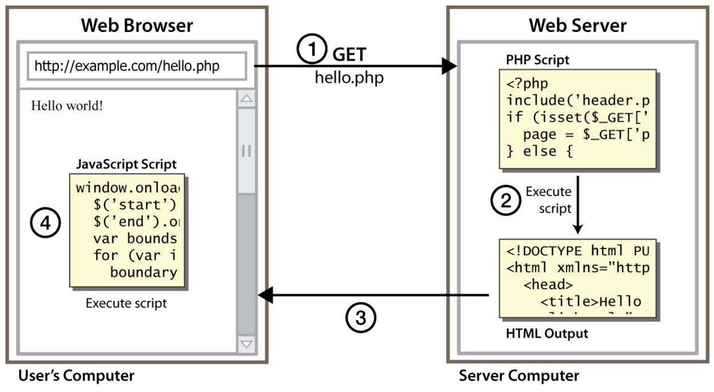
Introduction to Web Programming

Lecture 15: JavaScript

15.1: Key JavaScript Concepts

- **15.1: Key JavaScript Concepts**
- 15.2: JavaScript Syntax
- 15.3: Program Logic
- 15.4: Advanced JavaScript Syntax

Client-side scripting



- **client-side script**: code runs in browser *after* page is sent back from server
  - often this code manipulates the page or responds to user actions

Why use client-side programming?

PHP already allows us to create dynamic web pages. Why also use client-side scripting?

- client-side scripting (JavaScript) benefits:
  - **usability**: can modify a page without having to post back to the server (faster UI)
  - **efficiency**: can make small, quick changes to page without waiting for server
  - **event-driven**: can respond to user actions like clicks and key presses
- server-side programming (PHP) benefits:
  - **security**: has access to server's private data; client can't see source code
  - **compatibility**: not subject to browser compatibility issues
  - **power**: can write files, open connections to servers, connect to databases, ...

What is JavaScript?

- a lightweight programming language ("scripting language")
- 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

JavaScript vs. 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
  - "first-class" functions are used in many situations
- contained within a web page and integrates with its HTML/CSS content

+

= JavaScript

JavaScript vs. PHP

- similarities:
  - both are **interpreted**, not compiled
  - both are relaxed about syntax, rules, and types
  - both are case-sensitive
  - both have built-in regular expressions for powerful text processing
- differences:
  - JS is more object-oriented: `noun.verb()`, less procedural: `verb(noun)`
  - JS focuses on UIs and interacting with a document; PHP on HTML output and files/forms
  - JS code runs on the client's browser; PHP code runs on the web server

JS <3

Linking to a JavaScript file: `script`

```
<script src="filename" type="text/javascript"></script>
```

```
<script src="example.js" type="text/javascript"></script>
```

- `script` tag should be placed in HTML page's `head`
- script code is stored in a separate `.js` file
- JS code can be placed directly in the HTML file's `body` or `head` (like CSS)
  - but this is bad style (should separate content, presentation, and behavior)

15.2: JavaScript Syntax

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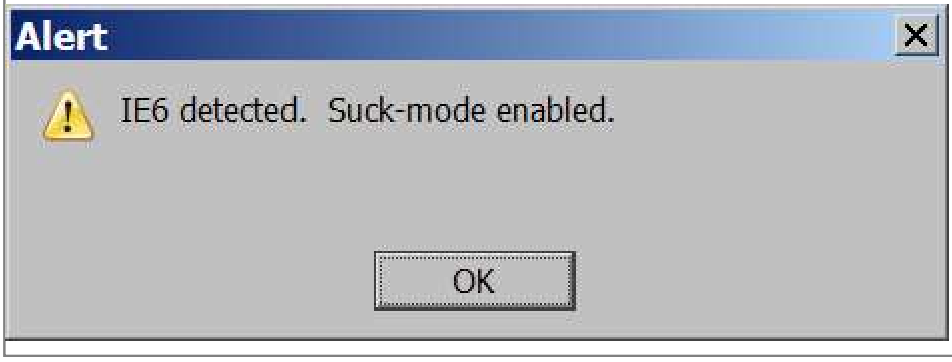
A JavaScript statement: `alert`

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

```
alert("IE6 detected.  Suck-mode enabled.");
```



IE6 detected. Suck-mode enabled.

- a JS command that pops up a dialog box with a message

Variables and types

```
var name = expression;
```

```
var age = 32;
var weight = 127.4;
var clientName = "Connie Client";
```

- variables are declared with the `var` keyword (case sensitive)
- types are not specified, but JS does have types ("loosely typed")
  - `Number`, `Boolean`, `String`, `Array`, `Object`, `Function`, `Null`, `Undefined`
  - can find out a variable's type by calling `typeof`

`Number` type

```
var enrollment = 99;
var medianGrade = 2.8;
var credits = 5 + 4 + (2 * 3);
```

- integers and real numbers are the same type (no `int` vs. `double`)
- same operators: `+ - * / % ++ -- = += -= *= /= %=`
- similar precedence to Java
- many operators auto-convert types: `"2" * 3` is `6`

String type

```
var s = "Connie Client";
var fName = s.substring(0, s.indexOf(" "));    // "Connie"
var len = s.length;                            // 13
var s2 = 'Melvin Merchant';                    // can use "" or ' '
```

- methods: charAt, charCodeAt, fromCharCode, indexOf, lastIndexOf, replace, split, substring, toLowerCase, toUpperCase
    - charAt returns a one-letter String (there is no char type)
- length property (not a method as in Java)
- concatenation with + : 1 + 1 is 2, but "1" + 1 is "11"

More about String

- escape sequences behave as in Java: \' \" \& \n \t \\
- to convert between numbers and Strings:

```
var count = 10;
var s1 = "" + count;                       // "10"
var s2 = count + " bananas, ah ah ah!";    // "10 bananas, ah ah ah!"
var n1 = parseInt("42 is the answer");     // 42
var n2 = parseFloat("booyah");             // NaN
```

- to access characters of a String, use [*index*] or charAt:

```
var firstLetter = s[0];
var firstLetter = s.charAt(0);
var lastLetter = s.charAt(s.length - 1);
```

Comments (same as Java)

```
// single-line comment

/* multi-line comment */
```

- identical to Java's comment syntax
- recall: 4 comment syntaxes
  - HTML: `<!-- comment -->`
  - CSS/JS/PHP: `/* comment */`
  - Java/JS/PHP: `// comment`
  - PHP: `# comment`

for loop (same as Java)

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

```
var sum = 0;
for (var i = 0; i < 100; i++) {
  sum = sum + i;
}
```

```
var s1 = "hello";
var s2 = "";
for (var i = 0; i < s.length; i++) {
  s2 += s1[i] + s1[i];
}
// s2 stores "hheellllloo"
```

Math object

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

- methods: `abs`, `ceil`, `cos`, `floor`, `log`, `max`, `min`, `pow`, `random`, `round`, `sin`, `sqrt`, `tan`
- properties: `E`, `PI`

Logical operators

- Relational: `>` `<` `>=` `<=`
- Logical: `&&` `||` `!`
- Equality: `==` `!=` `===` `!==`
  - most logical operators automatically convert types. These are all `true`:
    - `5 < "7"`
    - `42 == 42.0`
    - `"5.0" == 5`
  - The `===` and `!==` are strict equality tests; checks both type and value:
    - `"5.0" === 5` is `false`

`if/else` statement (same as Java)

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

- identical structure to Java's `if/else` statement
- JavaScript allows almost anything as a *condition*

Boolean type

```
var iLikeJS = true;
var ieIsGood = "IE6" > 0;   // false
if ("web dev is great") {  /* true */ }
if (0) {  /* false */ }
```

- any value can be used as a `Boolean`
  - "falsey" values: `0`, `0.0`, `NaN`, `""`, `null`, and `undefined`
  - "truthy" values: anything else
- converting a value into a `Boolean` explicitly:
  - `var boolValue = Boolean(otherValue);`
  - `var boolValue = !!(otherValue);`

`while` loops (same as Java)

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

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

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

Arrays

```
var name = [];                          // empty array
var name = [value, value, ..., value];  // pre-filled
name[index] = value;                    // store element
```

```
var ducks = ["Huey", "Dewey", "Louie"];

var stooges = [];        // stooges.length is 0
stooges[0] = "Larry";    // stooges.length is 1
stooges[1] = "Moe";      // stooges.length is 2
stooges[4] = "Curly";    // stooges.length is 5
stooges[4] = "Shemp";    // stooges.length is 5
```

- two ways to initialize an array
- `length` property (grows as needed when elements are added)

Array methods

```
var a = ["Stef", "Jason"];    // Stef, Jason
a.push("Brian");              // Stef, Jason, Brian
a.unshift("Kelly");           // Kelly, Stef, Jason, Brian
a.pop();                      // Kelly, Stef, Jason
a.shift();                    // Stef, Jason
a.sort();                     // Jason, Stef
```

- array serves as many data structures: list, queue, stack, ...
- methods: `concat`, `join`, `pop`, `push`, `reverse`, `shift`, `slice`, `sort`, `splice`, `toString`, `unshift`
  - `push` and pop add / remove from back
  - `unshift` and `shift` add / remove from front
  - `shift` and pop return the element that is removed

Splitting strings: `split` and `join`

```
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"
```

- `split` breaks apart a string into an array using a delimiter
  - can also be used with **regular expressions** surrounded by /:

    ```
    var a = s.split(/[ \t]+/);
    ```

- `join` merges an array into a single string, placing a delimiter between them

Defining functions

```
function name() {
  statement ;
  statement ;
  ...
  statement ;
}
```

```
function myFunction() {
  alert("Hello!");
  alert("How are you?");
}
```

- the above could be the contents of `example.js` linked to our HTML page
- statements placed into functions can be evaluated in response to user events

Special values: `null` and `undefined`

```
var ned = null;
var benson = 9;
var caroline;

// at this point in the code,
//   ned is null
//   benson's 9
//   caroline is undefined
```

- `undefined` : has not been declared, does not exist
- `null` : exists, but was specifically assigned an empty or `null` value
- Why does JavaScript have both of these?

Event-Driven Programming with JavaScript

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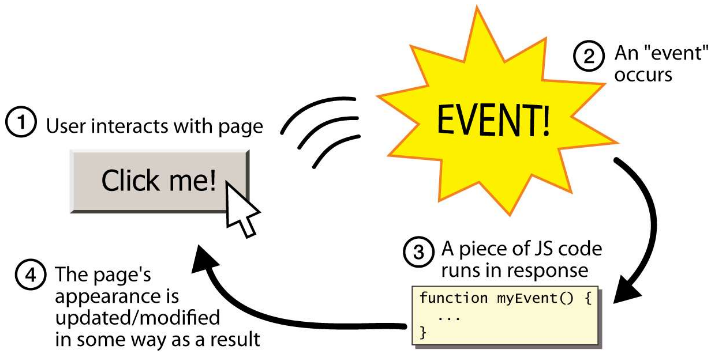
Event-driven programming



1 User interacts with page
Click me!
EVENT!
2 An "event" occurs
3 A piece of JS code runs in response
function myEvent() { ... }
4 The page's appearance is updated/modified in some way as a result

- JS programs have no `main`; they respond to user actions called **events**
- **event-driven programming**: writing programs driven by user events

Event handlers

```
<element attributes onclick="function();">...
```

```
<div onclick="myFunction();">Click me!</div>
```

Click me!

- JavaScript functions can be set as **event handlers**
    - when you interact with the element, the function will execute
- `onclick` is just one of many event HTML attributes we'll use

Buttons: `<button>`

the canonical clickable UI control (inline)

```
<button onclick="myFunction();">Click me!</button>
```

Click me!

- button's text appears inside tag; can also contain images
- To make a responsive button or other UI control:
    1. choose the control (e.g. button) and event (e.g. mouse click) of interest
    2. write a JavaScript function to run when the event occurs
    3. attach the function to the event on the control