Comp 424 - Client-side Web Design

Fall Semester 2016 - Week 5

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Contents

CSS - a return to inline styles

- *inline* styles are once more gaining in popularity
  - *helped by the rise of React &c.*
- for certain web applications they are now an option
  - *allow us to dynamically maintain and update our styles*
- their implementation is not the same as simply embedding styles in HTML
  - *dynamically generated*
  - *can be removed and updated*
  - *can form part of our maintenance of the underlying DOM*
- inherent benefits include
  - *no cascade*
  - *built using JavaScript*
  - *styles are dynamic*

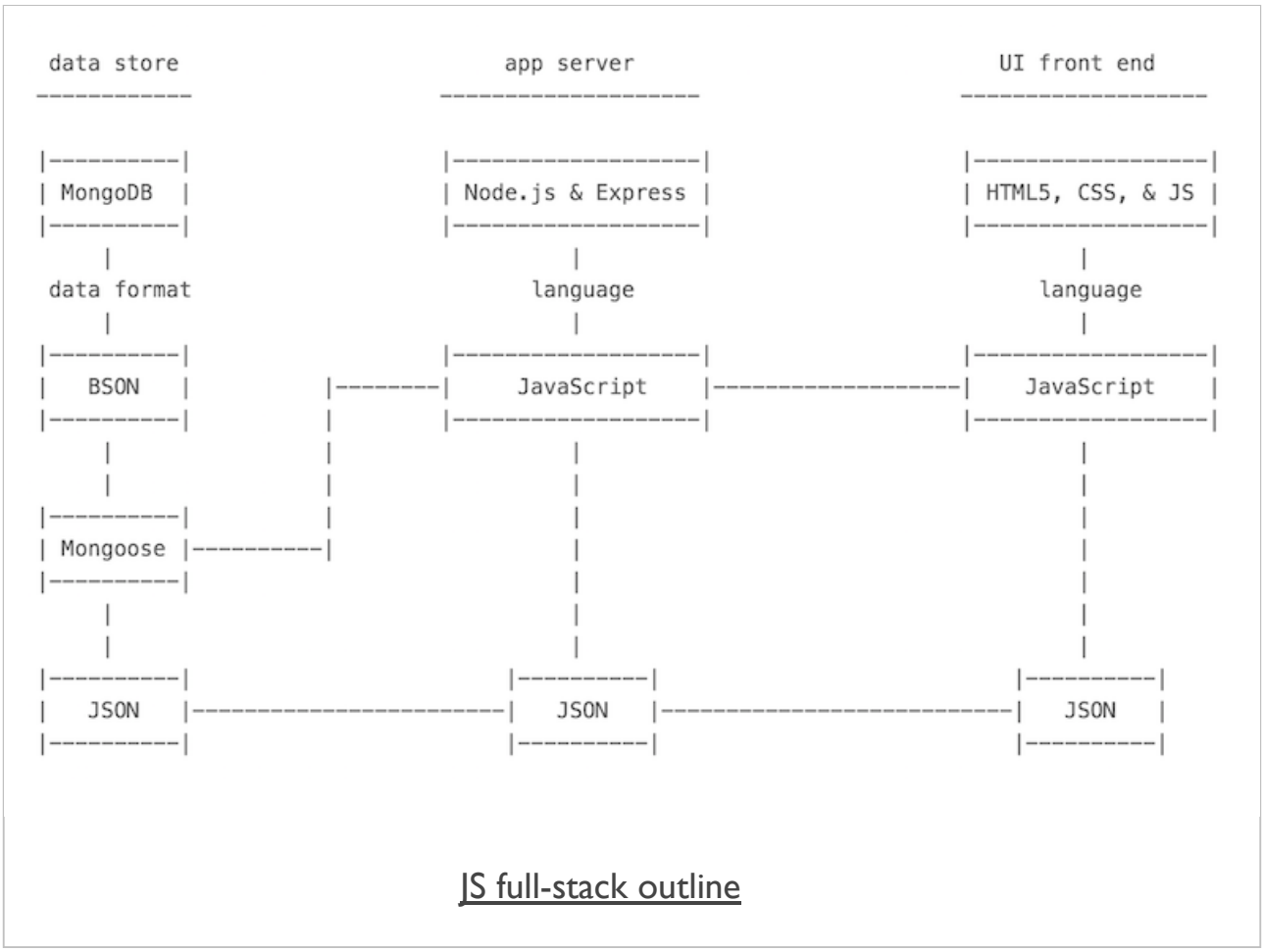
CSS - against inline styles

- CSS is designed for styling
  - *this is the extreme end of the scale - in effect, styling is only done with CSS*
- abstraction is a key part of CSS
  - *by separating out concerns, i.e. CSS for styling, our sites are easier to maintain*
- *inline* styles are too specific
  - *again, abstraction is the key here*
- some styling and states are easier to represent using CSS
  - *psuedoclasses etc, media queries...*
- CSS can add, remove, modify classes
  - *dynamically update selectors using classes*

building a web app - sample outline of underlying structure

- apps developed using a full JavaScript stack
- using and incorporating JS into each part of app's development
  - *UI front-end*
  - *app server and management*
  - *data store and management*
- Technologies will include
  - *front-end: HTML5, CSS, JS...*
  - *app server: Node.js, Express...*
  - *data store: MongoDB, Redis, Mongoose...*
- Data format is JSON

Image - building a web app - sample outline



JS full-stack outline

n.b. *I've explicitly omitted any arrows for flow within this diagram. This is something we'll return to as we start to work with Node.js, Mongoose, and MongoDB.*

JS 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*
- Embedded systems
  - *Espruino - http://www.espruino.com/*
  - *Tessel - https://tessel.io/*

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 I

Assignment

- `=`
- e.g. `a = 4`

Comparison

- <, > <=, >=
- e.g. `a <= b`

Compound assignment

- `+=, -=, *=, /=`
- compound operators combine a mathematical operation with assignment
- same as `result = result + expression`
- e.g. `a += 4`

Equality

- == is **loose equals**
- === is **strict equals**
- != is **loose not equals**
- !== is **strict not equals**
  - e.g.

```
a != b
```

JS Basics - some common operators - part 2

Increment/Decrement

- increment or decrement an existing value by 1
  - `++`, `--`
  - *e.g.* `a++` *is equal to* `a = a + 1`

Logical

- used to express compound conditionals - **and**, **or**
  - `&&`, `||`
  - *e.g.* `a || b`

Mathematical

- +, –, *, /
  - *e.g.* `a * 4` *or* `a / 4`

Object property access

- properties in objects are specific named locations for holding values and data
- effectively, values within values
  - `.`
  - *e.g.* `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*
  - *e.g.* ***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 e.g.* `"some text"` *or* `'some more text'`
  - *numbers and booleans are represented without being escaped e.g.* `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 I

- **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 values to vary over time*
- JS can emphasize 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 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
  - *change rejected for a running app*
  - *in `strict` mode, app will fail with an error for any change*

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...
we'll need a second line */
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*
  - *e.g. 0...*
- 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 in 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
- a loop includes the *test condition* as well as a *block*
  - *normally within curly braces*
  - *block executes, an iteration of the loop has occurred*
- good examples of this behaviour include `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*
  - *conditional test clause*
  - *update clause*

JS Basics - logic - functions - part I

- functions are a type of object
  - *may also have their own properties*
  - *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; // or use a *= 3;

outputTotal(a);
```

JS Basics - logic - functions - part 2

```
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 Demo

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 Demo

JS Basics - strict mode

- intro of ES5 - JS now includes option for **strict** mode
  - *ensures tighter code and better compliance...*
  - *often helps ensure greater compatibility, safer use of language...*
  - *can also help optimise code for rendering engines*
- add **strict** at different levels within our JS code
  - *e.g. single function level or enforce for whole file*

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

  function innerScope() {
  //code is strict

  }
}
```

- if we set **strict** mode for complete file - set at top of file
  - *all functions and code will be checked against **strict** mode*
  - *e.g. check against auto-create for global variables*
  - *or missing `var` keyword for variables...*

```
function outerScope() {
  "use strict";
  a = 49; // `var` missing - ReferenceError
}
```

JS Core - values and types

- JS has typed values, not typed variables
- JS provides the following built-in types
  - *boolean*
  - *null*
  - *number*
  - *object*
  - *string*
  - *symbol (new in ES6)*
  - *undefined*
- 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 in 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 - known bug in JS...
```

JS Core - objects - part I

Objects

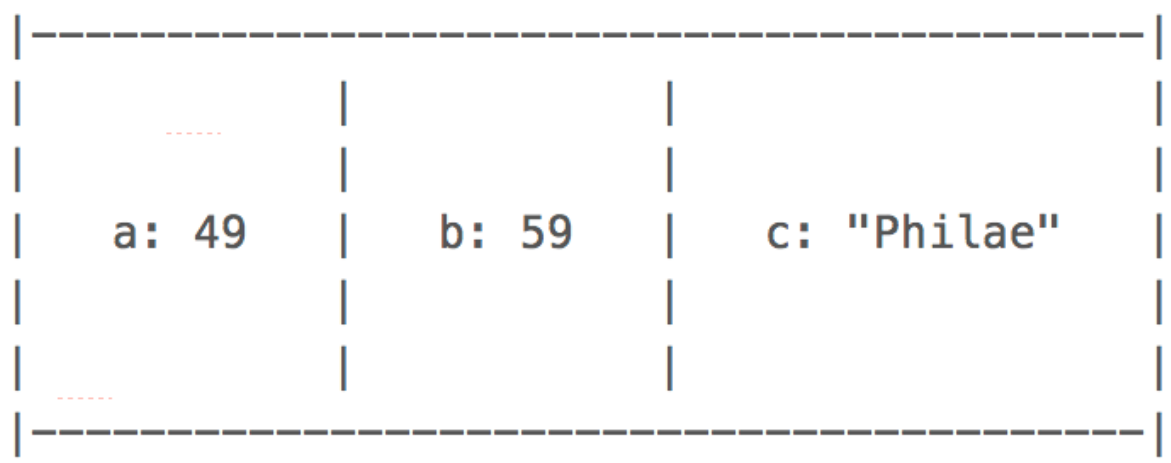
- **object** type includes a compound value
  - *JS can use to set properties, or named locations*
- each of these properties holds its own value
  - *can be defined as any type*

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

- access these values using either **dot** or **bracket** notation
  - ***dot** notation more common in JS...*

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

Image - JS Object



JS Object

JS Core - objects - part 2

Arrays

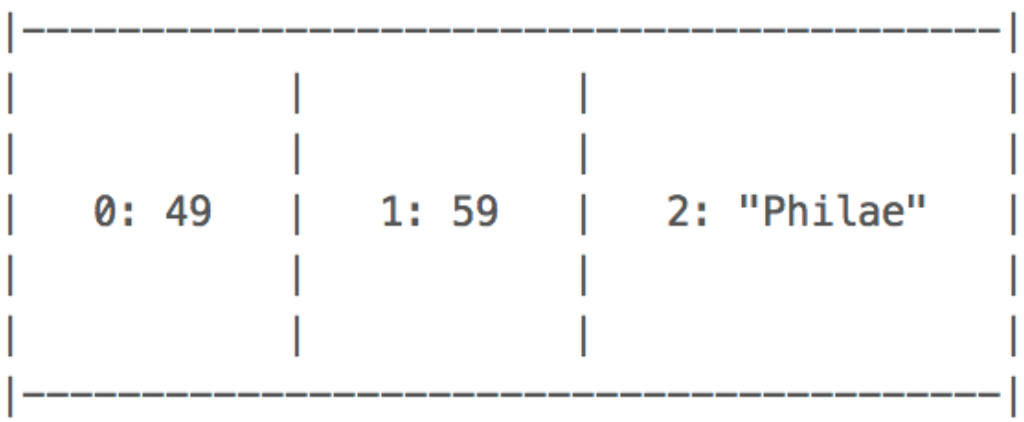
- JS array an object that contains values, of any type, in numerically indexed positions
  - *store a number, a string...*
  - *array will start at index position 0*
  - *increments by **1** for each new value*
- arrays can also have properties
  - *e.g. automatically updated **length** property*

```
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 I

- 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, try 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

JS Core - checking inequality - part I

- 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 tests - part 1

- JSFiddle - Functions 1
- JSFiddle - Scope 1

References - JS & Libraries

- AngularJS
- Apache Cordova
- Electron
- jQuery
- MDN
  - *MDN - JS*
  - *MDN - JS Data Types and Data Structures*
  - *MDN - JS Grammar and Types*
  - *MDN - JS Objects*
- Node.js
- React
- W3 - JS Object
- W3 - JS Performance