Ajax: The Basics

Originals of Slides and Source Code for Examples:
http://courses.coreservlets.com/Course-Materials/ajax.html

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Topics in This Section

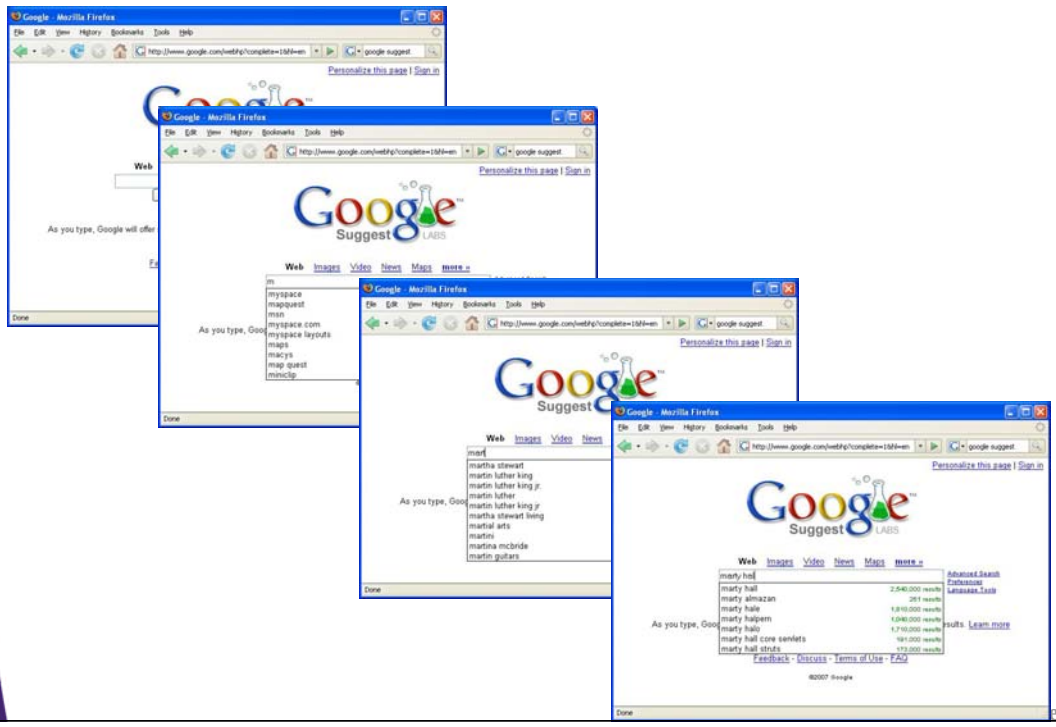
- Ajax motivation
- The basic Ajax process
- Using dynamic content and JSP
- Using dynamic content and servlets
- Sending GET data
- Sending POST data
- Displaying HTML results
- Parsing and displaying XML results
- Toolkits

Motivation

Why Ajax?

- **HTML and HTTP are weak**
  - Non-interactive
  - Coarse-grained updates
- **Everyone wants to use a browser**
  - Not a custom application
- **"Real" browser-based active content**
  - Failed: Java Applets
    - Not universally supported; can't interact with the HTML
  - Serious alternative: Flash (and Flex)
    - Not yet universally supported; limited power
  - New and unproven
    - Microsoft Silverlight
    - JavaFX
    - Adobe Apollo

Google Suggest (http://labs.google.com/suggest/)



The Basic Process

The Basic Ajax Process

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
      - Supply as onreadystatechange attribute of request
    - Initiate a GET or POST request
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
- **HTML**
  - Loads JavaScript
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script

Define a Request Object

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}
```

Version for Internet Explorer 5 and 6

Object for Netscape 5+, Firefox, Opera, Safari, and Internet Explorer 7

Fails on older and nonstandard browsers

Initiate Request

```
function sendRequest() {
  request = getRequestObject();
  request.onreadystatechange = handleResponse;
  request.open("GET", "message-data.html", true);
  request.send(null);
}
```

Response handler function name

URL of server-side resource

Don't wait for response
(Send request asynchronously)

POST data
(always null for GET)

Handle Response

```
function handleResponse() {
  if (request.readyState == 4) {
    alert(request.responseText);
  }
}
```

Response is returned from server
(handler gets invoked multiple times)

Text of server response

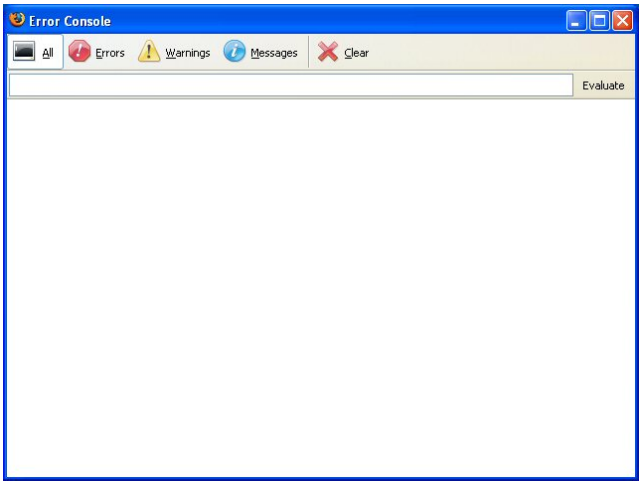
Pop up dialog box

Complete JavaScript Code (show-message.js)

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}

function sendRequest() {
  request = getRequestObject();
  request.onreadystatechange = handleResponse;
  request.open("GET", "message-data.html", true);
  request.send(null);
}

function handleResponse() {
  if (request.readyState == 4) {
    alert(request.responseText);
  }
}
```

The Firefox JavaScript Console

- **Open via Tools → Error Console**



- **Also see Venkman JavaScript debugger**
  - http://www.mozilla.org/projects/venkman/
  - https://addons.mozilla.org/firefox/216/

HTML Code

- **Use xhtml, not HTML 4**
  - In order to manipulate it with DOM

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">...</html>
```

    - Due to IE bug, do not use XML header before the DOCTYPE
- **Load the JavaScript file**

```
<script src="relative-url-of-JavaScript-file"
        type="text/javascript"></script>
```

    - Use separate </script> end tag
- **Designate control to initiate request**

```
<input type="button" value="button label"
       onclick="mainFunction()"/>
```

Internet Explorer XHTML Bugs

- **Can't handle XML header**
  - XML documents in general are supposed to start with XML header:
    - <?xml version="1.0" encoding="UTF-8"?>
      <!DOCTYPE html ...>
      <html xmlns="http://www.w3.org/1999/xhtml">...</html>
  - XHTML specification recommends using it
  - *But*... Internet Explorer will switch to quirks-mode (from standards-mode) if DOCTYPE is not first line.
    - Many recent style sheet formats will be ignored
    - So omit XML header
- **Needs separate end tags in some places**
  - Scripts will not load if you use <script .../> instead of <script...></script>

HTML Code (show-message.html)

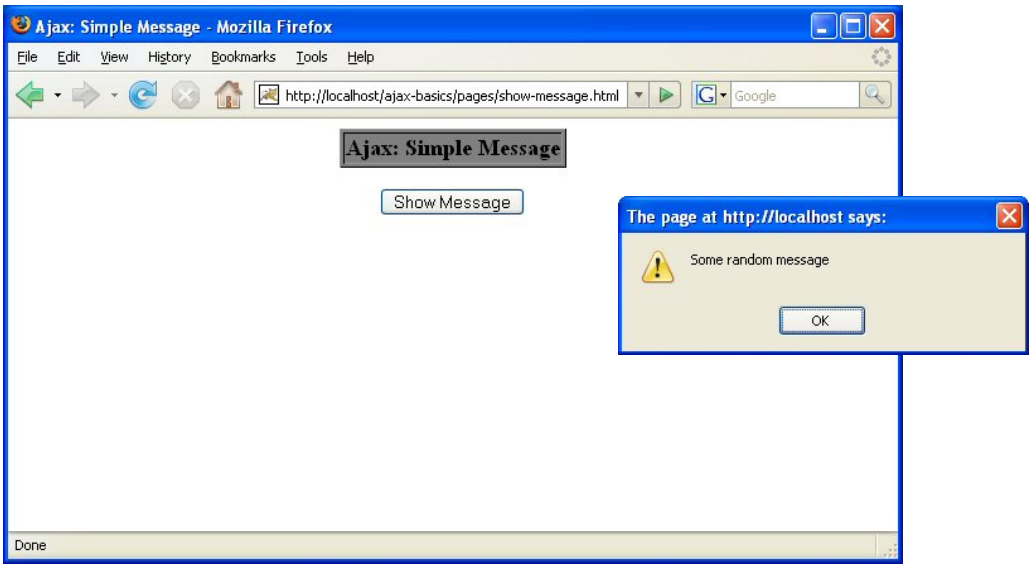
```
<!DOCTYPE html PUBLIC "..."
  "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Ajax: Simple Message</title>
<script src="show-message.js"
        type="text/javascript"></script>
</head>
<body>
<center>
<table border="1" bgcolor="gray">
  <tr><th><big>Ajax: Simple Message</big></th></tr>
</table>
<p/>
<form action="#">
 <input type="button" value="Show Message"
        onclick="sendRequest()"/>
</form>
</center></body></html>
```

HTML Code (message-data.html)

```
Some random message
```

- **Note: executing this example**
  - Since main page uses relative URL and HTML content has no dynamic content, you can run this example directly from the disk without using a server. But later examples require dynamic content, so all examples will be shown running on Tomcat.

The Basic Process: Results



Dynamic Content from JSP

First Example: Design Deficiencies

- **Content was the same on each request**
  - Could have just hardcoded the alert value in JavaScript
  - Instead, invoke a JSP page on the server
- **Resource address hardcoded in JavaScript**
  - Prevents functions from applying to multiple situations
  - Instead, make generic function and pass address to it
- **JavaScript file was in same folder as HTML**
  - Makes it hard to reuse the JavaScript in different pages
  - Instead, make a special directory for JavaScript
- **No style sheet was used**
  - Less for JavaScript to work with when manipulating page
  - Use CSS for normal reasons as well as for JavaScript

Steps

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
      - Supply as onreadystatechange attribute of request
    - Initiate a GET or POST request to a JSP page
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
- **HTML**
  - Loads JavaScript from centralized directory
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script

Define a Request Object

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}
```

No changes from previous example

Initiate Request

```
function sendRequest(address) {
  request = getRequestObject();
  request.onreadystatechange = showResponseAlert;
  request.open("GET", address, true);
  request.send(null);
}
```

Relative URL of server-side resource.
(In this example, we will pass in the address of a JSP page.)

Handle Response

```
function showResponseAlert() {
  if ((request.readyState == 4) &&
      (request.status == 200)) {
    alert(request.responseText);
  }
}
```

Server response came back with no errors.
(HTTP status code 200.)

Complete JavaScript Code (Part of ajax-basics.js)

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}

function sendRequest(address) {
  request = getRequestObject();
  request.onreadystatechange = showResponseAlert;
  request.open("GET", address, true);
  request.send(null);
}

function showResponseAlert() {
  if ((request.readyState == 4) &&
      (request.status == 200)) {
    alert(request.responseText);
  }
}
```


HTML Code

- **Loads JavaScript from central location**

```
<script src="../scripts/ajax-basics.js"
        type="text/javascript"></script>
```

- **Passes JSP address to main function**

```
<input type="button" value="Show Server Time"
       onclick='sendRequest("show-time.jsp")'/>
```

- **Uses style sheet**

```
<link rel="stylesheet"
      href="../css/styles.css"
      type="text/css"/>
```

Note single quotes (Because of double quotes inside parens.)

HTML Code (show-time-1.html)

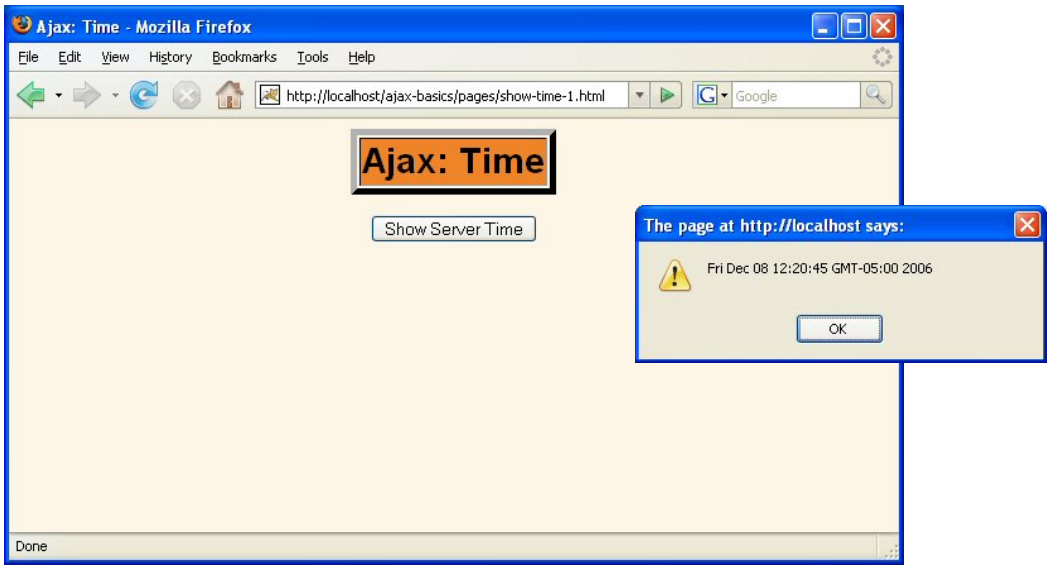
```
<!DOCTYPE html PUBLIC "..."
  "http://www.w3.org/...">
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Ajax: Time</title>
<link rel="stylesheet"
      href="../css/styles.css"
      type="text/css"/>
<script src="../scripts/ajax-basics.js"
        type="text/javascript"></script>
</head>
<body>
...
<form action="#">
 <input type="button" value="Show Server Time"
        onclick='sendRequest("show-time.jsp")'/>
</form>
</center></body></html>
```


JSP Code (show-time.jsp)

```
<%= new java.util.Date() %>
```

- **Note: executing this example**
  - You must run from Tomcat.
    - Otherwise JSP cannot execute
    - Otherwise status code is -1, not 200

Message from JSP: Results



Dynamic Content from Servlet

JSP Example: Design Deficiencies

- **Caching problems**
  - The URL stays the same but the output changes
  - So if browser caches page, you get the wrong time
  - Solution: send Cache-Control and Pragma headers
- **Date was not formatted**
  - Just used the toString method of Date
  - Solution: use String.format (sprintf) and %t controls
- **JSP is wrong technology**
  - JSP is best for lots of HTML and little or no logic/Java
  - But now we have logic but no HTML
  - Solution: use a servlet

Steps

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
      - Supply as onreadystatechange attribute of request
    - Initiate a GET or POST request to a servlet
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
- **HTML**
  - Loads JavaScript from centralized directory
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script

Define a Request Object

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}
```

No changes from previous example

Initiate Request

```
function sendRequest(address) {
  request = getRequestObject();
  request.onreadystatechange = showResponseAlert;
  request.open("GET", address, true);
  request.send(null);
}
```

No changes from previous example

Handle Response

```
function showResponseAlert() {
  if ((request.readyState == 4) &&
      (request.status == 200)) {
    alert(request.responseText);
  }
}
```

No changes from previous example

HTML Code (show-time-2.html)

```
<!DOCTYPE html PUBLIC "..."
  "http://www.w3.org/...">
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Ajax: Time</title>
<link rel="stylesheet"
      href="../css/styles.css"
      type="text/css"/>
<script src="../scripts/ajax-basics.js"
        type="text/javascript"></script>
</head>
<body>
...
<form action="#">
 <input type="button" value="Show Server Time"
        onclick='sendRequest("../show-time")'/>
</form>
</center></body></html>
```

Address of servlet. (From url-pattern of servlet-mapping.)

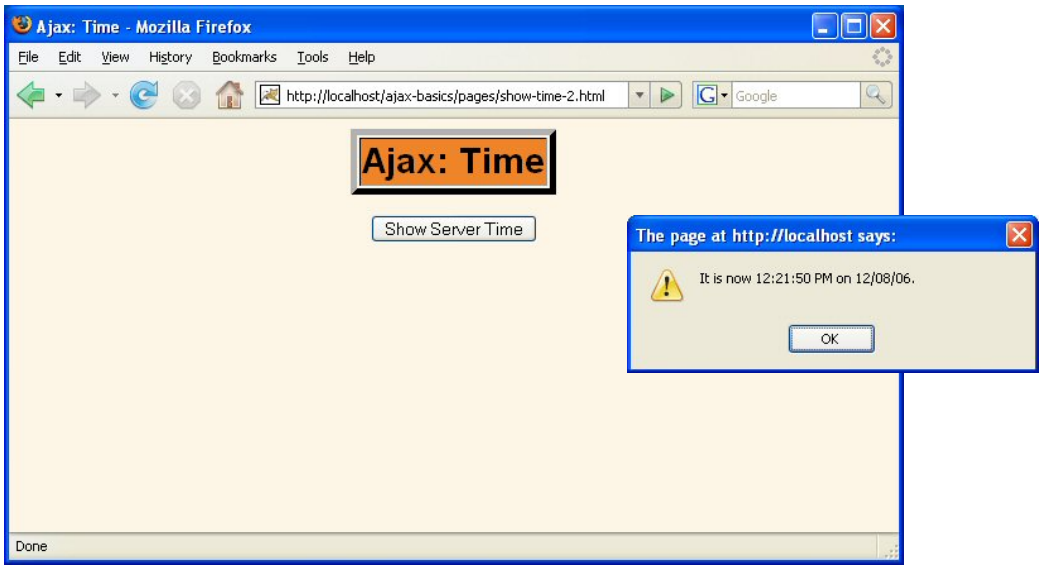
Servlet Code

```
package coreservlets;
import ...

public class ShowTime extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    response.setHeader("Cache-Control", "no-cache");
    response.setHeader("Pragma", "no-cache");
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    Date currentTime = new Date();
    String message =
      String.format("It is now %tr on %tD.",
                    currentTime, currentTime);
    out.print(message);
  }
}
```


web.xml

```
...
  <servlet>
    <servlet-name>ShowTime</servlet-name>
    <servlet-class>coreservlets.ShowTime</servlet-class>
  </servlet>
  <servlet-mapping>
    <servlet-name>ShowTime</servlet-name>
    <url-pattern>/show-time</url-pattern>
  </servlet-mapping>
...
```

Message from Servlet: Results



Sending GET Data

Servlet Example: Design Deficiencies

- **No data sent from HTML page to servlet**
  - Solution: attach data to end of the URL (GET data)
    - Use normal GET format:
      - *mainaddress?var1=val1&var2=val2*

Steps

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
      - Supply as onreadystatechange attribute of request
    - Initiate a GET request to a servlet
      - URL has GET data attached at the end
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
- **HTML**
  - Loads JavaScript from centralized directory
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script

JavaScript Code

- No changes from previous example

HTML Code (show-time-3.html)

```
<!DOCTYPE html PUBLIC "..."
  "http://www.w3.org/...">
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Ajax: Time</title>
<link rel="stylesheet"
      href="../css/styles.css"
      type="text/css"/>
<script src="../scripts/ajax-basics.js"
        type="text/javascript"></script>
</head>
<body>
...
<form action="#">
 <input type="button" value="Show Time in Chicago"
        onclick=
         'sendRequest("../show-time-in-city?city=Chicago")'/>
</form>
</center></body></html>
```

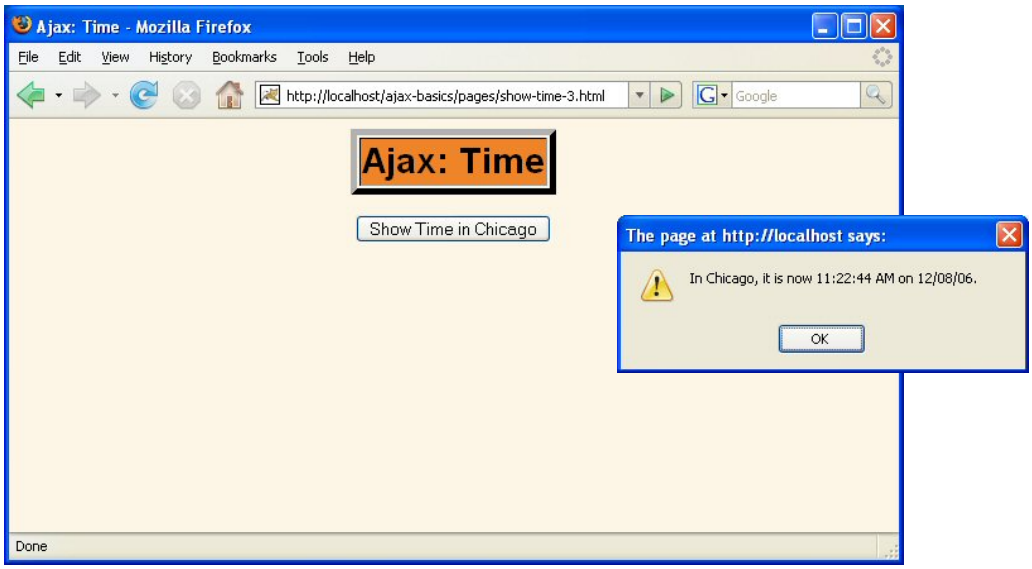
Servlet Code

```
public class ShowTimeInCity extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    response.setHeader("Cache-Control", "no-cache");
    response.setHeader("Pragma", "no-cache");
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String city = request.getParameter("city");
    ...
    String message = TimeZone.getTimeString(city);
    ...
    out.print(message);
  }

  ...
}
```


TimeZone Class

- **Maintains a list of cities and associated time zones**
  - Given the name of a city, it finds the difference in hours between that city's time and server time (east coast US)
- **Computes server time**
  - Using standard GregorianCalendar class
- **Converts to time in that city**
  - By calling the "add" method with the timezone offset
- **Formats the time and day**
  - Using String.format with %tr and %tD

Sending GET Data: Results



Sending POST Data

GET Example: Design Deficiencies

- **City name was always Chicago**
  - Solution: read data from textfield
- **Data sent by GET**
  - Sometimes POST is preferred
  - Solution: use POST instead of GET
- **GET vs. POST**
  - In normal Web pages, there are compelling reasons for choosing POST or GET
    - POST: simpler URL, data hidden from people looking over your shoulder, larger amounts of data can be sent
    - GET: can bookmark results page
  - With Ajax, end users don't see URL, so choice is relatively arbitrary
    - Unless there is a very large amount of data

Steps

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
      - Supply as onreadystatechange attribute of request
    - Initiate a POST request to a servlet
      - Put data to the "send" function
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
- **HTML**
  - Loads JavaScript from centralized directory
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script

Sending POST Data in JavaScript

- **Collect data from form**
  - Give ids to input elements
    <input type="text" id="*some-id*"/>
  - Read data
    var value1 = document.getElementById("*some-id*").value;
  - URL-encode data and form into query string
    var data = "var1=" + escape(value1);
- **Specify POST instead of GET in "open"**
  request.open("POST", address, true);
- **Specify form encoding type**
  request.setRequestHeader("Content-Type",
  "application/x-www-form-urlencoded");
- **Supply data in "send"**
  request.send(data);

Define a Request Object

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}
```

No changes from previous example

Initiate Request

```
function sendRequestWithData(address, data,
                             responseHandler) {
  request = getRequestObject();
  request.onreadystatechange = responseHandler;
  request.open("POST", address, true);
  request.setRequestHeader("Content-Type",
          "application/x-www-form-urlencoded");
  request.send(data);
}

function showTimeInCity() {
  var address = "../show-time-in-city";
  var city = document.getElementById("city").value;
  var data = "city=" + escape(city);
  sendRequestWithData(address, data, showResponseAlert);
}
```

No changes from previous example

Handle Response

```
function showResponseAlert() {
  if ((request.readyState == 4) &&
      (request.status == 200)) {
    alert(request.responseText);
  }
}
```

No changes from previous example

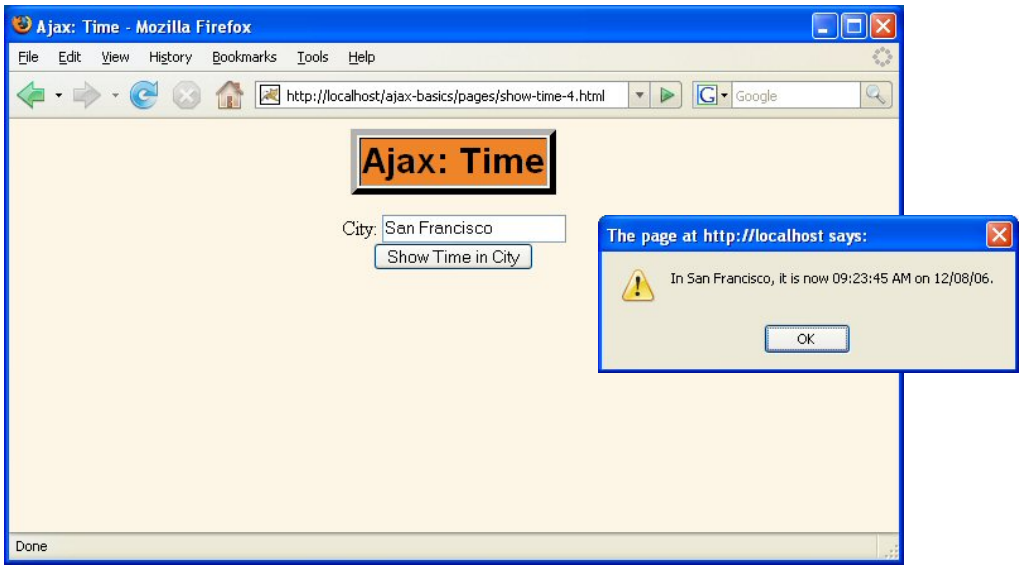
HTML Code

```
<!DOCTYPE html PUBLIC "..."
  "http://www.w3.org/...">
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Ajax: Time</title>
<link rel="stylesheet"
      href="../css/styles.css"
      type="text/css"/>
<script src="../scripts/ajax-basics.js"
        type="text/javascript"></script>
</head>
<body>
...
<form action="#">
 City: <input type="text" id="city"/><br/>
 <input type="button" value="Show Time in City"
        onclick="showTimeInCity()"/>
</form>
</center></body></html>
```


Servlet Code

```
public class ShowTimeInCity extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    response.setHeader("Cache-Control", "no-cache");
    response.setHeader("Pragma", "no-cache");
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String city = request.getParameter("city");
    ...
    String message = TimeZone.getTimeString(city);
    ...
    out.print(message);
  }

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

Sending POST Data: Results



Displaying HTML Output

POST Example: Design Deficiencies

- **Results always shown in dialog (alert) box**
  - Alerts usually reserved for errors or warnings
  - Users prefer normal results inside page
  - Solution: use DOM to update page with result text

Steps

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
    - Initiate a POST request to a servlet
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
      - Use innerHTML to insert result into "div" element
- **HTML**
  - Loads JavaScript from centralized directory
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script
  - Defines a blank "div" element with a known id

Updating HTML Page Asynchronously

- **HTML**
  - Defines initially blank div element

- **JavaScript**
  - Finds element (getElementById) and inserts text into innerHTML property
    document.getElementById("resultText").innerHTML =
    request.responseText;

Define a Request Object

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}
```

No changes from previous example

Initiate Request

```
function sendRequestWithData(address, data,
                             responseHandler) {
  request = getRequestObject();
  request.onreadystatechange = responseHandler;
  request.open("POST", address, true);
  request.setRequestHeader("Content-Type",
          "application/x-www-form-urlencoded");
  request.send(data);
}


function displayTimeInCity() {
  var address = "../show-time-in-city";
  var city = document.getElementById("city").value;
  var data = "city=" + escape(city) + "&useHTML=true";
  sendRequestWithData(address, data, showResponseText);
}
```

No changes from previous example

Handle Response

```
function showResponseText() {
  if ((request.readyState == 4) &&
      (request.status == 200)) {
    document.getElementById("resultText").innerHTML =
      request.responseText;
  }
}
```

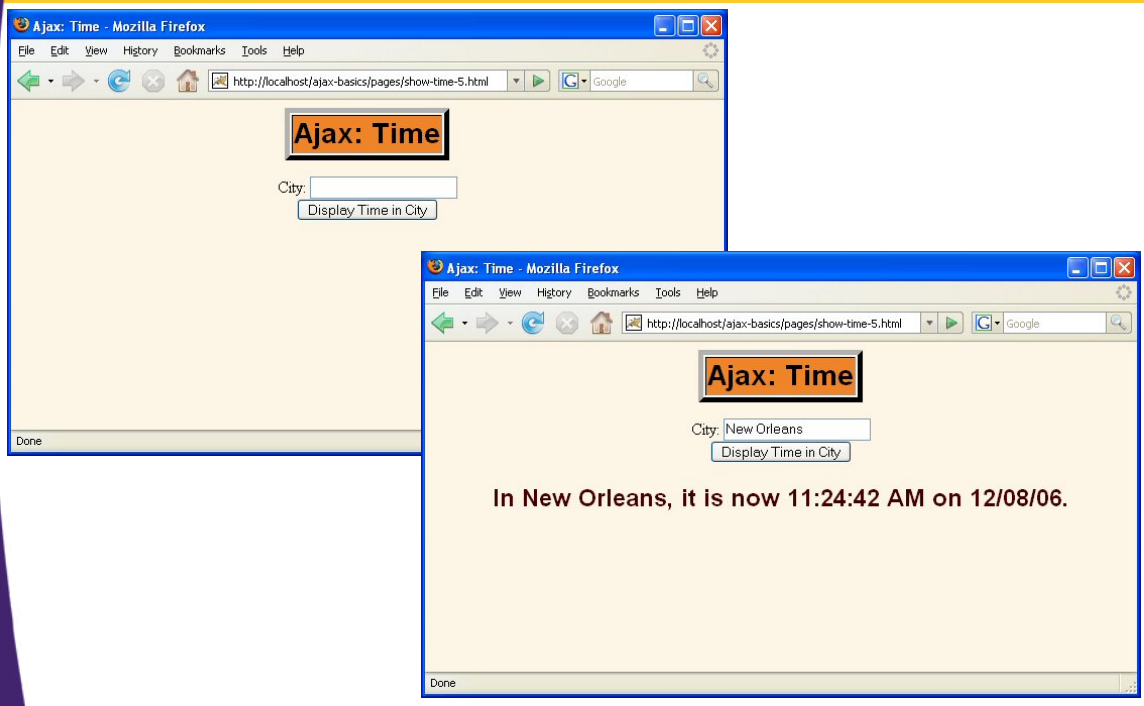
HTML Code (show-time-5.html)

```
<!DOCTYPE html PUBLIC "..." "http://www.w3.org/...">
<html xmlns="http://www.w3.org/1999/xhtml">
<head><title>Ajax: Time</title>
<link rel="stylesheet".../>
<script src="../scripts/ajax-basics.js"
        type="text/javascript"></script>
</head>
<body>
...
<form action="#">
 City: <input type="text" id="city"/><br/>
 <input type="button" value="Display Time in City"
        onclick="displayTimeInCity()"/>
</form>
<div id="resultText"></div>
</center></body></html>
```


Servlet Code

```
public class ShowTimeInCity extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    response.setHeader("Cache-Control", "no-cache");
    response.setHeader("Pragma", "no-cache");
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String city = request.getParameter("city");
    boolean useHTML = false;
    if (request.getParameter("useHTML") != null) {
      useHTML = true;
    }
    String message = TimeZone.getTimeString(city);
    if (useHTML) {
      message = String.format("<h2>%s</h2>", message);
    }
    out.print(message);
  }
  public void doPost(...) ... { doGet(request, response); }
```

Displaying HTML Output: Results



Parsing and Displaying XML Output

HTML Example: Design Deficiencies

- **Java code generated HTML**
  - Page author has no control over format
  - Cannot use the same data for different tasks
  - Having server-side resource (servlet) generate HTML is often easier and better. But not always.
- **Solution**
  - Have servlet return XML content
  - JavaScript parses XML and decides what to do with it
- **Secondary problem**
  - Generating XML from a servlet is inconvenient
- **Secondary solution**
  - Use MVC architecture on server
    - Servlet creates dynamic data
    - JSP formats the data
    - See detailed lecture on using MVC in Java: http://courses.coreservlets.com/Course-Materials/csajsp2.html

Steps

- **JavaScript**
  - Define an object for sending HTTP requests
  - Initiate request
    - Get request object
    - Designate a response handler function
    - Initiate a POST request to a servlet (that uses MVC)
    - Send data
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
      - Parse data. Use innerHTML to insert result into "div" element
- **HTML**
  - Loads JavaScript from centralized directory
  - Designates control that initiates request
  - Gives ids to input elements that will be read by script
  - Defines a blank "div" element with a known id

Parsing XML in JavaScript

- **Getting the main XML document**
  - Use responseXML instead of responseText
    ```
    var xmlDocument = request.responseXML;
    ```
  - Get array of elements with getElementsByTagName
    ```
    var names = xmlDocument.getElementsByTagName("name");
    ```
  - Get body text by getting value of first child node
    ```
    for(var i=0; i<names.length; i++) {
      var name = names[i].childNodes[0].nodeValue;
      doSomethingWith(name);
    }
    ```
- **See detailed lecture on parsing XML with DOM in Java**
  - http://courses.coreservlets.com/Course-Materials/java5.html
  - Java API and JavaScript API are very similar

Define a Request Object

```
var request;

function getRequestObject() {
  if (window.ActiveXObject) {
    return(new ActiveXObject("Microsoft.XMLHTTP"));
  } else if (window.XMLHttpRequest) {
    return(new XMLHttpRequest());
  } else {
    return(null);
  }
}
```

No changes from previous example

Initiate Request

```
function sendRequest() {
  request = getRequestObject();
  request.onreadystatechange = showCityTable;
  request.open("POST", "../show-times-in-cities", true);
  request.setRequestHeader("Content-Type",
          "application/x-www-form-urlencoded");
  var timezone = document.getElementById("timezone").value;
  request.send("timezone=" + timezone);
}
```


Handle Response

```
function showCityTable() {
  if ((request.readyState == 4) &&
      (request.status == 200)) {
    var xmlDocument = request.responseXML;
    var names = xmlDocument.getElementsByTagName("name");
    var times = xmlDocument.getElementsByTagName("time");
    var days = xmlDocument.getElementsByTagName("day");
    var tableData = getTableStart();
    for(var i=0; i<names.length; i++) {
      var name = names[i].childNodes[0].nodeValue;
      var time = times[i].childNodes[0].nodeValue;
      var day = days[i].childNodes[0].nodeValue;
      tableData = tableData + getRowData(name, time, day);
    }
    tableData = tableData + getTableEnd();
    document.getElementById("resultText").innerHTML =
      tableData;
  }
}
```

Auxiliary Functions

```
function getTableStart() {
  return("<table border='1'>\n" +
    "  <tr><th>City</th><th>Time</th><th>Day</th></tr>\n");
}

function getRowData(name, time, day) {
  return("  <tr><td>" + name +
         "</td><td>" + time +
         "</td><td>" + day +
         "</td></tr>\n");
}

function getTableEnd() {
  return("</table>\n");
}
```

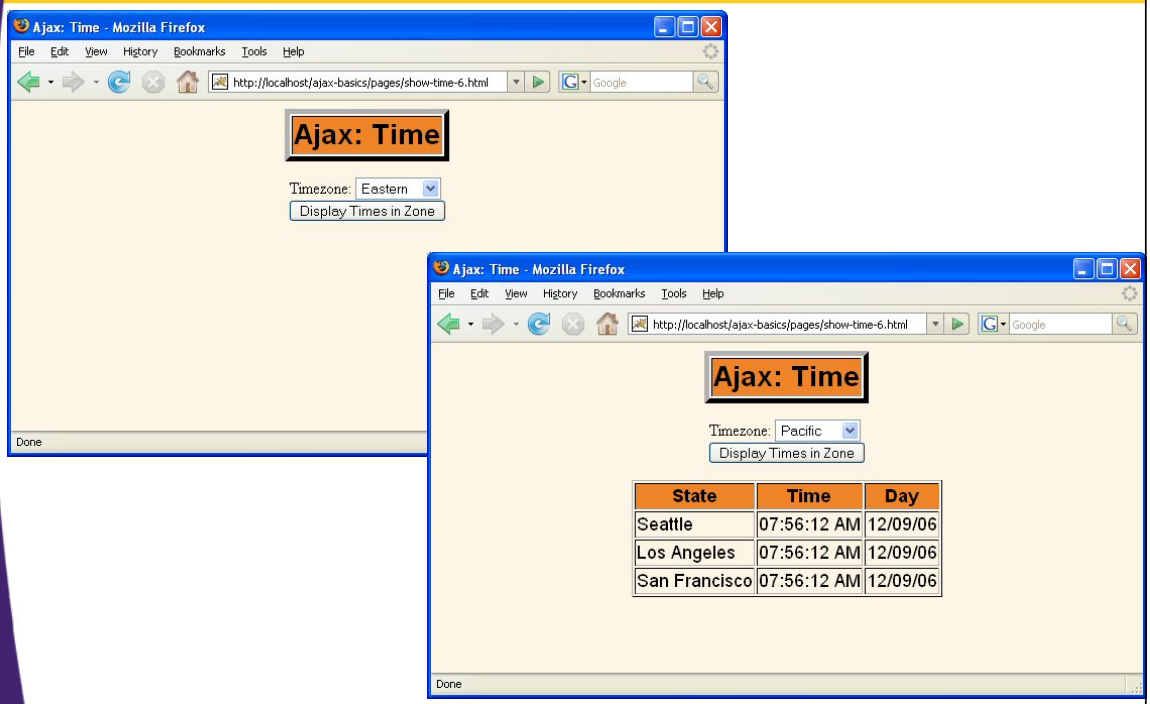

Servlet Code

```
response.setHeader("Cache-Control", "no-cache");
response.setHeader("Pragma", "no-cache");
response.setContentType("text/xml");
String timezone = request.getParameter("timezone");
List legalZones =
  Arrays.asList("eastern", "central", "mountain", "pacific");
if ((timezone == null) || (!legalZones.contains(timezone))) {
  timezone = "eastern";
}
timezone = timezone.toLowerCase();
String outputPage =
  String.format("/WEB-INF/results/%s.jsp", timezone);
FormattedTimeAndDay timeAndDay =
  new FormattedTimeAndDay(timezone);
request.setAttribute("timeAndDay", timeAndDay);
RequestDispatcher dispatcher =
  request.getRequestDispatcher(outputPage);
dispatcher.include(request, response);
```

JSP Code (eastern.jsp)

```
<?xml version="1.0" encoding="UTF-8"?>
<cities>
  <city>
    <name>New York</name>
    <time>${timeAndDay.time}</time>
    <day>${timeAndDay.day}</day>
  </city>
  <city>
    <name>Philadelphia</name>
    <time>${timeAndDay.time}</time>
    <day>${timeAndDay.day}</day>
  </city>
  <city>
    <name>Boston</name>
    <time>${timeAndDay.time}</time>
    <day>${timeAndDay.day}</day>
  </city>
</cities>
```


Parsing and Displaying XML Output: Results



Ajax Tools

Tools and Toolkits

- **Client-Side Tools (JavaScript Libraries with Ajax Support)**
  - Dojo
    - http://www.dojotoolkit.org/
  - Google Web Toolkit
    - Write code in Java, translate it to JavaScript
      - http://code.google.com/webtoolkit/
    - Also see https://ajax4jsf.dev.java.net/
      - GWT/JSF Integration Toolkit
  - script.aculo.us
    - http://script.aculo.us/
  - ExtJS
    - http://extjs.com/
  - Yahoo User Interface Library (YUI)
    - http://developer.yahoo.com/yui/

Tools and Toolkits (Continued)

- **Server-Side Tools**
  - Direct Web Remoting
    - Lets you call Java methods semi-directly from JavaScript
    - http://getahead.ltd.uk/dwr/
  - JSON/JSON-RPC
    - For sending data to/from JavaScript with less parsing
    - http://www.json.org/
    - http://json-rpc.org/
  - JSP custom tag libraries
    - Create tags that generate into HTML and JavaScript
    - http://courses.coreservlets.com/Course-Materials/msajsp.html

Tools and Toolkits (Continued)

- **Hybrid Client/Server Tools**
  - AjaxTags (built on top of script.aculo.us)
    - JSP custom tags that generate Ajax functionality
      - Supports many powerful Ajax capabilities with very simple syntax
      - http://ajaxtags.sourceforge.net
  - JavaServer Faces (JSF) component libraries
    - Trinidad (formerly Oracle ADF)
      - http://www.oracle.com/technology/products/jdev/htdocs/partners/addins/exchange/jsf/ (also myfaces.apache.org)
    - Tomahawk
      - http://myfaces.apache.org/tomahawk/
    - Ajax4JSF
      - http://labs.jboss.com/jbossajax4jsf/
    - IceFaces
      - http://www.icefaces.org/
    - Build your own
      - http://courses.coreservlets.com/Course-Materials/jsf.html

Books

- **Foundations of Ajax**
  - Asleson and Schutta. APress.
  - Geared around Java on the server-side.
- **Ajax in Action**
  - Crane, Pascarello, and James. Manning.
  - Geared around Java on the server-side.
- **Pro JSF and Ajax**
  - Jacobi and Fallows. APress.
  - Geared around JavaServer Faces integration.
- **Professional Ajax**
  - Zakas, et al. Wrox. *Wait for 2nd edition.*
  - Geared around Java on the server-side.

Summary

- **JavaScript**
  - Define request object
    - Check for both Microsoft and non-MS objects. Identical in all apps.
  - Initiate request
    - Get request object
    - Designate a response handler function
    - Initiate a GET or POST request
    - Send data (null for GET)
  - Handle response
    - Wait for readyState of 4 and HTTP status of 200
    - Extract return text with responseText or responseXML
    - Do something with result
      - Use innerHTML to insert result into "div" element
- **HTML**
  - Give ids to input elements and to div. Initiate process.
- **Java**
  - Use JSP, servlet, or combination (MVC) as appropriate.

Questions?