SWE 432 -Web Application Development

Fall 2022

George Mason University

Dr. Kevin Moran

Week 1: Introduction to Javascript

Office Hours Posted!

- **Dr. Moran**
  - Tuesdays & Thursdays, 2:00pm - 3:00pm
  - ENGR 4404 or Zoom
- **Divesh**
  - Tuesdays 9:30am - 10:30am
  - Thursdays 3:15pm - 4:15pm
  - Zoom and TBA

HW Assignment Posted

- I will cover HW 1 in detail at the beginning of the next class.

Course Timeline

You are here.

- JavaScript and Backend development (first half of semester)
  - JavaScript, back-end development, programming models, testing, performance, privacy, security, scalability, deployment, etc.
- Frontend development and user experience design (second half of semester)
  - Templates and data binding, React, user-centered design, user studies, information visualization, visual design, etc.

This Lecture

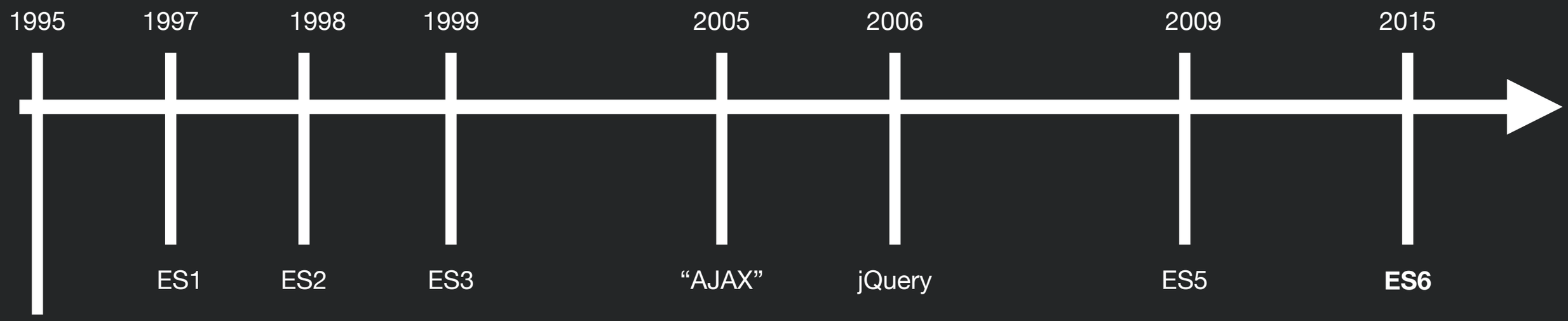
- Brief history of JavaScript/ECMAScript
- Overview of core syntax and language semantics
- Overview of key libraries
- In class activity working with JavaScript
- Next:
  - Testing and tooling

In Class Follow-Along

https://replit.com/@kmoran/Intro-to-JavaScript?v=1

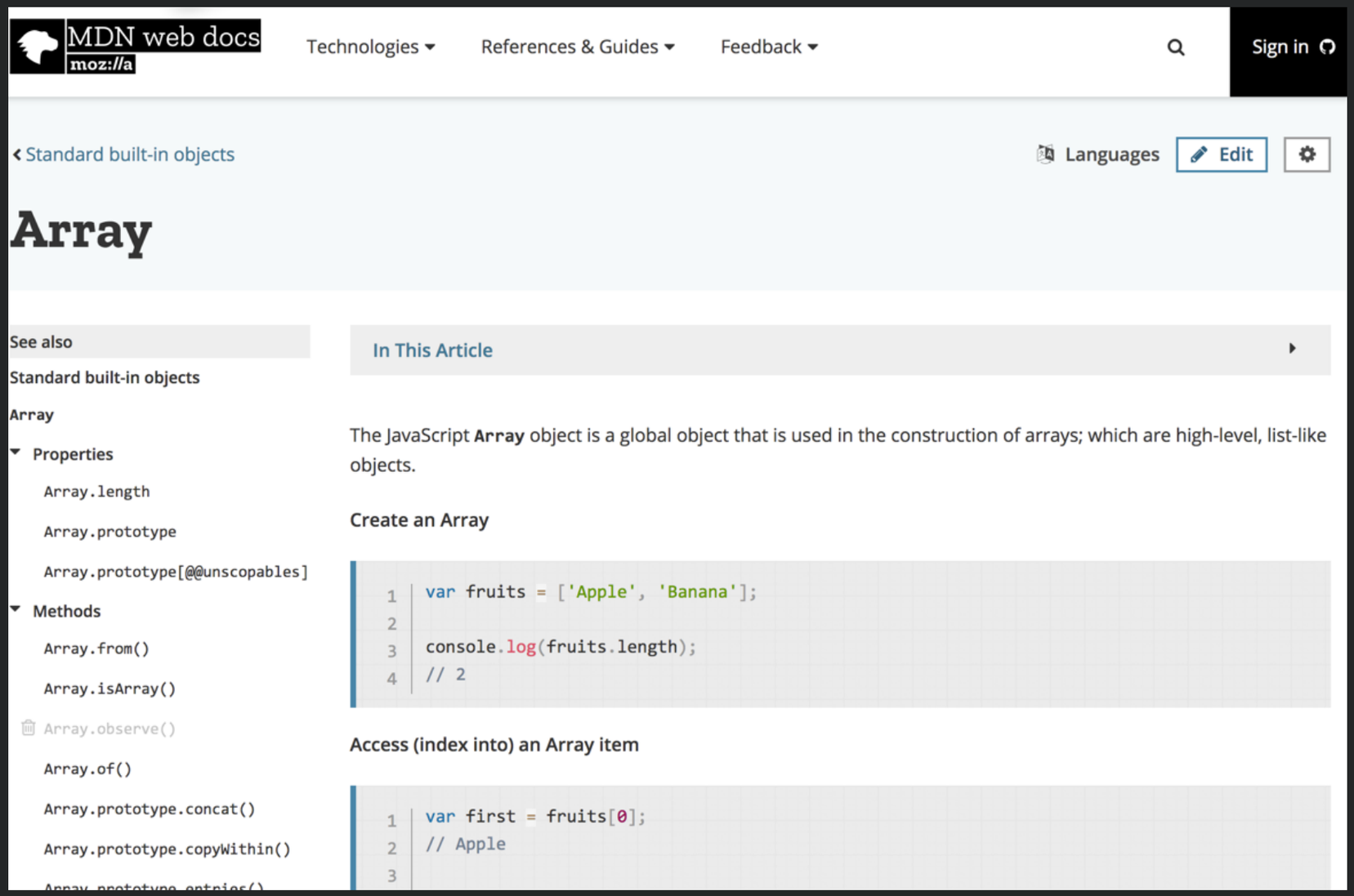
JavaScript: Some History

- 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, Replit, Codesandbox

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 identity 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` `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 might you want to do this?

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 profHacker = {
    firstName: "Alyssa",
    lastName: “P Hacker",
    teaches: "SWE 432",
    office: "ENGR 6409”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

Working with Objects

```
var profMoran = {
    firstName: “Alyssa",
    lastName: “P Hacker",
    teaches: "SWE 432",
    office: "ENGR 4448”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

Our Object

```
console.log(profHacker.firstName); //Alyssa
console.log(profHacker[“firstName”]); //Alyssa
```

Accessing Fields

```
console.log(profHacker.fullName()); //Alyssa P Hacker
```

Calling Methods

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

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 profHacker = {
    firstName: "Alyssa",
    lastName: “P Hacker",
    teaches: "SWE 432",
    office: “ENGR 6409”,
    fullName: function(){
        return this.firstName + " " + this.lastName;
    }
};
```

Our Object

```
var profHacker = {
    firstName: "Alyssa",
    lastName: “P Hacker",
    teaches: "SWE 432",
    office: "ENGR 6409",
    fullName: {
        firstName: “Alyssa”,
        lastName: “P Hacker”}
};
```

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 = [profHacker];
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 profHacker){
    console.log(prop + ": " + profHacker[prop]);
}
```

Output:
firstName: Alyssa
lastName: P Hacker
teaches: SWE 432
office: ENGR 6409

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

- Enable embedding expressions **inside** strings

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

- 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}}
```

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 () {}
```

In Class Exercise

https://replit.com/@kmoran/In-Class-Excercise-Javascript?v=1

Acknowledgements

Slides adapted from Dr. Thomas LaToza's SWE 432 course