Building User Interfaces

Javascript

An Introduction

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Disclaimer

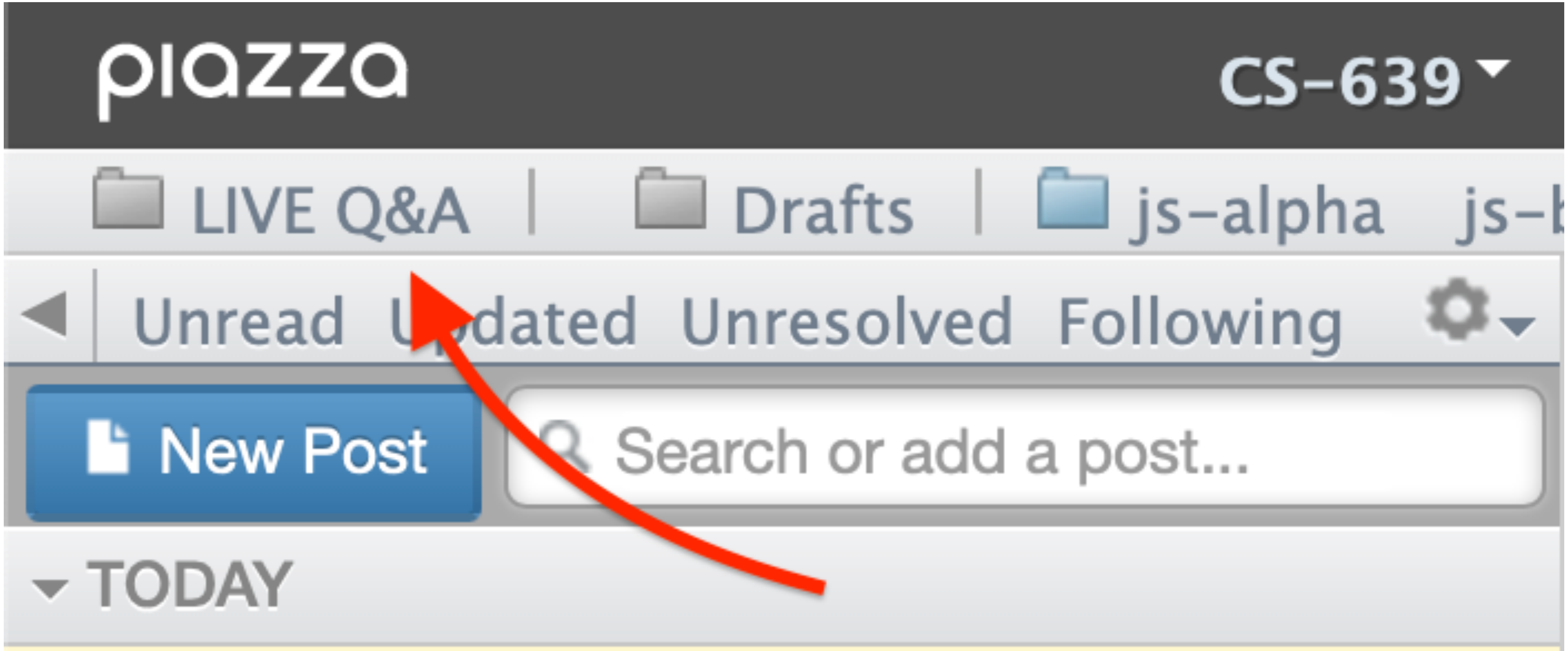
This is not a comprehensive introduction to JS, so below are links to great additional resources:

- MDN Web Docs
- DevDocs
- W3 Schools
- FreeCodeCamp

What we will learn today?

- History and overview of web programming
- Syntax, JS for Java developers
- Interacting with user-facing elements

Live Q&A Reminder



What we will you need?

- A modern web browser (developer tools enabled)
- A source-code editor (e.g., Visual Studio Code, Atom, Sublime Text)

A little bit of history

- JavaScript (JS) was developed by Netscape Communications (Brendan Eich) in 1995 to make the web more dynamic — a "glue language" for HTML — *Marc Andreessen*
- Mocha > LiveScript > JavaScript/VBScript > JScript (Microsoft)
- Client-side and server-side JS (e.g., Node.js)
- Standardization through ECMAScript (ES)[1]

This class

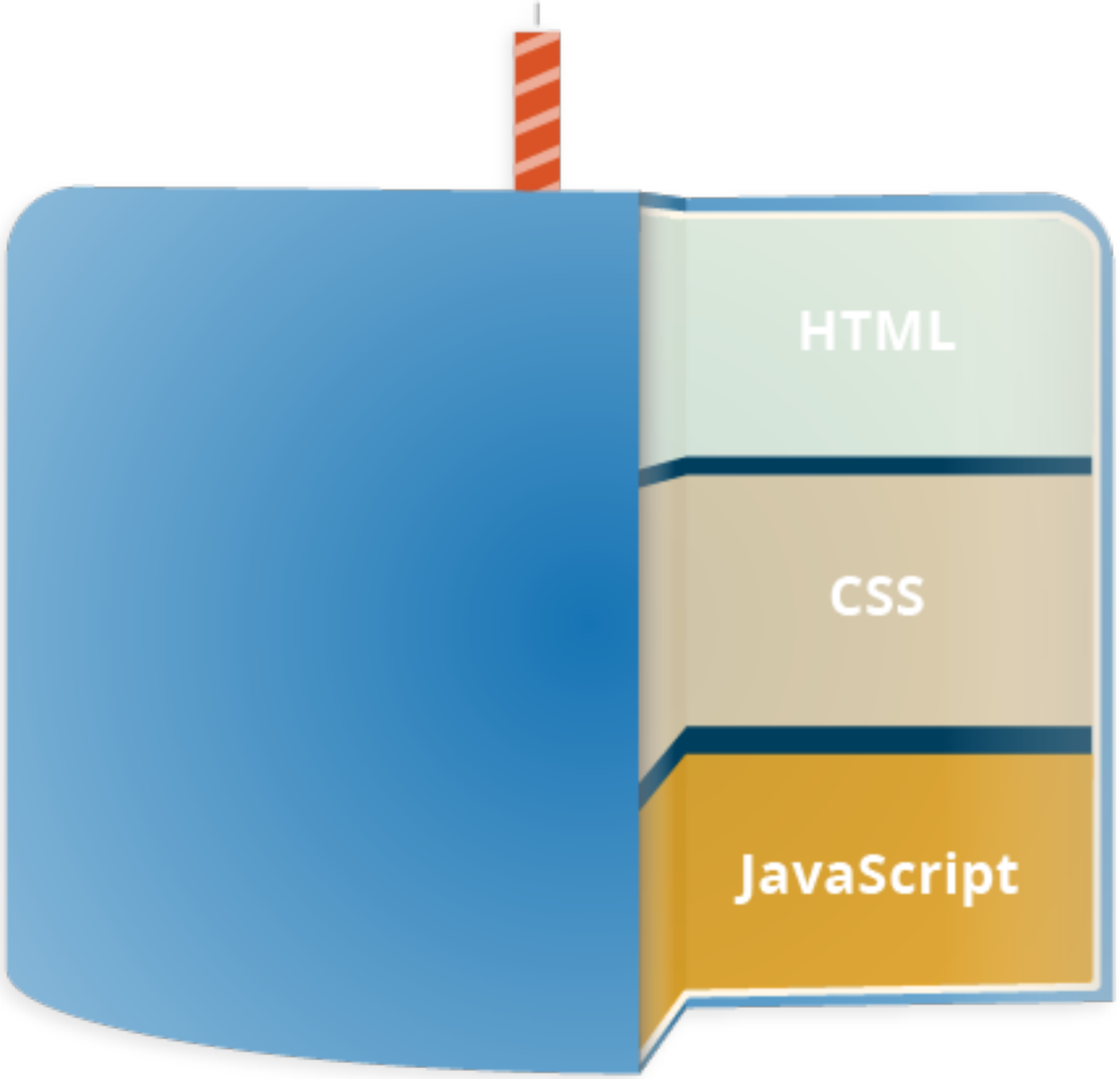
[1] The three layers of designing for the web

How does the "front-end" of the web work?

A three-layered cake:[1]

1. HTML: Base cake layer
2. CSS: Icing (appearance)
3. JS: Clown hidden in the cake

→ Behavior, interaction



[1] The three layers of designing for the web

Let's see an example

Consider the following *very* simple HTML page:

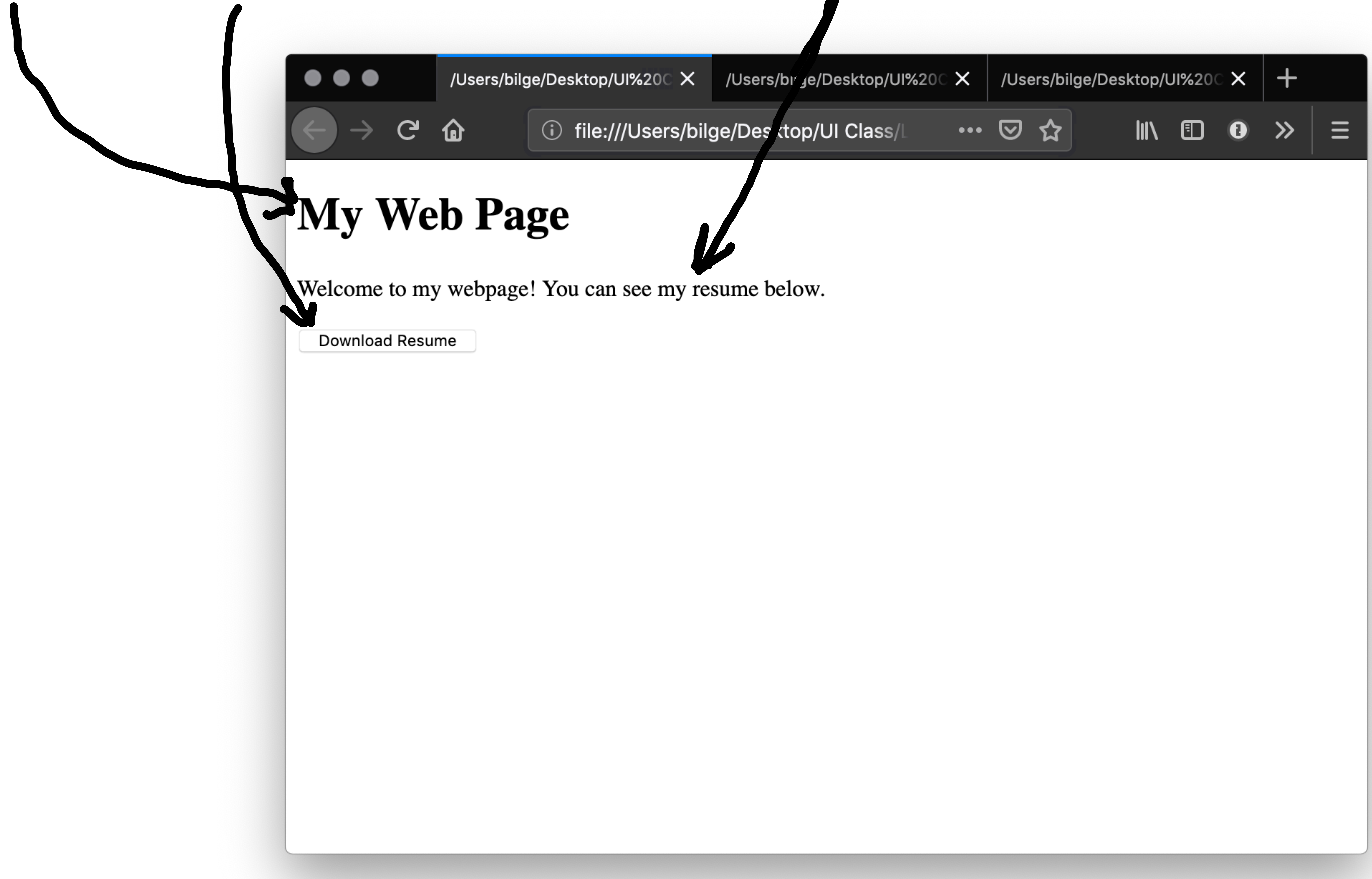
```
<!DOCTYPE html>
<html>
<head>
</head>
<body>

<h1>My Web Page</h1>

<p>Welcome to my webpage! You can see my resume below.</p>

<button>Download Resume</button>

</body>
</html>
```



/Users/bilge/Desktop/UI%20C
/Users/bilge/Desktop/UI%20C
/Users/bilge/Desktop/UI%20C
file:///Users/bilge/Desktop/UI Class/L

My Web Page

Welcome to my webpage! You can see my resume below.

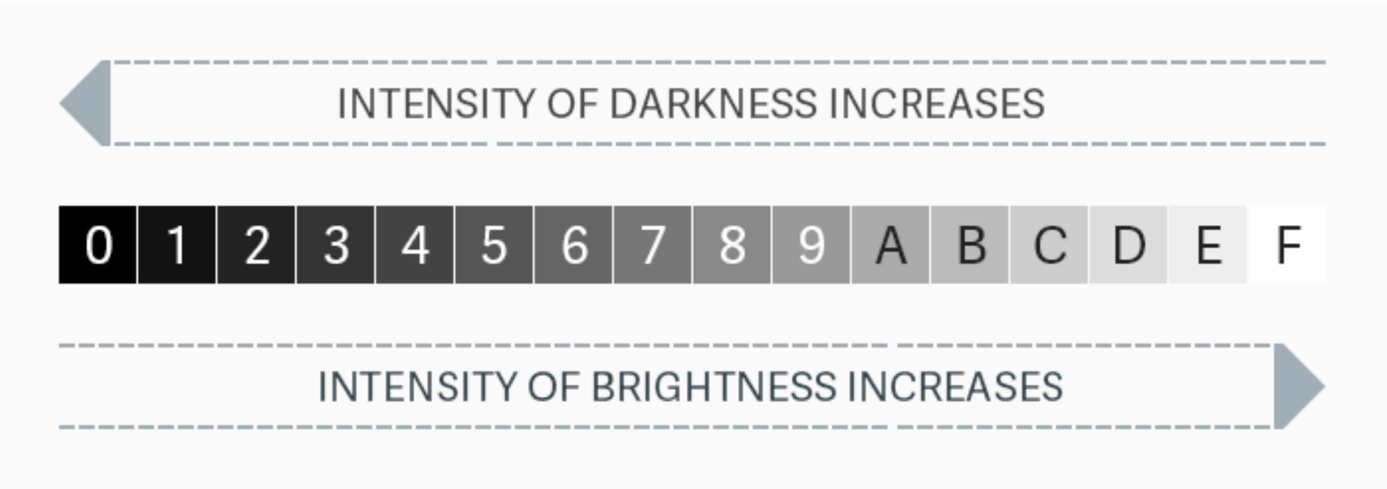
Let's improve its appearance. Within `head` and then `style`:

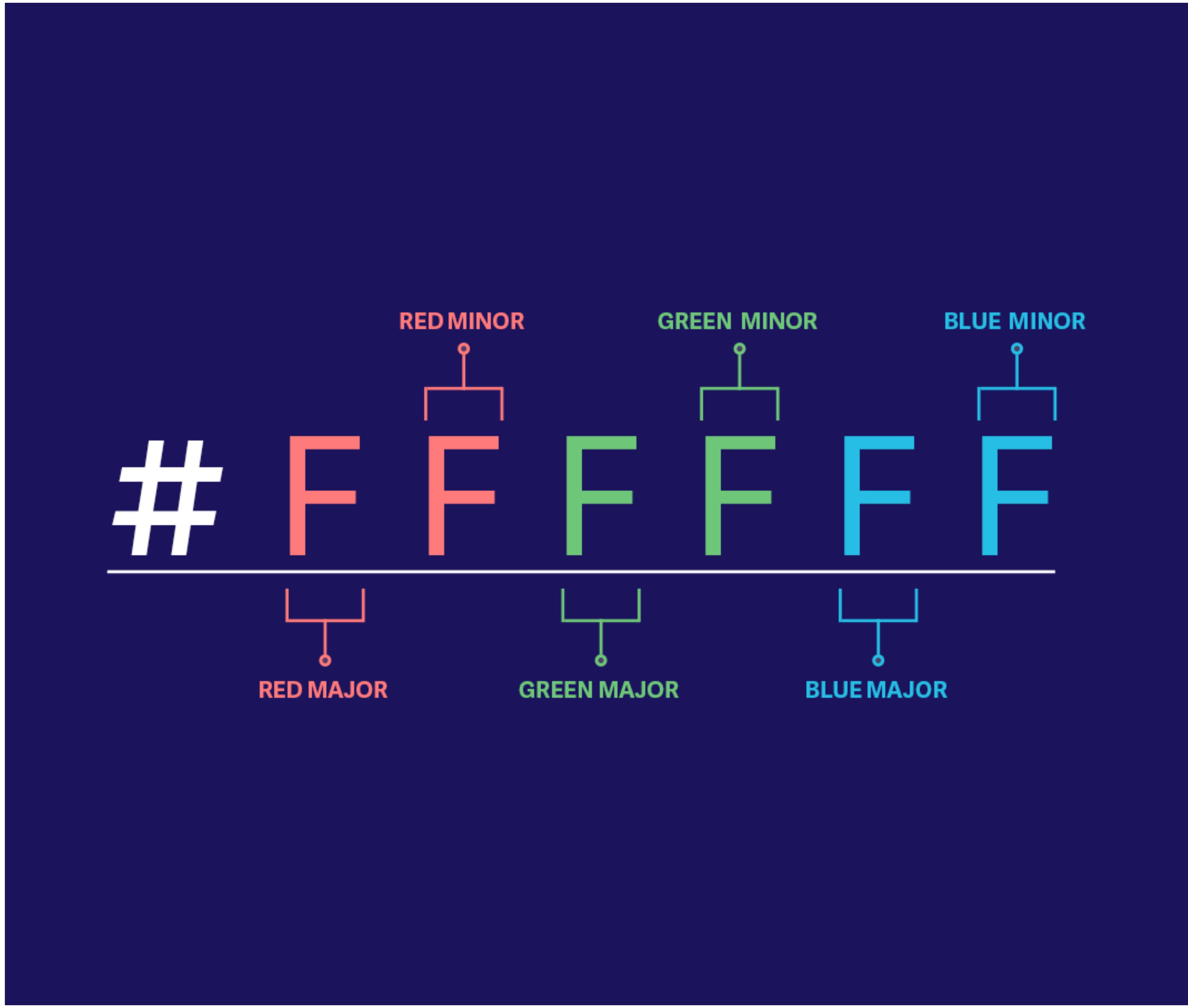
```
body {background-color: lightgrey;}
h1   {
    color: darkslategray;
    text-align: center;
    font-family: 'Gill Sans', 'Gill Sans MT', Calibri, 'Trebuchet MS', sans-serif}
p    {
    color: darkolivegreen;
    margin-left: 50px;
    margin-right: 50px;
    font-family: 'Gill Sans', 'Gill Sans MT', Calibri, 'Trebuchet MS', sans-serif}
button {
    background-color: darkolivegreen;
    border: none;
    color: white;
    padding: 15px 32px;
    text-align: center;
    display: inline-block;
    font-size: 16px;
    margin-left: 50px; margin-right: 50px;
    font-family: 'Gill Sans', 'Gill Sans MT', Calibri, 'Trebuchet MS', sans-serif}
```

Color = text color

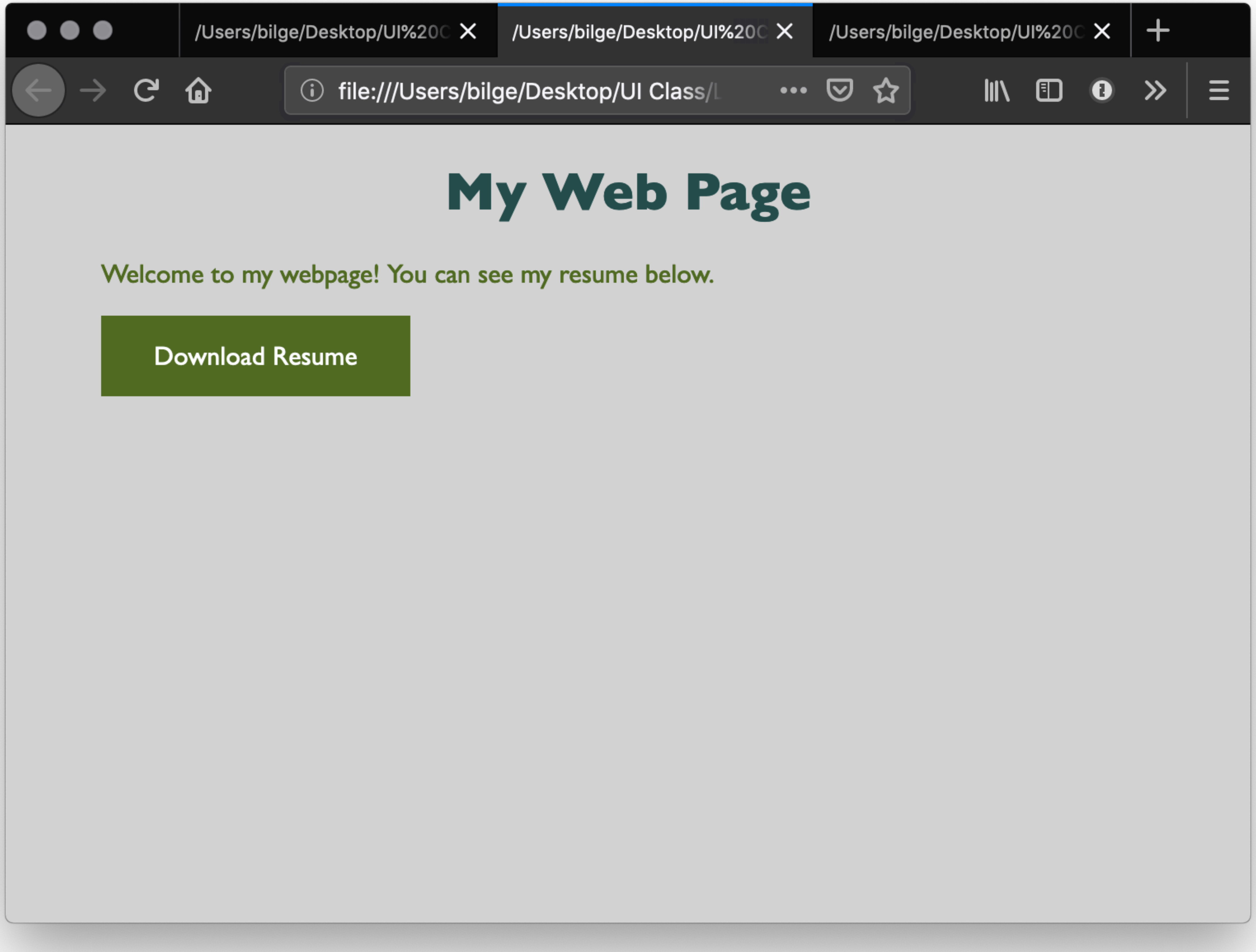
Detour: Specifying Color[2]

- RGB triplet, HEX triplet
- Majors > tone; minors > shade
- Values 0–9–A–F (16 values)
- Search for "hex color"


INTENSITY OF DARKNESS INCREASES
0
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
INTENSITY OF BRIGHTNESS INCREASES



[2] Nitish Khagwal


/Users/bilge/Desktop/UI%20C
/Users/bilge/Desktop/UI%20C
/Users/bilge/Desktop/UI%20C
file:///Users/bilge/Desktop/UI Class/L

My Web Page

Welcome to my webpage! You can see my resume below.

Let's add some *minor* interactivity. Within `head` and then `script`:

```
function myFunction() {
    document.getElementById("message").innerHTML = "Downloading...";
}
```

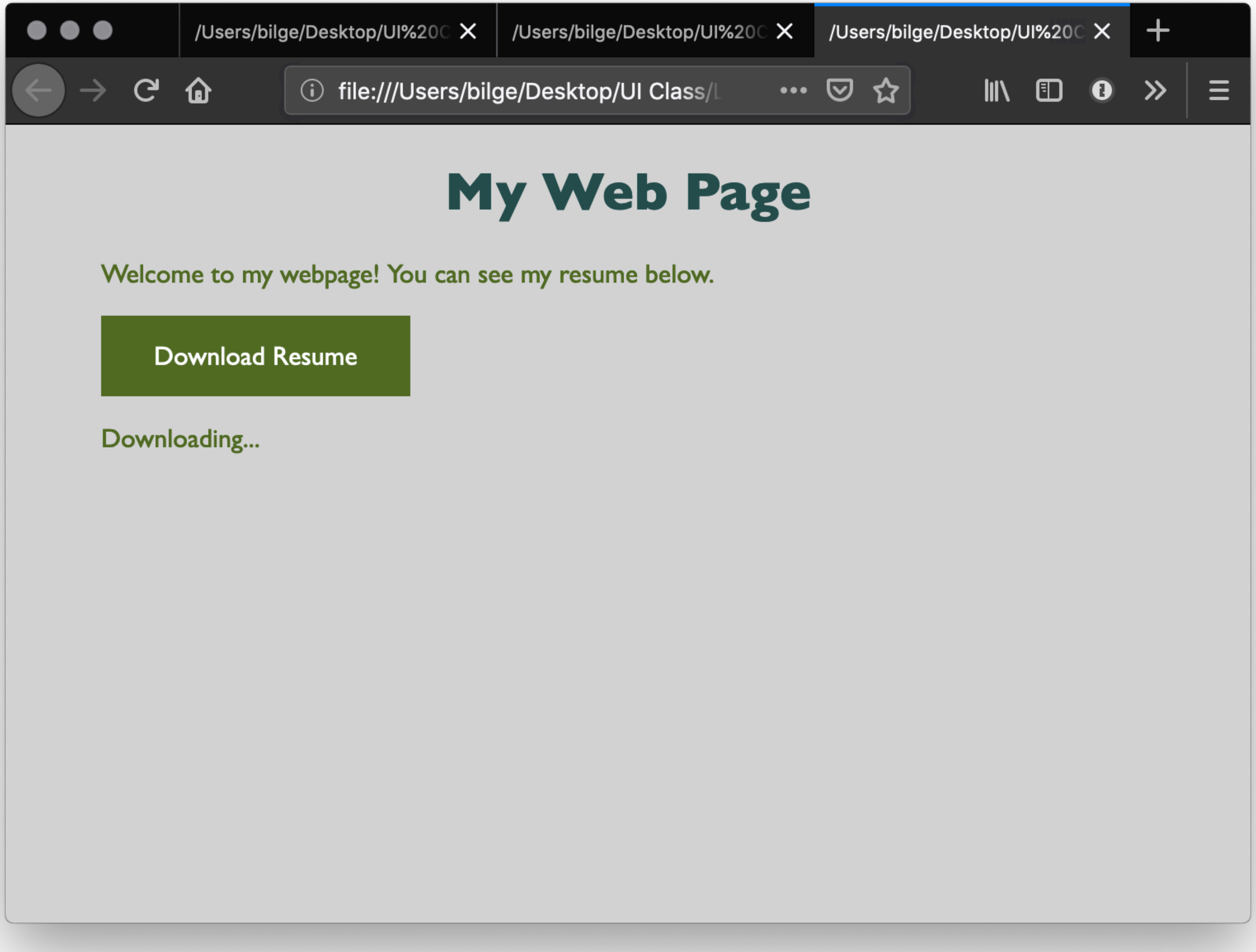
Grab object

Modify HTML content

Then within `body`:

```
<button onclick="myFunction()">Download Resume</button>

<p id="message"></p>
```



/Users/bilge/Desktop/UI%20C
/Users/bilge/Desktop/UI%20C
/Users/bilge/Desktop/UI%20C
file:///Users/bilge/Desktop/UI Class/L

My Web Page

Welcome to my webpage! You can see my resume below.

Downloading...

Quiz 1

Complete the Canvas quiz.

How does JS interact with the page?

1. Internal JS → within HTML
2. External JS → separate file
3. Inline JS handler → within HTML tag

Internal JS

Internal JS is included within the HTML inside `<script>` tags.

```
<head>
    <script>
        // JS goes here
    </script>
</head>
```

External JS

Create a `script.js` file, which will contain your JS code, and include the filed within `head`:

↳ of HTML file

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

Here, `defer` indicates that `script.js` should be executed *after* the page is parsed.

Inline JS handlers (not a good idea)

```
<button onclick="myFunction()">Download Resume</button>
```

Pro Tip 1: In general, inline JS handlers result in inefficient and unorganized code.

Pro Tip 2: Different loading strategies are used for internal JS (listening for `DOMContentLoaded` event; including `script` after the page content) and external JS (`defer` and `async` attributes).

How is JS interpreted?

- All modern browsers have a JS engine, e.g., v8, SpiderMonkey[3]
- Node.js encompasses v8 within a C++-based environment to compile JS outside the browser[4]
- In this class, we will exclusively work within the browser environment

[3] List of ECMAScript engines

[4] Node.js

How do I start JS development?

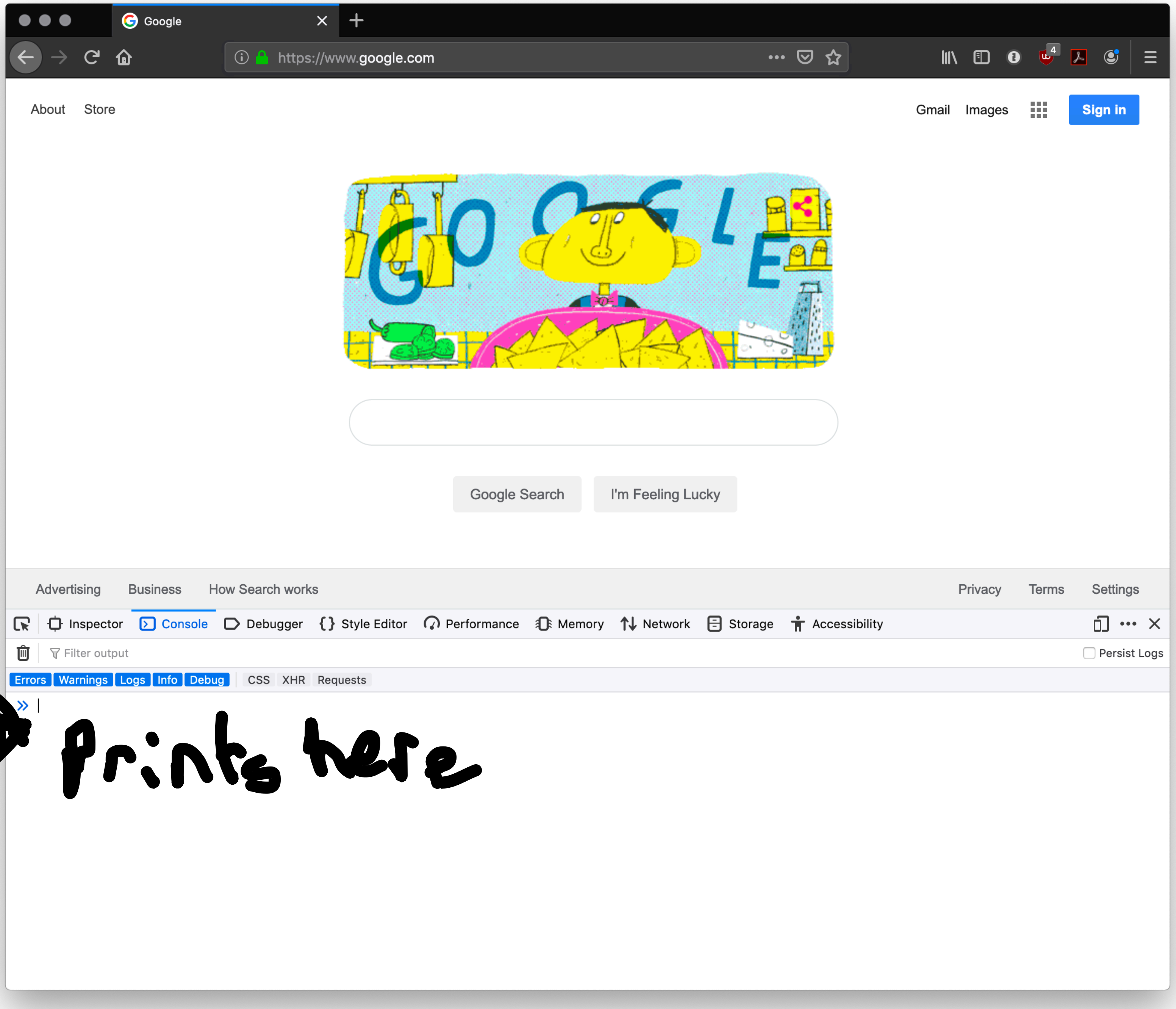
1. In the **browser** — best for testing ideas, code, etc.
2. In a **coding environment** — best for application development

Running JS in the browser

`Ctrl-Shift-K` or `Command-Option-K`

Try out:

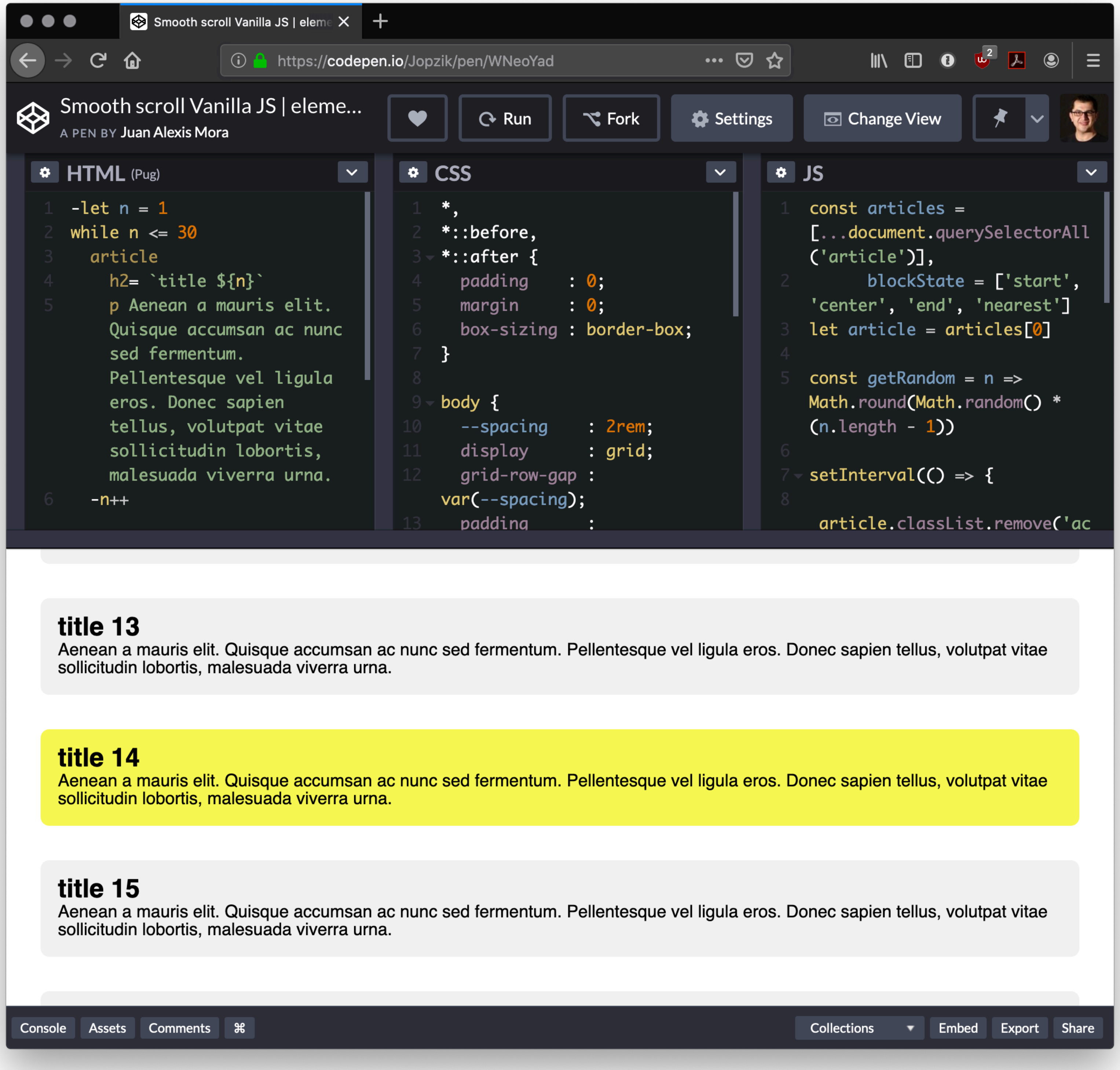
```
console.log("On Wisconsin!")
```



Prints here

Running JS in an online sandbox

- https://codepen.io/
- https://codesandbox.io/
- https://glitch.com/
- https://playcode.io/
- https://jsfiddle.net/
- https://jsbin.com/


Smooth scroll Vanilla JS | eleme
https://codepen.io/Jopzik/pen/WNeoYad
Smooth scroll Vanilla JS | eleme...
A PEN BY Juan Alexis Mora
Run
Fork
Settings
Change View
HTML (Pug)
CSS
JS
Console
Assets
Comments
⌘
Collections
Embed
Export
Share

```
-let n = 1
while n <= 30
  article
    h2= `title ${n}`
    p Aenean a mauris elit.
    Quisque accumsan ac nunc
    sed fermentum.
    Pellentesque vel ligula
    eros. Donec sapien
    tellus, volutpat vitae
    sollicitudin lobortis,
    malesuada viverra urna.
  -n++
```

```
*,
*::before,
*::after {
  padding    : 0;
  margin     : 0;
  box-sizing : border-box;
}

body {
  --spacing    : 2rem;
  display      : grid;
  grid-row-gap :
var(--spacing);
  padding      :
```

```
const articles =
[...document.querySelectorAll
('article')],
      blockState = ['start',
'center', 'end', 'nearest']
let article = articles[0]

const getRandom = n =>
Math.round(Math.random() *
(n.length - 1))

setInterval(() => {

  article.classList.remove('ac
```

title 13
Aenean a mauris elit. Quisque accumsan ac nunc sed fermentum. Pellentesque vel ligula eros. Donec sapien tellus, volutpat vitae sollicitudin lobortis, malesuada viverra urna.

title 14
Aenean a mauris elit. Quisque accumsan ac nunc sed fermentum. Pellentesque vel ligula eros. Donec sapien tellus, volutpat vitae sollicitudin lobortis, malesuada viverra urna.

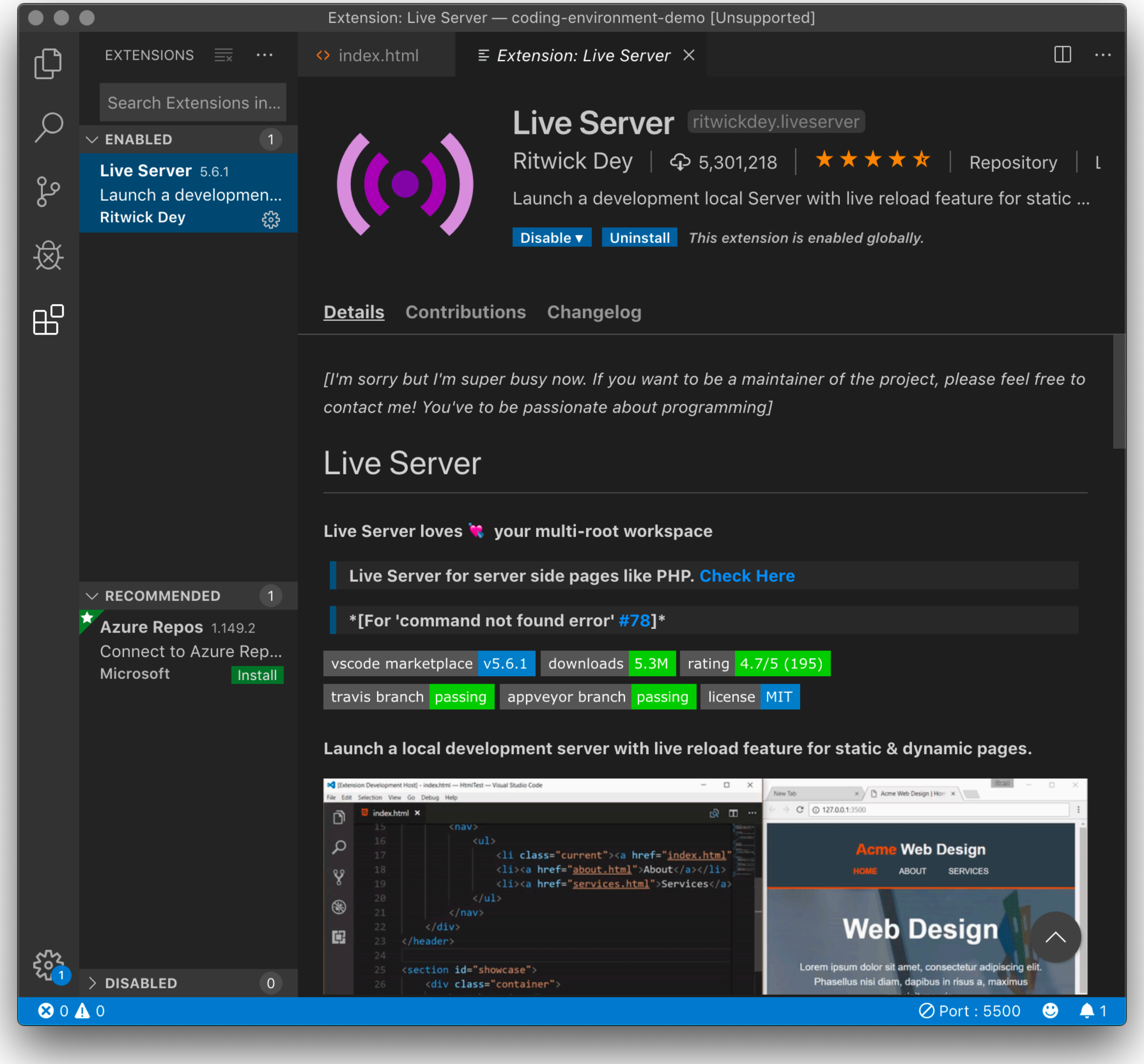
title 15
Aenean a mauris elit. Quisque accumsan ac nunc sed fermentum. Pellentesque vel ligula eros. Donec sapien tellus, volutpat vitae sollicitudin lobortis, malesuada viverra urna.

Running JS in a coding environment

If you are using VS Code install *Live Server*, start a simple HTML file, and try adding:

```
<script>alert("On Wisconsin");</script>
```

http://127.0.0.1:5500/index.html



Live Server ritwickdey.liveserver

Ritwick Dey | 5,301,218 | ★★★★★ | Repository

Launch a development local Server with live reload feature for static ...

This extension is enabled globally.

[I'm sorry but I'm super busy now. If you want to be a maintainer of the project, please feel free to contact me! You've to be passionate about programming]

Live Server

Live Server loves 💘 your multi-root workspace

Live Server for server side pages like PHP. Check Here

[For 'command not found error' #78]

vscode marketplace	v5.6.1	downloads	5.3M	rating	4.7/5 (195)
travis branch	passing	appveyor branch	passing	license	MIT

Launch a local development server with live reload feature for static & dynamic pages.

What is this "TypeScript" I hear about?

Definition: TypeScript is a strict syntactical superset of JS developed to enable the development of large-scale applications and to add *static typing* (ensuring type safety).

Alternatives: CoffeeScript, LiveScript, Babel

Preprocessors compile code written in TS, CS, LS, and Babel into JS that can be executed by a JS engine.

TypeScript code: Strict typing

```
var peerMentors: string[] = ['Sanjana', 'Vera'];
var firstPeerMentor: string = array[0];
```

Compiles into JS code: Loose typing

```
var peerMentors = ['Sanjana', 'Vera'];
var firstPeerMentor = array[0];
```

Syntax, JS for Java Developers

Variables

Definition: Variables are *containers* that hold reusable data.

- ES6 defines seven standard data types: *numbers, string, boolean, null, undefined, symbol, object*
- JS is a dynamically, or loosely, typed language, and data type is inferred from the declaration and can be changed over time — Let's try!

Consider the following three variable containers:

```
var userName = "Jack";
let userName = "Jill";
const interestRate = 4.25;
```

- — `var` and `let` work identically but have different *scopes*
- — `var` declares a variable that is globally accessible
- — `let` declares a variable that is only accessible within the current block, e.g., a `for` loop
- — `const` declares a variable that is unchangeable — Let's try!

* var scope > let scope *

- JS has a flexible and powerful declaration syntax, for example:

```
var firstName = "Cole", lastName = "Nelson", age = 26;
var firstName = "Cole",
lastName = "Nelson",
age = 26;
var fullName = firstName + " " + lastName;
```

- Because JS is dynamically typed, you can query the data type:

```
typeof firstName;
"string"
```

Quiz 2

Complete the Canvas quiz.

Objects

Definition: Objects are unordered collections of related data of primitive or reference types — defined using `key: value` statements.

```
var teachingAssistant = {
    firstName: "John",
    lastName: "Balis",
    age: 24
}
```

Keys

Values

```
teachingAssistant;
> {firstName: "John", lastName: "Balis", age: 24}
```

Object Properties

Different notations to access object properties:

```
teachingAssistant.lastName;
> "Balis"

teachingAssistant["lastName"];
> "Balis"

let userFocus = "lastName";
teachingAssistant[userFocus];
> "Balis"
```

Arrays

Definition: An array is a variable that contains multiple elements.

- Like variables, arrays are also dynamically typed.
- JS arrays can contain elements of different types.

```
var myGradStudents = ["Andy", "David", "Laura"];
myGradStudents[3] = "Nathan";
myGradStudents;
> ["Andy", "David", "Laura", "Nathan"]

myGradStudents[4] = 4;
myGradStudents;
> ["Andy", "David", "Laura", "Nathan", 4]
```

very flexible in Javascript

Functions[5]

Definition: A procedure that includes a set of statements that performs a task or calculates a value. The function must be defined and called within the same scope.

Functions can be used to perform specific tasks.

```
function fahrenheitToCelcius(temperature) {
    return (temperature - 32) * 5/9;
}

fahrenheitToCelcius(77);
> 25
```

[5] Functions

Functions can also serve as methods associated with objects.

```
var latestWeatherReport = {
    temperature: 77,
    humidity: 64,
    wind: 6,
    celcius: function() {
    return (this.temperature - 32) * 5/9;
    }
}

latestWeatherReport.temperature;
> 77

latestWeatherReport.celcius();
> 25
```

Anonymous functions

Definition: Anonymous functions are declared without named identifiers that refer to them.

used all the time in practice

Form 1:

```
var firstItem = function (array) {return array[0]};
```

Form 2 ("arrow" functions[6]):

```
const firstItem = array => return array[0];
```

[6] Zen Dev

Declared vs. Anonymous[7]

Advantages of *declared* and *anonymous* functions are:

Named	Anonymous
Debugging	Scope
Recursion	Brevity

[7] Scott Logic

Conditionals

Definition: Conditionals allow the code to make decisions and carry out different actions depending on different inputs.

Three types:

1. `if...else` statements
2. `switch` statements
3. Ternary operator

Comparison and logical operators

- `===` and `!==` (identical to/not identical *objects*)
- `==` and `!=` (identical to/not identical *values*)
- < and > (less/greater than)
- <= and => (less/greater than or equal to)
- `&&` (AND)
- `||` (OR)

Example *object* comparison:

```
var ta1 = { name: "Derek" };
var ta2 = { name: "Cole" };
console.log(ta1 === ta2);
> false
```

Same object?

Example *value* comparison:

```
var ta1 = { name: "John" };
var ta2 = { name: "John" };
console.log(ta1.name == ta2.name);
> true
```

Same value?

Pro Tip: In JS, any value that is not `false`, `undefined`, `null`, `0`, `NaN`, or "" returns `true`.

```
var currentMember = false;

if (currentMember) {
  para.textContent = 'Sign In';
} else {
  para.textContent = 'Sign Up';
}
> Sign up
```

We don't need to explicitly specify `=== true`.

`if...else` statements[8]

```
<select id="sign">
  <option value="">--Make a choice--</option>
  <option value="illinois">Illinois</option>
  <option value="indiana">Indiana</option>
...
```

```
var select = document.querySelector('select');
var para = document.querySelector('p');

select.addEventListener('change', setSign);

function setSign() {
  var choice = select.value;
  var messageText = 'Current mortgage loan rate is ';
// Data from https://www.astrology.com/horoscope/daily.html
  if (choice === 'illinois') {
    para.textContent = messageText + 4.50 + '%';
  } else if (choice === 'indiana') {
    para.textContent = messageText + 3.50 + '%';
...
```

Values
From HTML

[8] See in JSFiddle

```
var select = document.querySelector('select');
var para = document.querySelector('p');

select.addEventListener('change', setSign);

function setSign() {
  var choice = select.value;
  var messageText = 'Current mortgage loan rate is ';
  if (choice === 'illinois') {
    para.textContent = messageText + 4.50 + '%';
  } else if (choice === 'indiana') {
    para.textContent = messageText + 3.50 + '%';
...
```

Ternary operator

Definition: An operator that tests a condition and returns one output if `true` and another if it is `false`.

Prototype:

```
( condition ) ? doSomething : doSomethingElse;
```

Example:

```
(currentMember) ? para.textContent = 'Sign In' : para.textContent = 'Sign Up';
```

Looping

Definition: Executing one or more statements repeatedly until certain conditions are met. To express a loop, we need a counter, an exit condition, and an iterator.

A `for` loop:

```
for (initializer; exit-condition; final-expression) {
  // statement
}
```

`while` and `do...while` loops:

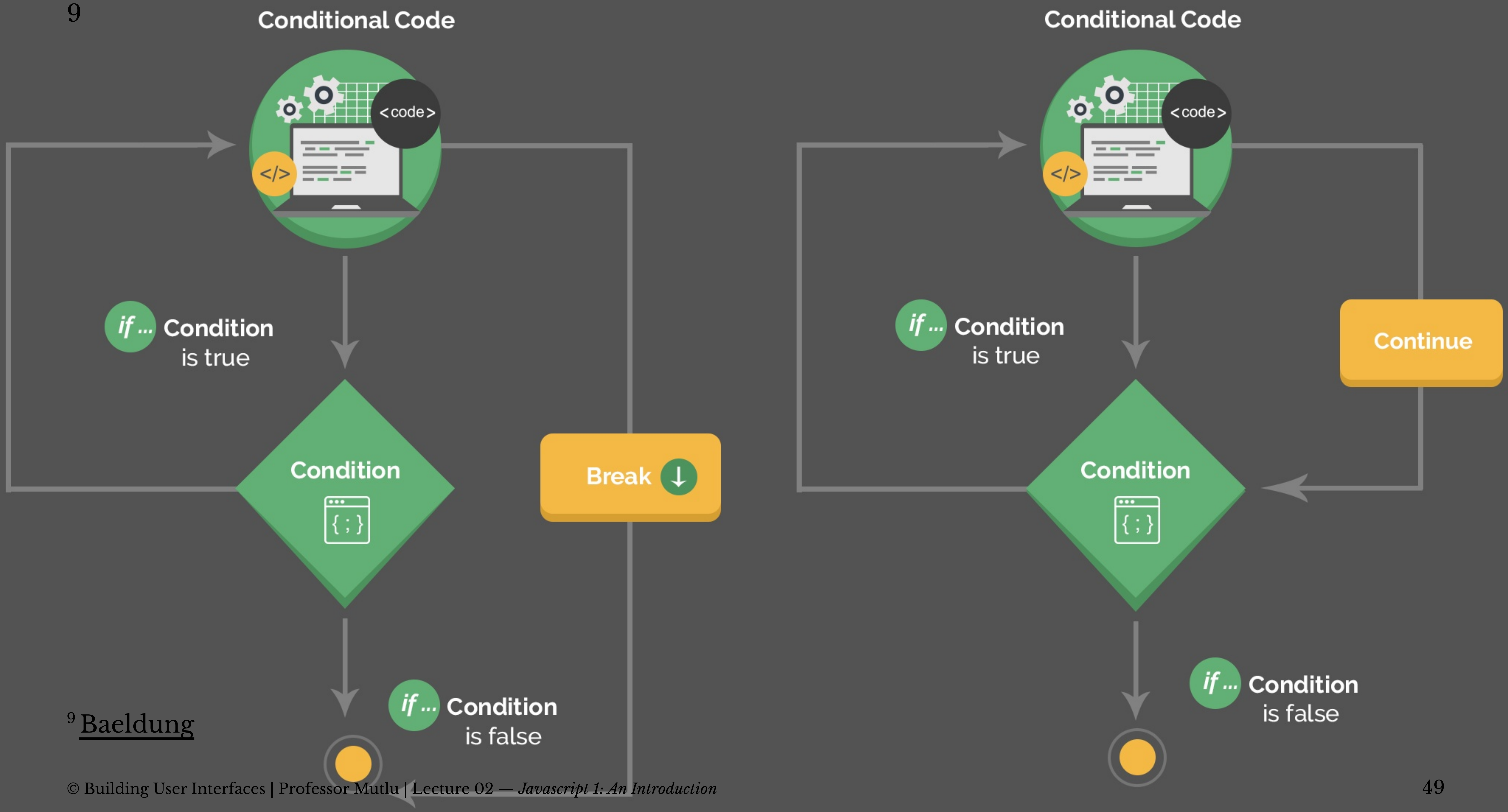
```
initializer
while (exit-condition) {
  // statement
  final-expression
}

initializer
do {
  // statement
  final-expression
} while (exit-condition)
```

Exiting loops, skipping iterations

```
for (initializer; exit-condition; final-expression) {
  // statement
  if (special-condition-exit) { break; }
    if (special-condition-skip) { continue; }
    // statement
}
```

[9]


Conditional Code
<code>
</>
if … Condition is true
Condition
{ ; }
Break
if … Condition is false
Conditional Code
<code>
</>
if … Condition is true
Continue
Condition
{ ; }
if … Condition is false

[9] Baeldung

Quiz 3

Complete the Canvas quiz.

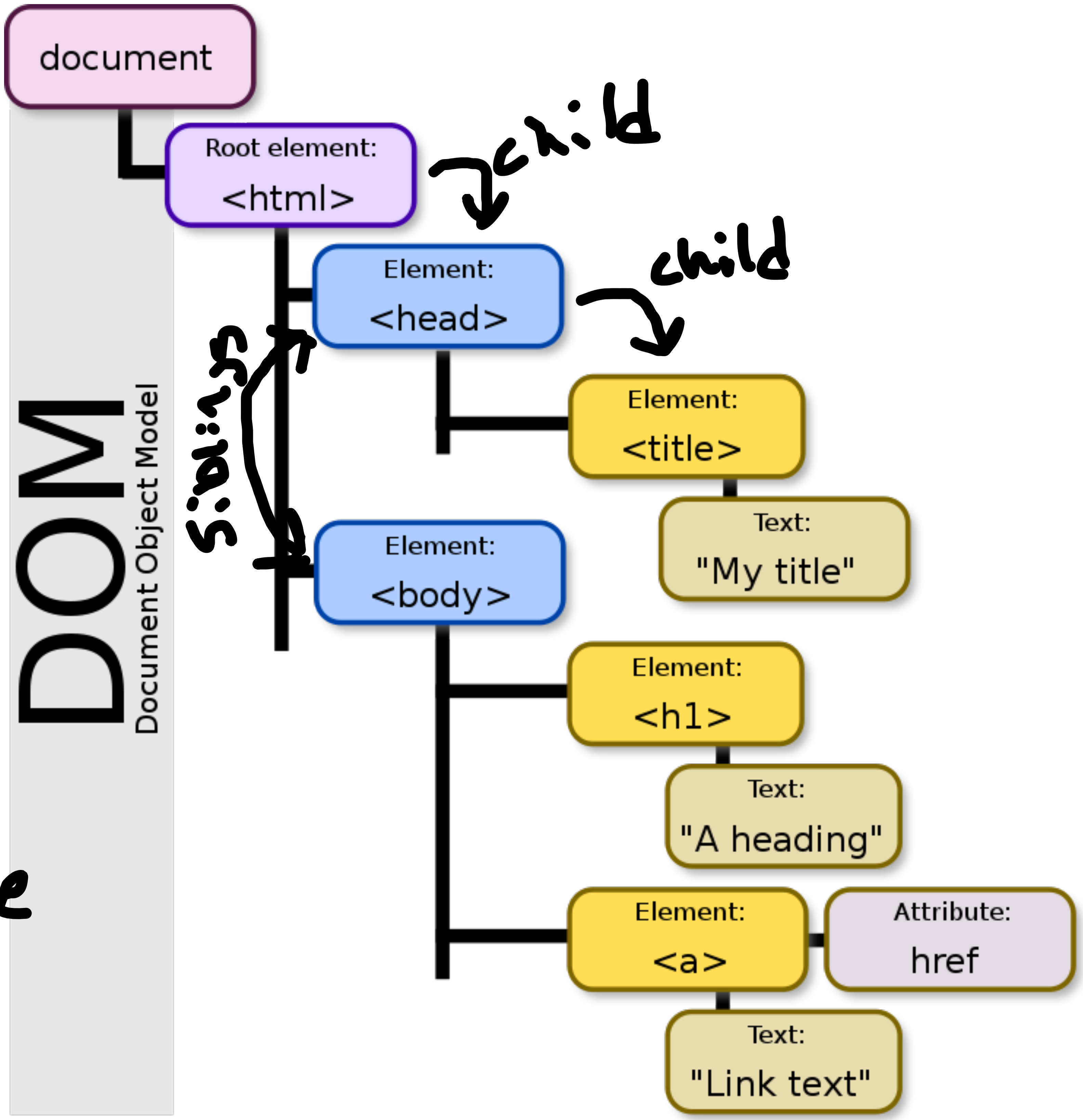
Interacting with User-facing Elements

Document Object Model[10]

Definition: Document Object Model (DOM) translates an HTML or XML document into a tree structure where each node represents an object on the page.

This is great news for us, because JS can interact with this structure.

modify, create, remove elements



[10] Wikipedia: DOM

DOM Programming Interface

- **Objects:** HTML elements, such as a paragraph of text.
- **Property:** Value that we can get or set, such as the `id` of an element.
- **Method:** An action we can take, such as adding or deleting an HTML element.

For JS to interact with user-facing elements, we first need to access them...

Accessing HTML elements

Most common way of accessing content is `getElementById()`.

```
<p id="userName"></p>
```

id's are unique (modify a single element)

```
<script>
    document.getElementById("userName").innerHTML = "Cole Nelson";
</script>
```

Get object

modify property

We can also find elements using tag name, class name, CSS selectors, and HTML object collections.

Manipulating HTML elements

Changing content:

```
document.getElementById("userName").innerHTML = "cnelson";
```

Changing attributes:

```
document.getElementById("userImage").src = "Headshot.png";
document.getElementById("userName").style.color = "red";
```

DOM Events

Now things are heating up! 🔥

HTML monitors events...

DOM provides access to HTML events: `onclick`, `onload`, `onunload`, `onchange`, `onmouseover`, `onmouseout`, `onmousedown`, `onmouseup`, `formaction`.

Three ways of registering functions to events:

... JavaScript can access these events

1. Inline event handlers
2. DOM on-event handlers
3. Using event listeners

Inline Event Handlers

Prototype:

"call this function"

```
<button id="id-name" onclick="function();">Button name</button>
```

Example:

```
<p id="currentTemp">77</p>
<button id="convertButton" onclick="convertTemp();">Convert to Celcius</button>

<script>
    function convertTemp() {
        document.getElementById("currentTemp").innerHTML
        = (document.getElementById("currentTemp").innerHTML - 32) * 5/9; }
</script>
```

DOM on-event Handlers

Prototype:

Defined within script

```
<script>
    document.getElementById("button").onclick = doSomething();
</script>
```

Example:

```
<p id="currentTemp">77</p>
<button id="convertButton">Convert to Celcius</button>

<script>
    document.getElementById("convertButton").onclick = convertTemp;
    function convertTemp() {
        document.getElementById("currentTemp").innerHTML = (document.getElementById("currentTemp").innerHTML - 32) * 5/9; }
</script>
```

Using Event Listeners (preferred)

Prototype:

```
document.getElementById("button").addEventListener("click", function(){ doSomething() });
```

Grab element

type of event

function to run on event

Example:

```
<p id="currentTemp">77</p>
<button id="convertButton">Convert to Celcius</button>
<script>
    document.getElementById("convertButton").addEventListener("click", function(){ convertTemp() });

    function convertTemp() {
        document.getElementById("currentTemp").innerHTML
        = (document.getElementById("currentTemp").innerHTML - 32) * 5/9;
    }
</script>
```

Pro Tip: When we add event listeners, we are assigning a function to a handler for the handler to execute the function when needed, not calling the function right there.

Do not:

```
document.getElementById("button").addEventListener("click", doSomething() );
```

Do:

```
document.getElementById("button").addEventListener("click", function(){ doSomething() });
```

Define code that will be executed

"Bookmark"

Pro Tip: *Listeners* are the most efficient way to manage events.[11][12]

```
<button>A</button>
<button>B</button>
<button>C</button>
<script>
  document.body.addEventListener("click", event => {
    if (event.target.nodeName == "BUTTON") {
      console.log("Clicked", event.target.textContent);
    }
  });
</script>
```

[11] Eloquent JavaScript

[12] See in CodePen

Quiz 4

Complete the Canvas quiz.

What did we learn today?

- History and overview of web programming
- Syntax, JS for Java developers
- Interacting with user-facing elements