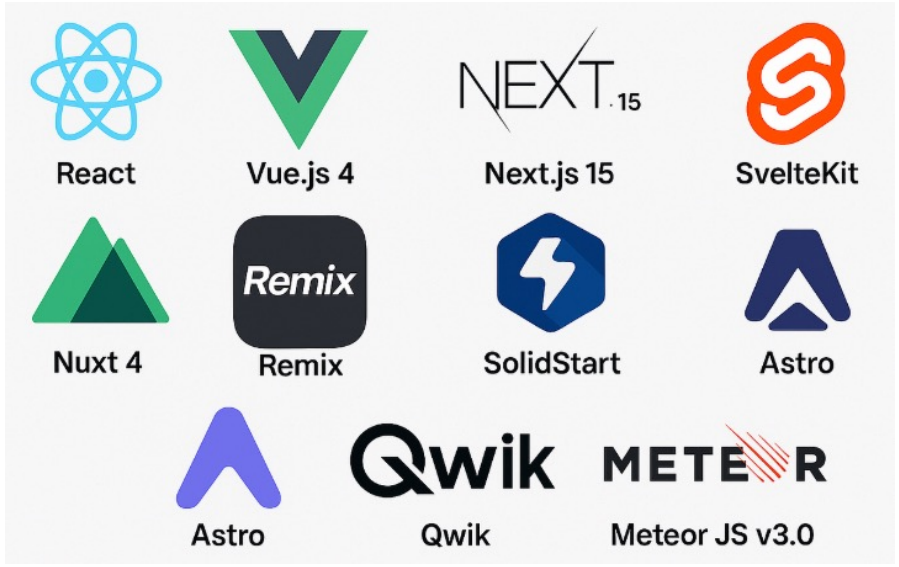


JavaScript

CSC309

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So far

- How web works
  - Client vs server
  - HTTP

- HTML tags and elements
  - Describes what should be on our page

- CSS styles
  - Describes how elements should look like
  - More on styles later in the course

This session

- JavaScript history and syntax
- Scope, destructuring, and arrow functions
- Dynamic web pages

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Location: about:

What's New! What's Cool! Handbook Net Search Net Directory Software

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Version 2.02

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Brendan Eich

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Java vs JavaScript

- Eich's script language had a somewhat similar syntax to Java
  - The C-style syntax was very popular in the 90s

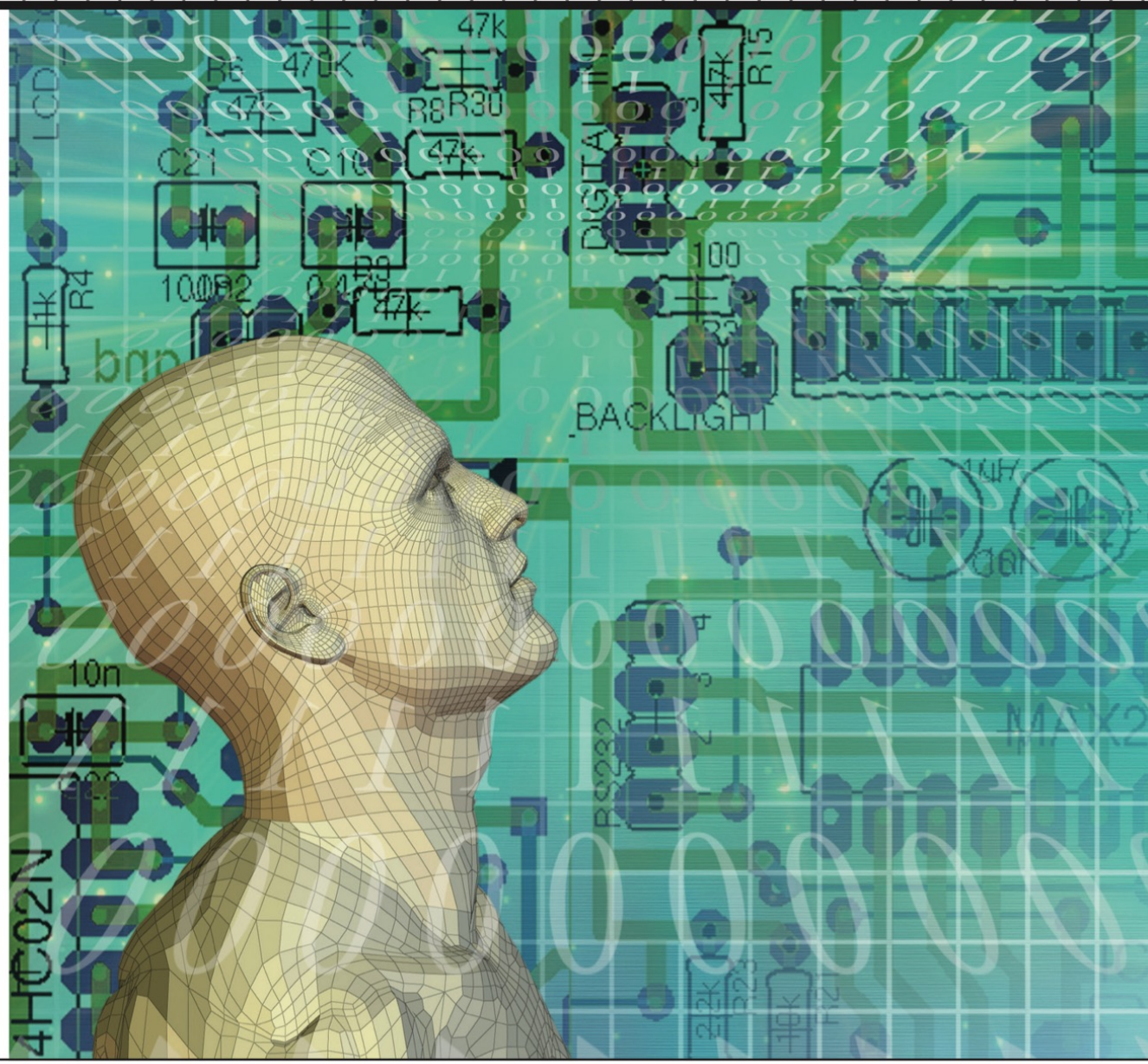
- Netscape-Sun deal:
  - Netscape browser will support Java apps
  - Eich's language will be called JavaScript!

- No further relevance between Java and JavaScript!

Visit https://www.computer.org/csdl/magazine/co/2012/02/mco2012020007/13rRUy08M

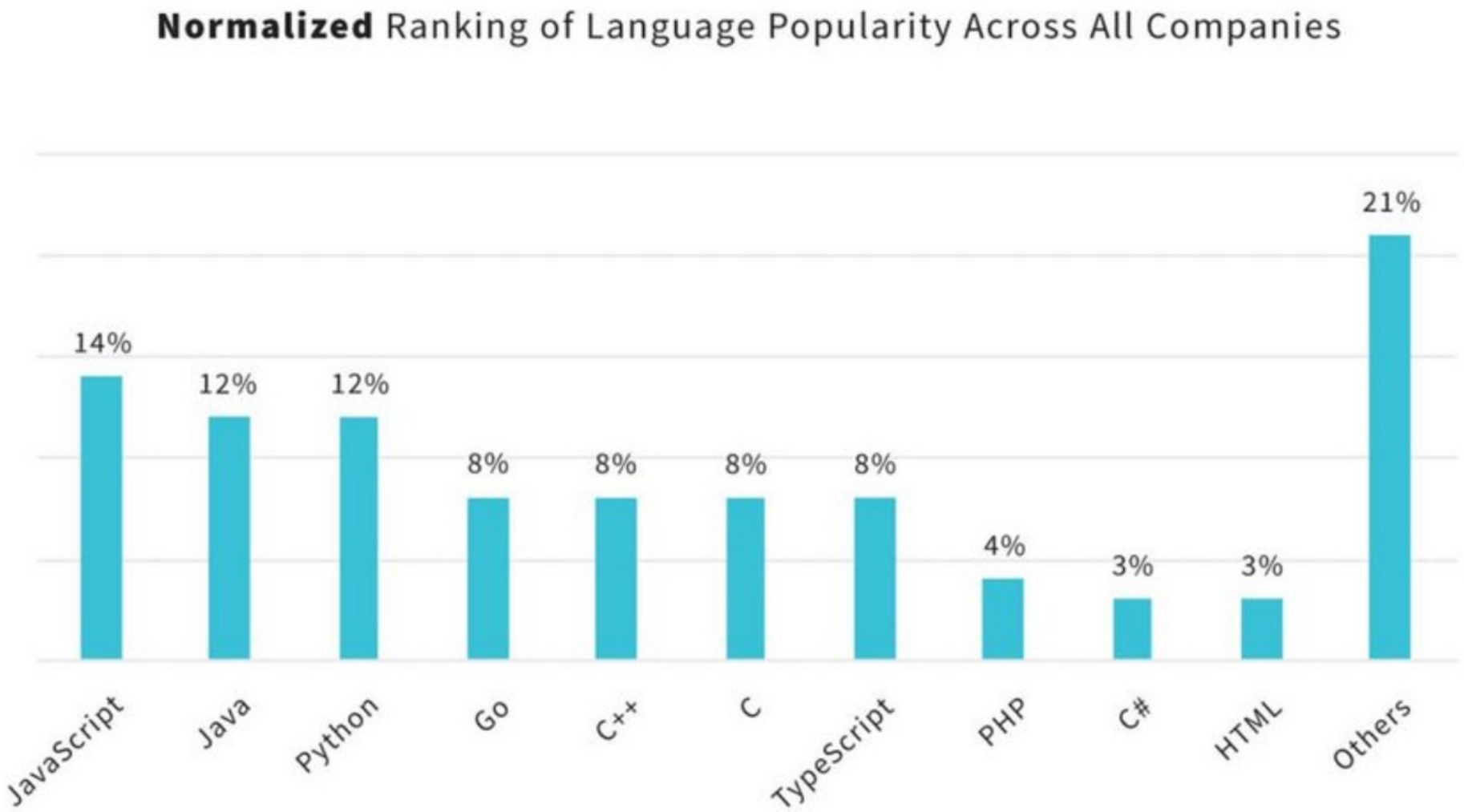
JavaScript: Designing a Language in 10 Days

Charles Severance
University of Michigan



There we go!

Visit: https://madnight.github.io/githut



Source: https://solutionshub.epam.com/blog/post/programming-language-popularity-on-github

- JavaScript is a scripting language
  - Interpreted at runtime
  - No JAR or exe file

- All browsers have a JS interpreter

- Not exclusive to client-side web applications!
  - Example: Node.js, Next.js, Express, etc.
  - JS is just a language! You can sort an array of integers with it.

- JavaScript changed the web forever!

Syntax

- Declaring variables

```
var x = 5;
var y = "hello";
console.log(x + y);
```

- Data types:
  - Number, string, boolean, undefined
  - Object, function

- JS is dynamically-typed (like Python)

Objects

- Examples:

```
var cars = ["Saab", "Volvo", "BMW"];
var person = {firstName: "John", lastName: "Doe", age: 50, eyeColor: "blue"};
var ref = null;
```

- Ever heard of JSON?
  - Stands for JavaScript Object Notation
  - The most popular way to serialize all kind of objects

- Note: null is different than undefined
  - `typeof(null)` returns object, while `typeof(undefined)` returns undefined!

Properties

- Examples:

```
person.firstName = "Joe"
person["lastName"] = "Jordan"
cars[0] = 1
cars.push(2323)
```

- Objects (including arrays) are the only mutable types in JavaScript

Functions

- Syntax:

```
function name(parameter1, parameter2, parameter3) {
  // code to be executed
}
```

- Properties can be functions (methods)

```
var obj = {f: function(x) {
   return x + 2
}}

cars.clear = function(){
    this.length = 0;
}
```

Classes

Visit https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes

- A template for creating objects
- Are in fact special functions
  - Check `typeof(Rectangle)`
- Classes support inheritance

```
class Rectangle {
  constructor(height, width) {
    this.height = height;
    this.width = width;
  }
  // Getter
  get area() {
    return this.calcArea();
  }
  // Method
  calcArea() {
    return this.height * this.width;
  }
}

const square = new Rectangle(10, 10);

console.log(square.area); // 100
```

Conditions

- If statements:

```
if (typeof(cars[0]) === "number" && cars[0] < 0)
    cars[0] *= -1
else
    console.log("Bad element")
```

- Important: notice ===
  - Visit https://codeahoy.com/javascript/2019/10/12/==-vs-===-in-javascript/

More statements

- While loops:

```
while (cars.length > 0){
    cars.pop()
}
```

- Switch statement:

```
switch(cars[0]){
    case 1:
        console.log("int")
        break
    case "name":
        console.log("str")
        break
    case x:
        console.log("var " +x);
        break
    default:
        console.log("none")
}
```

For loops

- Classic for loop:

```
for (var i=0; i<10; i++)
    console.log(i * i * i)
```

- Iterable objects:

```
for (name of names)
    console.log("There is a " + name)
```

- Array-specific forEach:

```
names.forEach(function(name, index){
    console.log(name + " at index " + index)
})
```

Scope

Visit: https://www.w3schools.com/js/js_scope.asp

- Three types of scope:
  - Global scope
  - Function scope
  - Block scope

- Global scope
  - Outside any function
  - Variables can be accessed from anywhere in the program

Function scope

- Variables defined anywhere inside a function are local to that function
- Can be used anywhere inside that function
- Cannot be used outside that function

```
// code here can NOT use carName

function myFunction() {
  var carName = "Volvo";
  // code here CAN use carName
}

// code here can NOT use carName
```

Code by Sadia Sharmin (rainsharmin.com)

Block scope

- To limit a variable to its block inside the function, use let

```
function f(n){
    if (n > 10){
        var tmp = 2;
    }
    // tmp CAN be accessed here
}
```

```
function f(n){
    if (n > 10){
        let tmp = 2;
    }
    // tmp can NOT be accessed here
}
```

Codes by Sadia Sharmin (rainsharmin.com)

Let vs var

- At global and function scopes, let and var work similarly
- var supports redeclaration, while let does not
- Both support re-assignment. Use const to disallow it
- let is more like regular variables in other languages
  - Preferred over var

Arrow functions

- A more convenient way to define functions
- Almost equivalent to regular functions
  - More on that later

```
function regular(a, b){
  return a + b;
}

const arrow = (a, b) => {
    return a + b;
}

const conciseArrow = (a, b) => a + b;
```

Simplify the code!

- Today, for loops are rarely used
- Instead of a for loop, use forEach or map
- Example:

```
var names = ["ali", "hassan"]
names.forEach((item, index) => console.log(item + " at " + index))
upper = names.map(item => item.toUpperCase())
```

Simplify even further

- Use the filter method to take out elements with a specific condition
- Example:

```
let students = [{name: "John", id: 1}, {name: "Ali", id:2}]
let john = students.filter(item => item.name === "John")
```

- reduce lets you do a lot of cool things with just 1 inline arrow function
- Example:

```
let maxCredit = employee.reduce(
    (acc, cur) => Math.max(cur.credit, acc), Number.NEGATIVE_INFINITY)
```

Power of arrow functions!

Regular functions

```
var totalJediScore = personnel
  .filter(function (person) {
    return person.isForceUser;
  })
  .map(function (jedi) {
    return jedi.pilotingScore + jedi.shootingScore;
  })
  .reduce(function (acc, score) {
    return acc + score;
  }, 0);
```

Arrow functions

```
const totalJediScore = personnel
  .filter(person => person.isForceUser)
  .map(jedi => jedi.pilotingScore + jedi.shootingScore)
  .reduce((acc, score) => acc + score, 0);
```

Source: https://medium.com/poka-techblog/simplify-your-javascript-use-map-reduce-and-filter-bd02c593cc2d

Destructuring

Visit https://dmitripavlutin.com/javascript-object-destructuring/

```
const hero = {
  name: 'Batman',
  realName: 'Bruce Wayne'
};

const { name, realName } = hero;

name;     // => 'Batman',
realName; // => 'Bruce Wayne'
```

```
const hero = {
  name: 'Batman',
  realName: 'Bruce Wayne'
};

const { name, ...realHero } = hero;

realHero; // => { realName: 'Bruce Wayne' }
```

```
const heroes = [
  { name: 'Batman' },
  { name: 'Joker' }
];

const names = heroes.map(
  function({ name }) {
    return name;
  }
);

names; // => ['Batman', 'Joker']
```

Subtlety

- Regular functions have their own `this` value

- The object that called the function
  - Methods and event listeners (described in later slides): the actual object/element
  - Global function: global object (window)

- Arrow functions do not have their own `this`

- Do not use arrow functions as object method or event listener
  - You can use them as class methods though. Why?

- However, unlike regular functions, they can bind (capture) `this` like any other closure value

```
const person = {
    name: 'Kianoosh',
    sayHi() {
        setTimeout(() =>
            console.log(this.name + " says hi!"), 500);
    }
}
```

- For more information, visit

  https://www.javascripttutorial.net/es6/when-you-should-not-use-arrow-functions

Client-side JavaScript

```
alert("Are you sure you want to leave this page?")
```

Where to put JS

- JS code should be placed inside the <script> tag

- Inline JS:

```
<script>
   console.log(1 + 2 + 3)
</script>
```

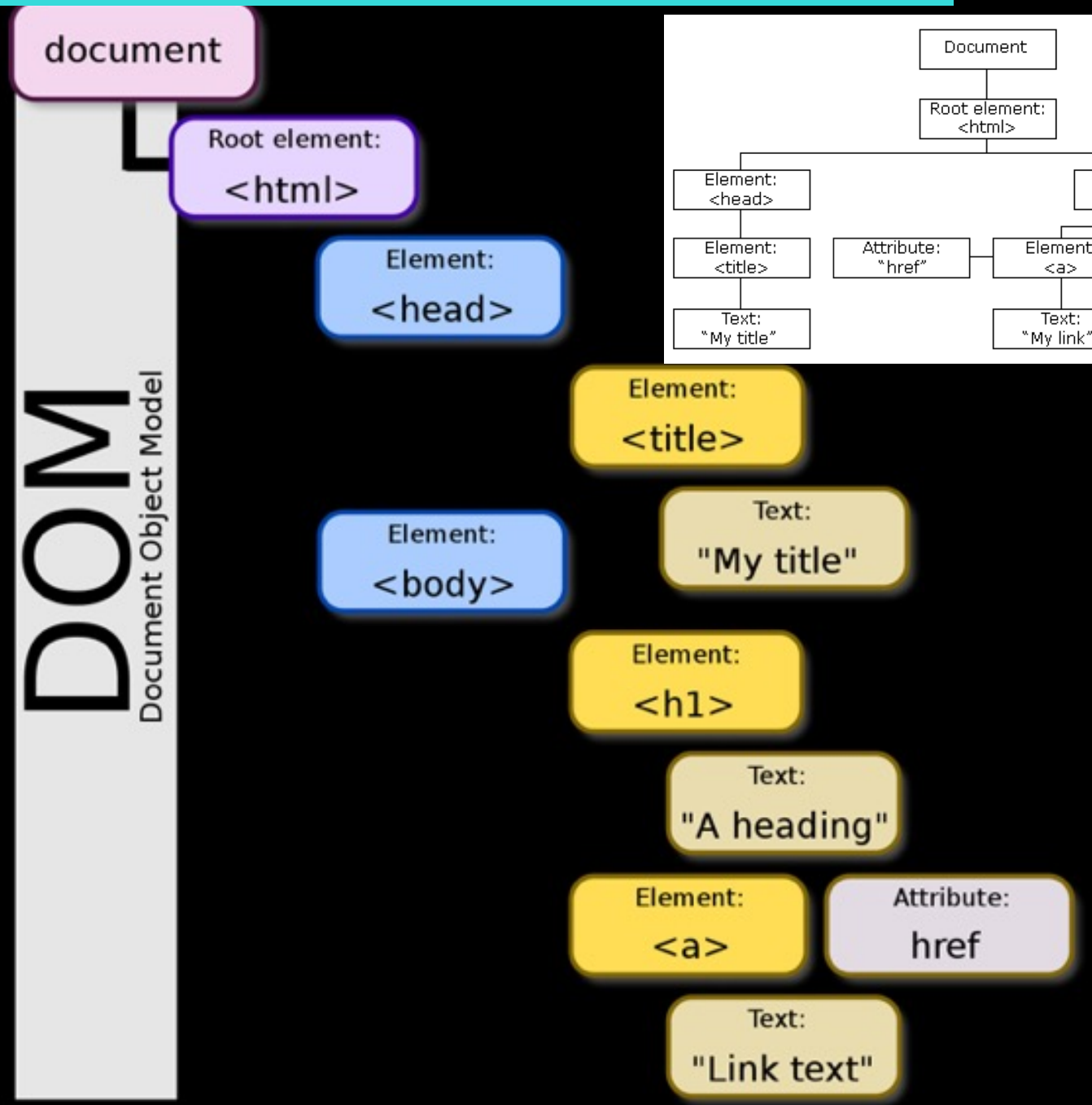
- JS file

```
<script src="city_region_dropdown.js"></script>
```

Document object model

- Browser creates the DOM tree of the page
- Each element is a node
- Child elements are children of the parent node
- Scripts access DOM through the document variable

```
<html>
  <head>
    <title>My title</title>
  </head>
  <body>
    <h1>A heading</h1>
    <a href="...">Link
    text</a>
  </body>
</html>
```



Getting elements

- Various ways to get an element

```
document.getElementById("st-2")
document.getElementsByClassName("ne-share-buttons")
document.getElementsByTagName("ul")

document.querySelector("#submit-btn")
document.querySelectorAll(".col-md-12")
```

- Good exercise at:

  https://javascript.info/task/find-elements/table.html

Navigating through DOM

- Relevant nodes can be accessed through properties

```
parentNode, firstChild, lastChild, childNodes, nextSibling
```

- Example

```
let img = document.querySelector("#my-image")
let par = img.parentNode

console.log(par.childNodes.length)
```

Manipulating elements

- Element properties
  `innerHTML, style, getAttribute()`

- Example

```
let body = document.body
body.innerHTML = "<h3>hello!</h3>"

h3 = document.getElementsByTagName("h3")
h3.style.color = "green"
h3.setAttribute("class", "title")
console.log(h3.getAttribute("style"))
```

Events

Visit https://www.w3schools.com/tags/ref_eventattributes.asp

- Various events are monitored by the browser

- document events

  `onload, onkeydown, onkey, …`

- Element events

  `onclick, onmouseover, ondrag, oncopy, onfocus, onselect, onsubmit, …`

Event listeners

- You can define a function

```
h3.onclick = function() {
    this.innerHTML = "you just clicked on me!"
}
```

- Alternative:

```
<script>
    function h3click(h3){
        h3.style.color = "blue"
    }
</script>

<h3 onclick="h3click(this)" onmouseover="console.log(new
Date())"></h3>
```

Next session

- Modern architecture of web apps
  - Frontend & backend
  - APIs
- Server-side JavaScript
  - JS projects with Node.js
- Intro to Next.js