Comp 388/424 - Client-side Web Design

Fall Semester 2015 - Week 4

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Contents

Intro

- JavaScript (JS) a core technology for client-side design and development
- now being used as a powerful technology to help us
  - *rapidly prototype and develop web, mobile, and desktop apps*
- libraries such as JQuery, React, AngularJS, and Node.js
- helps develop cross-platform apps
  - *Apache Cordova*
  - *Electron*

JS Basics - operators

- operators allow us to perform
  - *mathematical calculations*
  - *assign one thing to another*
  - *compare and contrast...*
- simple * operator, we can perform multiplication

```
2 * 4
```

- we can add, subtract, and divide numbers as required
- mix mathematical with simple assignment

```
a = 4;
b = a + 2;
```

JS Basics - some common operators - part 1

Assignment

- = eg: `a = 4`

Comparison

- <, > <=, >=
- eg: `a <= b`

Compound assignment

- +=, -=, *=, /=
- compound operators combine a mathematical operation with assignment
- eg: `a += 4`

Equality

operator	description
==	loose equals
===	strict equals
!=	loose not equals
!==	strict not equals

- eg: `a != b`

JS Basics - some common operators - part 2

Increment/Decrement

- increment or decrement an existing value by 1
  - *`++`, `--`, ``*
  - *eg: `a++` is equal to `a = a + 1`*

Logical

- used to express compound conditionals - **and**, **or**
  - *`&&`, `||`*
  - *eg: `a || b`*

Mathematical

- +, –, *, /
  - *eg: `a * 4` or `a / 4`*

Object property access

- properties in objects are specific named locations for holding values and data
- effectively, values within values
  - *`.`*
  - *eg: `a.b` means object a with a property of b*

JS Basics - values and types

- able to express different representations of values
  - *often based upon need or intention*
  - *known as **types***
- JS has built-in types
  - *allow us to represent **primitive** values*
  - *eg: **numbers**, **strings**, **booleans***
- such values in the source code are simply known as **literals**
- **literals** can be represented as follows,
  - *string literals use double or single quotes eg: `"some text"` or `'some more text'`*
  - *numbers and booleans are represented without being escaped eg: `49`, `true;`*
- also consider arrays, objects, functions

JS Basics - type conversion

- option and ability to convert types in JS
  - *in effect,* ***coerce*** *our values and types from one type to another*
- convert a number, or coerce it, to a string
- built-in JS function, `Number()`, is an explicit coercion
  - *explicit coercion, convert any type to a number type*
- implicit coercion, JS will often perform as part of a comparison

```
"49" == 49
```

- JS implicitly coerces left string to a matching number
  - *then performs the comparison*
- often considered bad practice
  - *convert first, and then compare*
- implicit coercion still follows rules
  - *can be very useful*

JS Basics - variables - part 1

- **symbolic** container for values and data
- applications use containers to keep track and update values
- use a **variable** as a container for such values and data
  - *allow such values to vary over time*
- JS emphasises types for values, does not enforce on the variable
  - ***weak typing*** *or* ***dynamic typing***
  - *JS permits a variable to hold a value of any type*
- often a benefit of the language
- a quick way to maintain flexibility in design and development

JS Basics - variables - part 2

- declare a variable using the keyword `var`
- declaration does not include **type** information

```
var a = 49;
//double var a value
var a = a * 2;
//coerce var a to a string
var a = String(a);
//output string value to console
console.log(a);
```

- `var a` maintains a running total of the value of `a`
- keeps record of changes, effectively **state** of the value
- **state** is keeping track of changes to any values in the application

JS Basics - variables - part 3

- use variables in JS to enable central, common references to our values and data
- Better known in most languages simply as **constants**
- allow us to define and declare a variable with a value
  - *not intended to change throughout the application*
- **constants** are often declared together
- form a store for values abstracted for use throughout an app
- JS normally defines constants using uppercase letters,

```
var NAME = "Philae";
```

- ECMAScript 6, ES6 uses the keyword `const` instead of `var`

```
const TEMPLE_NAME = "Philae";
```

- benefits of abstraction, ensuring value is not accidentally changed

JS Basics - comments

- JS permits comments in the code
- two different implementations

single line

```
//single line comment
var a = 49;
```

multi-line

```
/* this comment has more to say
hence the need for many lines... */
var b = "forty nine";
```

JS Basics - logic - blocks

- simple act of grouping contiguous and related code statements together
  - *known as **blocks***
- block defined by wrapping statements together
  - *within a pair of curly braces, { }*
- **blocks** commonly attached to other forms of control statement

```
if (a > b) {
...do something useful...
}
```

JS Basics - logic - conditionals - part I

- conditionals, conditional statements require a decision to be made
- code statement, application, consults state
  - *answer will predominantly be a simple **yes** or **no***
- JS includes many different ways we can express **conditionals**
- most common example is the `if` statement
  - *if this given condition is true, do the following...*

```
if (a > b) {
console.log("a is greater than b...");
}
```

- `if` statement requires an expression between the parentheses
  - *evaluates as either true or false*

JS Basics - logic - conditionals - part 2

- additional option if this expression returns false
  - *using an **else** clause*

```
if (a > b) {
console.log("a is greater than b...");
} else {
console.log("no, b is greater...");
}
```

- for an `if` statement, JS expects a `boolean`
- JS defines a list of values that it considers *false*
- any value not on this list of *false* values will be considered true
  - *coerced to true when defined as a `boolean`*
- conditionals in JS also exist another form
  - *the `switch` statement*
  - *more to come...*

JS Basics - logic - loops

- loops allow repetition of sets of actions until a condition fails
- repetition continues whilst the requested condition holds
- loops take many different forms and follow this basic behaviour
- loop includes the *test condition* as well as a *block*
  - *normally within curly braces*
  - *block executes, an iteration of the loop has occurred*
- good example of this behaviour are `while` and `do...while` loops
- basic difference between these loops, `while` and `do...while`
  - *conditional tested is before the first iteration (`while` loop)*
  - *after the first iteration (`do...while`) loop*
- if the condition is initially false
  - *a `while` loop will never run*
  - *a `do...while` will run through for the first time*
- also stop a JS loop using the common `break` statement
- `for` loop has three clauses, including
  - *initialisation clause*
  - *conditonal test clause*
  - *update clause*

JS Basics - logic - functions - part I

- define once, then re-use as needed throughout our application
- **function** is a named grouping of code
  - *name can be called, and code will be run each time*
- JS functions can be designed with optional arguments
  - *known as **parameters***
  - *allow us to pass values to the function*
- functions can also optionally return a value

```
function outputTotal(total) {
  console.log(total);
}
var a = 49;
a = a * 3;

outputTotal(a);
```

JS Basics - logic - functions - part 2

We can obviously update this example to better abstract the code by adding an additional function,

```
function outputTotal(total) {
  console.log(total);
}

function calculateTotal(amount, times) {
  amount = amount * times;
  return amount;
}

var a = 49;
a = calculateTotal(a, 3);
outputTotal(a);
```

- JSFiddle - Functions 1

JS Basics - logic - scope

- scope or **lexical scope**
  - *collection of variables, and associated access rules by name*
- in JS each function gets its own scope
- variables within a function's given **scope**
  - *can only be accessed by code inside that function*
- variable name has to be unique within a function's scope
- same variable name could appear in different scopes
- nest one scope within another
  - *code in inner scope can access variables from either inner or outer scope*
  - *code in outer scope cannot, by default, access code in the inner scope*

JS Basics - logic - scope example

```
function outerScope() {
  var a = 49;
  //scope includes outer and inner
  function innerScope() {
    var b = 59;
    //output a and b
    console.log(a + b); //returns 108
  }
  innerScope();

  //scope limited to outer
  console.log(a); //returns 49
}

//run outerScope function
outerScope();
```

- JSFiddle - Scope 1

JS Basics - strict

- introduction of ES5, JS includes the option to add a **strict mode**
- ensure tighter code and better compliance with certain language behaviour and rules
- this option is often considered worthwhile to ensure greater compatibility
- also help optimise code for better use with rendering engines
- add it at different levels within our code
  - *limit **strict mode** to a function level*
  - *or enforce it for a whole file*
  - *set the required **strict mode** pragma to the required level*

```
function outerScope() {
  "use strict";
  //code is strict

    function innerScope() {
    //code is strict

  }
}
```

- set the **strict mode** pragma for the whole file
  - *placed at the top of our file*
  - *all functions and code will be checked against this strict mode*

JS Core - values and types

- JS has typed values, not typed variables
- JS provides the following built-in types
  - *boolean*
  - *null and undefined*
  - *number*
  - *object*
  - *string*
  - *symbol*
- more help provided by JS's `typeof` operator
  - *examine a value and return its type*

```
var a = 49;
console.log(typeof a); //result is a number
```

- as of ES6, there are 7 possible return types JS
- **NB:** JS variables do not have types, mere containers for values
  - *values specify the type*

```
var a = null;
console.log(typeof a); //result is object
```

JS Core - objects - part 1

Objects

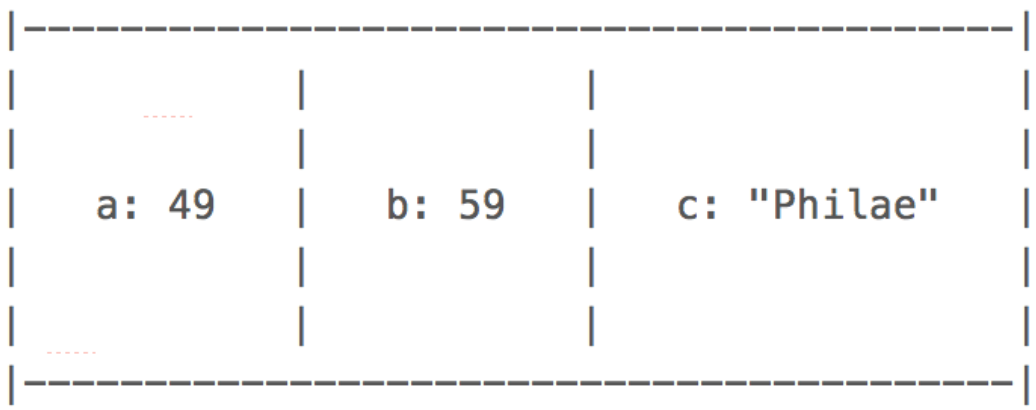
- **object** type includes a compound value
  - *JS can use to set properties, or named locations*
- each of these properties holds its own value
  - *can be defined as any type*

```
var objectA = {
  a: 49,
  b: 59,
  c: "Philae"
};
```

- access these values using either **dot** or **bracket** notation,

```
//dot notation
objectA.a;
//bracket notation
objectA["a"];
```

Image - JS Object



JS Object

JS Core - objects - part 2

Arrays

- JS array an object that contains values, of any type, in numerically indexed positions
  - *store a number, a string...*
  - *array will start at index position 0*
  - *increments by **1** for each new value*
- arrays can also have properties
  - *eg: automatically updated **length** property*

```
var arrayA = [
  49,
  59,
  "Philae"
];
arrayA.length; //returns 3
```

- each value can be retrieved from its applicable index position,

```
arrayA[2]; //returns the string "Philae"
```

Image - JS Array

JS Array

JS Core - checking equality - part 1

- JS has four equality operators, including two **not equal**
  - *==, ===, !=, !==*
- == - checks for value equality, whilst allowing coercion
- === - checks for value equality but without coercion

```
var a = 49;
var b = "49";

console.log(a == b); //returns true
console.log(a === b); //returns false
```

- first comparison checks values
  - *if necessary trys to coerce one or both values until a match occurs*
  - *allows JS to perform a simple equality check*
  - *results in* `true`
- second check is simpler
  - *coercion is not permitted, and a simple equality check is performed*
  - *results in* `false`

JS Core - checking equality - part 2

- which comparison operator should we use
- useful suggestions for usage of comparison operators
  - *use === if either side of the comparison could be true or false*
  - *use === if either value could be one of the following specific values,*
  - *0, " ", [ ]*
  - *otherwise, it's safe to use ==*
  - *simplify code in a JS application due to the implicit coercion.*
- **not equal** counterparts, `!` and `!==` work in a similar manner
- equality operators with non-primitive values, such as objects
  - *comparison will simply check if underlying references match, not the values*

```
var a = [49,59,69];
var b = [49,59,69];
var c = "49,59,69";

console.log(a == c); //returns true
console.log(b == c); //returns true
console.log(a == b); //returns false
```

JS Core - checking inequality - part 1

- known as **relational comparison**, we can use the inequality operators,
  - *<, >, <=, >=*
- inequality operators often used to check comparable values like numbers
  - *inherent ordinal check*
- can be used to compare strings

```
"hello" < "world"
```

- coercion also occurs with inequality operators
  - *no concept of **strict inequality***

```
var a = 49;
var b = "59";
var c = "69";

a < b; //returns true
b < c; //returns true
```

JS Core - checking inequality - part 2

- we can encounter an issue when either value cannot be coerced into a number

```
var a = 49;
var b = "nice";

a < b; //returns false
a > b; //returns false
a == b; //returns false
```

- issue for < and > is string is being coerced into invalid number value, `NaN`
- == coerces string to `NaN` and we get comparison between `49 == NaN`

JS Core - more variables - part I

- a few rules and best practices for naming valid **identifiers**
- using typical ASCII alphanumeric characters
  - *an identifier must begin with* `a-z, A-Z, $, _`
  - *may contain any of those characters, plus* `0-9`
- property names follow this same basic pattern
- careful not to use certain keywords, or reserved words
- reserved words can include such examples as,
  - `break, byte, delete, do, else, if, for, this, while` *and so on*
  - *further details are available at the W3 Schools site*
- in JS, we can use different declaration keywords relative to intended scope
  - `var` *for local,* `global` *for global...*
- such declarations will influence scope of usage for a given variable
- concept of **hoisting**
  - *defines the declaration of a variable as belonging to the entire scope*
  - *by association accessible throughout that scope as well*
  - *also works with JS functions - hoisted to the top of the scope*

JS Core - more variables - part 2

- concept of nesting, and scope specific variables
- ES6 enables us to restrict variables to a block of code
- use keyword **let** to declare a block-level variable

```
if (a > 5){
let b = a + 4;

console.log(b);

}
```

- **let** restricts variable's scope to `if` statement
- variable `b` is not available to the whole function

JS Core - more variables - part 3

- add **strict mode** to our code
- without we get a variable that will be hoisted to the top either
  - *set as a globally available variable, although it could be deleted*
  - *or it will set a value for a variable with the matching name*
- bubbled up through the available layers of scope
- becomes similar in essence to a declared global variable
- can create some strange behaviour in our applications
  - *tricky and difficult to debug*
- remember to declare your variables correctly and at the top

JS Core - more variables - example

```
var a;

function myScope() {
    "use strict";
    a = 49;
}

myScope()
a = 59;
console.log(a);
```

- JSFiddle - Variables 1
- JSFiddle - Variables 2

JS Core - variable declarations - example I

```
"use strict";
//global
var a = 49;

function myScope() {
  //local
  var b = 59;

    if (a > b) {
    //block
     let c = "a won";
     return c;
    } else {
    //block
     let c = "b won";
     return c;
    }
}

console.log(myScope());
```

- JSFiddle - Variables 3

JS Core - variable declarations - example 2

```
"use strict";
//global
var a = 69;

function myScope() {
  //local
  var b = 59;
  var c;

    if (a > b) {
     c = "a won";
    } else {
     c = "b won";
    }
  return c;
}

console.log(myScope());
```

- JSFiddle - Variables 4
- abstract and refine further with parameters, ternary operator...

JS Core - functions and values

- variables acting as groups of code and blocks
- act as one of the primary mechanisms for scope within our JS applications
- also use functions as values
- effectively using them to set values for other variables

```
var a;

function scope() {
  "use strict";
    a = 49;
  return a;
}

b = scope() * 2;
console.log(b);
```

- JSFiddle - Functions 2
- useful and interesting aspect of the JS language
  - *allows us to build values from multiple layers and sources*

JS Core - more conditionals - part I

- briefly considered conditional statements using the `if` statement,

```
if (a > b) {
console.log("a is the best...");
} else {
console.log("b is the best...");
}
```

- Switch statements effectively follow the same pattern as `if` statements
  - *designed to allow us to check for multiple values in a more succinct manner*
  - *enable us to check and evaluate a given expression*
  - *then attempt to match a required value against an available `case`*
- addition of `break` is important, ensures only matched case is executed
  - *then the application breaks from the switch statement*
- if no `break` execution after that case will continue
  - *commonly known as **fall through***
  - *may be an intentional feature of your code design*
  - *allows a match against multiple possible cases*

JS Core - Switch - example

```
var a = 4;

switch (a) {
case 3:
  //par 3
  console.log("par 3");
  break;
case 4:
  //par 4
  console.log("par 4");
  break;
case 5:
  //par 5
  console.log("par 5");
  break;
case 59:
  //dream score
  console.log("record");
  break;
default:
  console.log("more practice");
}
```

- JSFiddle - Switch

JS Core - more conditionals - part 2

- a more concise way to write our conditional statements
- known as the **ternary** or **conditional** operator
- consider this operator a more concise form of standard `if...else` statement

```
var a = 59;
var b = (a > 59) ? "high" : "low";
```

- equivalent to the following standard `if...else` statement

```
var a = 59;

if (a > 59) {
  b = "high";
} else {
  b = "low";
}
```

JS Core - closures - part 1

- important and useful aspect of JavaScript
- dealing with variables and scope
  - *continued, broader access to ongoing variables via a function's scope*
- closures as a useful construct to allow us to access a function's scope
  - *even after it has finished executing*
- can give us something similar to a private variable
  - *then access through another variable using relative scopes of outer and inner*
- inherent benefit is that we are able to repeatedly access internal variables
  - *normally cease to exist once a function had executed*

```
"use strict";

function addTitle(a) {
  var title = "hello ";
  function updateTitle() {
    var newTitle = title+a;
    return newTitle;
  }
    return updateTitle;
}

var buildTitle = addTitle("world");
console.log(buildTitle());
```

- JSFiddle - Closures 1

JS Core - closures - part 2

```
function count(a) {
return function(b) {
      return a + b;
  }
}

var add1 = count(1);
var add5 = count(5);
var add10 = count(10);

console.log(add1(8));
console.log(add5(8));
console.log(add10(8));
```

- using one function to create multiple other functions, `add1`, `add5`, `add10`, and so on.
- JSFiddle - Closures 2

Demos

- JSFiddle - Closures 1
- JSFiddle - Closures 2
- JSFiddle - Functions 1
- JSFiddle - Functions 2
- JSFiddle - Scope 1
- JSFiddle - Switch
- JSFiddle - Variables 1
- JSFiddle - Variables 2
- JSFiddle - Variables 3
- JSFiddle - Variables 4

References

- AngularJS
- Apache Cordova
- Electron
- JQuery
- MDN - JS
  - *MDN - JS Grammar and Types*
  - *MDN - JS Objects*
- Node.js
- React