Objectives

- Review: JSPs, Organization, Version Control
- JavaScript
  - Some slides are in PDF that were not covered in class

- Log into the lab machine
- We're going to create some HTML files that contain JavaScript in a js_practice directory in your public_html directory

JSPs and Organization Review

- Log into the lab machine
- We're going to create some HTML files that contain JavaScript in a js_practice directory in your public_html directory

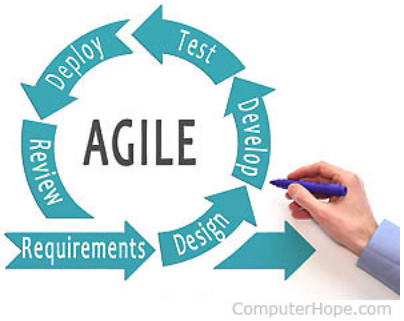
- What motivated the development of JSPs (in addition to servlets)?
- What is in a JSP file?
- How do JSPs execute?
- What are your goals when organizing your code in a JSP (versus what goes into a servlet)?
- Where can we put JSPs so that users can't directly access them?
  - Why would you want to do that?

Version Control Review

- Why do we need version control?
- What can we do with version control?
  - What doesn't it do?
- What version control software are we using?
- How do you get a copy of code that is stored in version control?
- How do you publish your changes to the public/remote copy of the code?
- What is our typical workflow?

Agile Development

- "focus on adapting to the changing nature of goals rather than predicting what those goals will be"
- Iterative process
- Reevaluate goals

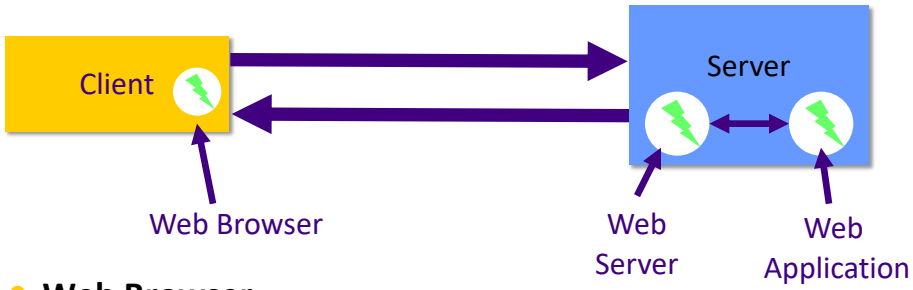


https://www.computerhope.com/jargon/a/agile-development-methods.htm

Changing Schedule

- Earlier more complete background for project
- Today
  - JavaScript
  - SQL/Databases
- Tomorrow
  - Nika
- With additional background, better poised to understand codebase
  - Still missing: Maven, Spring Framework, …

Web Programming



- **Web Browser**
  - Makes requests, renders responses
  - Executes **JavaScript**, client-side code
- **Web Server**: handles static requests
- **Web Application:** handles ***dynamic*** requests

JavaScript

- A lightweight programming language (scripting)
- Used to make web pages *interactive*
  - Insert dynamic text into HTML (ex: user name)
  - React to events (ex: page load user click)
  - Get information about a user's computer (ex: browser type)
  - Perform calculations on user's computer (ex: form validation)
- A Web standard but not supported identically by all browsers
- NOT related to Java other than by name and some syntactic similarities

Pros and Cons of JavaScript

- What can be done with JavaScript on the client side and cannot be done on the server side?
  - Monitor user events and take action
  - Some dynamic effects
- What can be done on both client and server sides but are better on the server?
  - Build HTML dynamically when page is loaded
  - Data validation
- What are the drawbacks of JavaScript?
  - Platform dependent
  - Can be turned off
  - Performance; Security-viruses

Differences between JavaScript and Java

- Interpreted not compiled
- More relaxed syntax and rules
  - Fewer and "looser" data types
  - Variables don't need to be declared
  - Errors often silent (few exceptions)
- Key construct is the *function* rather than the class
  - More procedural, less object-oriented
- Contained within a Web page and integrates with its HTML/CSS content

JavaScript Guidelines

- Case sensitive
  - `myVar` is not the same as `myvar`
- Extra white space is ignored

Injecting Dynamic Text

```
document.write("message");
```

- document object represents the current HTML document in the browser
  - Can access elements of document through document
- Prints specified text to page
- Can be used to display HTML
- Argument can be a literal string in quotes or a variable

Variables

```
var name = value;
```

```
var clientName = "Connie Client";
var age = 32;
var salary = 44794.45;
```

- Type is not specified but Javascript does have types
  - Dynamic, weakly typed language
  - Values are converted between types automatically as needed
- Variable names are case sensitive
- Explicitly declared using var keyword — Makes a local variable
- Implicitly declared through assignment
  - Give it a value and it exists! — Makes a global variable

What other programming language is this like?

JavaScript Reserved Words

```
abstract boolean break byte case catch
       char class const continue
debugger default delete do double else
    enum export extends false final
    finally float for function goto
if implements import in instanceof int
     interface long native new null
package private protected public return
short static super switch synchronized
  this throw throws transient true try
  typeof var void volatile while with
```


Operators

- Similar operators, precedence hierarchy to Java
- `+ - * / % ++ -- = += -= *=`
- `/= %= == != > < >= <= && || !`
- == checks value
  - "5.0" == 5 is true
- === also checks type
  - "5" === 5 is false
- Many operators auto-convert types
  - 5 < "7" is true

for loop

squared.html

- Syntax:

```
for (initialization; condition; update) {
    statements;
}
```

- Example:

```
for (var i = 0; i < 10; i++) {
    document.write("<p>" + i + "^2 = " +
                   (i * i) + "</p>");
}
```

What will the output of this be?

Using JavaScript tools: Firefox's Developer Tools

- Error Console

Inserting JavaScript in HTML

- JavaScript code can be added to a web page in 3 ways:
  - In the page's body
    - Runs when page loads
  - In the page's head
    - Runs when events occur
  - In a link to an external `.js` script file

JavaScript in HTML body

- Always runs on page load
- Useful for generating dynamic text

```
<body>
    …
    <script>
    JavaScript code
    </script>
    …
</body>
```

Practice Problem: Hello World

- Write a page that displays "Hello World!" using JavaScript.
- Make "Hello World!" appear 1000 times.
  - Make it so there's only one "Hello World!" per line.

helloworld.html
hello.html

JavaScript in HTML head

- Does not run unless *functions* are explicitly called
- Useful for event-triggered actions
  - Pop up an alert message when a user clicks a given element
  - Display a greeting message on refresh

```
<head>
…
<script>
      JavaScript code
</script>
…
</head>
```

Linking to a JavaScript File

- Can be placed in page's head or body
- Script is stored in a `.js` file
- The source file should not contain the `<script>` tag
- The preferred way to write scripts for large projects
- Syntax: `<script src="filename">`
- Example: `<script src="example.js">`

String type

```
var s = "this string";
```

- Can be specified with " " or ' '
- Some Methods
  - charAt, indexOf, lastIndexOf, replace, split, substring, toLowerCase, toUpperCase
  - charAt method returns a value of type *String*
    - No char type in JavaScript
- Example:

```
var first = s.substring(0, s.indexOf(" "));
```

More on Strings

- `length` property
  - `s.length` is 13
- Escape sequences behave as in Java
  - `\' \" \& \n \t \\`
- Converting a number to a String

```
var s = new String(myNum);
var sentence = count + " bananas, ah ah ah!"
```

  - Many operators, such as <, automatically convert

More `String` Methods

- `anchor` method

```
var txt="Hello world!";
document.write(txt.anchor("myanchor"));
```

  - Result:

```
<a name="myanchor">Hello world!</a>
```

- String style methods
  - bold, italics, fontsize, fontcolor
  - Typically, should be able to use CSS

Number type

- Integers and real numbers are the same type
  - Stored as 64-bit floating point
- Converting a String into a Number
- Syntax:

```
var integerValue = parseInt(string);
var floatValue = parseFloat(string);
```

- Examples:

```
parseInt("123hello")
parseInt("booyah")
```

returns 123

returns NaN (not a number)

if/else Statement

- Identical structure to Java's if/else statement
- JavaScript is more forgiving about what is in a condition
  - Not just booleans

```
if (condition) {
    statements;
} else if (condition) {
    statements;
} else {
    statements;
}
```

Boolean type

- Any value can be used as a Boolean
  - 0, NaN, "", null, and undefined are all `false`
  - All others are `true`

```
if ("CS is great") {  // true, of course!

}
```

- Converting a value into a Boolean explicitly

```
var boolValue = new Boolean(otherValue);
```


while Loops

```
while (condition) {
    statements;
}
```

```
do {
    statements;
} while (condition);
```

- `break` and `continue` keywords also behave as in Java

Math object

- Methods
  - abs, ceil, floor, round, log
  - max, min, pow, random, sqrt
  - cos, sin, tan
- Properties
  - E, PI

```
var rand1to10 = Math.floor(Math.random() * 10 + 1);
var three = Math.floor(Math.PI);
```


Comments

- Identical to Java's comment syntax

```
// single-line comment

/*
multi-line comment
*/
```

Practice Problem: Random Image

- Randomly display one of two images whenever the page is loaded

Functions

```
function name(parameterName, ..., parameterName) {
    statements;
}
```

- Parameter types and return types are not specified
  - `var` is not written in parameter declarations
- Functions with no return statement return an undefined value
  - Kind of like `void`
- Any variables declared in the function are **local** (only exist in that function)

Function Example

- Quadratic Function

```
function quadratic(a, b, c) {
    return -b + Math.sqrt(b*b - 4*a*c) / (2*a);
}
```

  - Again, note no type declarations for parameters, return types

Calling Functions

```
name(parameterValue, ..., parameterValue);
```

```
var root = quadratic(1, -3, 2);
```

- If the wrong number of parameters are passed
  - Too many: extra ones are ignored
  - Too few: remaining ones get an undefined value

Global and Local Variables

```
var count = 1;

function f1() {
    var x = 999;
    count *= 10;
}
function f2() {
     count++;
}

f2();
f1();
```

- Variable count is **global**
  - Seen by all functions
- Variable x is **local**
  - Can be seen by only f1
- Both f1 and f2 can use and modify count
- What is count's value at the end?

popup_boxes.html

3 Types of Popup Boxes

- Alert: Displays message

```
alert("message");
```

- Confirm: user can confirm or cancel
  - Returns true or false

```
confirm("message");
```

- Prompt: gives text box to user
  - Returns user input string

```
prompt("message" [, "default"] );
```

Date Creation Examples

```
//today
var today = new Date();

//example syntax
var date = new Date( year, monthindex, day);

// Oct 18, 1977
var reggieDay = new Date(1977, 9, 18);

//
var history = new Date('December 17, 1995
03:24:00');
```

Can compare Dates using < > etc.

Date Object Method Quirks

- `getYear` returns a 2-digit year
  - Use `getFullYear` instead
- `getDay` returns day of week from 0 (Sun) through 6 (Sat)
- `getDate` returns day of month from 1 to # of days in month
- `Date` stores month from 0-11 (not from 1-12)

Date object Methods

- Getters:
  - `getDate, getDay, getMonth, getFullYear, getHours, getMinutes, getSeconds, getMilliseconds, getTime, getTimezoneOffset`
- Setters:
  - `setDate, setMonth, setFullYear, setHours, setMinutes, setSeconds, setMilliseconds, setTime`
- `parse`
- `toString`

Event Handlers

- HTML elements have special ***attributes*** called ***events***
- JavaScript functions can be set as event handlers
- When you interact with the element, the function will execute
- An example of event-driven programming

```
<h2 onmouseover="myFunction();">Click me!</h2>
```

- `onmouseover` is one of many HTML **event** attributes

Practice Problem: Countdown to Graduation

- Write a JavaScript function that will display the number of days until graduation
  - Handle when graduation has past (i.e., when today is after graduation)
- Have the function execute when the mouse hovers over the **h1** element

countdown.html

Arrays: 3 Ways to Initialize

```
var stooges = new Array();
stooges[0] = "Larry";
stooges[1] = "Moe";
stooges[2] = "Curly";
```

```
var stooges = new Array("Larry", "Moe", "Curly");
```

```
var stooges = ["Larry", "Moe", "Curly"];
```

Arrays

- **Methods**
  - `pop, push`
    - Remove (return) and add from *end*
  - `shift, unshift`
    - Remove (return) and add from *front*
  - `concat, join, reverse, slice, sort, splice, toString`
- **Properties**
  - `length`

What does this code do?

```
var a = new Array();
a.push("Joey");
a.push("Chandler");
a.unshift("Ross");
a.push("Phoebe", "Monica");
x=a.shift();
a.pop();
a.sort();
document.write(x);
```

What is the value of x?
What does a look like?

Answer

friends.html

```
var a = new Array();
a.push("Joey");          // Joey
a.push("Chandler");   // Joey, Chandler
a.unshift("Ross");    // Ross, Joey, Chandler
a.push("Phoebe", "Monica");
// Ross, Joey, Chandler, Phoebe, Monica
x=a.shift(); // Joey, Chandler, Phoebe, Monica
a.pop();    // Joey, Chandler, Phoebe
a.sort();   // Chandler, Joey, Phoebe
document.write(x);
```

What is the value of x? "Ross"

Strings and Arrays: `split` and `join`

- `split` breaks apart a string into an array using a delimiter
- `join` groups an array of strings into a single string, placing the delimiter between them

```
var s = "the quick brown fox";
var a = s.split(" "); // [the,quick,brown,fox]
a.reverse();          // [fox,brown,quick,the]
s = a.join("!");      // "fox!brown!quick!the"
```

Special Values: undefined and null

- undefined : has not been declared
- null : has been declared but not assigned a value

```
var harry;
var sally = 9;

// at this point in the code,
//   harry is null
//   sally is 9
//   caroline is undefined
```


typeof Function

`typeof(value)`

- Given these declarations:

```
function foo() { alert("Hello"); }
var a = ["Huey", "Dewey", "Louie"];
```

- The following statements are true:

```
typeof(3.14) == "number"
typeof("hello") == "string"
typeof(true) == "boolean"
typeof(foo) == "function"
typeof(a) == "object"
typeof(null) == "object"
typeof(undefined) == "undefined"
```

arguments Array

- Every function has an array named `arguments` that represents the arguments passed
  - Can write functions that take varying numbers of arguments
- Can loop over them, print them, etc.

```
function example() {
    for (var i = 0; i < arguments.length; i++) {
        alert(arguments[i]);
    }
}
```

Call: `example("how", "are", "you");`

Arrays as Maps

- Indices of a JavaScript array need not be integers
  - Store mappings between an index of any type (***keys***) and value
- Similar to Java's Map collection or a hash table data structure

```
var map = new Array();
map[42] = "the answer";
map[3.14] = "pi";
map["champ"] = villanova;
```

For Each Loop

- Loops over
  - every index of the array **OR**
  - every property name of the object

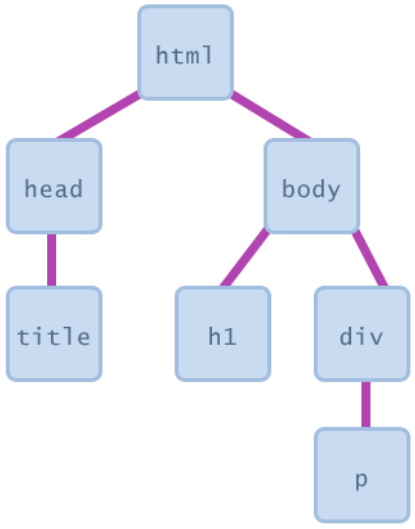
```
for (var name in arrayOrObject) {
     // do something with arrayOrObject[name]
}
```


Browser Object Model (BOM)

- `window` : the browser window
- `navigator` : info about the web browser you're using
- `screen` : info about the screen area occupied by the browser
- `history` : list of pages the user has visited
- `document` : current HTML page
  - Document Object Model (DOM): Our focus

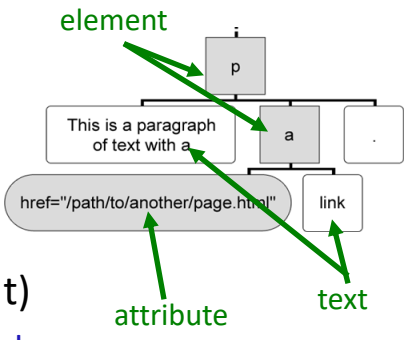
Document Object Model (DOM)

- A representation of the current web page as a set of JavaScript objects
- Allows you to view/modify page elements in script code



Types of Nodes

- **Element**
  - Can have children and/or attributes
- **Text** (text in a block element)
  - A child within an element node
  - Cannot have children or attributes
- **Attribute**
  - Attribute/value pair inside the start of a tag



DOM Node/Object Properties

- `firstChild, lastChild` : start/end of this node's list of children
- `childNodes` : array of all this node's children
- `nextSibling, previousSibling` : neighboring nodes that have the same parent
- `parentNode` : the element that contains this node

See W3Schools for all DOM node properties, browser incompatiblity information

DOM Element Properties

- DOM objects for all HTML **elements** contain the following properties:
  - `className, id, style, title`
- **`style`** property
  - Represents the combined styles that apply to element
  - Contains same properties as CSS style properties, **except** names are *capitalized* instead of hyphenated
  - Examples: `backgroundColor, borderLeftWidth, fontFamily`

DOM Node Methods

Method	Description
`appendChild(node)`	places the given node at the end of this node's child list
`insertBefore(newChild, oldChild)`	places the given new node in this node's child list just before `oldChild`
`removeChild(node)`	removes the given node from this node's child list
`replaceChild(newChild, oldChild)`	replaces the given child node with the given new node

More methods at w3Schools

Creating New Elements

- `document.createElement("tag")`
  - Constructs a new empty DOM node representing an element of that tag type
- The created node's properties can be set just like any other DOM node's
- After appropriate properties are set, the node can be added to the page

Event HTML Attributes

- Window Events (`body, frameset`):
  - `onload, onunload`
- Form Element Events (`form`):
  - `onchange, onsubmit, onreset, onselect, onblur, onfocus`
- Keyboard Events:
  - Available on non-window, non-style elements
  - `onkeydown, onkeypress, onkeyup`
- Mouse Events
  - Available on non-window, non-style elements
  - `onclick, ondblclick, onmousedown, onmousemove, onmouseout, onmouseover, onmouseup`

Accessing Nodes by id, tag, or name

- `document.getElementById("id")`
  - Returns an object representing the HTML element with the given id attribute
    - null if not found
- `document.getElementsByName("name")`
  - Returns an array of all elements with the given name
- `element.getElementsByTagName("tag")`
  - Returns an array of all children of the given tag name ("p", "div", etc.)
  - Can be called on the document or on a specific node

Using document object's getElementById method

hot.html

```
function makeRed() {
    var para = document.getElementById("announce");
    para.style.color = "red";
}
```

```
<h2 onmouseover="makeRed();">Sell</h2>
<p id="announce">Get it while it's hot!</p>
```


Buttons: <button>

- Button's text appears inside button tag
- onclick event handler specifies button's behavior
- Difference between input created buttons and these buttons:
  - **buttons** can contain content like text or images
  - No content within **input** tags

```
<button onclick="function();">
<img src="image.jpg" alt="" />
</button>
```

ididit.html

The DOM innerHTML Property

- innerHTML refers to the HTML text inside of an element:

```
<p>this is the innerHTML of the p tag </p>
```

- Event handler can modify the innerHTML of another element

```
<p><button id="b1" onclick="update('I did it!');">
Click me! </button></p>
<p id="target">This text will be replaced. </p>

function update(text) {
    var p = document.getElementById("target");
    p.innerHTML = text;
}
```


textarea (DOM)

- Initial text placed inside textarea tag (optional)
- DOM properties: disabled, readOnly, value
  - NOTE: get/set area's text using **value**, NOT innerHTML

Practice Problem

- Write the HTML and Javascript code to reverse the lines of text within a textarea whenever a Reverse button is clicked.

textarea_example.html

Images

cooler.html

- Changing Images

```
function MakeCooler() {
  document.images[ "cool" ].src ="cooltext.png";
}
```

```
<p><img src="cool.png" name="cool" alt="cool" /></p>
```

```
<img src="cool.png"
      onmouseover="this.src='cooltextMouseOver.png';"
      onmouseout="this.src='cool.png';" />
```

select Element

- DOM properties: `disabled, length, multiple, name, selectedIndex, size, value` (selected item's text)
- DOM methods: `add(option, index), remove(index)`

```
function addAwards() {
  var selectElem = document.getElementById("awards");
  count++;
  var newOption = document.createElement('option');
  newOption.text = count;
  newOption.value = count;
  newOption.selected = 'selected';
  try {
     selectElem.add( newOption, null);
  } catch( ex ) {  // for IE
     selectElem.add(newOption);
  }
}
```

select Element

- Attach `onchange` handler to select to cause behavior on each selection

```
<p>Who is your favorite Voice judge?</p>

<select onchange="alert('You chose ' + this.value);">
  <option>Adam</option>
  <option>Blake</option>
  <option>John</option>
  <option>Kelly</option>
</select>
```

select_example.html

<input>

- DOM properties for type="text" and type="password":
  - `disabled, maxLength, readOnly, size, value` (text in field)

Practice Problem

- Write the HTML and JavaScript code to present a text area and three on/off options for lions, tigers, and bears.
- When the user checks each box, it will add or remove that animal from the text area's text.

Form Validation

- Don't allow submission through browser until certain criteria is met
- Reduce network traffic, work that server does

- **Not the *only* place to do validation**
  - Still need to check on server-side
  - JavaScript can be turned off
  - Bad guys might not use browser

form_validation.html

Using JavaScript tools: Firefox's Developer Tools

- Error Console
- Breakpoints

jQuery

- Commonly used API for writing JavaScript
- Free, open source
- Works across a variety of browsers

- Recommended use:
  - Link to jQuery library from a CDN
  - Benefits: reduced latency, caching benefits
- More info here: `https://jquery.com/`

TODO

- Lab 6 - JavaScript practice
  - Due today at midnight
- This afternoon: Web Quality Attributes, SQL, JDBC
- Exam – Thursday
  - Exam prep document posted next week