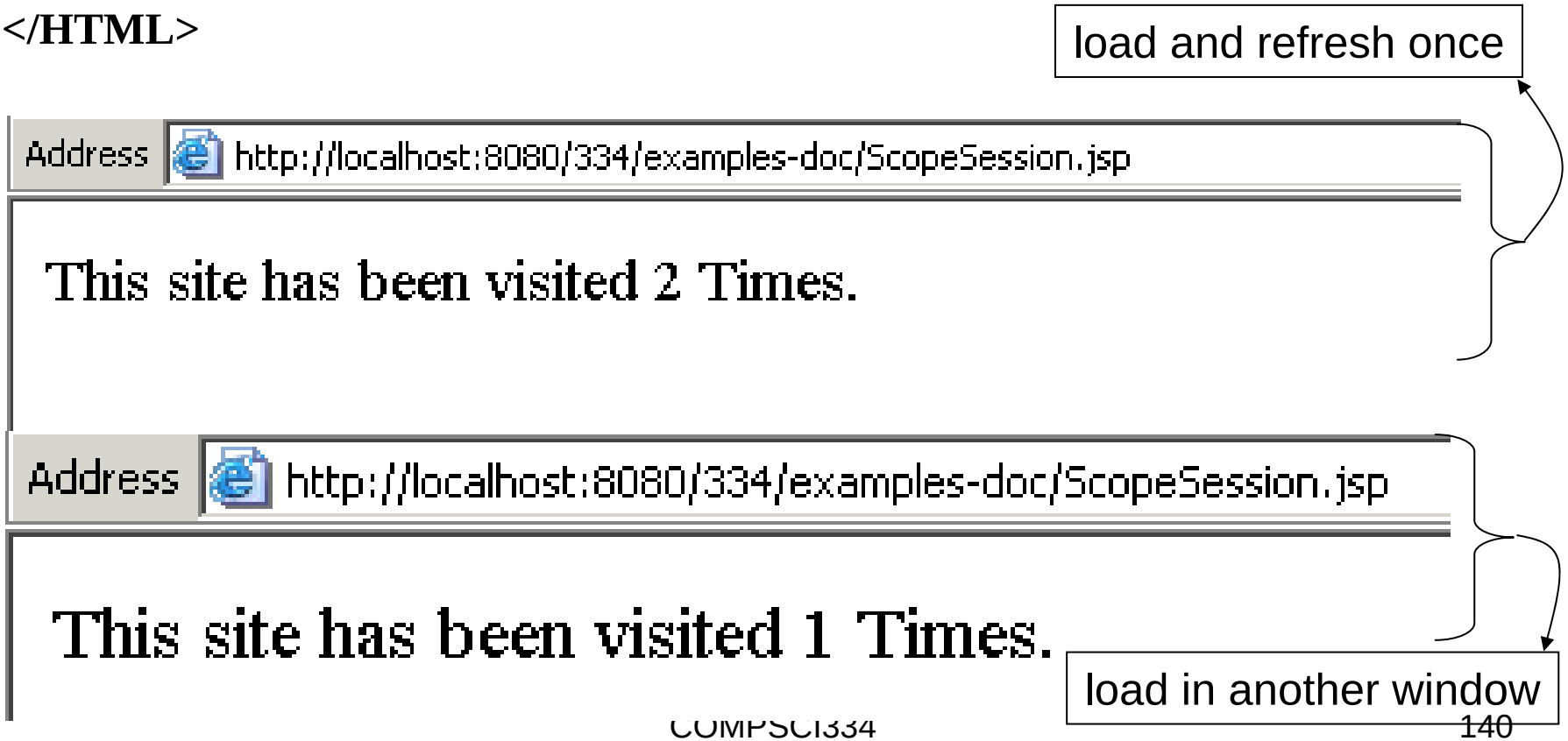

Client 1
server
application
Client 2

- When you store beans in different scopes, you should use different names for each bean. Otherwise, servers might be confused and retrieve the wrong bean.

```
<HTML>
<BODY>
<jsp:useBean id="acb_p" class="examples.AccessCountBean" scope="page" />
This site has been visited
<jsp:getProperty name="acb_p" property="accessCount" />
Times.
<jsp:setProperty name="acb_p" property="accessCountIncrement" value="1" />
</BODY>
</HTML>
```



```
<HTML>
<BODY>
<jsp:useBean id="acb_s" class="examples.AccessCountBean" scope="session" />
This site has been visited
<jsp:getProperty name="acb_s" property="accessCount" />
Times.
<jsp:setProperty name="acb_s" property="accessCountIncrement" value="1" />
</BODY>
</HTML>
```



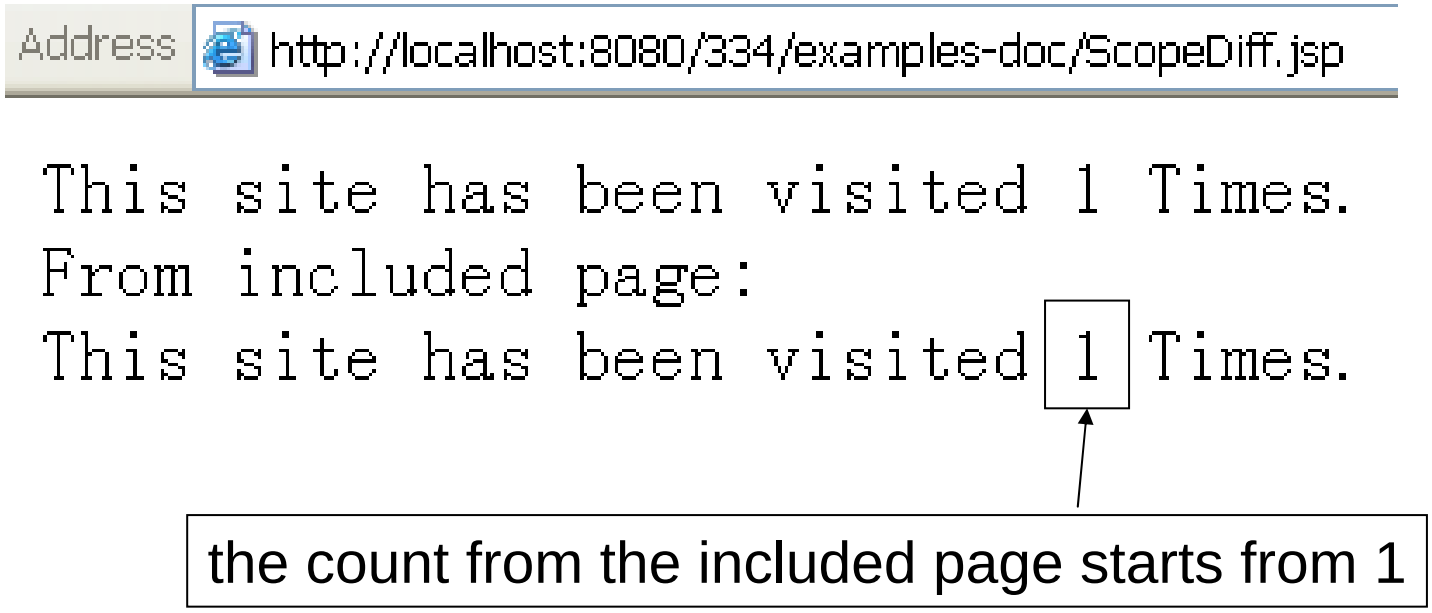
```
<HTML>
<BODY>
<jsp:useBean id="acb_a" class="examples.AccessCountBean" scope="application" />
This site has been visited
<jsp:getProperty name="acb_a" property="accessCount" />
Times.
<jsp:setProperty name="acb_a" property="accessCountIncrement" value="1" />
</BODY>
</HTML>
```

Difference between page and request scope

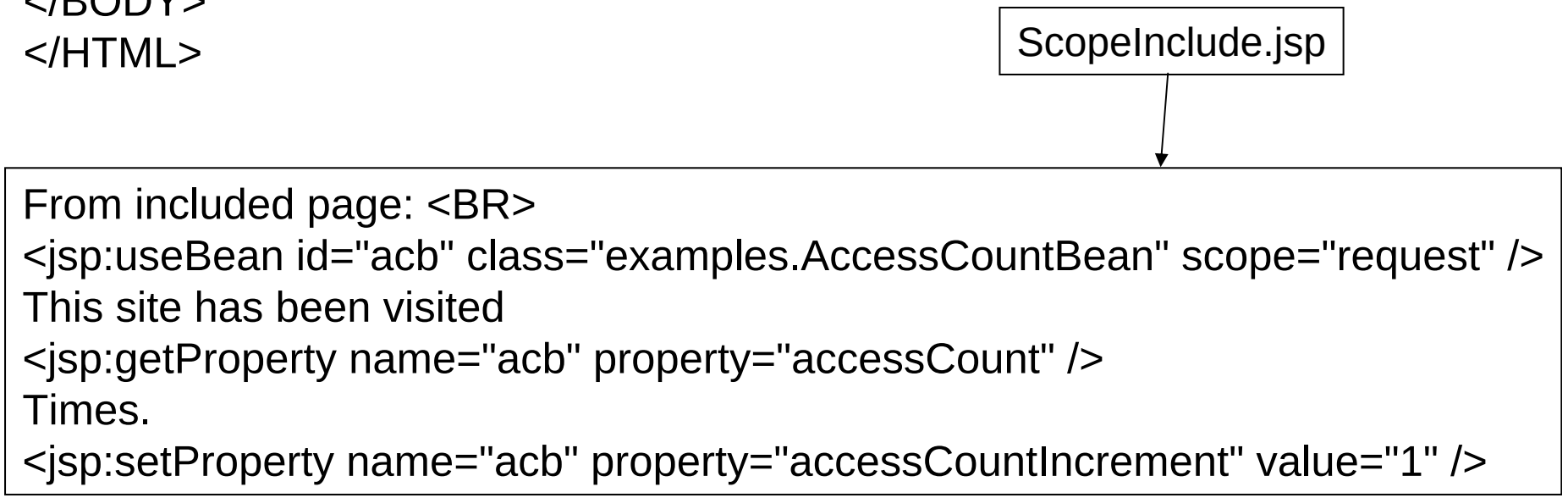
```
<HTML>
<BODY>
<jsp:useBean id="acb" class="examples.AccessCountBean" scope="page" />
This site has been visited
<jsp:getProperty name="acb" property="accessCount" />
Times.
<jsp:setProperty name="acb" property="accessCountIncrement" value="1" />
<BR>
<jsp:include page="ScopeIncludePage.jsp" />
</BODY>
</HTML>
```

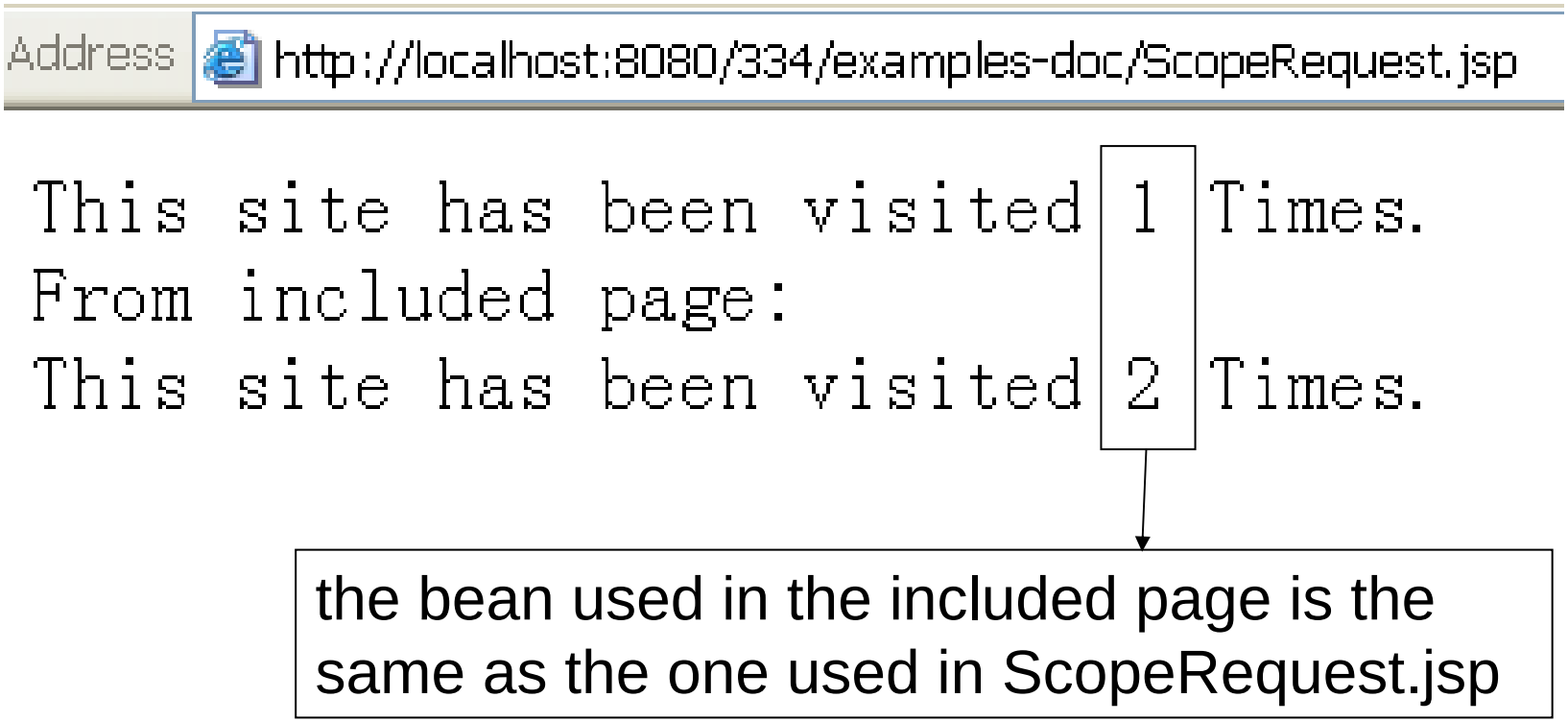
ScopeIncludePage.jsp


```
From included page: <BR>
<jsp:useBean id="acb" class="examples.AccessCountBean" scope="page" />
This site has been visited
<jsp:getProperty name="acb" property="accessCount" />
Times.
<jsp:setProperty name="acb" property="accessCountIncrement" value="1" />
```


Address
http://localhost:8080/334/examples-doc/ScopeDiff.jsp
This site has been visited 1 Times.
From included page:
This site has been visited 1 Times.
the count from the included page starts from 1

```
<HTML>
<BODY>
<jsp:useBean id="acb" class="examples.AccessCountBean" scope="request" />
This site has been visited
<jsp:getProperty name="acb" property="accessCount" />
Times.
<jsp:setProperty name="acb" property="accessCountIncrement" value="1" />
<BR>
<jsp:include page="ScopeInclude.jsp" />
</BODY>
</HTML>
```




Address
http://localhost:8080/334/examples-doc/ScopeRequest.jsp
This site has been visited 1 Times.
From included page:
This site has been visited 2 Times.
the bean used in the included page is the same as the one used in ScopeRequest.jsp

Integrating Servlets and JSP

- Chapter 15 of *Core SERVLETS and JAVASERVER*
- Why Combine Servlets & JSP?
  - The assumption behind JSP is that a *single* page gives a *single* basic look
  - For complex processing, starting with JSP is awkward

Joint servlet/JSP process

- Original request is answered by a servlet
- Servlet processes request data, does database lookup, business logic, etc.
- Results are placed in beans
- Request is forwarded to a JSP page to format result
- Different JSP pages can be used to handle different types of presentation

Dispatching Requests from Servlets to JSP Pages

- First obtain the servlet context.
  - There is one context per "web application“.
  - A "web application" is a collection of servlets and content installed under the server's URL namespace.
    - E.g. all the servlets, JSP file, etc. under the 334 directory.
  - getServletContext()

- Call the getRequestDispatcher method of ServletContext

```
String url = "/examples-doc/Integrate11.jsp";
RequestDispatcher dispatcher =
  getServletContext().getRequestDispatcher(url);
```

- Call forward to completely transfer control to destination page (no communication with client)

```
dispatcher.forward(request, response);
```

jsp:useBean

- The JSP page should not create the objects
  - The servlet, not the JSP page, should create all the data objects. So, to guarantee that the JSP page will not create objects, you should use

    <jsp:useBean ... type="package.Class" />

    instead of

    <jsp:useBean ... class="package.Class" />

Storing Data for Later Use: The Current Request

- Purpose
  - Storing data that servlet looked up and that JSP page will use only in this request.
- Servlet syntax to store data

```
SomeClass value = new SomeClass(…);
request.setAttribute("key", value);
```

- JSP syntax to retrieve data

```
<jsp:useBean
        id="key"
        type="somepackage.SomeClass"
        scope="request" />
```

Storing Data for Later Use: The Current Session

- Purpose
  - Storing data that servlet looked up and that JSP page will use in this request and in later requests from same client.
- Servlet syntax to store data

```
SomeClass value = new SomeClass(…);
HttpSession session = request.getSession(true);
session.setAttribute("key", value);
```

- JSP syntax to retrieve data

```
<jsp:useBean
        id="key"
        type="somepackage.SomeClass"
        scope="session" />
```

Storing Data for Later Use: The Application

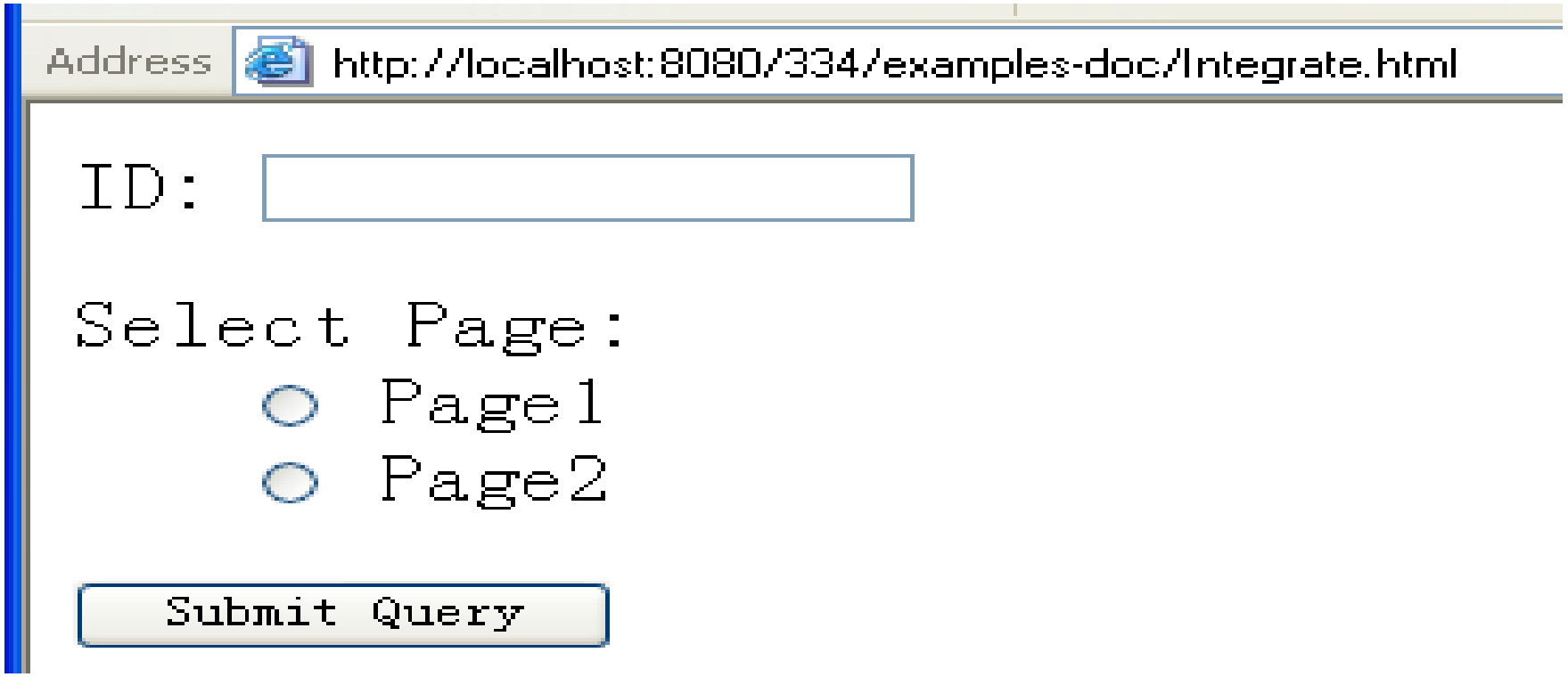
- Purpose
  - Storing data that servlet looked up and that JSP page will use in this request and in later requests from *any* client.
- Servlet syntax to store data

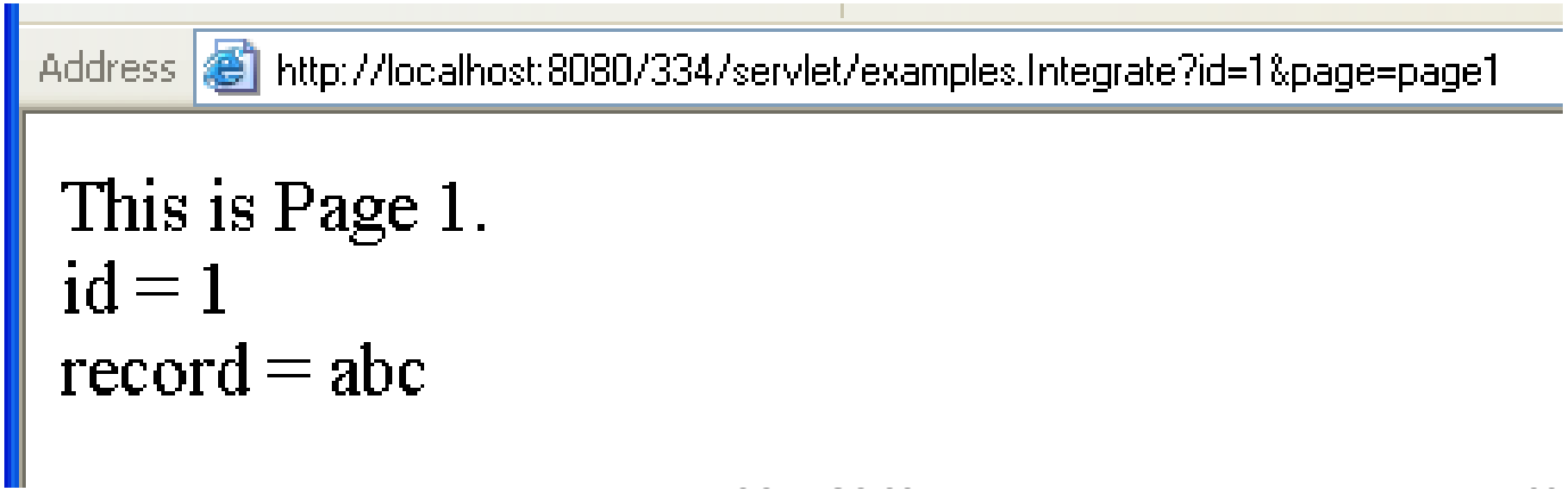
```
SomeClass value = new SomeClass(…);
getServletContext().setAttribute("key", value);
```

- JSP syntax to retrieve data

```
<jsp:useBean
        id="key"
        type="somepackage.SomeClass"
        scope="application" />
```

- This example shows the information of a student using the JSP page chosen by the user (assume different pages lay out the information differently)
- The servlet stores the retrieved information in a StudentBean and forwards the requests to the selected JSP page

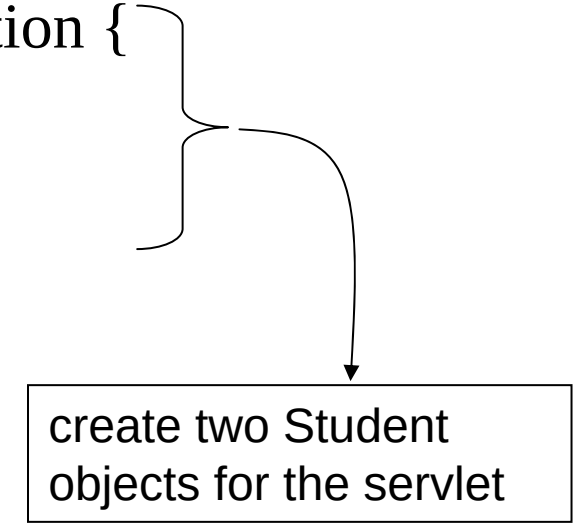

Address
http://localhost:8080/334/examples-doc/Integrate.html
ID:
Select Page:
Page1
Page2
Submit Query


Address
http://localhost:8080/334/servlet/examples.Integrate?id=1&page=page1
This is Page 1.
id = 1
record = abc

```
package examples;
public class Student {
  private String record;
  private int id;

  public Student(String record, int id) {
     this.record = record;
     this.id = id;
  }
  public String getRecord() {
     return record;
  }
  public int getId() {
     return id;
  }
}
```

```
package examples;
public class StudentBean {
   private String record;
   private int id;

   public String getRecord() {
      return record;
   }
   public int getId() {
       return id;
    }
    public void setRecord(String record) {
        this.record = record;
     }
     public void setId(int id) {
       this.id = id;
     }
}
```

```
package examples;
import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;

public class Integrate extends HttpServlet {
  private Student[] student= new Student[2];
  public void init() throws ServletException {
    student[0] = new Student("abc", 1);
    student[1] = new Student("def", 2);
  }
```



```
public void doGet(HttpServletRequest request,
                  HttpServletResponse response)
    throws ServletException, IOException {
        int id = Integer.parseInt(request.getParameter("id"));

        // create a bean for holding student's data
        StudentBean sb = new StudentBean();

        // set up the values in the bean
        // the values of the bean are from the Student object
        // with index given by the user
        sb.setRecord(student[id-1].getRecord());
        sb.setId(student[id-1].getId());
```

```
        // store the bean in session object
        HttpSession session = request.getSession(true);
        session.setAttribute("student", sb);

        // determine which JSP page to forward to
        // according to user's choice
        String url;
        if (request.getParameter("page").equals("page1"))
                url = "/examples-doc/Integrate1.jsp";
        else   url = "/examples-doc/Integrate2.jsp";

        // forward to the selected JSP page
        RequestDispatcher dispatcher =
                getServletContext().getRequestDispatcher(url);
        dispatcher.forward(request, response);
  }
}
```

```
<HTML>
This is Page 1. <BR>
<BODY>
<jsp:useBean  id="student"
              type="examples.StudentBean"
              scope="session" />
id = <jsp:getProperty  name="student"
                       property="id" />
<BR>
record = <jsp:getProperty      name="student"
                               property="record" />

</BODY>
</HTML>
```

Including Pages Instead of Forwarding to Them

- With the forward method of RequestDispatcher
  - Control is permanently transferred to new page
  - Original page cannot generate any output
- With the include method of RequestDispatcher
  - Control is temporarily transferred to new page
  - Original page can generate output before and after the included page

```
public class ServletInclude extends HttpServlet {
  String url = "/examples-doc/Secret.jsp";
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
          // tell the browser not to cache the page
          response.setHeader("Cache-Control", "no-cache");
          RequestDispatcher dispatcher =
                    getServletContext().getRequestDispatcher(url);
          dispatcher.include(request, response);
  }
}
```

JSP expression language

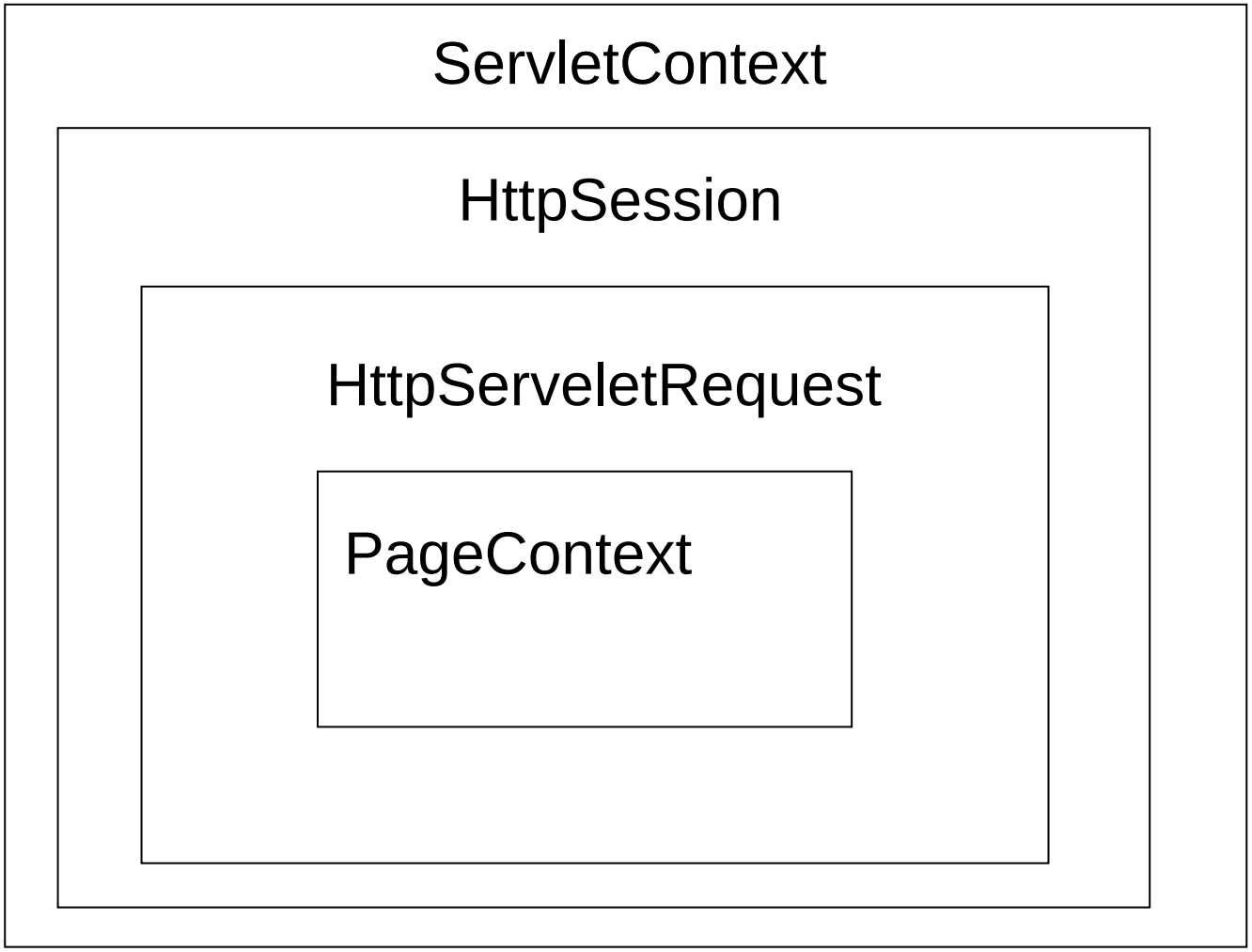
- Main drawbacks of using JSP tag, e.g. jsp:useBean, jsp:getProperty
  - Cannot access bean subproperties
- An expression language makes it possible to easily access application data stored in JavaBeans components.
  - More concise, succinct, and readable syntax
  - Ability to access subproperties
  - Ability to access collections

- The JSP expression language allows a page author to access a bean using simple syntax such as ${name} for a simple variable or ${name.id} for a nested property
  - ${stringBean}
  - ${stringBean.message}
    - <jsp:useBean id="stringBean"class="examples.StringBean" />
    - <jsp:getProperty name="stringBean“ property="message" />

Accessing scoped variables

- A servlet invokes code that create data, then forwards the request to a JSP page
- The servlet needs to use **setAttribute** to store data in one of the following locations
  - HttpServeletRequest
  - HttpSession
  - ServletContext
- A JSP page can access the value as ${name}

Retrieving values in JSP



- JSP searches for an attribute value in the following order
  - PageContext
  - HttpServeletRequest
  - HttpSession
  - ServletContext

```
public void doGet(HttpServletRequest request,
                  HttpServletResponse response)
    throws ServletException, IOException {

  // store “attribute1” in HttpServeletRequest object
  request.setAttribute("attribute1", "First Value");
  HttpSession session = request.getSession();
  // store “attribute2” in HttpSession object
  session.setAttribute("attribute2", "Second Value");
  // store “attribute3” in ServletContext object
  ServletContext application = getServletContext();
  application.setAttribute("attribute3",
                           new java.util.Date());
```

```
  // store “repeated” in HttpServeletRequest object
  request.setAttribute("repeated", "Request");
  // store “repeated” in HttpSession object
  session.setAttribute("repeated", "Session");
  // store “repeated” in ServletContext object
  application.setAttribute("repeated", "ServletContext");
  // forward request to a JSP page
  RequestDispatcher dispatcher =
    request.getRequestDispatcher("/examples-doc/scoped-vars.jsp");
  dispatcher.forward(request, response);
}
```

```
<HTML>
<HEAD><TITLE>Accessing Scoped Variables</TITLE>
</HEAD>
<BODY>
<UL>
  <LI><B>attribute1:</B> ${attribute1}
  <LI><B>attribute2:</B> ${attribute2}
  <LI><B>attribute3:</B> ${attribute3}
  <LI><B>Source of "repeated" attribute:</B> ${repeated}
</UL>
</BODY>
</HTML>
```

- **attribute1:** First Value
- **attribute2:** Second Value
- **attribute3:** Fri Mar 14 15:15:14 NZDT 2008
- **Source of "repeated" attribute:** Request

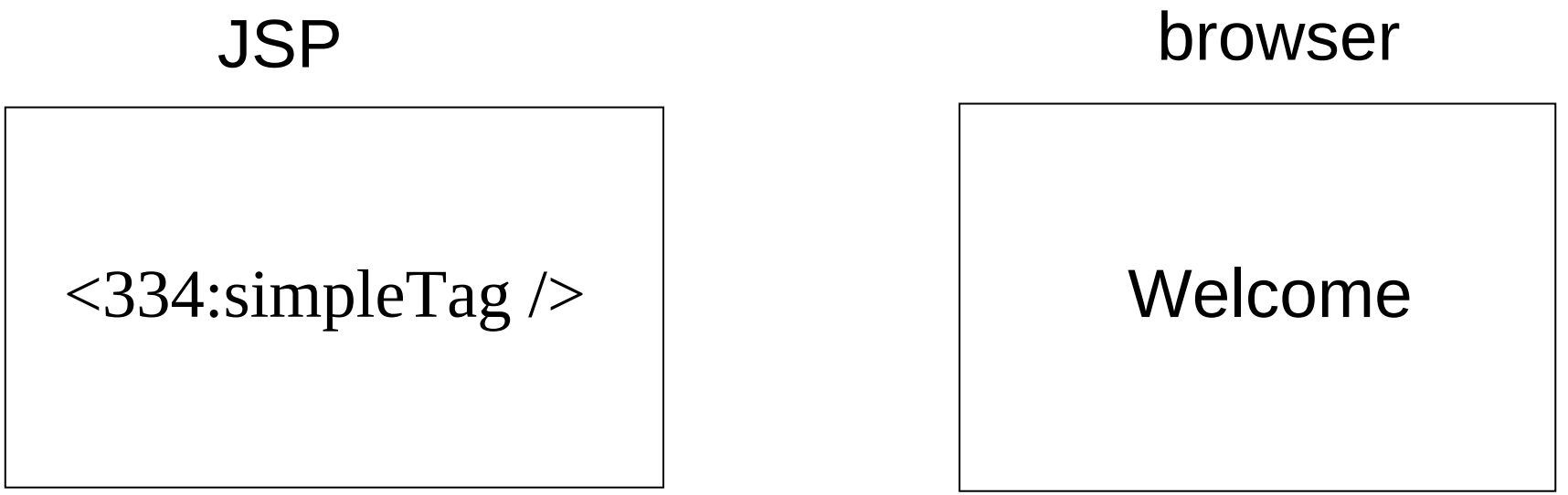
Creating Custom JSP Tag Libraries

- Chapter 7 & 8 of *Core Servlets and JavaServer Pages, Volume 2: Advanced Technologies, Second Edition*
- Improve the flexibility and power of JSP pages
- Separate JSP page content from behavior:
  - Content authors author content.
  - Code developers create tags.

Components That Make Up a Tag Library

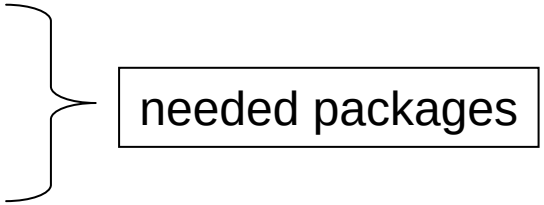
- The Tag Handler Class
  - Java code that says how to actually translate tag into code
  - Usually extends javax.servlet.jsp.tagext.SimpleTagSupport
  - Goes in same directories as servlet class files
    - On Tomcat, the tag class files must be in a package.

- The Tag Library Descriptor File
  - XML file describing tag name, attributes, and tag handler class
  - Normally stored with the JSP file
- The JSP File
  - Imports a tag library (referencing URL of descriptor file)
  - Defines tag prefix, e.g. 334:simplePrime
  - Uses tags


JSP
<334:simpleTag />
browser
Welcome

- This example shows how to implement a tag handler class
  - Display a message
  - Body is empty: <334:simpleTag />
- The tag handler class should extend SimpleTagSupport class
  - Need to overwrite the doTag method
- In the doTag method
  - Display the message corresponds to the tag
  - Obtain a JspWriter object for sending response back to the browser
    - JspWriter out = getJspContext().getOut();
  - Send response using print
    - out.print("Welcome");

```
package examples.tags;
import javax.servlet.jsp.*;
import javax.servlet.jsp.tagext.*;
import java.io.*;

public class SimpleTag extends SimpleTagSupport
{
        public void doTag() throws JspException, IOException
        {
                JspWriter out = getJspContext().getOut();
                out.print("Welcome");
        }
}
```



Defining a Simple Tag Library Descriptor

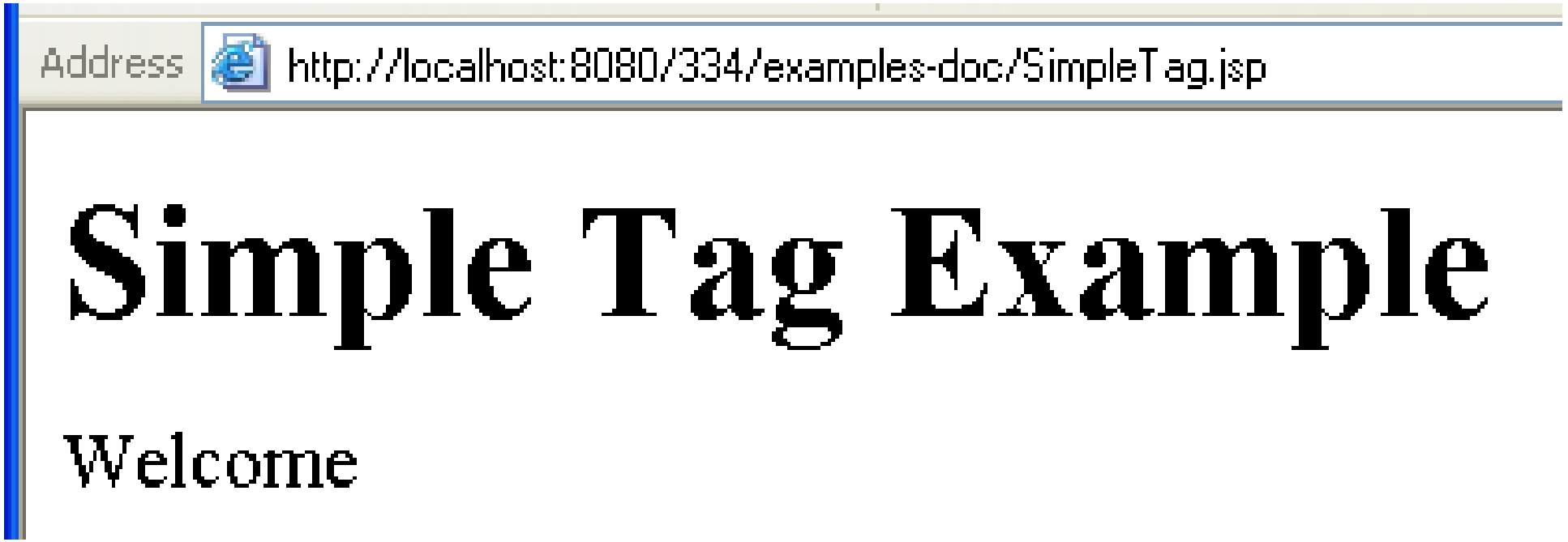
- Start with XML header and DOCTYPE
- Top-level element is taglib
- Each tag defined by tag element with:
  - name, whose body defines the base tag name.
    - <name>simpleTag</name>
  - tagclass, which gives the fully qualified class name of the tag handler.
    - <tagclass>examples.tags.SimpleTag</tagclass>
  - bodycontent, which specifies if the tag contains content between start and end tag
    - <bodycontent>empty</bodycontent>
  - info, which gives a short description.
    - <info>Outputs a welcome message.</info>

```
<taglib>
…
        <tag>
                <name>simpleTag</name>
                <tagclass>examples.tags.SimpleTag</tagclass>
                <bodycontent>empty</bodycontent>
                <info>Outputs a welcome message.</info>
        </tag>
…
</taglib>
```

Accessing Custom Tags From JSP Files

- Import the tag library
  - Specify location of TLD file
  - Define a tag prefix (namespace)
  - **<%@ taglib uri="334-taglib.tld" prefix="334" %>**
- Use the tags
  - <prefix:tagName />
  - Tag name comes from TLD file
  - Prefix comes from taglib directive
  - <334:simpleTag />

```
<HTML>
<BODY>
<H1>Simple Tag Example</H1>
<%@ taglib uri="334-taglib.tld" prefix="334" %>
<334:simpleTag />
</BODY>
</HTML>
```



Assigning Attributes to Tags

- Allowing tags like

```
<prefix:name
    attribute1="value1“
    attribute2="value2“
    ...
    attributeN="valueN“
/>
```

Attributes: The Tag Handler Class

- Use of an attribute called attribute1 simply results in a call to a method called setAttribute1
  - Attribute value is supplied to method as a String
  - Use a class variable to hold the value of the attribute
- To support <prefix:tagName attribute1="x" />, add the following to tag handler class:

```
public void setAttribute1(String value1) {
    doSomethingWith(value1);
}
```

- In this example, we want to provides two attributes to the welcomeTag
  - colour: the colour of the word being displayed
  - repeat: the number of times that the word to be displayed
- Declare two class variables to hold the values of the two attributes
  - colour, repeat
- Need to implement two methods to set the values of the two variables
  - setColour, setRepeat
- The doTag method needs to output the html code to display word “Welcome” in the specified colour and repeat the html code according to the value in the repeat variable
  - Welcome
  - Welcome < Welcome ><

```
package examples.tags;
import javax.servlet.jsp.*;
import javax.servlet.jsp.tagext.*;
import java.io.*;
public class WelcomeTag extends SimpleTagSupport {
  // there are two attribute, repeat and colour
  private int repeat = 1;
  private String colour = "black";

  // method for setting up the value of “colour”
  public void setColour(String colour) {
          this.colour = colour;
  }
```

```
  // method for setting up the value of “repeat”
  public void setRepeat(String repeat) {
          try {
            this.repeat = Integer.parseInt(repeat);
          } catch(NumberFormatException nfe) {
            this.repeat = 2;
          }
}
```

```
<334:welcomeTag />

With no attributes: <font color="black">Welcome </font><BR>
```

```
<334:welcomeTag colour="red" />

With "colour": <font color="red">Welcome </font><BR>
```

```
<334:welcomeTag colour="blue" repeat="3" />

With both attributes: <font color="blue">Welcome </font><font
color="blue">Welcome </font><font color="blue">Welcome
</font><BR>
```

html code for displaying “Welcome” in blue

```
<font color="blue">Welcome </font>
```

```
public void doTag() throws JspException, IOException
{
   JspWriter out = getJspContext().getOut();
   for (int i = 0; i < repeat; i++)
      out.print("<font color=\"" + colour + "\">" + "Welcome " + "</font>");
    out.println("<BR>");
}
```

Attributes: The Tag Library Descriptor File

- The tag element must contain a nested attribute element
- The attribute element has three further nested elements
  - name, a required element that defines the case-sensitive attribute name. <name>colour</name>
  - required, a required element that stipulates whether the attribute must always be supplied (true) or is optional (false). E.g. <required>false</required>
  - rtexprvalue, an optional attribute that indicates whether the attribute value can be a JSP expression like <%= expression %> (true) or whether it must be a fixed string (false). The default value is false.

```
<tag>
  <name>welcomeTag</name>
  <tagclass>examples.tags.WelcomeTag</tagclass>
  <bodycontent>empty</bodycontent>
  <info>Outputs a welcome message.</info>
  <attribute>
    <name>colour</name>
    <required>false</required>
  </attribute>
  <attribute>
    <name>repeat</name>
    <required>false</required>
  </attribute>
</tag>
```

Using welcomeTag Tag

```
<HTML>

<BODY>
<H1>Simple Tag Example</H1>

<%@ taglib uri="334-taglib.tld" prefix="334" %>

With no attributes: <334:welcomeTag />
With "colour": <334:welcomeTag colour="red" />
With both attributes: <334:welcomeTag colour="blue" repeat="3" />
</BODY>
</HTML>
```


http://localhost:8080/334/examples-doc/WelcomeTag.jsp - Microsoft Intern
File Edit View Favorites Tools Help
Back
Search
Favorites
Media
Address
http://localhost:8080/334/examples-doc/WelcomeTag.jsp
Simple Tag Example
With no attributes: Welcome
With "colour": Welcome
With both attributes: Welcome Welcome Welcome

Including the Tag Body

- Simplest tags
  - <prefix:tagName />
- Tags with attributes
  - <prefix:tagName att1="val1" ... />
- Now

<prefix:tagName>
JSP Content
</prefix:tagName>

<prefix:tagName att1="val1" ... >
JSP Content
</prefix:tagName>

Using Tag Body: The Tag Handler Class

- doTag
  - Output the opening html font tag
    -
  - Output the word “Welcome” according to the attribute “repeat”
  - Include the tag body by
    - **getJspBody().invoke(null);**
  - Output the closing html font tag:
- The two methods for handling the attributes are the same as before.

```
public void doTag() throws JspException, IOException {
   JspWriter out = getJspContext().getOut();
   out.print("<font color=\"" + colour + "\">");
   for (int i = 0; i < repeat; i++)
       out.print("Welcome ");
   getJspBody().invoke(null);
   out.print("</font>");
}
```

```
<font color="red">Welcome
xxx
</font>
```

Using Tag Body: The Tag Library Descriptor File

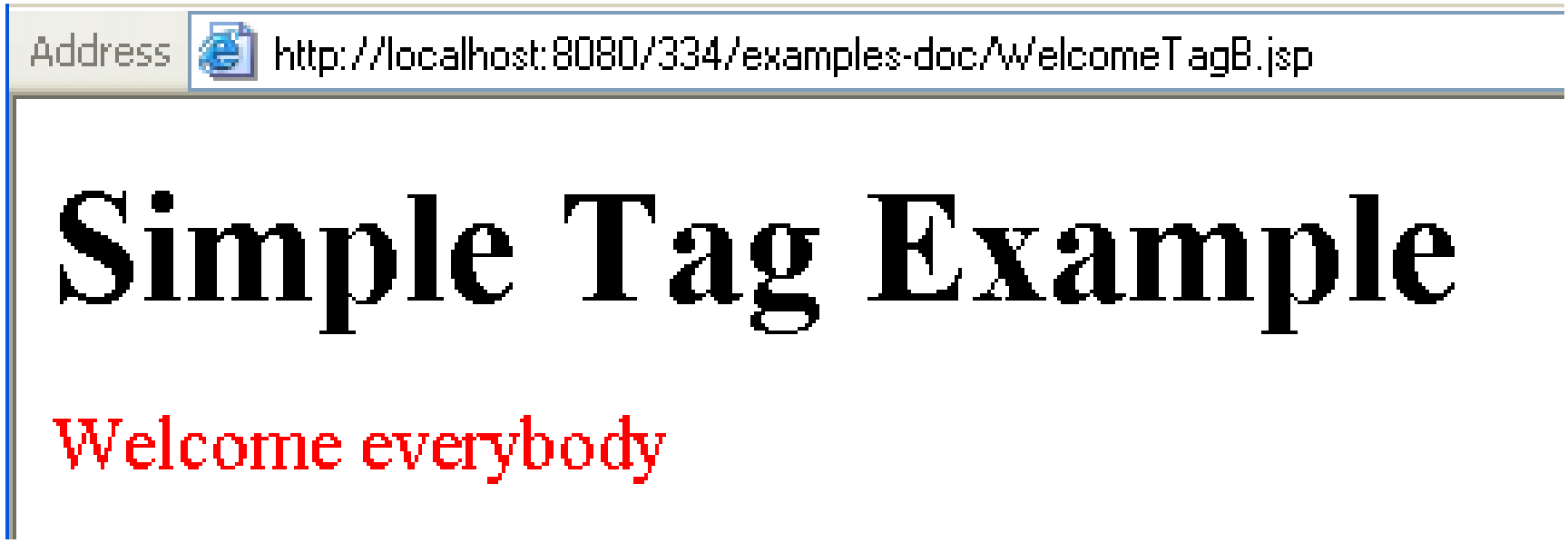
- Only difference is bodycontent element
  - Should be **scriptless** instead of empty:

```
<tag>
  <name>…</name>
  <tagclass>…</tagclass>
  <bodycontent>scriptless</bodycontent>
  <info>…</info>
</tag>
```

```
<tag>
  <name>welcomeTagB</name>
  <tagclass>examples.tags.WelcomeTagB</tagclass>
  <bodycontent>scriptless</bodycontent>
  <info>Outputs a welcome message.</info>
  <attribute>
    <name>colour</name>
    <required>false</required>
  </attribute>
  <attribute>
    <name>repeat</name>
    <required>false</required>
  </attribute>
 </tag>
```

Using welcomeTagB Tag

```
<HTML>

<BODY>
<H1>Simple Tag Example</H1>

<%@ taglib uri="334-taglib.tld" prefix="334" %>

<334:welcomeTagB colour="red">
everybody
</334:welcomeTagB>
</BODY>
</HTML>
```


Address
http://localhost:8080/334/examples-doc/WelcomeTagB.jsp
Simple Tag Example
Welcome everybody

Manipulating Tag Body

- Modifying tag body

```
<334:filterTag>
  if (a<b)
     doThis();
  else
     doThat();
</334:filterTag>
```

- Use a StringWriter object to hold the tag body
  - StringWriter stringWriter = new StringWriter();
  - getJspBody().invoke(stringWriter);
- Manipulate the tag body
  - String modifiedBody = modifyString(stringWriter.toString());
- Output the modified body using JspWriter object
  - JspWriter out = getJspContext().getOut();
  - out.print(output);

```
public void doTag() throws JspException, IOException {
    StringWriter stringWriter = new StringWriter();
    getJspBody().invoke(stringWriter);
    String output = filter(stringWriter.toString());
    JspWriter out = getJspContext().getOut();
    out.print(output);
}
```

```
<tag>
    <name>filterTag</name>
    <tagclass>examples.tags.FilterTag</tagclass>
    <bodycontent>scriptless</bodycontent>
    <info>Replaces HTML-specific characters in body.</info>
 </tag>
```

```
<HTML>
<BODY>

<%@ taglib uri="334-taglib.tld" prefix="334" %>

<334:filterTag>
if (a<b)
        doThis();
else
        doThat();
</334:filterTag>

</BODY>
</HTML>
```

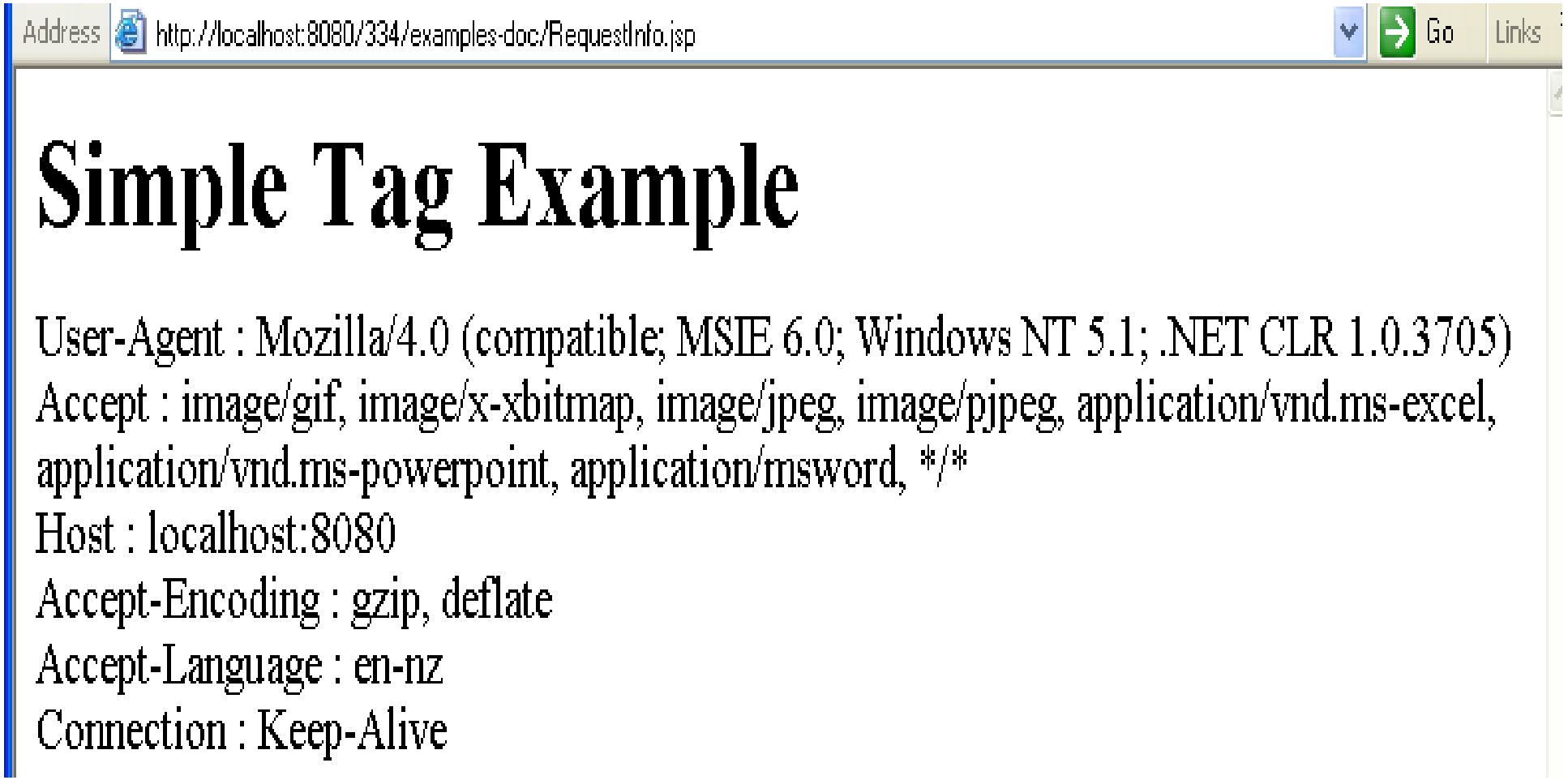

```
if (a<b) doThis(); else doThat();
```

Obtaining request time information

- This example defines a tag for displaying the values of the request headers
- The request time information are stored in HttpServletRequest object.
- To obtain the HttpServletRequest object

```
HttpServletRequest request =
    (HttpServletRequest)pageContext.getRequest();
```

- The method for retrieving the values of the request headers are the same as the servlet examples
  - request.getHeaderNames(), request.getHeader(header)


Address
http://localhost:8080/334/examples-doc/RequestInfo.jsp
Go
Links
Simple Tag Example
User-Agent : Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.1; .NET CLR 1.0.3705)
Accept : image/gif, image/x-xbitmap, image/jpeg, image/pjpeg, application/vnd.ms-excel, application/vnd.ms-powerpoint, application/msword, */*
Host : localhost:8080
Accept-Encoding : gzip, deflate
Accept-Language : en-nz
Connection : Keep-Alive

```
public class RequestInfo extends SimpleTagSupport {
    public void doTag() throws JspException, IOException    {
        PageContext pageContext =
                                    (PageContext)getJspContext();
        HttpServletRequest request =
                (HttpServletRequest)pageContext.getRequest();
        Enumeration headers = request.getHeaderNames();
        JspWriter out = getJspContext().getOut();
        while (headers.hasMoreElements()) {
            String header = (String)headers.nextElement();
            out.print(header + " : "
                    + request.getHeader(header) + "<BR>");
        }
    }
}
```

```
<tag>
  <name>RequestInfo</name>
  <tagclass>examples.tags.RequestInfo</tagclass>
  <bodycontent>Empty</bodycontent>
  <info>Display request information.</info>
 </tag>
```

```
<HTML>
<BODY>
<H1>Simple Tag Example</H1>

<%@ taglib uri="334-taglib.tld" prefix="334" %>

<334:RequestInfo />
</BODY>
</HTML>
```

Looping Tag

- A tag that outputs its body more than once
  - the body has different values each time

```
<334:forEach items="${courses}" var="course">
<LI>${course}
</334:forEach>
```

- Attribute items
  - Attribute should be defined with rtexprvalue as true
    - items="${courses}“
    - Usually supply value with the JSP EL
  - The value of the attribute value is a collection
    - items, e.g. {314, 334, 335}
    - An array of Object type variable to hold the attribute value

- Attribute var
  - Define the name of the bean holding the value to be displayed

Some COMPSCI courses

- 313
- 314
- 334
- 335
- 340

```
private Object[] items;
private String attributeName;
public void setItems(Object[] items)
{
        this.items = items;
}

public void setVar(String attributeName)
{
        this.attributeName = attributeName;
}
```

- Body should have access to each item in collection
  - Retrieve each item in the items array
  - assign “course” as the name of the retrieved item and store it on the server
    - getJspContext().setAttribute(key, object)

```
public void doTag() throws JspException, IOException
{
   for (int i = 0; i < items.length; i++)
   {
         getJspContext().setAttribute(attributeName, items[i]);
         getJspBody().invoke(null);
    }
}
```

forEach: The Tag Library Descriptor File

```
<tag>
    <name>forEach</name>
    <tag-class>examples.tags.ForEachTag</tag-class>
    <body-content>scriptless</body-content>
    <attribute>
        <name>items</name>
        <required>true</required>
        <rtexprvalue>true</rtexprvalue>
    </attribute>
    <attribute>
        <name>var</name>
        <required>true</required>
    </attribute>
 </tag>
```

Servlet for testing forEach Tag

```
public class ForTagTest extends HttpServlet {
   public void doGet(HttpServletRequest request,
                     HttpServletResponse response)
                     throws ServletException, IOException {
      String[] courses ={"313", "314", "334", "335", "340" };
      request.setAttribute("courses", courses);
      String address = "/examples-doc/ForTag.jsp";
      RequestDispatcher dispatcher =
                     request.getRequestDispatcher(address);
      dispatcher.forward(request, response);
   }
}
```

Another example of using forEach Tag

Assignment Marks

Name	Asg1	Asg2
abc	100	90
def	80	70

```
<H2>Assignment Marks</H2>
<TABLE BORDER=1>
<334:forEach items="${records}" var="row">
    <TR>
    <334:forEach items="${row}" var="col">
        <TD>${col}</TD>
    </334:forEach>
     </TR>
</334:forEach>
</TABLE>
```

- The outer tag displays row
- The inner tag displays columns in each row
- records is a two dimensional array
  - { { "Name", "Asg1", "Asg2" }, { "abc", "100", "90" }, { "def", "80", "70" } }
- row is a one dimensional array
  - { "Name", "Asg1", "Asg2" }
- col is a simple value
  - "Name",

Another servlet for testing forEach Tag

```
public void doGet(HttpServletRequest request,
                  HttpServletResponse response)
                  throws ServletException, IOException {
    String[][] records ={ { "Name", "Asg1", "Asg2" },
                  { "abc", "100", "90" }, { "def", "80", "70" } };
    request.setAttribute("records", records);
    String address = "/examples-doc/ForTagB.jsp";
    RequestDispatcher dispatcher =
                  request.getRequestDispatcher(address);
    dispatcher.forward(request, response);
}
```