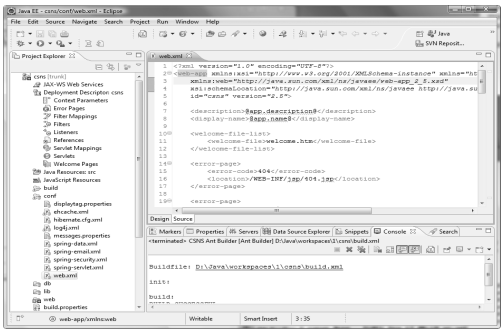
CS520 Web Programming
Introduction to Ajax

Chengyu Sun
California State University, Los Angeles

The Desktop Experience



The Desktop Advantage

- Large selection of GUI components
- Rich event model
- Low response time

HTML Event Models

- HTML 4 Event Model
  - HTML 4.01 Specification - http://www.w3.org/TR/REC-html40/interact/scripts.html#h-18.2.3
  - Limited but widely supported
- Standard Event Model
  - DOM Level 2 HTML Specification - http://www.w3.org/TR/DOM-Level-2-Events/events.html
- Browser specific event models

Events and Event Handler

- Events
  - onfocus, onblur, onkeypress, onkeydown, onkeyup, onclick, ondbclick, onmousedown, onmouseup, onmousemove, onmouseover …
- Specify event handler
  - <element event="code">
  - For example:

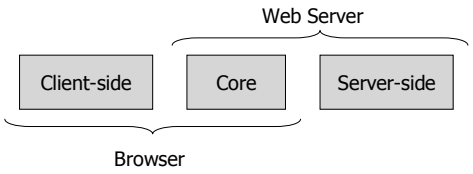
```
<button onclick="clickHandler();">click</button>
```

Example: Event Handling

- `j1.html`
  - Uses X Library from http://cross-browser.com/
  - *Handles events*
  - *Modifies the HTML document*

JavaScript

- Interpreted language
- Originally developed by Netscape
- Syntax is similar to Java



Core JavaScript

- Mainly covers language syntax, which is similar to Java
- Some "un-Java-like" language features
  - Object creation
  - Functions as first-class citizens

Object Creation – Approach 1

```
var car = new Object();
car.make = 'Honda';
car.model = 'Civic';
car.year = 2001;

var owner = new Object();
owner.name = 'Chengyu';

car.owner = owner;
```

- A JavaScript object consists of a set of properties which can be added dynamically

Object Creation – Approach 2

```
var car = {
  make: 'Honda',
  model: 'Civic',
  year:  2001,
  owner: {
    name: 'Chengyu'
  }
};
```

- Object literal

Functions as First-class Citizens

- In JavaScript, functions are considered objects like other object types
  - Assigned to variables
  - Assigned as a property of an object
  - Passed as a parameter
  - Returned as a function result
  - *Function literals* (i.e. functions without names)

Function Examples

```
function foo() {
  alert('foo');
}
```

Regular function creation

```
bar = function() {
  alert('bar');
}
```

- Function literal
- Function assignment

```
setTimeout( bar, 5000 );
```

Function as parameter

```
setTimeout( function() {
  alert('foobar');},
  5000 )
```

Function literal as parameter

Client-Side JavaScript

- Embed JavsScript in HTML
  - <script>
    - `type="text/javascript"`
    - `language="JavaScript"`
    - `src="path_to_script_file"`
- Run inside a browser

Processing an HTML Document

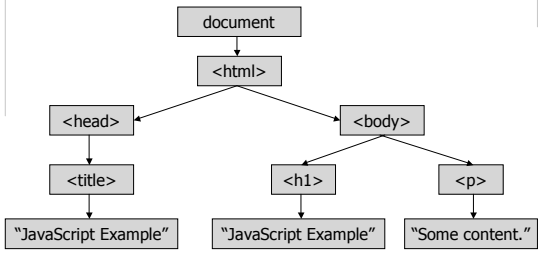
```
<html>
<head><title>JavaScript Example</title></head>
<body>
    <h1>JavaScript Example</h1>
    <p>Some content.</p>
</body>
</html>
```

- As a text file – very difficult
- As an object

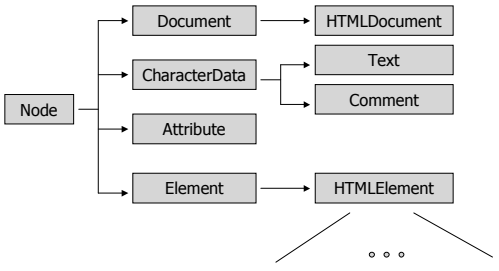
Document Object Model (DOM)

- Representing documents as objects so they can be processed more easily by a programming language

DOM Representation



Nodes



Manipulate a Document

- Find Elements
- Modify Elements
- Create Elements

Find Elements

- document.getElementById()
- document.getElementsByName()
- document.getElementsByTagName()

Modify Elements ...

- HTMLElement properites and methods
  - IE
    - innerHTML
    - innerText
    - insertAdjacentHTML()
    - insertAdjacentText()
  - Netscape/Mozilla
    - innerHTML
  - Element-specific

... Modify Elements

- node
  - setAttribute(), removeAttribute()
  - appendChild(), removeChild()
  - insertBefore(), replaceChild()

Create Elements

- document
  - createElement()
  - createTextNode()

Example: Document Manipulation

- `j2.html`
  - Read and display the text input
  - *Display "Hello <name>"??*
  - *Add text input to table??*

Communicate with Server

- The request-response model is still a limiting factor in user interactivity
- Solution: XMLHttpRequest
  - A JavaScript object
    - Send request and receive response
  - Response can be handled *asynchronously*
    - Do not need to wait for the response

Understand Asynchronous

- Synchronous

```
send( request );

// wait for response

process( response );

// do other things
…
```

- Asynchronous

```
send( request );

// don't wait for response

process( response );

// do other things
…
```

What's the problem??
What's the solution??

An XMLHttpRequest Example

- `a1.html`
  - A client scripts sends an XMLHttpRequest
  - A servlet responses with a random number
  - When the message arrives on the client, a *callback function* is invoked to update the document

About the Example

- clickHandler()
- newXMLHttpRequest()
- updateDocument()
- getReadyStateHandler()

XMLHttpRequest - Properties

- onreadystatechange
- readyState
  - 0 – uninitialized
  - 1 – loading
  - 2 – loaded
  - 3 – interactive
  - 4 – complete
- status
- statusText
- responseBody
- responseStream
- responseText
- responseXML

XMLHttpRequest - Methods

- abort()
- getAllResponseHeaders()
- getResponseHeader(header)
- open(method, url, asyncFlag, username, password)
  - asyncFlag, username, password are optional
- send(messageBody)
- setRequestHeader(name, value)

So What is Ajax?

- Asynchronous JavaScript and XML
  - http://www.adaptivepath.com/ideas/essays/archives/000385.php
  - JavaScript + XMLHttpRequest
- Characteristics of Ajax
  - Non-blocking – the server response is handled asynchronously with a callback function
  - Partial page update using JavaScript

More About AJAX

- XMLHttpRequest used to be an IE specific feature that received little attention
- It's all started by Google Maps
- The beginning of "Web 2.0"

Key Elements of an Ajax Operation

Client	Server
◆ Event ◆ Event handler ▪ Create a XMLHttpRequest ▪ Attach a callback function ▪ Send the request ◆ Callback function ▪ Process the response ▪ Update the HTML Page	◆ Process the request ◆ Send back a response

Problems of Plain JavaScript + XmlHttpRequest

- Each browser has their own JavaScript implementation
  - Code that works on some browsers may not work on others
- Lack of pre-made GUI components
- Implementing Ajax operations is quite tedious

JavaScript/Ajax Frameworks and Libraries

- http://ajaxpatterns.org/Ajax_Frameworks
  - Cross-browser compatibility
    - New JavaScript API, e.g. X Lib, JQuery
    - New language, e.g. ZK, Taconite
  - Pre-made, Ajax-enabled GUI component
  - Simplify the implementation of Ajax operations

One Library to Rule Them All - JQuery

- jQuery - http://jquery.com/
- jQuery UI - http://jqueryui.com/
- The increasing market share of jQuery
  - http://trends.builtwith.com/javascript
  - http://trends.builtwith.com/javascript/JQuery

A jQuery Example

- `a2.html`
  - The document ready handler `$(function(){…})`
    - Similar to `window.onload` but better
  - Selectors `$('#clickBtn')` and `$('#number')`
  - Events `click()`
  - Ajax call `$.ajax()`

More Ajax Examples

- `a3.html` - a Taconite example
  - http://taconite.sourceforge.net/
  - Simplifies request creation
  - Response generated by JSP
  - No JavaScript required to update page
- CSNS
  - Toggle file public
  - Add section

Readings

- AJAX:Getting Started - https://developer.mozilla.org/en/AJAX/Getting_Started
- *jQuery in Action* by Bear Bibeault and Yehuda Katz

What's in the Future? – RIA vs. Ajax

- Rich Internet Application (RIA) platforms
  - Flex, Silverlight, JavaFX
- vs. Ajax
  - Proprietary
  - Require browser plugins
  - Rich GUI features
  - Good development tool support
- HTML5??