# JavaScript

SWE 432, Fall 2017

Design and Implementation of Software for the Web

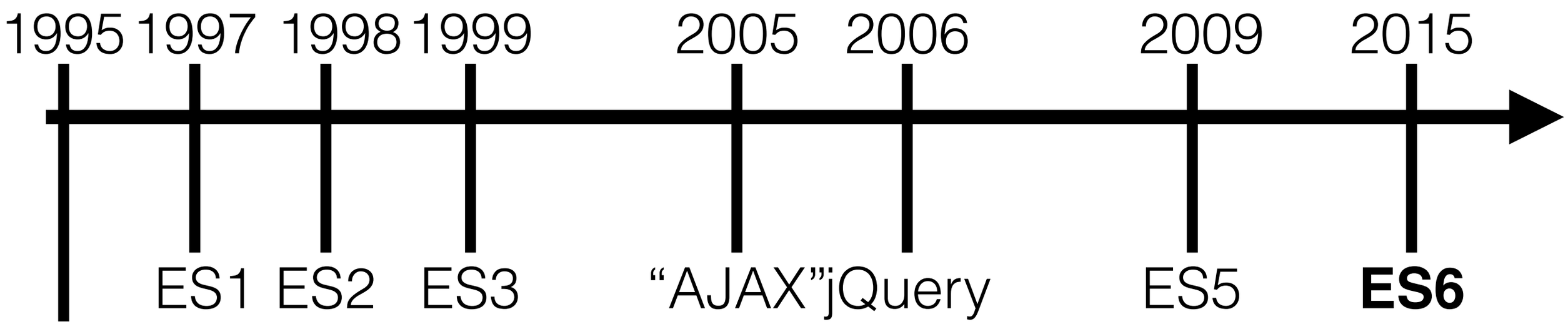
GEORGE MASON UNIVERSITY

# Next two lectures: JavaScript

- Today
  - Brief history of JavaScript/ECMAScript
  - Overview of core syntax and language semantics
  - Overview of key libraries
  - In class activity working with JavaScript
- Next Tuesday
  - Overview of approaches for organizing code with web apps
  - Constructs for organizing code: closures, class

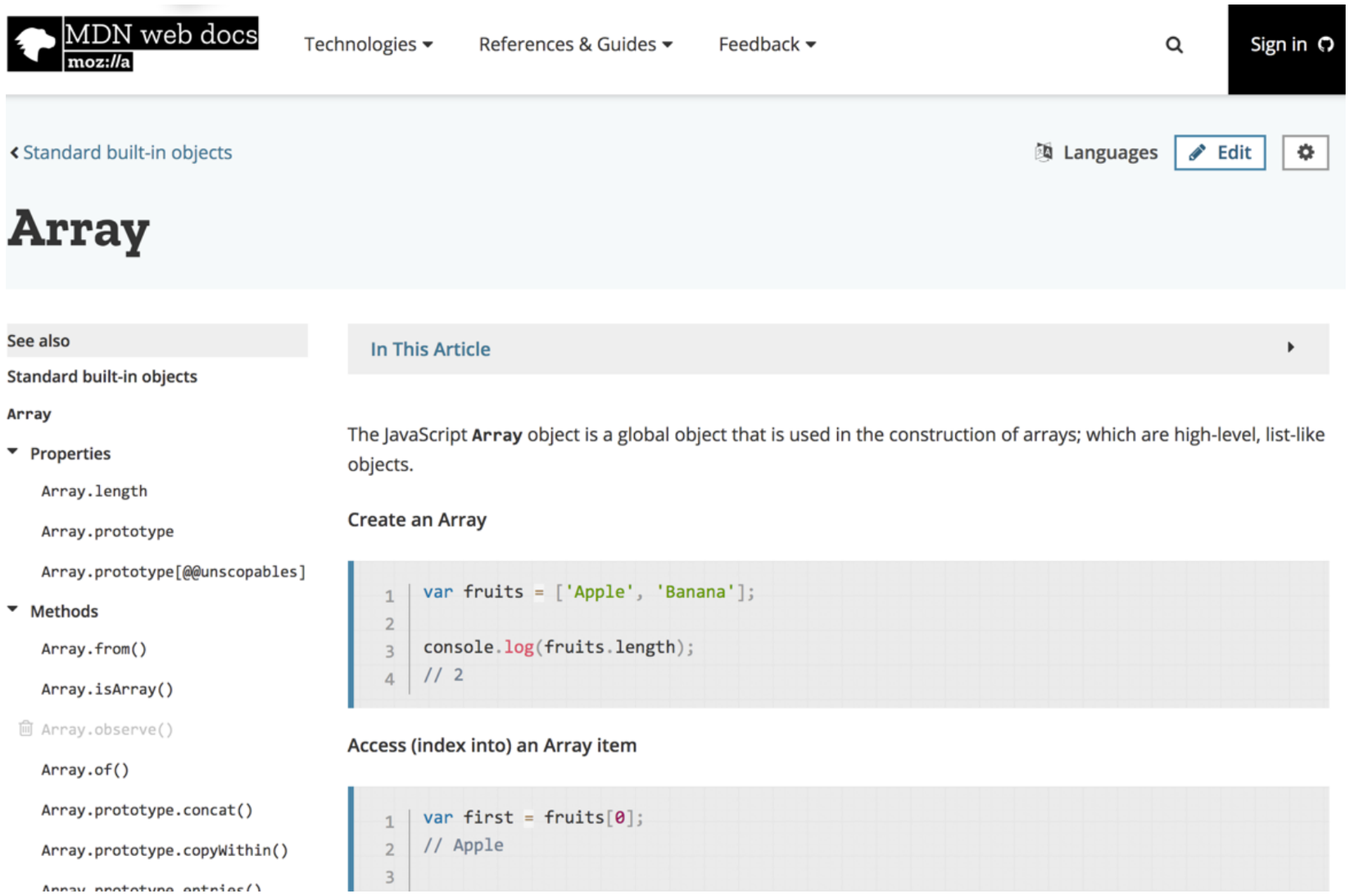
# JavaScript: Some History

- JavaScript: 1995 at Netscape (supposedly in only 10 days)
  - No relation to Java (maybe a little syntax, that's all)
  - Naming was marketing ploy
  - ECMAScript -> International standard for the language



# Reference materials

- Not any “official” documentation
- Most definitive source for JavaScript, DOM, HTML, CSS: Mozilla Development Network (MDN)
- StackOverflow posts, blogs often have good examples




https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Array

# Pastebins


- Code snippet hosted on the web with an in-browser editor
- Used to share code and experiment with small code snippets
- Examples: JSFiddle, JSBin, seeCode.run
- We'll often use seeCode.run to try out examples

# Variables

- Variables are *loosely* typed
  - String:
    ```
    var strVar = 'Hello';
    ```
  - Number:
    ```
    var num = 10;
    ```
  - Boolean:
    ```
    var bool = true;
    ```
  - Undefined:
    ```
    var undefined;
    ```
  - Null:
    ```
    var nulled = null;
    ```
  - Objects (includes arrays):
    ```
    var intArray = [1,2,3];
    ```
  - Symbols (named magic strings):
    ```
    var sym = Symbol('Description of the symbol');
    ```
  - Functions (We'll get back to this)
- Names start with letters, $ or _
- Case sensitive

# Const

- Can define a variable that cannot be assigned again using const

```
const numConst = 10; //numConst can’t be changed
```

- For objects, properties may change, but object identify may not.

# More Variables

- Loose typing means that JS figures out the type based on the value

```
let x; //Type: Undefined
x = 2; //Type: Number
x = 'Hi'; //Type: String
```

- Variables defined with let (but not var) have block scope
  - If defined in a function, can only be seen in that function
  - If defined outside of a function, then global. Can also make arbitrary blocks:

```
{
    let a = 3;
}
//a is undefined
```

# Loops and Control Structures

- `if` - pretty standard

```
if (myVar >= 35) {
    //...
} else if(myVar >= 25){
    //...
} else {
    //...
}
```

- Also get `while`, `for`, and `break` as you might expect

```
while(myVar > 30){
    //...
}

for(var i = 0; i < myVar; i++){
        //...
        if(someOtherVar == 0)
            break;
}
```

# Operators

```
var age = 20;
```

| Operator | Meaning | Examples |
|---|---|---|
| == | Equality | `age == 20`<br>`age == '20'` |
| != | Inequality | `age != 21` |
| > | Greater than | `age > 19` |
| >= | Greater or Equal | `age >= 20` |
| < | Less than | `age < 21` |
| <= | Less or equal | `age <= 20` |
| === | Strict equal | `age === 20` |
| !== | Strict Inequality | `age !== '20'` |

**Annoying**

# Functions

- At a high level, syntax should be familiar:

```
function add(num1, num2) {
    return num1 + num2;
}
```

- Calling syntax should be familiar too:

```
var num = add(4,6);
```

- Can also assign functions to variables!

```
var magic = function(num1, num2){
    return num1+num2;
}
var myNum = magic(4,6);
```

- Why is this cool?

# Default Values

```
function add(num1=10, num2=45) {
    return num1 + num2;
}

var r = add(); // 55
var r = add(40); //85
var r = add(2,4); //6
```

# Rest Parameters

```
function add(num1, ... morenums) {
    var ret = num1;
    for(var i = 0; i < morenums.length; i++)
        ret += morenums[i];
    return ret;
}
```

```
add(40,10,20); //70
```

# => Arrow Functions

- Simple syntax to define short functions *inline*
- Several ways to use

Parameters

```
var add = (a,b) => {
            return a+b;
          }
```

```
var add = (a,b) => a+b;
```

**If your arrow function only has one expression, JavaScript will automatically add the word "return"**

# Objects

- What are objects like in other languages? How are they written and organized?
- Traditionally in JS, no *classes*
- Remember - JS is not really typed… if it doesn't care between a number and a string, why care between two kinds of objects?

```
var profLaToza = {
    firstName: "Thomas",
    lastName: "LaToza",
    teaches: "SWE 432",
    office: "ENGR 44431”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

# Working with Objects

```
var profJon = {
    firstName: "Thomas",
    lastName: "LaToza",
    teaches: "SWE 432",
    office: "ENGR 4431”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

**Our Object**

```
console.log(profLaToza.firstName); //Thomas
console.log(profLaToza[“firstName”]); //Thomas
```

**Accessing Fields**

```
console.log(profLaToza.fullName()); // Thomas LaToza
```

**Calling Methods**

```
console.log(profLaToza.fullName);//function...
```

# Destructuring

```
// What you write
let { firstName, lastName } = Zell

// ES6 does this automatically
let firstName = Zell.firstName
let lastName = Zell.lastName
```

```
[a, b] = [b, a]
```

- Convenient syntax for extracting property values into a variable
- Works with objects and arrays

# JSON: JavaScript Object Notation

Open standard format for transmitting *data* objects.

- No functions, only key / value pairs
- Values may be other objects or arrays

```
var profJon = {
    firstName: "Thomas",
    lastName: "LaToza",
    teaches: "SWE 432",
    office: "ENGR 4431”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

**Our Object**

```
var profJon = {
    firstName: "Thomas",
    lastName: "LaToza",
    teaches: "SWE 432",
    office: "ENGR 4431",
    fullName: {
        firstName: “Thomas”,
        lastName: “LaToza”}
};
```

**JSON Object**

# Interacting w/ JSON

- Important functions
- JSON.parse(jsonString)
  - Takes a *String* in JSON format, creates an *Object*
- JSON.stringify(obj)
  - Takes a Javascript *object*, creates a JSON *String*
- Useful for persistence, interacting with files, debugging, etc.
  - e.g., console.log(JSON.stringify(obj));

# Arrays

- Syntax similar to C/Java/Ruby/Python etc.
- Because JS is loosely typed, can mix types of elements in an array
- Arrays automatically grow/shrink in size to fit the contents

```
var students = ["Alice", "Bob", "Carol"];
var faculty = [profLaToza];
var classMembers = students.concat(faculty);
```

**Arrays are actually objects… and come with a bunch of "free" functions**

# Some Array Functions

- Length
```
var numberOfStudents = students.length;
```
- Join
```
var classMembers = students.concat(faculty);
```
- Sort
```
var sortedStudents = students.sort();
```
- Reverse
```
var backwardsStudents = sortedStudents.reverse();
```
- Map
```
var capitalizedStudents = students.map(x =>
                                  x.toUpperCase());
 //["ALICE","BOB","CAROL"]
```

# For Each

- JavaScript offers two constructs for looping over arrays and objects
- For **of** (iterates over values):

```
for(var student of students)
{
    console.log(student);
} //Prints out all student names
```

- For **in** (iterates over keys):

```
for(var prop in profLaToza){
    console.log(prop + ": " + profLaToza[prop]);
}
```

**Output:**
firstName: Thomas
lastName: LaToza
teaches: SWE 432
office: ENGR 4431

# Arrays vs Objects

- Arrays are Objects
- Can access elements of both using syntax
  ```
  var val = array[idx];
  ```
- Indexes of arrays must be integers
- Don’t find out what happens when you make an array and add an element with a non-integer key :)

# String Functions

- Includes many of the same String processing functions as Java
- Some examples
  - var stringVal = ‘George Mason University’;
  - stringVal.endsWith(‘University’)  // returns true
  - stringVal.match(….)  // matches a regular expression
  - stringVal.split(‘ ‘) // returns three separate words

- https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/String

# Template Literals

```
var a = 5;
var b = 10;
console.log(`Fifteen is ${a + b} and
not ${2 * a + b}.`);
// "Fifteen is 15 and not 20."
```

- Enable embedding expressions **inside** strings
- Denoted by a back tick grave accent `, **not** a single quote

# Set Collection

```
var mySet = new Set();

mySet.add(1); // Set { 1 }
mySet.add(5); // Set { 1, 5 }
mySet.add(5); // Set { 1, 5 }
mySet.add('some text'); // Set { 1, 5, 'some text' }
var o = {a: 1, b: 2};
mySet.add(o);

mySet.add({a: 1, b: 2}); // o is referencing a different object so this is okay

mySet.has(1); // true
mySet.has(3); // false, 3 has not been added to the set
mySet.has(5);              // true
mySet.has(Math.sqrt(25));  // true
mySet.has('Some Text'.toLowerCase()); // true
mySet.has(o); // true

mySet.size; // 5

mySet.delete(5); // removes 5 from the set
mySet.has(5);    // false, 5 has been removed

mySet.size; // 4, we just removed one value
console.log(mySet);// Set {1, "some text", Object {a: 1, b: 2}, Object {a: 1, b: 2}}
```

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Set

# Map Collection

```
var myMap = new Map();

var keyString = 'a string',
    keyObj = {},
    keyFunc = function() {};

// setting the values
myMap.set(keyString, "value associated with 'a string'");
myMap.set(keyObj, 'value associated with keyObj');
myMap.set(keyFunc, 'value associated with keyFunc');

myMap.size; // 3

// getting the values
myMap.get(keyString);    // "value associated with 'a string'"
myMap.get(keyObj);       // "value associated with keyObj"
myMap.get(keyFunc);      // "value associated with keyFunc"

myMap.get('a string');   // "value associated with 'a string'"
                         // because keyString === 'a string'
myMap.get({});           // undefined, because keyObj !== {}
myMap.get(function() {}) // undefined, because keyFunc !== function () {}
```

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Map

# Demo

- Primitives: equality
- Objects: literals, JSON, stringify / parse,
- Arrays: literals, accessing, length, sort, push, pop, map
- Strings: template literals
- Collections: Map, Set
- Functions: first class, anonymous, arrow

# Exercise

https://jsfiddle.net/4sgz8dn3/

# Next time

- Organizing code in web apps

- Required Readings:
  - Closures: https://medium.freecodecamp.org/lets-learn-javascript-closures-66feb44f6a44
  - Classes: https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes