JavaScript pt. 1: Intro and Ajax

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CSC309 Winter 2022

Some content is from Dr. Sadia Sharmin's slides of CSC309 Winter 2021: www.rainsharmin.com

So far

- Front-end:
  - HTML: tags and forms
  - CSS: styles, selectors, layout
- Back-end: Django
  - Setup, simple views, forms, templates
  - MVC, database, ORM, Auth
  - Custom models, migrations, class-based views
  - JSON, Restful APIs

This session

- Intro to JavaScript
- DOM
- Getting and manipulating elements
- Asynchronous requests: Ajax

Front-end so far

- HTML: Describes what should be on our page
- CSS: Describes how elements should look like
- But the web age is not interactive!
  We need something that responds to events and user actions
- JavaScript: a language that browsers understand!

Netscape - [Version 2.02]

File Edit View Go Bookmarks Options Directory Window Help

Back Forward Home Reload Images Open Print Find Stop

Location: about:

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

Netscape Navigator (TM)

Version 2.02

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NETSCAPE

JAVA COMPATIBLE

Contains Java™ software developed by Sun Microsystems, Inc.

RSA PUBLIC KEY CRYPTOSYSTEM

Contains security software from RSA Data Security, Inc.

This version supports International security with RSA Public Key Cryptograph

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Java vs JavaScript

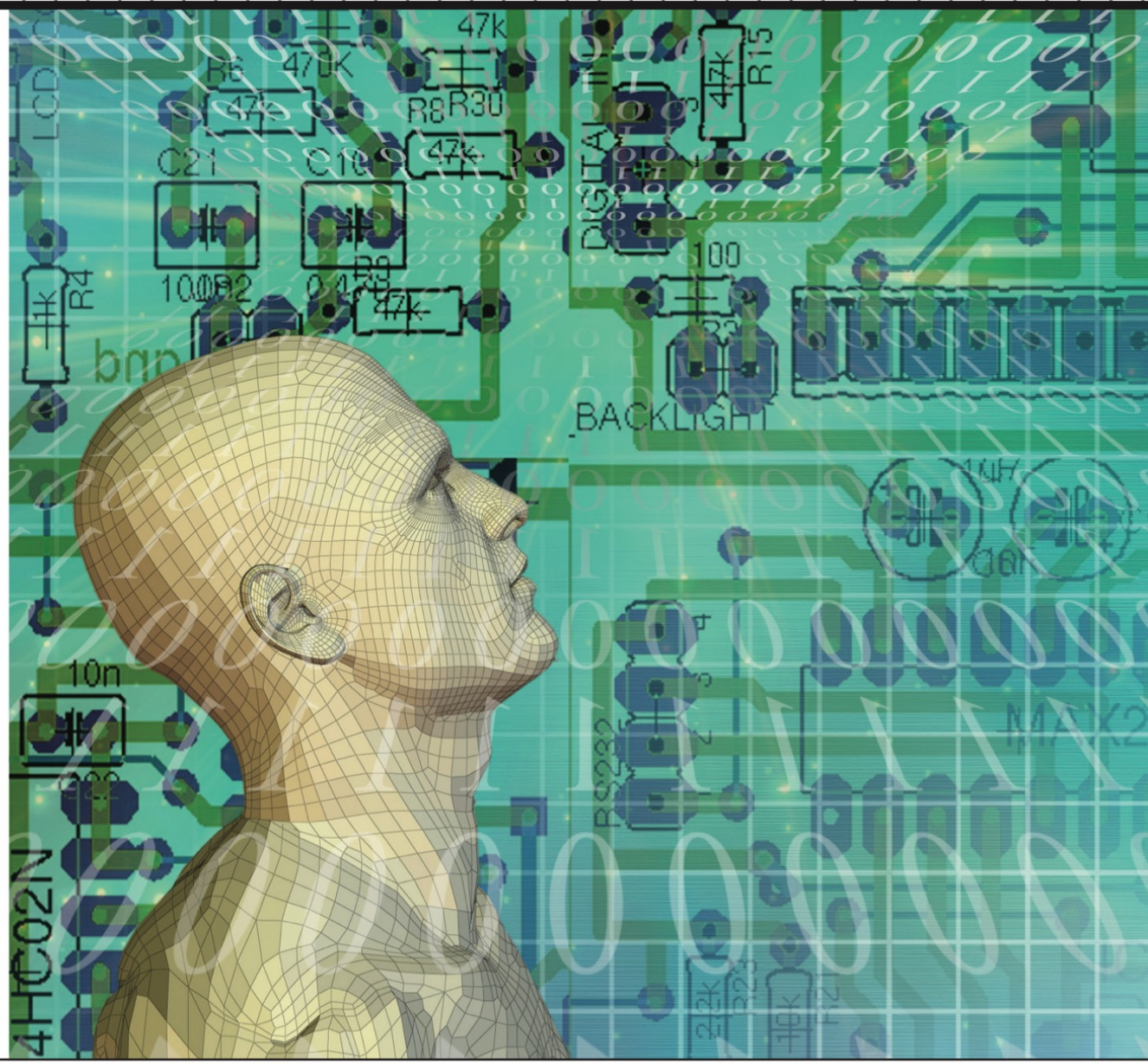
- Eich's script language had a somewhat similar syntax to Java

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

- No further relevance between Java and JavaScript!

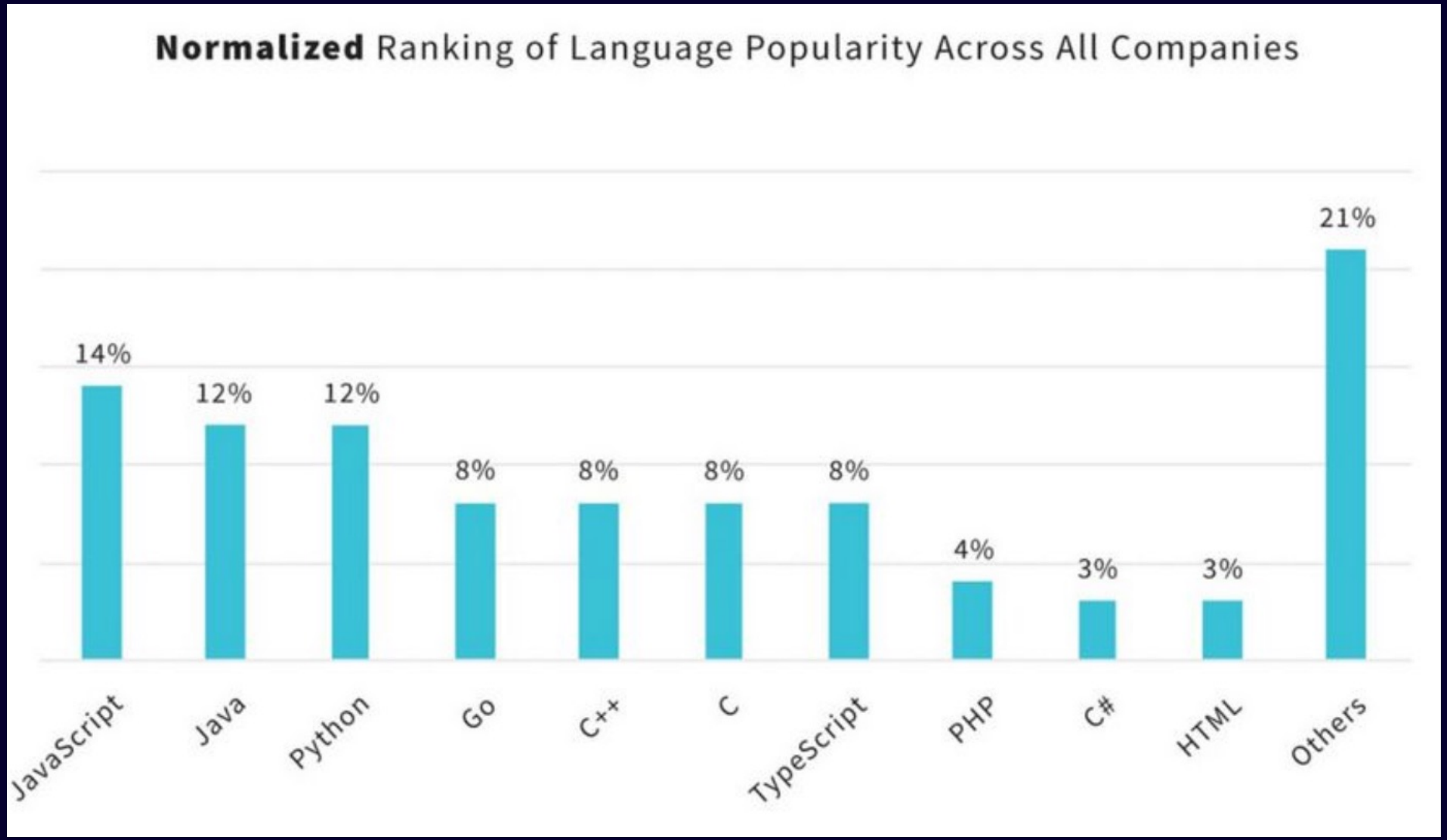
JavaScript: Designing a Language in 10 Days

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
- Almost all browsers have a JS interpreter
  - Run JS code accompanying the HTML (i.e., static files)
- Is it exclusive to client-side web applications?
- Answer: NO!
  - Example: NodeJS (more on that later)
  - Moreover, JS is just a language! You sort an array of integers with it

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;
```

- Looks like JSON, doesn't it?
  That's where the JS in JSON comes from

- 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 JS

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(index, name){
    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
```

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
}
```

Let vs var

- At global and function scopes, let and var work the same
- 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

Manipulating the web page

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

Where to put JS

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

- Inline JS:

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

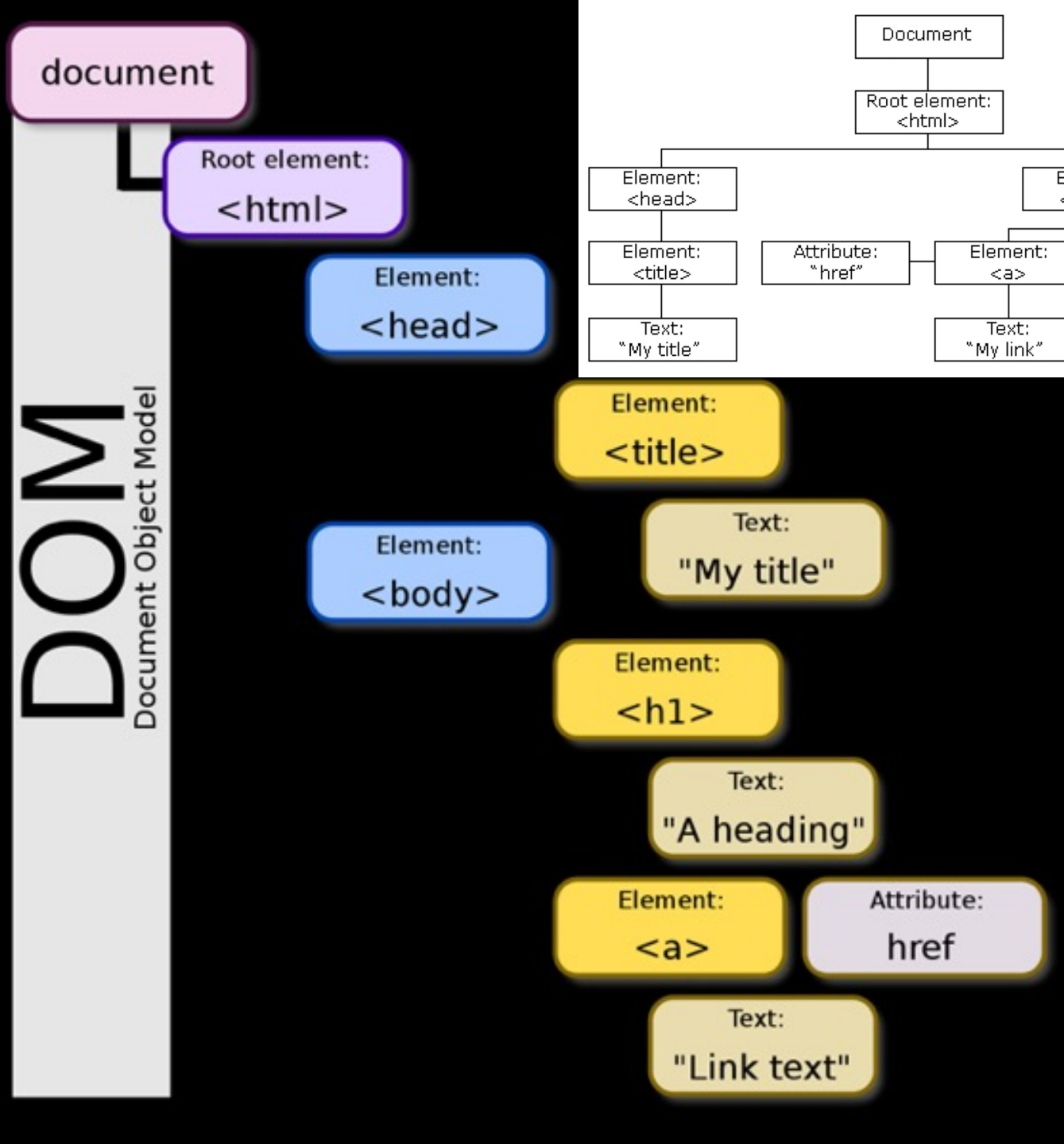
- JS file

```
<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(
                "body section:first-child > img")
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, onkeyup

- Element events

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

Events

- 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>
```

Exercise: A form with client-side validation

- Examples:

  Checks if a security question is answered correctly

  Checks if the email input is valid

  Checks password and repeat password are the same

- Errors should appear dynamically and disappear if user has fixed the issue

Asynchronous requests

Requests

- Currently, one main request is made to the server (upon entering the URL or submitting a form)
- Response is rendered and additional requests made by browser to fetch static data (js, css, images, fonts, etc.)
- This way entails a full reload for just one request!!

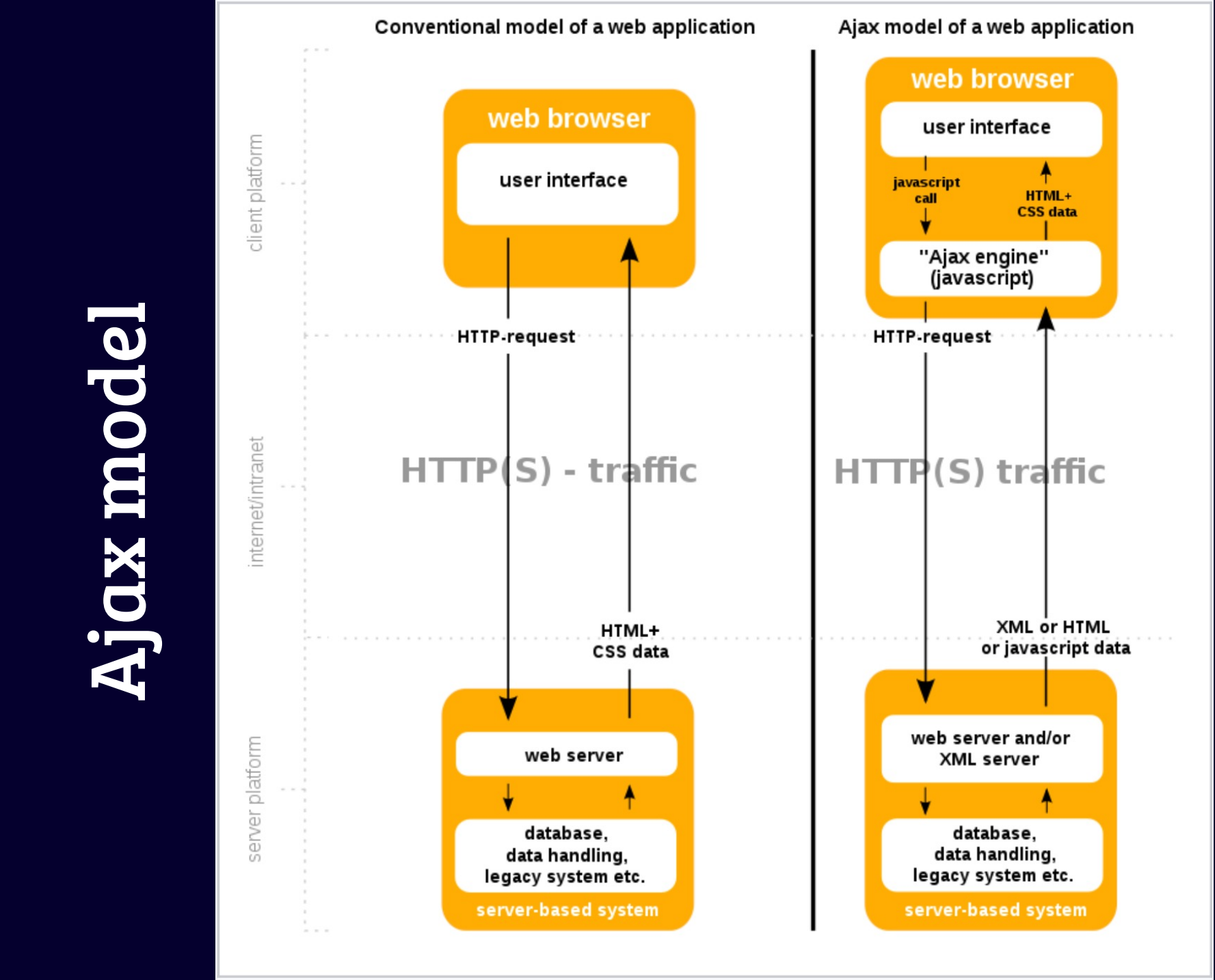
Solution

- Asynchronous JavaScript and XML (Ajax)

- Browser sends the request in background
  Does not block the main thread

- Response is handled by a series of events and callbacks
  Further changes are made to the document

Ajax model



Source: https://en.wikipedia.org/wiki/Ajax_(programming)

Why is it important

- Offers more control over the web page
  - You lose everything once the browser exits the current page!
- Most modern websites do not use the submit feature
  - Instead, they send an Ajax request and handle response
  - Client-side JS code redirects if necessary
- Basis for single-page frameworks like React

Sending an Ajax request

- Instantiate the request

```
let req = new XMLHttpRequest();
```

- Define a handler for onreadystatechange

```
req.onreadystatechange = function(){
    // Process the server response here.
};
```

- Set method & endpoint and send!

```
req.open("GET", "http://localhost/accounts/");
req.send();
```

Ajax Example

Visit https://www.w3schools.com/xml/ajax_intro.asp

```
<script>
function loadDoc() {
  var xhttp = new XMLHttpRequest();

  xhttp.onreadystatechange = function() {
    if (this.readyState == XMLHttpRequest.DONE && this.status == 200) {
      document.getElementById("demo").innerHTML = this.responseText;
    }
  };

  xhttp.open("GET", "ajax_info.txt");
  xhttp.send();
}
</script>
```

- You must always check if the ready state is DONE to access `responseText`
  - Other values: loading, loaded, interactive
- GET params are appended to the URL
- POST data is the body of HTTP request
  - Should be specified as the argument to `req.send()`
- Verbose, isn't it?
  - Everything with pure JS is verbose!
  - Next session, we will talk about a library that makes lives easier!

This session

- Intro to JavaScript
- DOM
- Getting and manipulating elements
- Asynchronous requests: Ajax

Next session

- Intro to jQuery

- Advanced JS (React prep)
  - Closure
  - Arrow functions
  - Promises

Final notes

- Project phase 2 due is next Friday
- Keep in mind what your front-end would look like
  Design your APIs based on that
- Very important to implement reasonable APIs
  Saves you a lot of time at phase 3 and front-end connection
- Sign up for mentor sessions for phase 2