

FRONTEND DEVELOPMENT WINTERSEMESTER 2020

ABOUT/CONTACT

- » Thomas Mayrhofer (@webpapaya)
- » E-Mail: tmayrhofer.1ba@fh-salzburg.ac.at

ROADMAP

- » 5.11. 4 EH
 - » JS History Intro etc.
 - » Modules
 - » build setup
- » 11.11. 2EH
 - » Asynchronous JS
- » 24.11. 2EH
 - » ES 6

ROADMAP

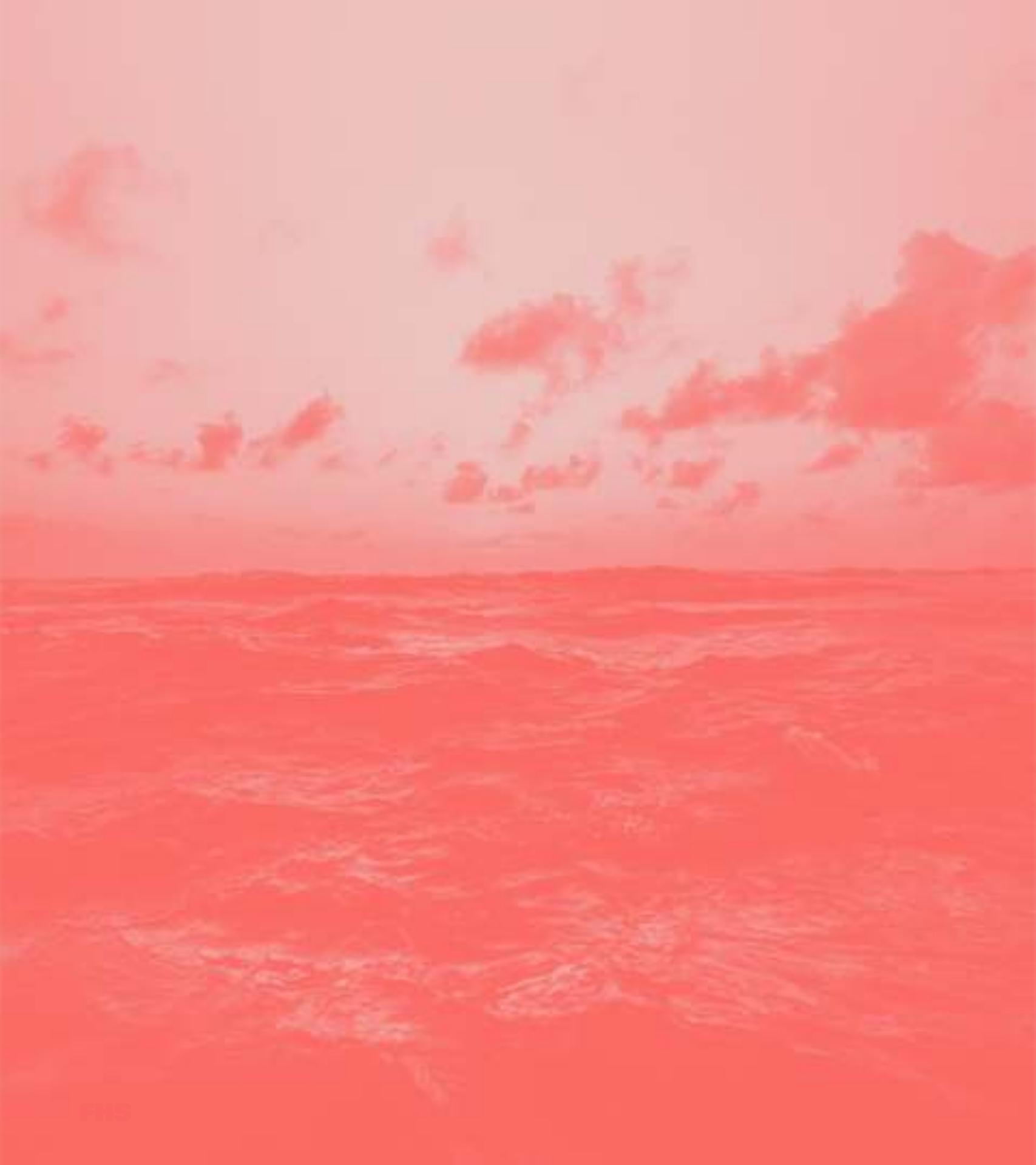
- » 3.12. 2EH
 - » Single Page App Routing
- » 17.12. 3EH
 - » JS Build tools
- » 22.12. 2EH
 - » Recap
 - » Gimme your questions!

GRADING

- » 50% Homework
- » 50% Exam (Date will be sent to you)
- » Both positive

HOMEWORK

- » can be done in pairs
- » hand-in via email
`tmayrhofer.lba@fh-salzburg.ac.at`
- » email contains link to git repository
- » name of students who worked on the assignment



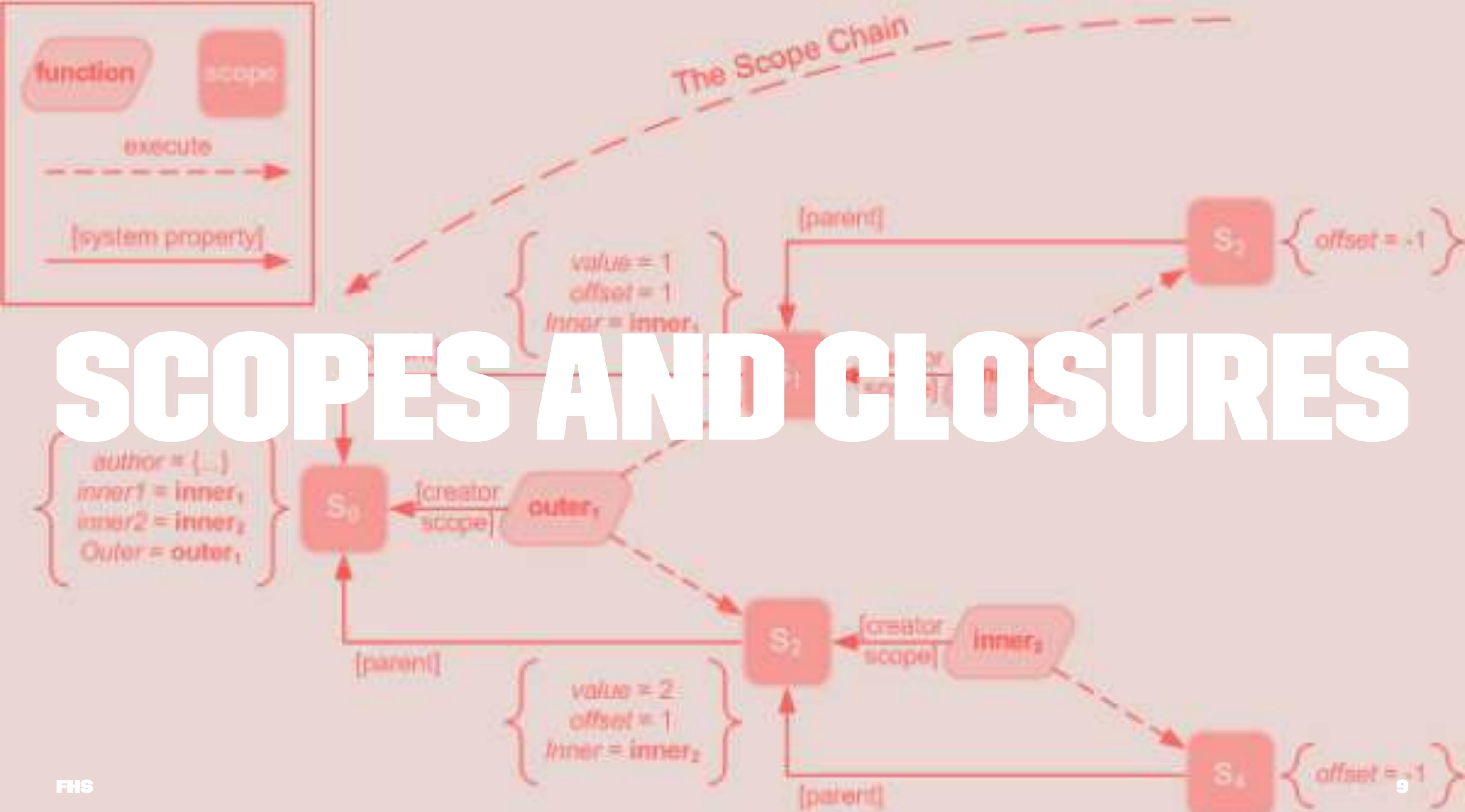
THINGS I WILL LOOK AT

- » functionality
- » naming
- » duplications
- » code consistency
- » function/component length
- » commits + commit messages

FEEDBACK

- » Questions:
tmayrhofer.lba@fh-salzburg.ac.at
- » Feedback Link





SCOPES AND CLOSURES

```
author = []
inner1 = inner1
inner2 = inner2
Outer = outer1
```

S_0

creator
scope

outer

S_1

creator
scope

inner₁

S_2

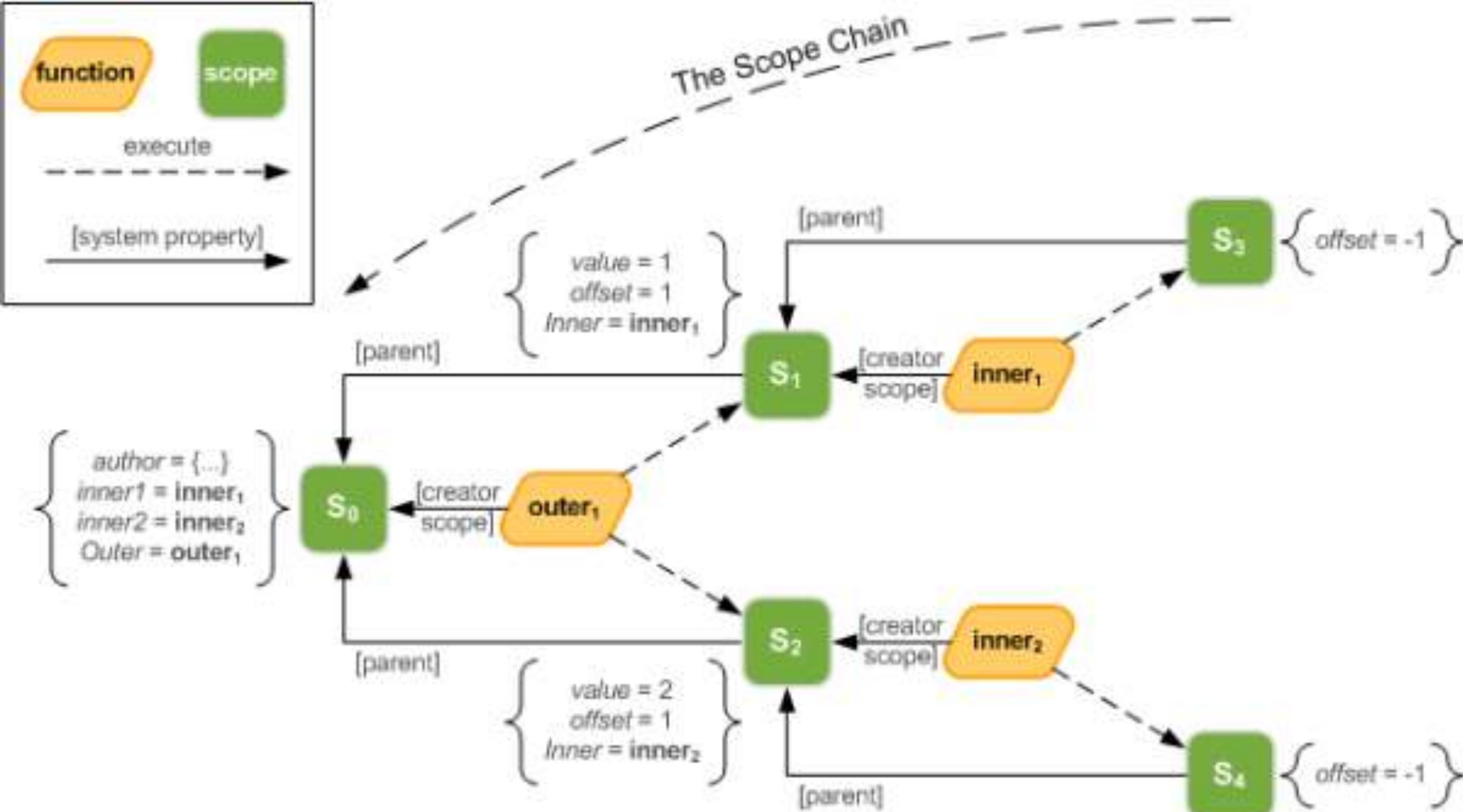
creator
scope

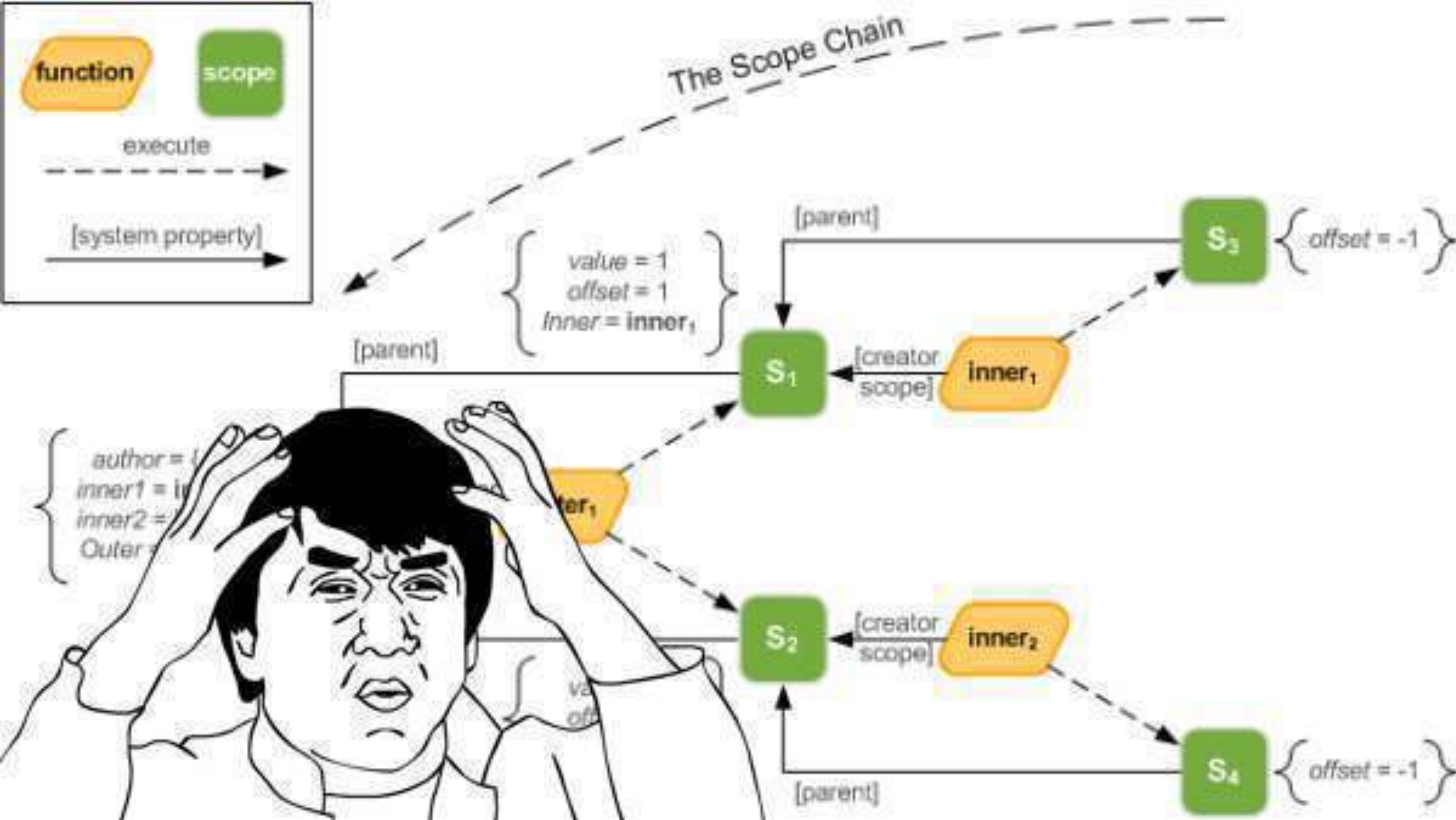
inner₂

S_3

creator
scope

inner₃





SCOPE DETERMINES THE ACCESSIBILITY (VISIBILITY) OF VARIABLES.

SCOPES AND CLOSURES

In JavaScript there are 3 types of scope:

- » Global scope
- » Local scope or function scoped
- » Block Scope

Define the visibility of a variable within a program.

LOCAL SCOPE

Variables declared within a JavaScript function, become LOCAL to the function.

```
function myFunction() {  
    var university = "FHS";  
  
    // code here CAN use university  
}  
  
// code here CAN NOT use university
```

- » Created when function execution starts
- » Deleted when function execution completes

BLOCK SCOPE (BEFORE ES6)

- » A block statement is used to group zero or more statements.
- » Used in loops, if/else statements
- » Everything between curly brackets {}
- » Before es6 all variables were function scoped

BLOCK SCOPE (BEFORE ES6)

```
function myFunction() {  
  if (true) {  
    var university = 'FHS'  
    // code here CAN use university  
  }  
  // code here CAN use university as well  
}
```

WHAT IS THE BEST UNIVERSITY?

```
function findBestUniversity() {  
    var bestUniversity = 'FHS'  
    if (true) {  
        var bestUniversity = 'Hagenberg'  
    }  
    console.log(bestUniversity)  
}
```

WHAT IS THE BEST UNIVERSITY?

```
function findBestUniversity() {  
  var bestUniversity = 'FHS'  
  if (true) {  
    var bestUniversity = 'Hagenberg'  
  }  
  console.log(bestUniversity)  
  // Hagenberg will be logged 🤢  
}
```

ES6 STORE RESCUE

BLOCK SCOPE WITH ES6

- » let and const introduced as new keywords
- » define variables in a block scope

```
function myFunction() {  
  let university = 'FHS'  
  if (true) {  
    let university = 'Hagenberg'  
    // university is set to Hagenberg  
  }  
  console.log(university)  
  // FHS will be logged   
}
```

WHAT WILL BE THE LOGGED?

```
function myFunction() {  
    let university1 = 'FHS1'  
    var university2 = 'FHS2'  
    let university3 = 'FHS3'  
  
    if (true) {  
        let university1 = 'FHS1 overwritten'  
        var university2 = 'FHS2 overwritten'  
        university3 = 'FHS3 overwritten'  
    }  
  
    console.log(university1)  
    console.log(university2)  
    console.log(university3)  
}
```

WHAT WILL BE THE RESULT?

```
function myFunction() {  
    let university1 = 'FHS1'  
    var university2 = 'FHS2'  
    let university3 = 'FHS3'  
  
    if (true) {  
        let university1 = 'FHS1 overwritten'  
        var university2 = 'FHS2 overwritten'  
        university3 = 'FHS3 overwritten'  
    }  
  
    console.log(university1) // FHS1  
    console.log(university2) // FHS2 overwritten  
    console.log(university3) // FHS3 overwritten  
}
```

let vs const

- » variables declared with let can be reassigned
- » variables declared with const can NOT be reassigned

```
let mutable = "some value"  
mutable = "some updated value"  
console.log(someValue) // "some updated value"
```

```
const immutable = "some value"  
immutable = "some updated value" // Uncaught TypeError: Assignment to constant variable.
```

IMMUTABILITY⁵

“An immutable data structure is an object that doesn't allow us to change its value.
(Remo H. Jansen)”

⁵ https://exploringjs.com/es6/ch_modules.html#sec_importing-exporting-details

CONST REALLY IMMUTABLE

- » const variables cannot be reassigned
- » the objects itself can change

```
const immutable = { some: "value" }
immutable.some = "updated"
console.log(immutable.some) // "some updated value"
```

IMMUTABLE OBJECTS IN JS

```
const immutableObject = Object.freeze({ test: 1 })
immutableObject.test = 10
console.log(immutableObject) // => { test: 1 }
```

GLOBAL SCOPE

A variable declared outside a function, becomes **GLOBAL**.

```
var university = "FHS";
```

```
function myFunction() {  
    // code here CAN use university  
}
```

```
// code here CAN use university as well
```

All scripts and functions can access this variable.

GLOBAL SCOPE

- » window is the global scope in the browser
- » global is the global object in nodejs

```
var university = "FHS";
window.university // "FHS"
```

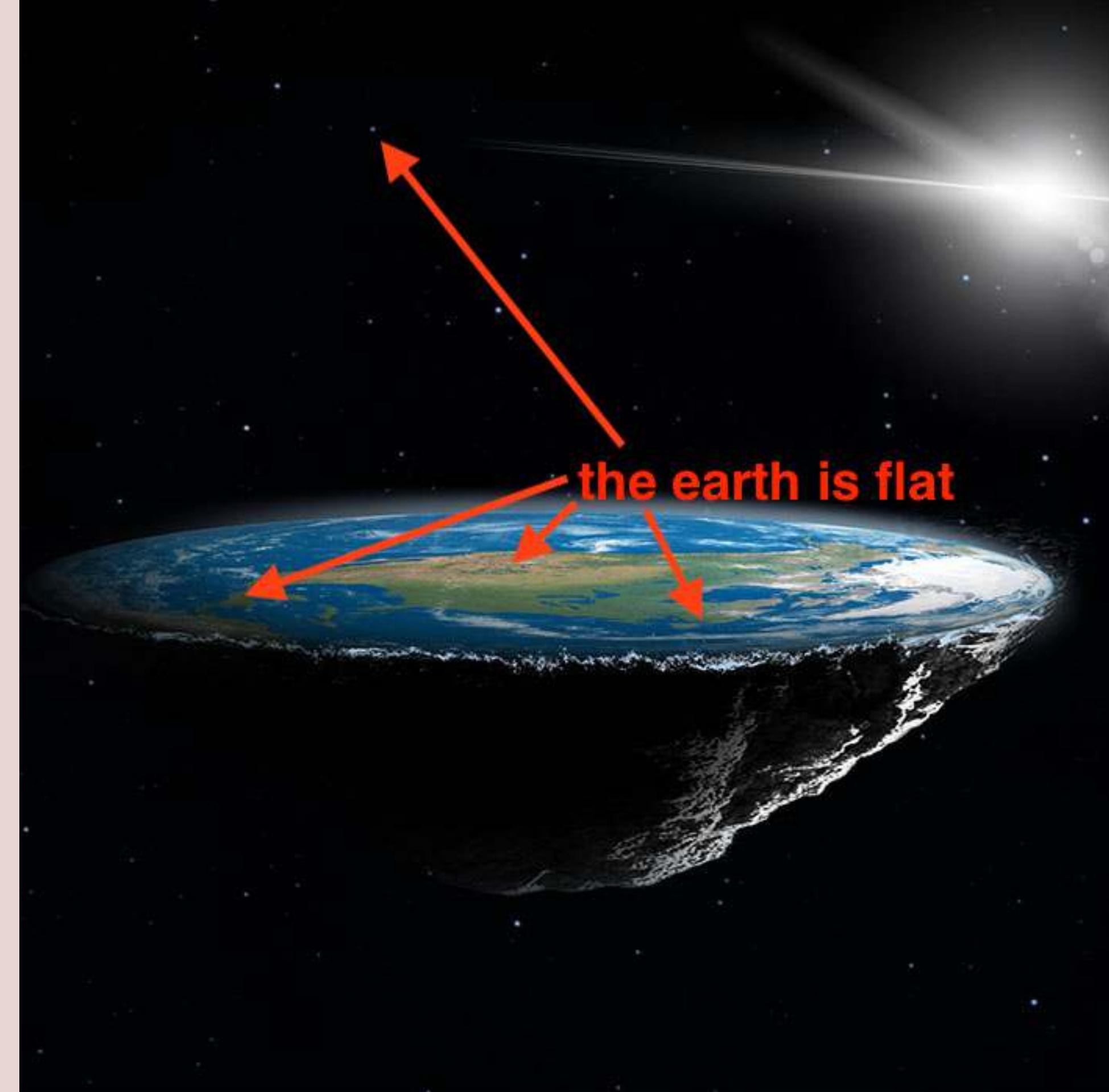


GLOBAL NAMESPACE POLLUTION







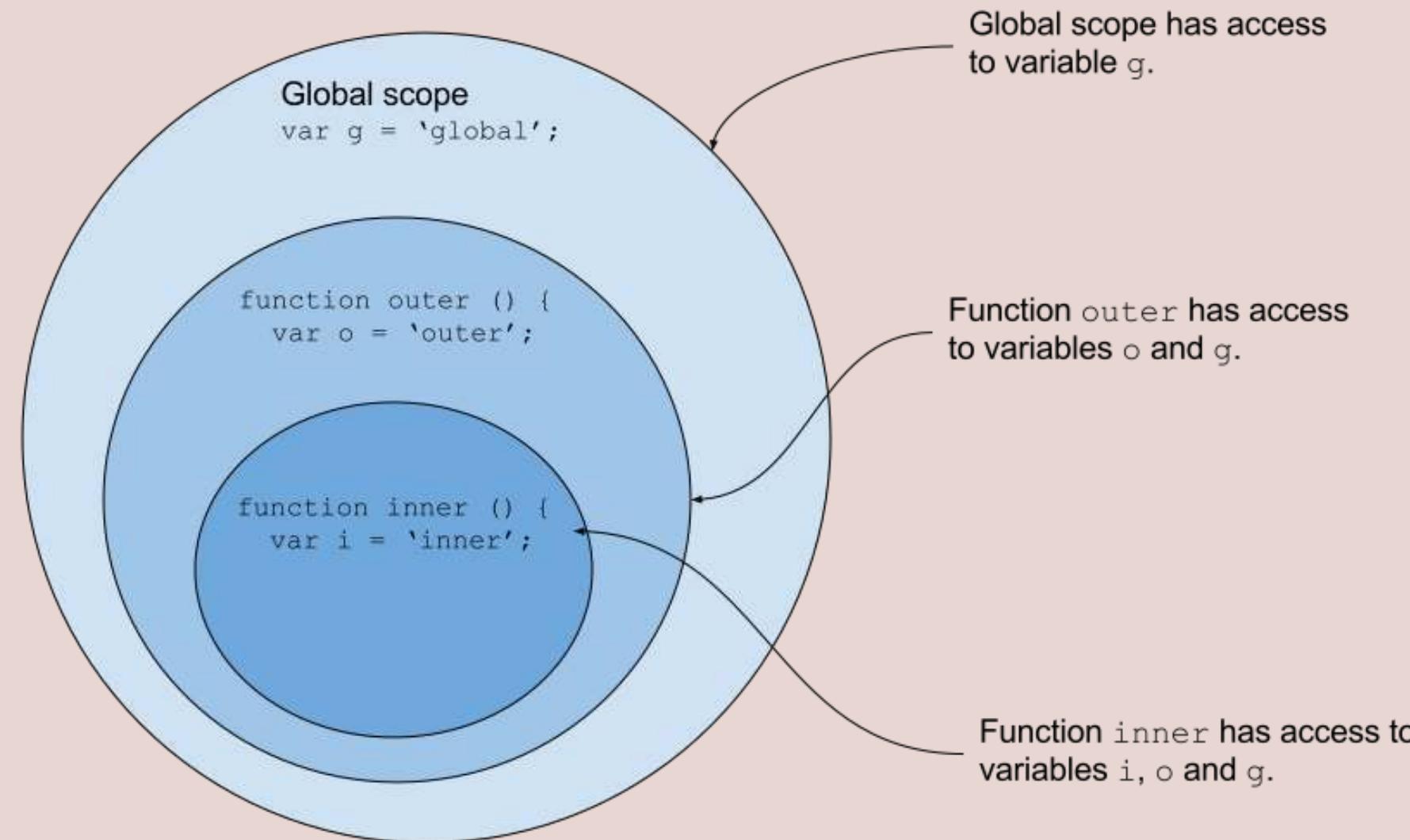


CLOSURES

A closure is the combination of a function bundled together (enclosed) with references to its surrounding state (the lexical environment)

```
const globalScope = `Global`  
  
function outerFunction () {  
  const outer = `I'm the outer function!`  
  
  function innerFunction() {  
    const inner = `I'm the inner function!`  
    console.log(outer) // I'm the outer function!  
  }  
  
  console.log(inner) // Error, inner is not defined  
}
```

CLOSURES



ENCAPSULATING STATE IN CLOSURES

```
function counter(name) {  
  let i = 0;  
  return function () {  
    i++;  
    console.log(name + ' ; ' + i);  
  }  
}  
  
const counter1 = counter('Counter1')  
counter1(); // Counter1: 1  
counter1(); // Counter1: 2  
const counter2 = counter('Counter2')  
counter2(); // Counter2: 1  
counter2(); // Counter2: 2
```



EXERCISE



- » go to (jsfiddle)[<https://jsfiddle.net/>] or open dev tools
- » implement a calculator using a closure (see previous slide)
- » calculator should support adding and subtracting numbers



EXERCISE USAGE

```
const calculator1 = calculator()  
calculator1(10) // logs: 10  
calculator1(-1) // logs: 9
```

```
const calculator1 = calculator()  
calculator1(5) // logs: 5
```

nick



POSSIBLE SOLUTION WILL BE ADDED AFTER THE LECTURE

JAVASCRIPT MODULES

JAVASCRIPT MODULES

- » A way to split applications into smaller pieces
- » Similar to chapters/paragraphs in a book

WHY MODULES¹

- » Maintainability
- » Namespacing
- » Reusability

¹ <https://www.freecodecamp.org/news/javascript-modules-a-beginner-s-guide-783f7d7a5fcc/>

MODULE PATTERN MIMIC OBJECTS WITH PRIVATE VARIABLES

ANONYMOUS CLOSURE

```
(function () {  
  var someVariable = 'irrelevant'  
  
  console.log(someVariable);  
}());  
// `irrelevant` will be logged
```

ANONYMOUS CLOSURE

```
(function () { // create a new function
  var someVariable = 'irrelevant' // function

  console.log(someVariable);
}()); // immediately execute the newly created function
```

ANONYMOUS CLOSURE

- » Hides variables from global scope
- » global variables can't be overwritten
 - » var defined in new function scope
- » no global namespace pollution



GLOBAL IMPORT

```
var myGlobalModule = {}  
  
(function (myModule) {  
  myModule.value = 'some value'  
}(myGlobalModule)); // "import" myGlobalModule into module  
  
console.log(myGlobalModule.value) // 'some value'
```

GLOBAL IMPORT

- » myGlobalModule is only global variable
- » myGlobalModule is explicitly passed to module
- » values will be assigned to myGlobalModule

OBJECT INTERFACE

```
const myCalculator = (function () {
  let value = 0
  return {
    increment: function() {
      value += 1
    },
    getValue: function() {
      return value
    }
  }
})();

myCalculator.increment()
console.log(myCalculator.getValue()) // 1
myCalculator.increment()
console.log(myCalculator.getValue()) // 2
```

COMMONJS AND AMD

COMMONJS AND AMD

- » Previous approaches encapsulate internals
- » Make Applications Modular
- » Define boundaries for functionality
 - » Similar to chapters in books
- » Scripts need to be loaded in correct order



COMMONJS AND AMD ORDER OF SCRIPTS

- » finding the right order is tough
- » eg: backbone requires underscore.js
 - » underscore.js needs to be loaded before backbone
- » complexity of finding right

COMMONJS MODULE

- » reusable piece of JavaScript
- » used in node.js
- » each file is own module with own context
- » `module.exports` exposes contents of a modules
- » prevents global namespace

COMMONJS MODULE

```
// myCalculator.js
let value = 0

module.exports = {
  increment: function() {
    value += 1
  },
  getValue: function() {
    return value
  }
}

// -----
// app.js
const myCalculator = require('./myCalculator')

myCalculator.increment()
console.log(myCalculator.getValue()) // 1
myCalculator.increment()
console.log(myCalculator.getValue()) // 2
```

AMD MODULE

- » Asynchronous Module Definition
- » CommonJS loads all modules synchronous
- » Browser blocks other JS execution until everything is loaded
- » modules can be loaded when needed
- » used in browsers which don't support es6 modules

```
define([
  'myModule', 'myOtherModule'], // define dependencies
  function(myModule, myOtherModule) { // callback will be executed once myModule/myOtherModule was loaded
    console.log(myModule.hello());
});
```

UMD MODULE

- » Combines CommonJS und AMD modules
- » Sees which environment is available
 - » loads modules by either CommonJS or AMD
- » Work both on the server and on the client
- » When building a library use UMD as target

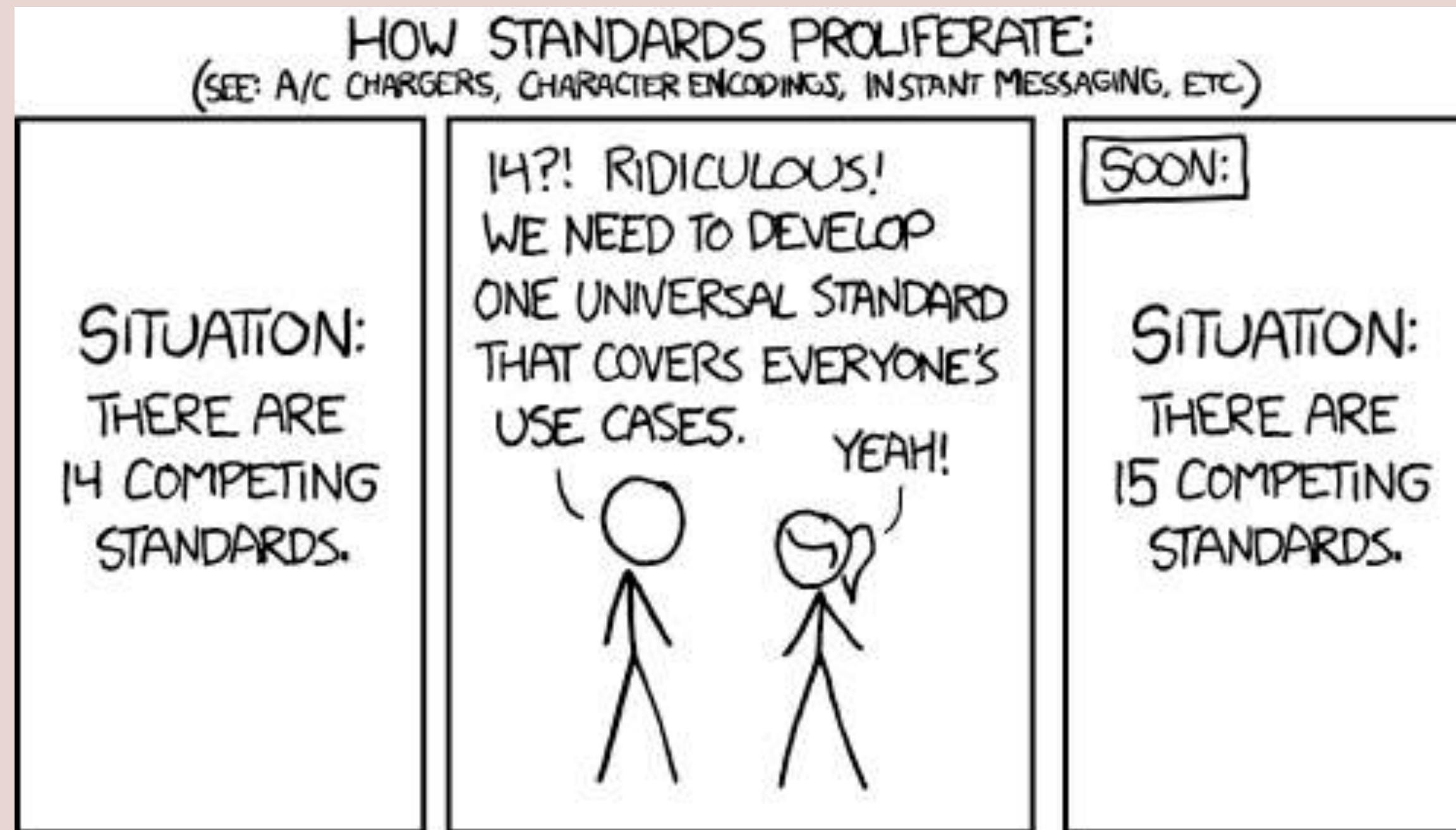
UMD MODULE²

```
(function (root, factory) {
  if (typeof define === 'function' && define.amd) {
    // AMD
    define(['myModule', 'myOtherModule'], factory);
  } else if (typeof exports === 'object') {
    // CommonJS
    module.exports = factory(require('myModule'), require('myOtherModule'));
  } else {
    // Browser globals (Note: root is window)
    root.returnExports = factory(root.myModule, root.myOtherModule);
  }
})(this, function (myModule, myOtherModule) {
  let value = 0

  return {
    increment: function() {
      value += 1
    },
    getValue: function() {
      return value
    }
  }
}));
```

² Writing a UMD module won't be part of the exam.

NATIVE JS MODULES



ES6 MODULES

- » CommonJS and UMD are not standardized by ECMA
 - » both standards emulate module pattern via JS
- » Built in modules with ES6 ⁴
 - » compact and declarative syntax
 - » asynchronous loading
 - » server and browser

⁴ source: <https://medium.freecodecamp.org/javascript-modules-a-beginner-s-guide-783f7d7a5fcc>

ES6 MODULES³

The compatibility matrix shows the following data:

	Chrome	Edge	Firefox	Internet Explorer	Opera	Safari	Android webview	Chrome for Android	Firefox for Android	Opera for Android	Safari on iOS	Samsung Internet	Node.js
<code>export</code>	61	16	60	No	48	10.1	No	61	60	45	10.3	8.0	13.2.0
<code>default keyword with export</code>	61	16	60	No	48	10.1	No	61	60	45	10.3	8.0	13.2.0
<code>export * as namespace</code>	72	79	80	No	60	No	No	72	No	51	No	11.0	12.0.0

Legend: Computer monitor icon (top left), Mobile phone icon (top right), GitHub icon (top center). Icons for each browser and platform are placed above their respective columns.

³ <https://developer.mozilla.org/en-US/docs/Web/JavaScript/Guide/Modules> 01.11.2020

ES6 MODULES NAMED EXPORTS

```
// counter.js
let value = 0

export function increment () {
  value += 1
}
export function getValue () {
  return value
}

// app.js
import { increment, getValue } from './counter.js'

increment()
console.log(getValue()) // 1
increment()
console.log(getValue()) // 2
```

ES6 MODULES NAMED EXPORTS, IMPORT ENTIRE MODULE

```
// counter.js
// ...
```

```
// app.js
import * as myCalculator from './counter.js'

myCalculator.increment()
console.log(myCalculator.getValue()) // 1
myCalculator.increment()
console.log(myCalculator.getValue()) // 2
```

ES6 MODULES

DEFAULT EXPORT

```
// myModule.js
export default function myAmazingJSFunction () {
  console.log('FHS')
}

// app.js

import myAmazingJSFunction from './myModule.js'
import nameCanBeAnythingForDefaultExports from './myModule.js'

myAmazingJSFunction() // will log "FHS"
nameCanBeAnythingForDefaultExports() // will log "FHS"
```

ES6 MODULES

DYNAMIC IMPORT

- » import statement must be top level
- » conditional loading of scripts is not possible

```
if (Math.random()) {  
    import 'foo'; // SyntaxError  
}
```

ES6 MODULES

DYNAMIC IMPORT

- » dynamic import to rescue
- » adds ability to load scripts
 - » conditionally
 - » on demand
- » harder to analyze statically

ES6 MODULES

DYNAMIC IMPORT

```
if (loadCounter) {
  // counter won't be loaded when loadCounter === false
  const { increment, getValue } = await import('./counter.js')
  increment()
  console.log(getValue()) // 1
  increment()
  console.log(getValue()) // 2
}
```

ES6 MODULES IMPORTING STYLES

```
// import a default export
import someModule from './my-module.js'

// import an entire module (excluding the default export)
import * as namedExports from './my-module.js'

// import an entire module (including the default export)
import defaultExport, * as namedExports from './my-module.js'

// import a named export
import { export1, export2 } from './my-module.js'

// alias a named export
import { export1 as aliasedExport1 } from './my-module.js'

// dynamic import
const { default, export1, export2 } = await import('./my-module.js')
```

ES6 MODULES

EXPORT⁵

```
export let myVar2 = '...';
export const MY_CONST = '...';

export function myFunc() {
    //...
}

export function* myGeneratorFunc() {
    //...
}

export class MyClass {
    //...
}
```

⁵ https://exploringjs.com/es6/ch_modules.html#sec-importing-exporting-details

ES6 MODULES

EXPORT⁵

```
const MY_CONST = 'MY_CONST'  
function myFunc() {}
```

```
// Export all at the end  
export { MY_CONST, myFunc };
```

```
// Export with a different name  
export { MY_CONST as FOO, myFunc as myAliasedFunc };
```

⁵ https://exploringjs.com/es6/ch_modules.html#sec-importing-exporting-details

USING ES6 MODULES IN THE BROWSER

```
<!-- index.html -->
<script src="./index.js" type="module"></script>
<!--
<!-- required so the browser knows you're using modules -->

import { myApp } from './appliction.js'
// import application from a different module
// note .js extension is required in the browser

myApp()
```



HOMEWORK

- » Due Date: 10.11. 8pm
- » can be done in pairs
- » hand-in via email
`tmayrhofer.lba@fh-salzburg.ac.at`
- » email contains link to
git repository
- » name of students who
worked on the assignment

HOMEWORK

- » We'll be building a quiz application
- » This assignment includes the game logic only (no ui)
- » setup
 - » clone Repository
 - » if you're having troubles let me know

HOMEWORK

- » define and export a list of questions from `questions.js`
- » a question looks like this: `{ question: 'some question', correctAnswer: 'a', a: 'answer', b: '', c: '', d: '' }`
- » implement a function `askQuestion()` in `quiz.js`
- » this function returns a random question (without the `correctAnswer` property)

HOMEWORK EXAMPLE USAGE IN INDEX.JS

```
// index.js
import { askQuestion, answerQuestion } from './quiz.js'

const question = askQuestion()
console.log(question)

/**
 * {
 *   question: 'Whats the best university?',
 *   a: 'Hagenberg',
 *   b: 'FHS',
 *   c: 'TU',
 *   d: 'JKU'
 * }
 */

const answer = answerQuestion(question, 'a')
console.log(answer ? 'correct' : 'incorrect')
```

FEEDBACK

- » Questions:
tmayrhofer.lba@fh-salzburg.ac.at
- » Feedback Link

