

## Chapter 6: Javascript: Introduction to Scripting

CS 80: Internet Programming

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### Welcome to Javascript!

- What is javascript?
  - Client side scripting language
- What is scripting?
  - Generally tied with interpreted languages, meaning the code is translated to machine code right before execution (vs. compiled code)

### Welcome to Javascript!

Why do we care?

- HTML and CSS give us a lot of control over content, structure, and presentation, but we still lack the ability to have dynamic or computational websites
- Javascript offers client-side programming, enabling fun stuff like these:
  - <https://codepen.io/HarrisCarney/pen/dPjKyK>
  - <https://codepen.io/GabbeV/pen/viAec>
  - <https://codepen.io/dissimulate/details/eZxEBO/>
- Clearly some powerful stuff!
- We will start small and with fundamentals; there are many libraries to help you with graphics
- We will concentrate on logic

### Getting Started

- `<script>` HTML element allows us to add Javascript to our HTML document
  - Typically goes in the `<head>` portion of the document
- Example:

```
1 <script type="text/javascript"> script_stuff </script>
```

### Example: hello\_world.html

```
1 <!DOCTYPE html>
2 <!-- Fig. 6.1: welcome.html -->
3 <!-- Displaying a line of text. -->
4 <html>
5
6 <head>
7   <meta charset="utf-8">
8   <title>A First Program in JavaScript</title>
9   <script type="text/javascript">
10     // the document object accesses the current HTML document
11     // writeln is a method that writes a line to the document
12     // the enclosed argument to writeln is the content to write to the
        document
13     document.writeln("<h1>Welcome to JavaScript Programming!</h1>");
14   </script>
15 </head>
16
17 <body>
18   <!-- Notice our empty body -->
19 </body>
20
21 </html>
```

### Example: hello\_world.html

- Finally we see the object model!
- We will see more, but for now:
- `document` is the HTML document, represented through a javascript object
  - We will cover this concept in more detail in Chapter 12 (Document Object Model)
- `.writeln()` is a method within the `document` object
  - It writes content to the HTML document, followed by a new line (that's the `ln`)
  - `"<h1>Welcome to JavaScript Programming!</h1>"` is a **string** and is the content to write to the HTML document

### External Javascript Files

- Example

```
1 <script src="script.js">
```

- Loads the Javascript in `script.js` into this HTML document

## Javascript Basics

### Statements and Keywords

- **Keywords** are words with special meaning to javascript
  - `var` is an example
- A **statement** is a program statement to execute by the javascript interpreter
  - Statements are terminated with a semicolon `;`, as in `hello_world.html`

## Javascript Basics

### Variables

- A **variable** is a container to store data in
  - Think about this like a math variable, but in javascript, variables can store any data
  - Declared with `var myVar;`
    - \* Can declare multiple variables at once with a comma-separated list
      - E.g. `var myVar, myVar1, myVar2;`
  - Assign the variable a value with `myVar = 5;`

### Example: `hello_world_variables.html`

```
1 <!DOCTYPE html>
2 <!-- Fig. 6.1: welcome.html -->
3 <!-- Displaying a line of text. -->
4 <html>
5
6 <head>
7   <meta charset="utf-8">
8   <title>A First Program in JavaScript</title>
9   <script type="text/javascript">
10     // declare a variable to hold our string
11     var text = "<h1>Welcome to JavaScript Programming!</h1>";
12     var myDocVar = document;
13
14     // use the variables to write the content to the document
15     myDocVar.writeln(text);
16   </script>
17 </head>
```

```
18
19 <body>
20   <!-- Notice our empty body -->
21 </body>
22
23 </html>
```

## Javascript Basics

### Variables

- Sidenote: Javascript variables do not have a type; their type is determined by the content they store
  - What does this mean? Well, we've seen `var` be assigned to a string (`hello_world_variables.html`) and to a number (above, `myVar = 5`);.
    - \* So `var` represents any variable, could be a string, could be an int
    - \* This contrasts with many programming languages, like C/C++, Java
    - \* Moreover, a variable is not bound to a particular type. We can reassign it at any time to any type (e.g. `myVar = 5`; `myVar = "cheese"`);

## Javascript Basics

### Variables

- Despite the fact variables can store any types, we still have to have a notion of types (take more CS courses to learn more about this!)
  - **String**: a string of text. E.g. `var myVar = "cheese"`;
    - \* Can use double or single quotes, but must be consistent (whatever you start the string with, you must end the string with)
  - **Number**: a number. E.g. `var myVar = 5`;
  - **Boolean**: True/False value. E.g. `var myVar = true`;

## Javascript Basics

### Variables

- **Array**: multiple of values in one variable. E.g. `var myVar = [5, "cheese", false]`;
  - Elements are accessed using 0-indexing
  - E.g. `myVar[0]` is 5, `myVar[2]` is `false`

- **Object:** everything in javascript is an object, and you can store objects in variables. E.g. `var myVar = document;`

## Javascript Basics

- **Identifiers**
  - Formal name for a variable's name (e.g. `myVar`)
  - Can contain letters, digits, underscores, and dollar signs.
  - Must not begin with a digit and must not be a keyword

## Javascript Basics

- **Comments**
  - Single line: start with `//`
  - Multiline: start with `/*` ends with `*/`

## Javascript Basics

- **Literals** are literal values you provide your script
  - They do not change value
  - Can you spot the literal?
    - \* `var myVar = 5;`
    - \* `var myVar = "cheese";`
  - These are not modifiable, fixed values provided by you, the programmer.

## Javascript Basics

### Basic Operators

- **Basic Operators** define operations on variables or literals. Used to process data. We will talk about more as we go along.

## Javascript Basics

### Basic Operators

- **Addition/Concatenation:** `+`, used to add two numbers together, or merge two strings
  - `6 + 9;` yields 15
  - `"Hello " + "world!"` yields "Hello world!"

## Javascript Basics

### Basic Operators

- **Subtract, multiply, divide:** -, \*, /, used just as they in basic math (you can't divide a string by another string, concatenation is special!)
  - `6 * 5`; yields 30

## Javascript Basics

### Basic Operators

- **Assignment:** =, we've already seen this. It's used to take a value (either an object or a literal) and assign it another object (typically a variable)
  - `var myVar = 6 * 5`; assigns `myVar` to 30

## Javascript Basics

### Basic Operators

- **Remainder:** %, used to perform modulo.
  - Modulo/remainder division finds the remainder of an integer division
  - E.g. `11 % 5` yields 1 because `11 = 5 * 2 + 1`
    - \* We are interested in the 1, since that is the remainder when you divide 11 by 5

## Javascript Basics

### Operator Precedence

- Remember PEMDAS? (Parenthesis, Exponents, Multiplication and Division, and Addition and Subtraction)
  - Defines the mathematical order-of-operations

## Javascript Basics

### Escape Sequences

- Used to give or take away meaning from special characters
- `\n`: a new line (carriage return, like hitting enter)
- `\t`: a tab
- `\\`: a literal backslash (since `\` normally has special meaning - to escape other characters!)
- `\"`: double quote - for nested double quotes

- Need to escape so we don't accidentally end the string!
- `\'`: single quote - for nested single quotes
  - Need to escape so we don't accidentally end the string!

## Javascript Basics

### Examples

- `alert.html`
  - `window` object refers the browser's window
  - `alert` opens a dialog to display the string
  - Take a look at `window` methods and attributes: [http://www.w3schools.com/jsref/obj\\_window.asp](http://www.w3schools.com/jsref/obj_window.asp)

### Example: `alert.html`

```
1 <!DOCTYPE html>
2 <!-- Fig. 6.3: welcome3.html -->
3 <!-- Alert dialog displaying multiple lines. -->
4 <html>
5
6 <head>
7   <meta charset="utf-8">
8   <title>Printing Multiple Lines in a Dialog Box</title>
9   <script type="text/javascript">
10     // Your book does the following <!-- // --> pattern inside the
       script tag all the time
11     // DONT DO THIS! It's for ANCIENT browsers that do not support
       scripts (and interprets them as an HTML comment)
12     // Seriously, I cannot stress how pointless this practice is, and
       you should not be doing it
13     <!--
14     window.alert("Welcome to\nJavaScript\nProgramming!");
15     // -->
16   </script>
17 </head>
18
19 <body>
20   <p>Click Refresh (or Reload) to run this script again.</p>
21 </body>
22
```

```
23 </html>
```

## Javascript Basics

### Examples

- `dynamic_welcome.html`
  - Again using `window` with `prompt()` method to ask for user input
  - Creates a dynamic welcome page
  - We couldn't do with this HTML and CSS

### Example: `dynamic_welcome.html`

```
1 <!DOCTYPE html>
2 <!-- Fig. 6.5: welcome4.html -->
3 <!-- Prompt box used on a welcome screen -->
4 <html>
5
6 <head>
7   <meta charset="utf-8">
8   <title>Using Prompt and Alert Boxes</title>
9   <script type="text/javascript">
10     var name;
11     // string entered by the user
12     // read the name from the prompt box as a string
13     name = window.prompt("Please enter your name");
14     document.writeln("<h1>Hello " + name + ", welcome to JavaScript
15                       programming!</h1>");
16   </script>
17 </head>
18 <body></body>
19
20 </html>
```

## Javascript Basics

### Examples

- `addition.html`
  - `parseInt()` function converts a string to an integer



### Example: addition.html

```

1  <!DOCTYPE html>
2  <!-- Fig. 6.7: addition.html -->
3  <!-- Addition script. -->
4  <html>
5
6  <head>
7    <meta charset="utf-8">
8    <title>An Addition Program</title>
9    <script type="text/javascript">
10     <!--
11     var firstNumber; // first string entered by user
12     var secondNumber; // second string entered by user
13     var number1; // first number to add
14     var number2; // second number to add
15     var sum; // sum of number1 and number2
16     // read in first number from user as a string
17     firstNumber = window.prompt("Enter first integer");
18     // read in second number from user as a string
19     secondNumber = window.prompt("Enter second integer");
20     // convert numbers from strings to integers
21     number1 = parseInt(firstNumber);
22     number2 = parseInt(secondNumber);
23     sum = number1 + number2; // add the numbers
24     // sum = firstNumber + secondNumber; // add the numbers (as strings)
25     // display the results
26     document.writeln("<h1>The sum is " + sum + "</h1>");
27     // -->
28   </script>
29 </head>
30
31 <body></body>
32
33 </html>

```

## Javascript Basics

### Operators and Conditionals

- We need a way to encode logic - a way to direct the program based on the program's state
- Primary method of controlling a programs flow

- Basic idea: "if a condition is true, execute some code"
  - We can stop at the if or say "if a condition is true, execute some code, otherwise, execute this other code"

### Javascript Basics

#### Operators and Conditionals

- Example:

```
1 // basic conditional
2 if(5 <= 10){
3     document.writeln("5 is indeed less than 10");
4 } else {
5     document.writeln("5 is somehow not less than 10...");
6 }
```

### Javascript Basics

#### Operators and Conditionals

- But we can do even more by nesting if's!
  - Also allows us to check for multiple potential conditions at once (e.g. `if(cond) ...else if(cond) ...else...`)

### Javascript Basics

#### Operators and Conditionals

- Example: where `time` is the hour of the day (0-23)

```
1 // order of the conditionals matters; what happens if we flip them
  ?
2 if (time < 10) {
3     greeting = "Good morning";
4 } else if (time < 20) {
5     greeting = "Good day";
6 } else {
7     greeting = "Good evening";
8 }
```

## Javascript Basics

### Equality and Relational Operators

Standard algebraic equality operator or relational operator	JavaScript equality or relational operator	Sample JavaScript condition	Meaning of JavaScript condition
<i>Equality operators</i>			
=	==	x == y	x is equal to y
≠	!=	x != y	x is not equal to y
<i>Relational operators</i>			
>	>	x > y	x is greater than y
<	<	x < y	x is less than y
≥	>=	x >= y	x is greater than or equal to y
≤	<=	x <= y	x is less than or equal to y

**Figure 1:** Javascript relational operators

## Javascript Basics

### Operators and Conditionals

- Difference between === and ==
  - === is a more strict comparison operator
  - E.g. "75" == 75 yields true but "75" === 75 yields false

## Javascript Basics

### Operators and Conditionals

- Compound conditionals:
  - Use logical operations **AND**, **OR**, and **NOT**
  - **AND** is represented with &&
  - **OR** is represented with | |
  - **NOT** is represented with !
  - Combining conditions allows us to use much more powerful program flow

## Javascript Basics

### Operators and Conditionals

- Compound conditionals will evaluate left to right
  - If the program can determine the overall value of the compound conditional, it will stop evaluating the rest of the conditional
  - E.g. Suppose `cond_a` is **true** and `cond_b` is **false**.
    - \* `if(cond_a || cond_b)` doesn't need to look at the value of `cond_b`, the overall condition is determined by `cond_a`.
    - \* Similarly, `if(cond_b && cond_a)` doesn't need to look at the value of `cond_a`, since `cond_b` already determined the overall state of the compound conditional.
    - \* Remember: left to right!
  - **Key takeaway** order matters!

## Javascript Basics

### Operators and Conditionals

- Example: (pay close attention to evaluation order)

```
1 // be careful analyzing this conditional
2 if(cond_a && cond_b){
3   // only executes if cond_a AND cond_b are true
4 } else if(cond_a || cond_d){
5   // only executes if 1) (cond_a is true AND cond_b is false (
      think about why)) OR cond_d is true
6 } else if(!cond_d){
7   // only executes if cond_a is false AND cond_d is false
8 } else {
9   // will this ever execute?
10  // otherwise
11 }
```

## Exercise

- Display the current day and time in the following format:

```
1 Today is: Friday
2 Current time is: 4:50:22PM
```

- **First step:** look at the `Date()` javascript function

- [http://www.w3schools.com/jsref/jsref\\_obj\\_date.asp](http://www.w3schools.com/jsref/jsref_obj_date.asp)

### Example: date\_print.html

```
1 <!DOCTYPE html>
2 <html>
3
4 <head>
5   <meta charset="utf-8">
6   <title>Display Date</title>
7   <script type="text/javascript">
8     var today = new Date();
9     var day = today.getDay();
10    var daylist = ["Sunday", "Monday", "Tuesday", "Wednesday ", "
        Thursday", "Friday", "Saturday"];
11
12    document.writeln("Today is: " + daylist[day] + "<br>");
13
14    var hour = today.getHours();
15    var minute = today.getMinutes();
16    var second = today.getSeconds();
17    console.log("hour: " + hour);
18    var postpand = "";
19    if (hour >= 12) {
20      postpand = "PM";
21    } else {
22      postpand = "AM";
23    }
24    // special case for midnight
25    if (hour == 0){
26      hour == 12;
27    }
28    // convert military time to AM/PM hours
29    if (hour > 12) {
30      hour = hour - 12;
31    }
32    if (minute < 10) {
33      minute = "0" + minute;
34    }
35    if (second < 10) {
36      second = "0" + second;
37    }
```

```
38     document.writeln("Current time is: " + hour + ":" + minute + ":" +  
        second + postpand);  
39     </script>  
40 </head>  
41  
42 <body>  
43 </body>  
44  
45 </html>
```

## Exercise

- Write a program that determines if the inputted year is a leap year:
  - Every year that is divisible by 4, except for years divisible by 100, except for years that are divisible by 400
- **First step:** come up with an algorithm to check

## Example: leap\_year\_checker.html

```
1 <!DOCTYPE html>  
2 <html>  
3  
4 <head>  
5     <meta charset="utf-8">  
6     <title>Leap Year Checker</title>  
7     <script type="text/javascript">  
8         var year, leapYear = false,  
9             leapYearText = "";  
10        year = parseInt(window.prompt("Input a year: "));  
11        if (year % 100 === 0) {  
12            if (year % 400 === 0) {  
13                leapYear = true;  
14            }  
15        } else if (year % 4 === 0) {  
16            leapYear = true;  
17        }  
18        if (!leapYear) {  
19            leapYearText = " not";  
20        }  
21        document.writeln("<h2>" + year + " is" + leapYearText + " a leap  
        year</h2>");
```

```
22     </script>
23 </head>
24
25 <body>
26 </body>
27
28 </html>
```

### Developer Tools

- See the 'Dev Tools slides' for an introduction on debugging your programs

### Javascript Functions

- Functions enable reusable code
- Sum example:

```
1 // function declaration
2 function sum1(a, b){
3     // do other amazing javascript things here
4     return a + b;
5 }
```

- We can then call `sum(10, 5)` which would return 15

### Javascript Functions

- Assigning functions to variables
- Sum example:

```
1 // anonymous function assigned to variable
2 var sum2 = function(a,b){
3     return a + b;
4 }
```

- We can then call `sum2(10, 5)` which would return 15

### Javascript Functions

#### Hoisting

- The only thing you need to remember is that functions of the form of `sum1` are "hoisted" to the top of your program, meaning they can be used *before* they are declared