FRONTEND DEVELOPMENT WINTERSEMESTER 2021

ABOUT/CONTACT

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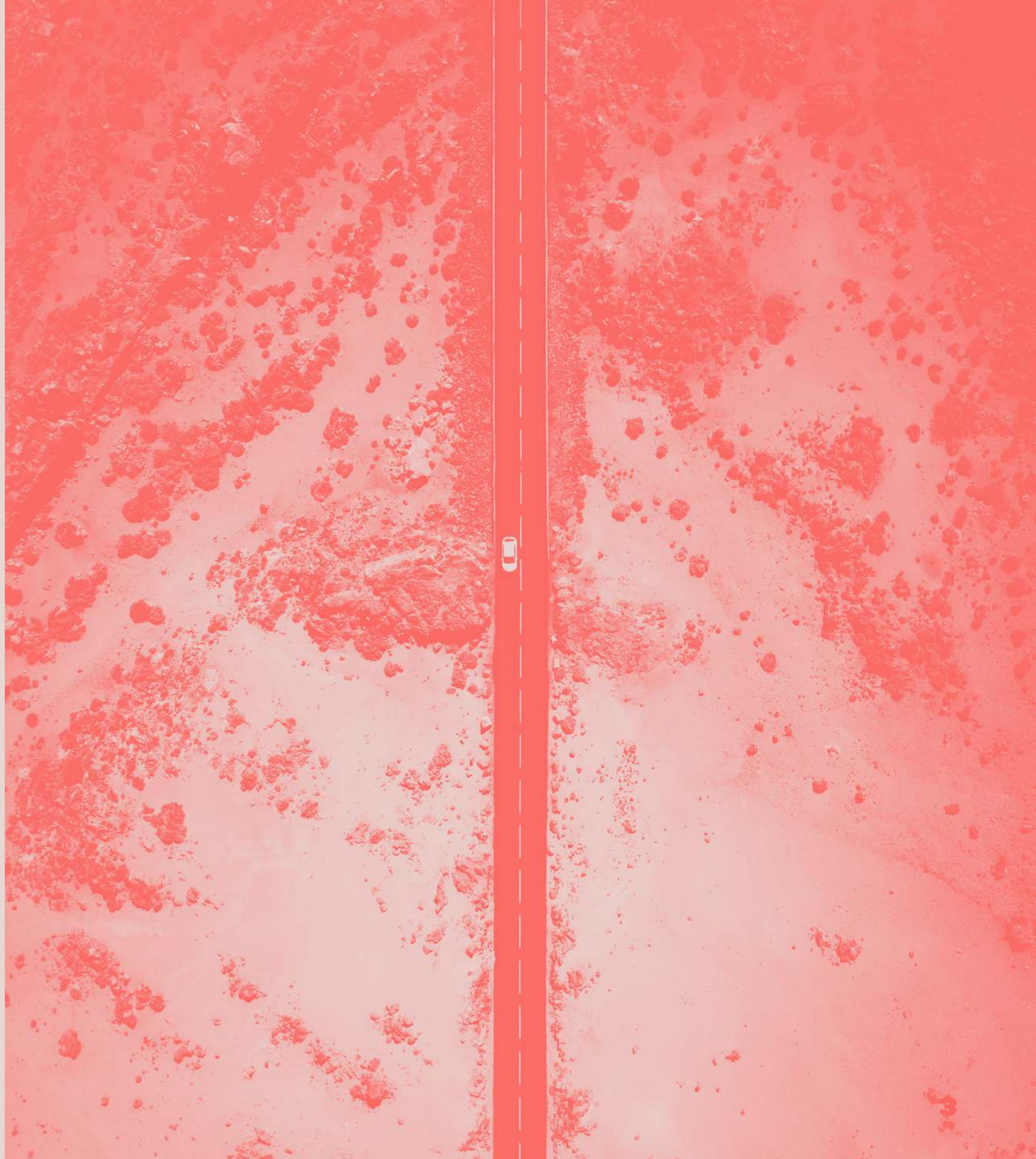
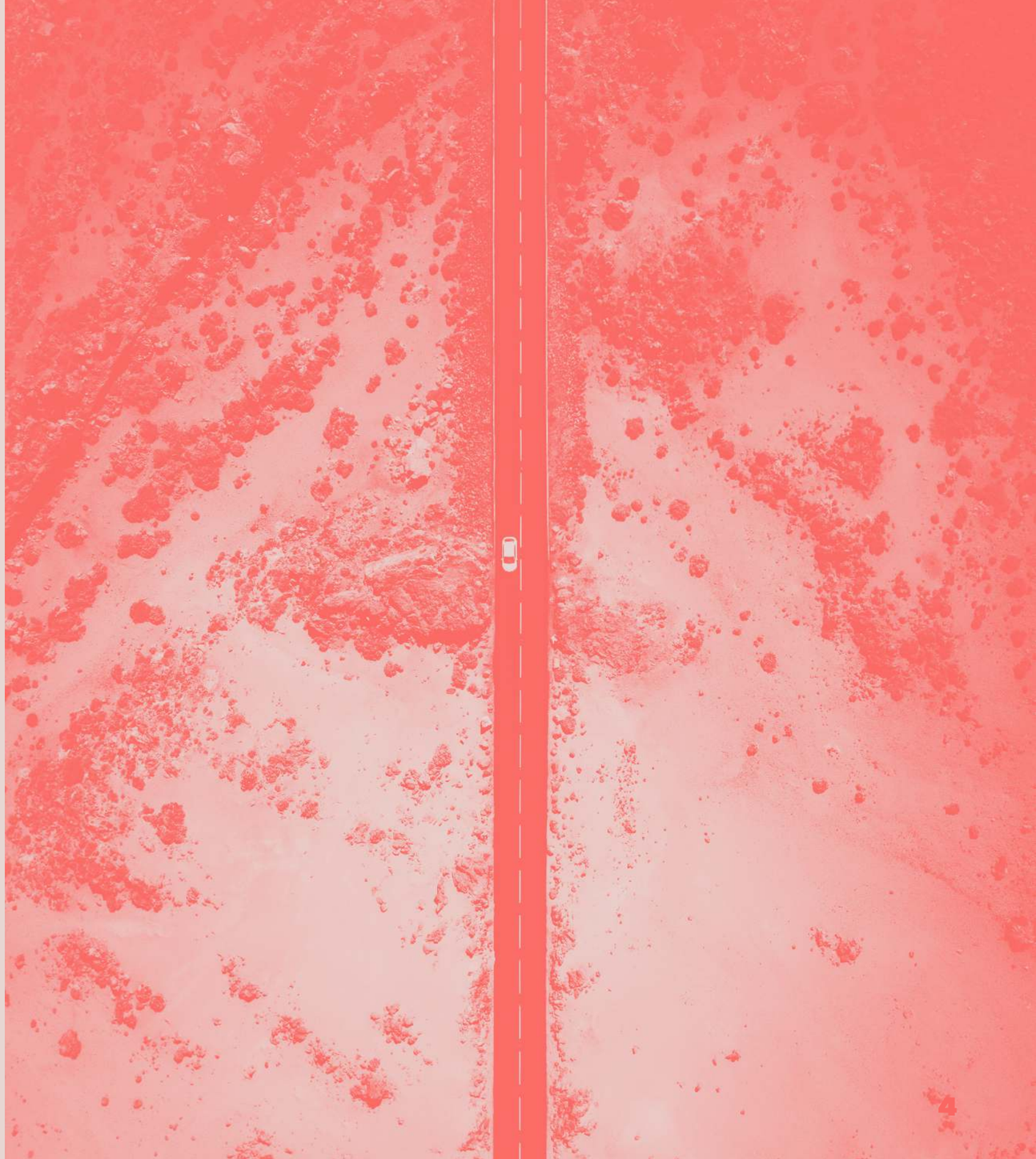
ROADMAP

- » 21.10. 3 EH (online)
  - » JS History Intro etc.
  - » Modules
- » 11.11. 4EH (on-site)
  - » build setup
  - » Asynchronous JS
  - » ES 6



ROADMAP

- 25.11. 3EH (on-site)
  - Single Page App Routing
- 9.12. 3EH (online)
  - JS Build tools
- 22.12. 3EH (on-site)
  - Wunschkonzert
  - 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 reporitory
  - name of students who worked on the assignment

THINGS I WILL LOOK AT

» functionality

» naming

» duplications

» code consistency

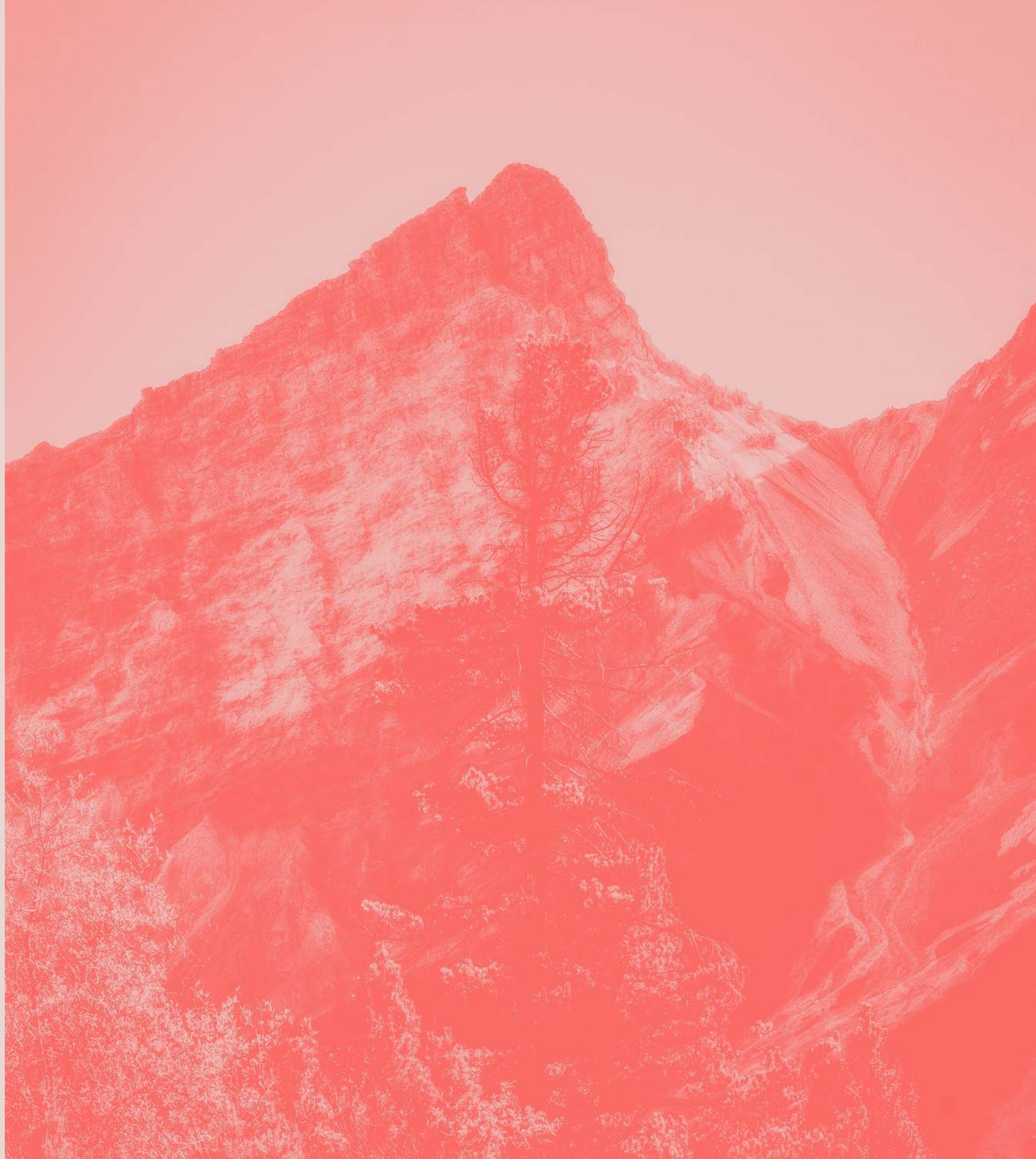
» function/component length

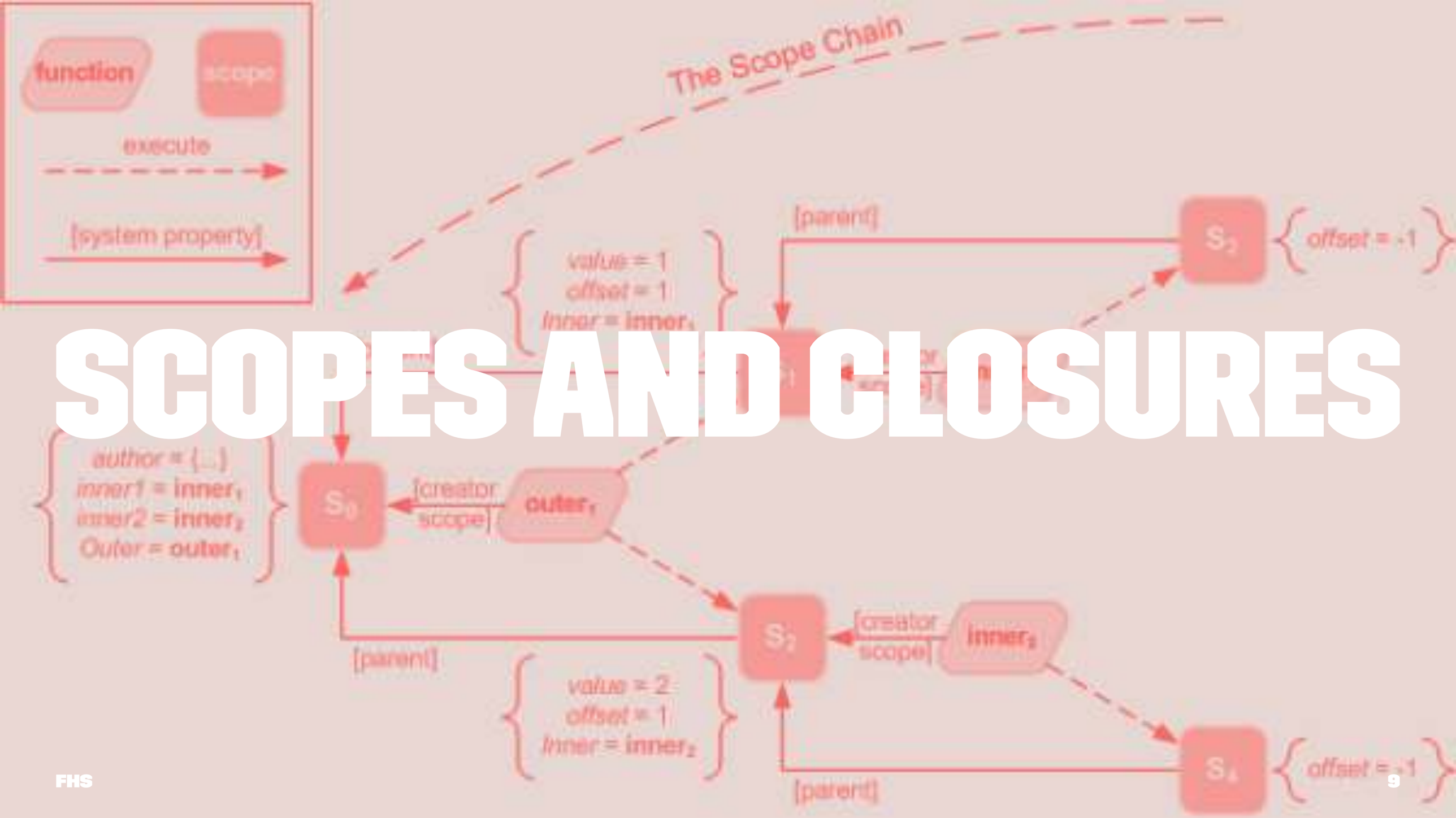
» commits + commit messages

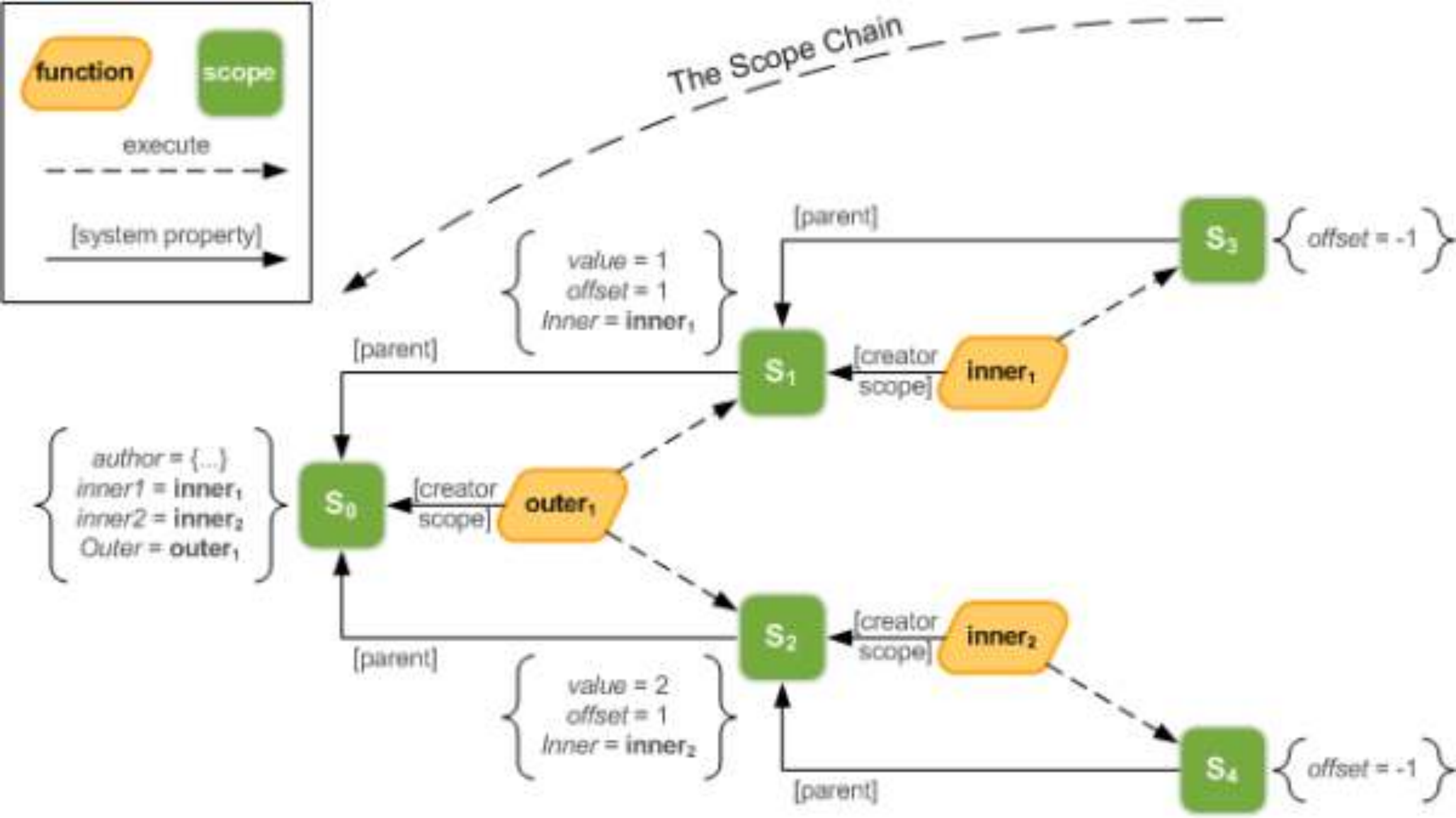
FEEDBACK

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

» Feedback Link




function
scope
execute
[system property]
The Scope Chain
SCOPES AND CLOSURES
[parent]
value = 1
offset = 1
inner = inner1
offset = -1
author = {...}
inner1 = inner1
inner2 = inner2
Outer = outer1
[creator scope]
outer1
[parent]
value = 2
offset = 1
inner = inner2
[creator scope]
inner2
offset = -1
[parent]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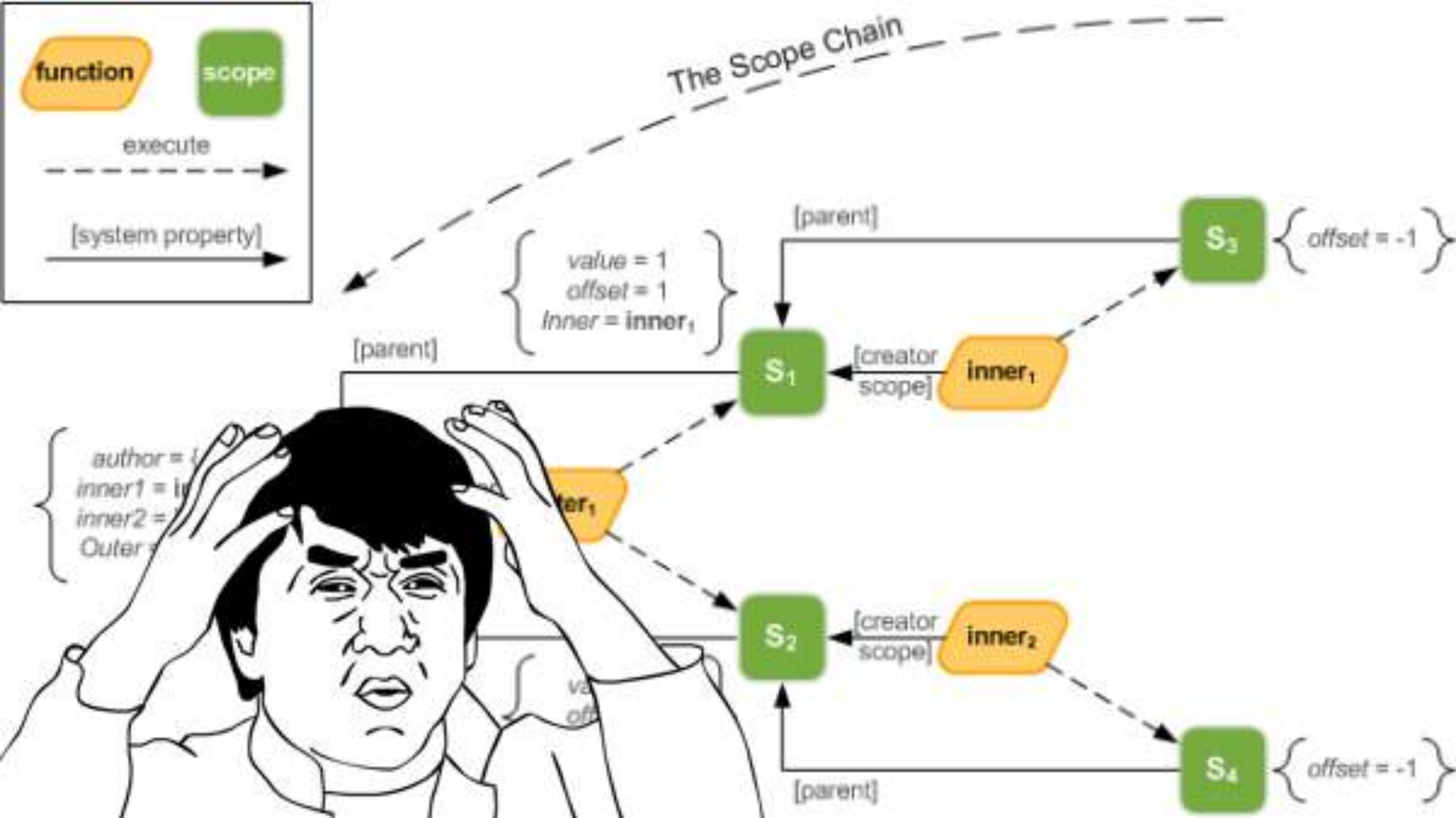
Inner = inner1
S3
offset = -1
[parent]
S1
[creator scope]
inner1
author = {...}
inner1 = inner1
inner2 = inner2
Outer = outer1
S0
[creator scope]
outer1
S2
[creator scope]
inner2
[parent]
value = 2
offset = 1
Inner = inner2
[parent]
S4
offset = -1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inner1
S2
[creator scope]
inner2
S4
offset = -1
[parent]

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 TO 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

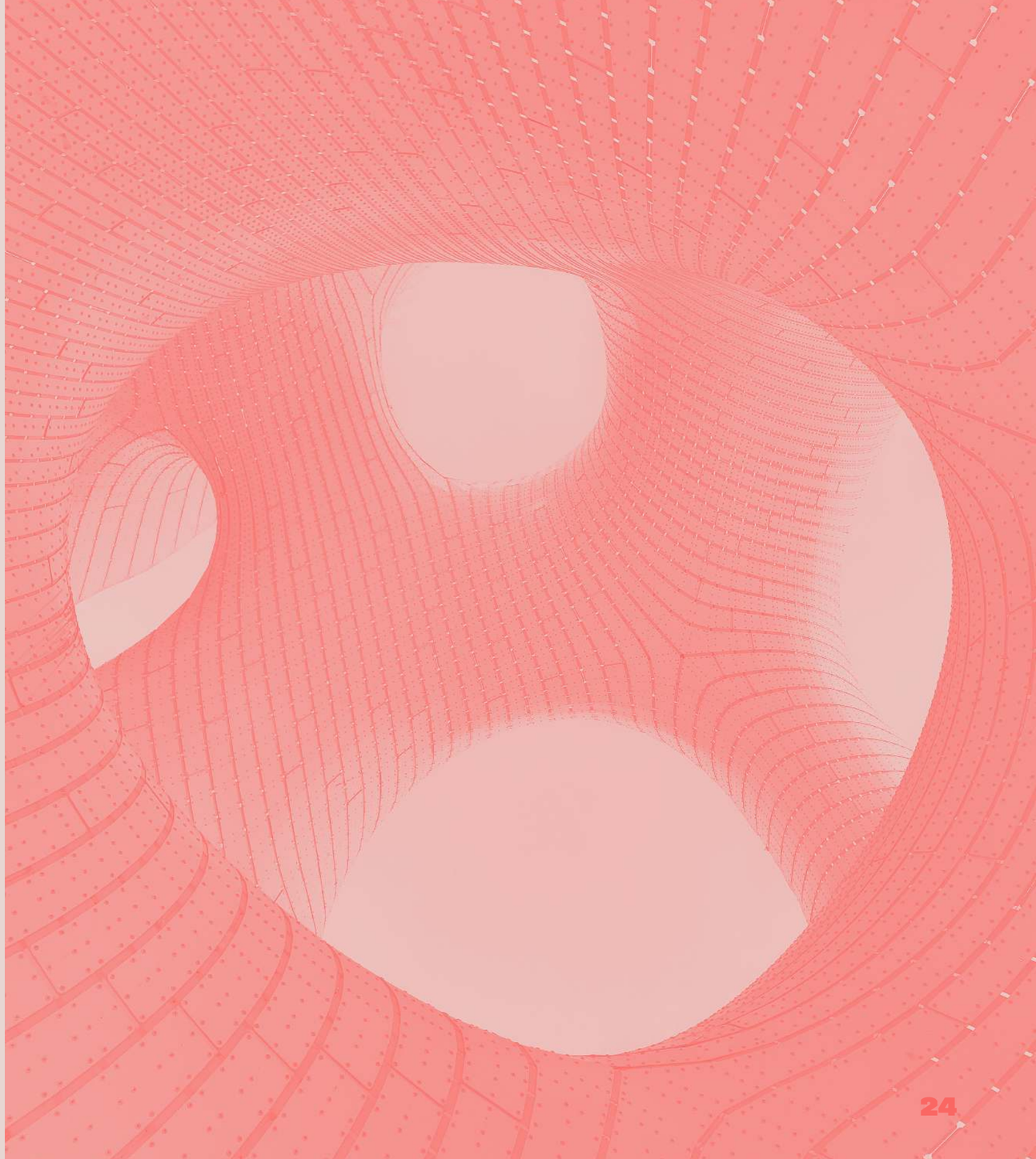
```
let mutable = "some value"
mutable = "some updated value"
console.log(someValue) // "some updated value"

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

IMMUTABILITY[5]

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

[5] https://exploringjs.com/es6/chmodules.html#secimporting-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 it the global object in nodejs

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

GLOBAL NAMESPACE POLLUTION


the earth is flat


the earth is flat


the earth is flat


the earth is flat

CLOSURES

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

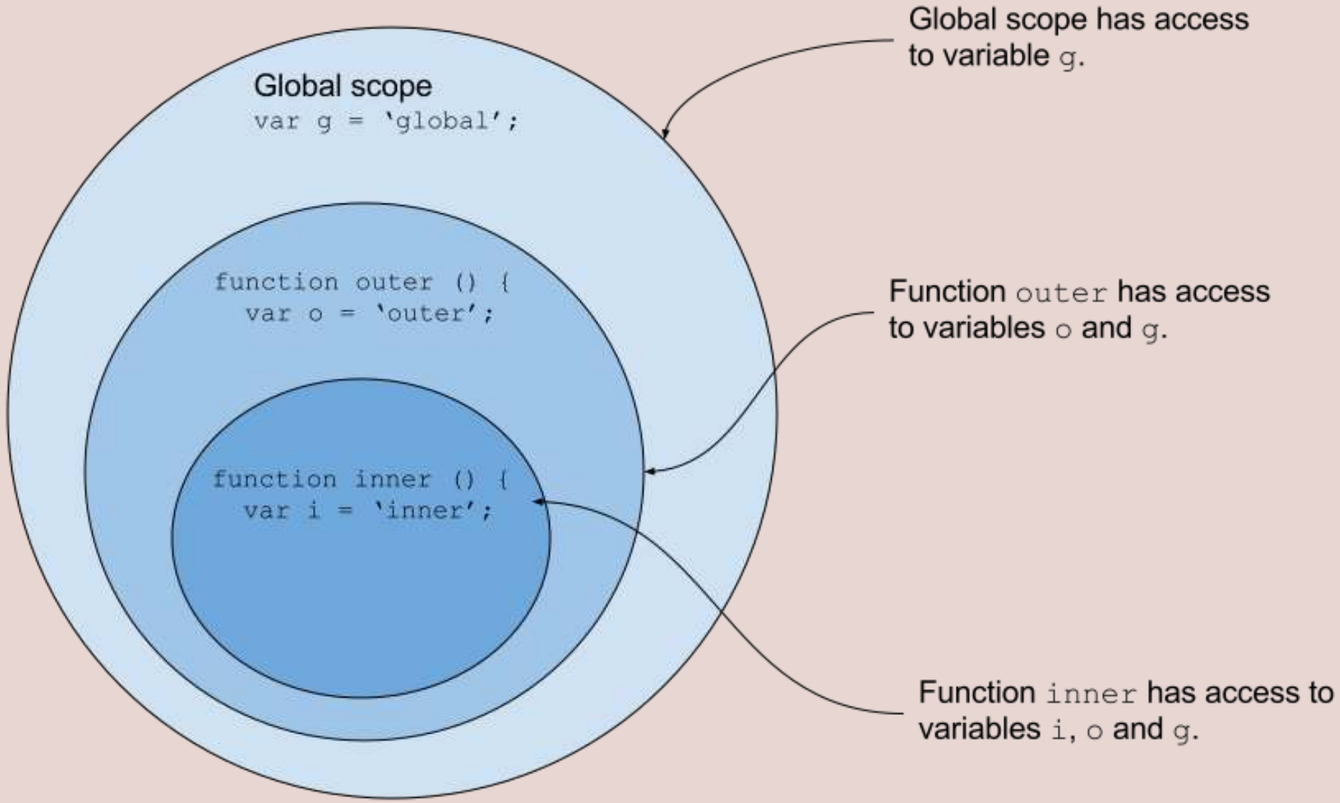
```
const globalScope = `Global`

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


Global scope
var g = 'global';
function outer () {
var o = 'outer';
function inner () {
var i = 'inner';
Global scope has access to variable g.
Function outer has access to variables o and g.
Function inner has access to variables i, o and g.

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
THE POWER OF WIND

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 MODULES [1]

» 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

» Asyncronous 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

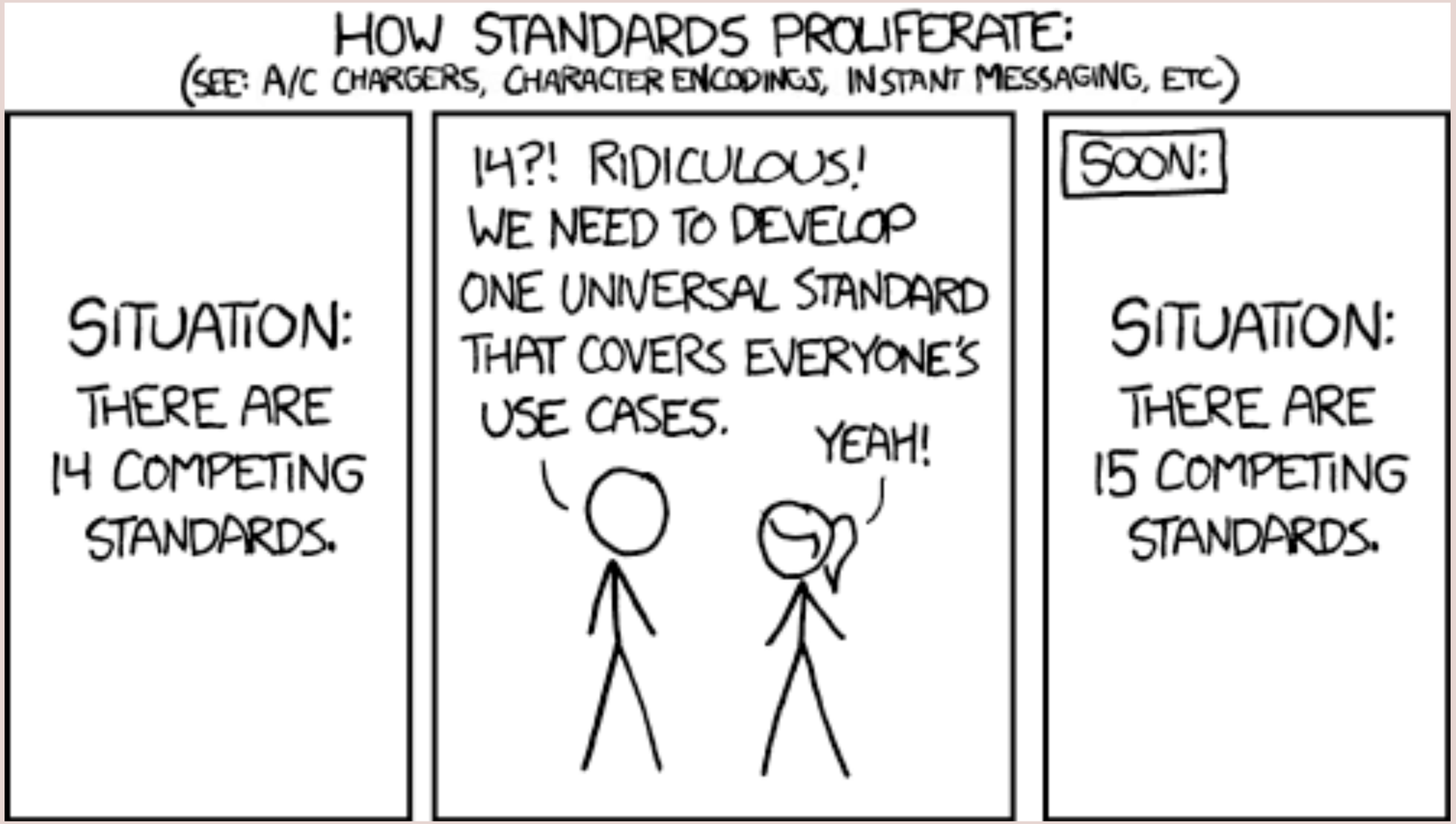
UMD MODULE [2]

```
(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 MODULES [3]

Update compatibility data on GitHub

	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
`export`	61	16	60	No	48	10.1	No	61	60	45	10.3	8.0	13.2.0 *
`default` keyword with `export`	61	16	60	No	48	10.1	No	61	60	45	10.3	8.0	13.2.0 *
`export * as namespace`	72	79	80	No	60	No	No	72	No	51	No	11.0	12.0.0

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

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

ES6 MODULES
EXPORT [5]

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

export function myFunc() {
    //...
}
export function* myGeneratorFunc() {
    //...
}
export class MyClass {
    //...
}
```

[5] https://exploringjs.com/es6/chmodules.html#secimporting-exporting-details

ES6 MODULES
EXPORT [5]

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

// 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/chmodules.html#secimporting-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()
```


FOX
5

HOMEWORK

- Due Date: 5.11. 8pm
- can be done in pairs
- hand-in via email tmayrhofer.lba@fh-salzburg.ac.at
  - email contains link to git reporitory
  - 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