Javascript

Many examples from Kyle Simpson: Scope and Closures

What is JavaScript?

- Not related to Java (except that syntax is C/Java- like)
- Created by Brendan Eich at Netscape later standardized through ECMA
- ECMAScript3 in 1999 is the baseline for modern day JS
- Microsoft showed no intention of implementing proper JS in IE stalled progress on ES4
- 2005 work restarted on ECMAScript 4 amid continued controversy

What is JavaScript?

- 2005 Jesse James Garrett's white paper coined the term Ajax
  - web apps could load data in the background
  - led to the development of JQuery, Prototype, Dojo
- ES6 came out in 2015
- See http://kangax.github.io/compat-table/es6/ for browser compatibility

JavaScript Engines

- An engine is the program that interprets and executes JavaScript code
- V8 - Google's open source engine used in Chrome and Node
- Spidermonkey - Mozilla
- JavaScriptCore (Nitro, Squirrelfish) - Safari, Webkit
- Chakra - MS Edge

Transpilers

- Transpiler = source-to-source compiler
- Babel - ES6 (ES2015 to ES5)
  - allows you to write ES6 JS without worrying about browser compatibility problems.
- CoffeeScript
- TypeScript
- ClojureScript

Language highlights

- Many things are as you would expect from your experience with Python, C and Java
- We will focus on features that are not quite what you might expect
- Always “use strict”;

Scoping Rules

```
a = 3;  // global scope
var b = 3; // global scope
function foo() {
    c = 10 // global
    var d = 5; // function scope (lexical)
    function nested() {
        d = 6;  // function (foo) scope
    }
    console.log(d);
}
```

```
“use strict”;
var a = 3;  // global scope
var b = 3; // global scopes
function foo() {
    var c = 10 // function scope
    var d = 5; // function scope
    function nested() {
        var d = 6;  // function scope
    }
    console.log(d);
}
```

ES6

```
“use strict”;
var a = 3;  // global scope
var b = 3; // global scope
function foo() {
    let c = 10 // block
    let d = 5; // block scope
    function nested() {
        let d = 6;  // block scope
    }
    console.log(d);
}
```

let gives you block scope rather than function scope

Hoisting

```
foo(); // 1

var foo;

function foo() {
    console.log( 1 );
}

// But why would you do this?
// Strange behaviour
```

Hoisting tip

- Declare variables at the top of your function.
- Easier to read
- Avoids strange behaviour attributable to hoisting

Functions are first-class objects

```
var sq = function(x) {
    return x * x;
}

function cube(x) {
   return x * x * x;
}
```

Anonymous functions

```
var sq = function(x) {
        return x * x;
    };

// If you can give a brief descriptive
// name you should for readability
```

IIFE
Immediately Invoked Function Expressions

```
var a = 2;

function foo() {
    var a = 3;
    console.log(a);
}
foo();
console.log(a);
```

```
var a = 2;

(function foo() {
    var a = 3;
    console.log(a);
})();

console.log(a);
```

Quiz: What if we removed “var” everywhere?

Naming anonymous functions?

```
setTimeout( function(){
    console.log( "I waited 1 second!" );
}, 1000);
```

- No function name to display in stack traces
- Can’t refer to itself for recursion or unbinding and event handler
- A name helps self-document the code

Naming anonymous functions?

```
setTimeout( function timeoutHandler(){
    console.log( "I waited 1 second!" );
}, 1000);
```

Closures

- “Closures happen as a result of writing code that relies on lexical scope.” Kyle Simpson
- An unsurprising result of first-class objects and lexical scope..

Normal code

```
function foo() {
    var a = 2;

    function bar() {
        console.log( a ); // 2
    }

    bar();
}

foo();
```

Closure

```
function foo() {
    var a = 2;

    function bar() {
        console.log( a ); // 2
    }

    return bar;
}

var baz  = foo();
baz();
```

Effectively carries its lexical scope with the function reference

Another example

```
function foo() {
    var a = 2;
    function baz() {
        console.log( a ); // 2
    }
    bar( baz );
}

function bar(fn) {
    fn();
}
```

For real

```
function wait(message) {

    setTimeout( function timer(){
        console.log( message );
    }, 1000 );
}

wait( "Hello, closure!" );”
// Implementation of setTimeout has a call
//to its parameter
```

Loops

```
for (var i=1; i<=5; i++) {
    setTimeout( function timer(){
        console.log( i );
    }, i*1000 );
}

//Output?
```

Loops: solution

```
for (var i=1; i<=5; i++) {
    (function() {
        setTimeout( function timer(){
            console.log( i );
        }, i*1000 );
    })();
}

// Maybe if we wrap it in a new scope…
```

Loops: attempt 2

```
for (var i=1; i<=5; i++) {
    (function() {
        setTimeout( function timer(){
            console.log( i );
        }, i*1000 );
    })();
}

// Maybe if we wrap it in a new scope…
```

The problem is there is only one i.

Loops: solution

```
for (var i=1; i<=5; i++) {
    (function() {
        var j = i;
        setTimeout( function timer(){
            console.log( j );
        }, i*1000 );
    })();
}
```

Loops: even better

```
for (var i=1; i<=5; i++) {
    let j = i;  // block scope!!
    setTimeout( function timer(){
        console.log( j );
    }, i*1000 );
}
```

Objects

- An object is a container of properties, where a property has a name and a value
- You can create object literals:

```
var point = { x: 10, y: 20};
var point = {“x”: 10, “y”: 20};
```

- Quotes are optional if the name would be a legal JS name
- object properties retrieved by point.x OR point[“x”]

Methods on Objects

```
function dist_from_orig() {
    console.log(this.x);
    return(Math.sqrt(this.x * this.x +
                     this.y* this.y));
}

var p1 = {
    x: 10,
    y: -6,
    dist_from_orig: dist_from_orig
};
console.log(p1.dist_from_orig());
```

Function Objects/ Constructors

```
function dist_from_orig() {
    console.log(this.x);
    return(Math.sqrt(this.x * this.x + this.y* this.y));
}
function Point(x, y) {
    this.x = x;
    this.y = y;
    this.dist = dist_from_orig;
}

var p3 = new Point(3,2);
console.log(p3.dist_from_orig);
```

Adding properties

```
var p3 = new Point(3,2);

p3.is_origin = function is_origin() {
    return this.x == 0 && this.y == 0;
}
p3.z = 33;

if(p3.is_origin()) {
    console.log("origin");
} else {
    console.log("not orgin");
}
```

`this`

- Mostly works as you would expect, but is really different than other programming languages.
- It refers to the containing object of the call-site of a function, not where the function is defined.
- Under “use strict” the global object is not eligible for `this` binding.

Implicit Binding

```
function bar() {
    console.log(this.a);
}
var obj2 = {
    a: 42,
    bar: bar
};
var obj1 = {
    a: 2,
    obj2: obj2
}
```

```
obj2.bar();
```

```
obj1.obj2.bar();
```

What is the result of these calls? What would you expect?

Try running it!

Lost binding

```
var p = obj1.bar;

p();  // undefined
```

This happens because `obj1.bar` is just a reference, it doesn't *belong* to `obj1`.

Explicit binding

```
bar.call(obj1); // 2
```

Forces `this` to be `obj1`

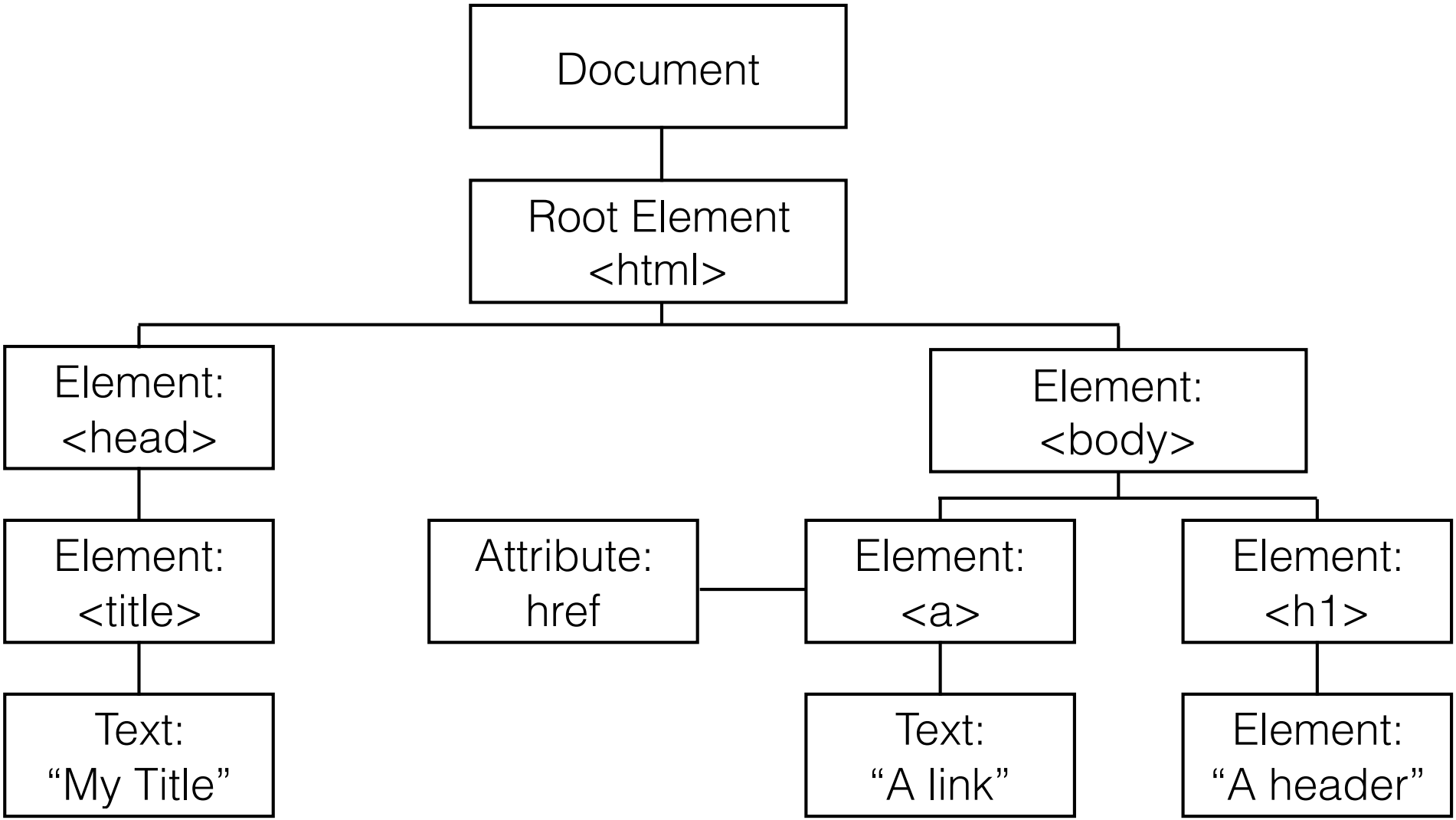
`new` binding

```
function Point(x, y) {
    this.x = x;
    this.y = y;
    this.dist = dist_from_orig;
}

var p3 = new Point(3,2);
```

DOM

DOM - Document Object Model



BOM: Browser Object Model

Name	Description
`document`	DOM (current HTML page)
`history`	List of pages user has visited
`location`	URL of current page
`navigator`	Info about the browser
`screen`	Screen area (viewport) occupied by the browser.
`window`	The browser window

window

- Top level object in the Browser Object Model
- Methods include:
  - `alert, confirm, prompt` (popup boxes)
  - `setInterval, setTimeout clearInterval, clearTimeout` (timers)
  - `open, close` (popping up new browser windows)
  - `blur, focus, moveBy, moveTo, print, resizeBy, resizeTo, scrollBy, scrollTo`

document

Current web page and its elements

- Properties:
  - `anchors, body, cookie, domain, forms, images, links, referrer, title, URL`
- Methods:
  - `getElementById`
  - `getElementsByName`
  - `getElementsByTagName`
  - `close, open, write, writeln`

Location: URL of the current page

- Properties:
  - `host, hostname, href, pathname, port, protocol, search`
- Methods:
  - `assign, reload, replace`

Navigator: Information about the web browser

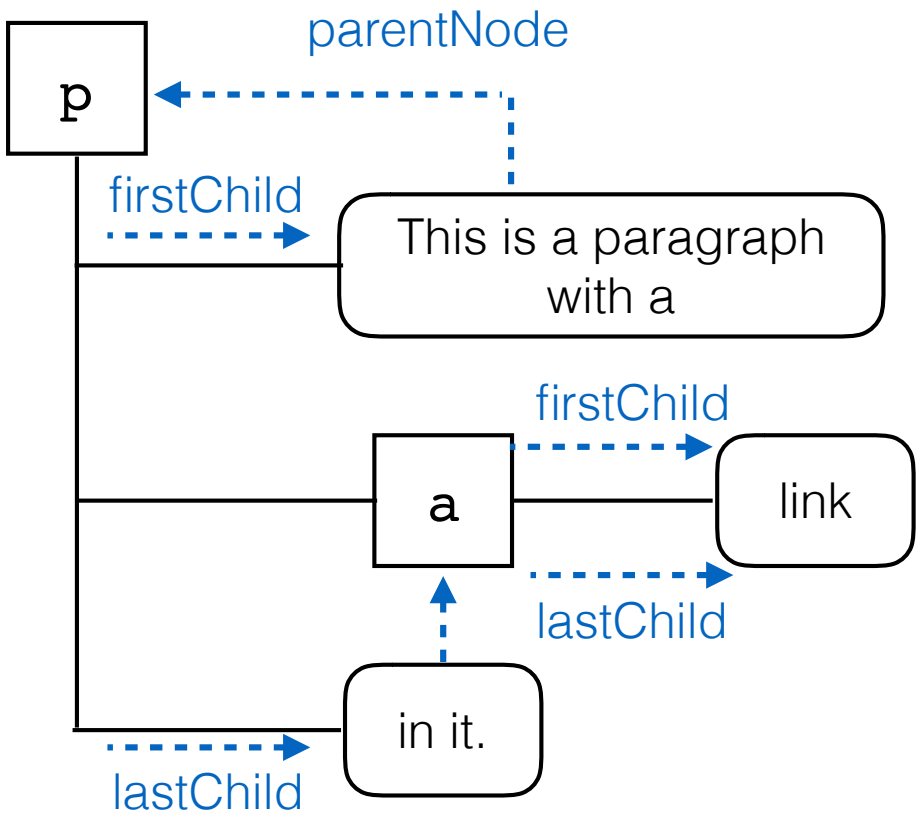
- Properties:
  - `appName, appVersion, browserLanguage, cookieEnabled, platform, userAgent`

- Screen : information about the display screen
  - Properties: `availHeight, availWidth, colorDepth, height, pixelDepth, width`
- Difference?
  - *Screen* is what's visible to you
  - *Window* is the browser window including scrollbars, navigation, bookmark bars, etc
  - *Document* can be larger than the screen/window

- The history object keeps a list of sites that the browser has visited in this window.
  - Properties: `length`
  - Methods: b`ack, forward, go`
- Sometimes the browser won't let scripts view history properties, for security reasons.

Name	Description
`firstChild` `lastChild`	Start/end of this node's list of children.
`childNodes`	Array of all this node's children
`nextSibling` `previousSibling`	Neighbouring nodes with the same parent.
`parentNode`	Node that contains this node

```
<p>
    This is a paragraph with a
    <a href="/path/page.html">link</a> in it.s
</p>
```



Name	Description
`document.createElement("tag")`	Create and return a new empty DOM nodes
`document.createTextNode("text")`	Create and return a text node with the given text
`appendChild(node)`	place node at end of this node's children
`insertBefore(new, old)`	place given new node just before old child
`removeChild(node)`	remove node from this child list
`replaceChild(new, old)`	replace node