Workshop

JavaScript Introduction

Hint for trainers

- Report each change or addition to the **trainers'** Discord-Channel.
- Tell which Slide is affected, why the change is important and what benefit your change provides.
- Use the code-highlighting-app if you work with code-snippets.
- Use the following slide if you want to repeat certain topics of the workshop.

Task: Test your knowledge

JavaScript

The language of the web

Primitive Data Types

Primitive Data Types

Data Initialization

```
// Number
const a1 = 8; const a2 = 4.3; const a3 = 0x16;
// BigInt
const a4 = 2n ** 53n
// String
const b = 'Sophie';
// Boolean
const c = false;

const d = null;
const e = undefined;
```

Objects

Objects

An object is an **unordered** collection of **key-value pairs**.

Objects

Object creation

```
const a = {};

const car = {
  brand: 'Ford'
};
```

Objects

Object property **access** and **assignment**

```
const car = {
  brand: 'Ford'
};

car.model = 'Mustang';
car['full year'] = 1969;

// {
//   brand: 'Ford',
//   model: ‘Mustang',
//   'full year': 1969
// }
```

Computed Property Names

Allows you to put an expression in brackets, that will be computed and used as the property name.

```
const param = 'size';
const config = {
  [param]: 12,
  ['mobile' + param.charAt(0).toUpperCase() + param.slice(1)]: 4
};

console.log(config); // {size: 12, mobileSize: 4}
```

Arrays

Arrays

Arrays are ordered - objects are not!

```
const myArray = ['a','b'];

console.log(myArray[0]); // a
console.log(myArray[1]); // b
```

Variables

declaration and usage

Variables - Declaration

Declared with the keyword `var`, `let` or `const`

```
var value = 23;

let anotherValue = 42;

const PI = 3.1416;
```

Variables - let, const, var

	`let`	`const`	`var`
scope	block	block	function
reassignable	✔	❌	✔
mutable	✔	✔	✔
Standard	ES2015 / TS	ES2015 / TS	since ever
Cases to use	~5%	~95%	nearly never

`let` is block scoped

```
let example = 1;

if (true) {
    let example = 2;
    console.log('Inside:  ' + example);
}

console.log('Outside: ' + example);
// => Inside:  2
// => Outside: 1
```

`var` is function scoped

```
var example = 1;

if (true) {
    var example = 2;
    console.log('Inside:  ' + example);
}

console.log('Outside: ' + example);
// => Inside:  2
// => Outside: 2
```

Variables - Fun fact

UTF-8 characters are also allowed!

```
const π = Math.PI;

const ლ_ಠ益ಠ_ლ = 42;
```

Variables

Hold the result of an expression

```
const helloWorld = 'Hello World';

const helloFunction = function() {};
const helloFunction = () => {};

const returnValue = getCurrentTime();
```

Variables - Primitive types

Call by value

```
let a = 'Hello World';
const b = a; // Only value is copied
a = 4;

console.log(b);
// => 'Hello World'
```

Variables - Object types (Array)

Call by reference

```
const a = [1, 2, 3];
const b = a;// Copy the reference
a[0] = 99;  // Modify the array using the reference

console.log(b);
// => [99, 2, 3]
```

Variables - Object types

Call by reference

```
const person = { firstName: 'John', lastName: 'Doe' };
const secondPerson = person;     // Copy the reference

secondPerson.firstName = 'Jane'; // Modify the object using the reference

console.log(secondPerson);
// => { firstName: 'Jane', lastName: 'Doe' }
console.log(person);
// => { firstName: 'Jane', lastName: 'Doe' }
```

Spread Operator

Spread Operator

Create shallow copies of arrays and objects.

```
const numbersObject = {
  one: 1,
  two: 2,
  three: 3,
};

const extendedNumbersObject = { ...numbersObject, four: 4 };

// { one: 1, two: 2, three: 3, four: 4 }
```

Shallow copy

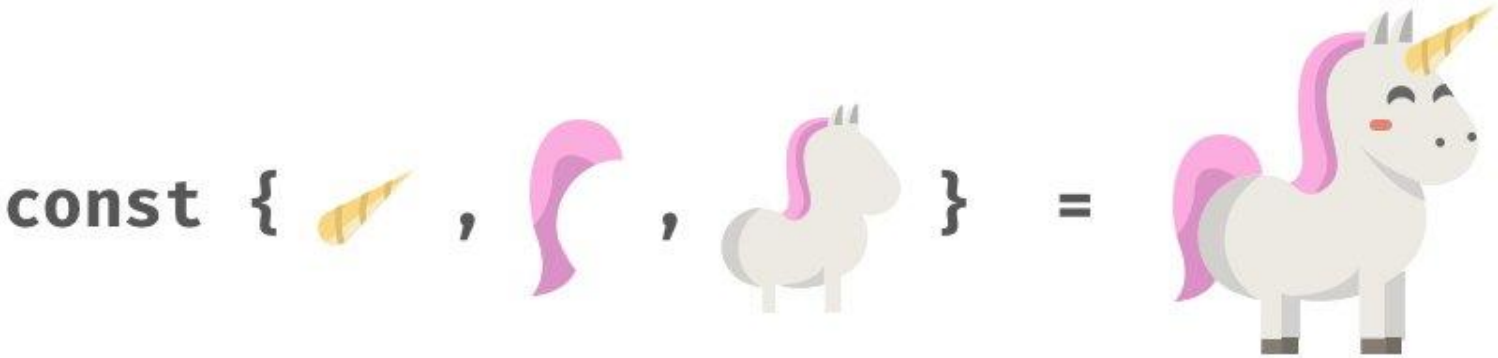
One method of copying an object is the shallow copy.

In that case a new object B is created, and the fields values of A are copied over to B. This is also known as a field-by-field copy.

If the field value is a reference to an object it copies the reference, hence referring to the same object as A does, and if the field value is a primitive type it copies the value of the primitive type. The referenced objects are thus shared, so if one of these objects is modified (from A or B), the change is visible in the other. Shallow copies are simple and typically cheap, as they can be usually implemented by simply copying the bits exactly.

Destructuring

Destructuring



Destructuring - Objects

Get multiple local variables from an object with destructuring.

```
const circle = {radius: 10, x: 140, y: 70};

const {x, y} = circle;
// const x = circle.x;
// const y = circle.y;

console.log(x, y)
// => 140, 70
```

Destructuring - Objects

Renaming keys

```
const circle = {radius: 10, x: 140, y: 70};

const {x: newX, y: newY} = circle;
// const newX = circle.x;
// const newY = circle.y;

console.log(newX, newY)
// => 140, 70
```

Destructuring - Arrays

Get multiple local variables from an object with destructuring.

```
const coords = [51, 6];

const [lat, lng] = coords;
// const lat = coords[0];
// const lng = coords[1];

console.log(lat, lng)
// => 51, 6
```

Destructuring - Arrays

Get specific local variables from an object with destructuring.

```
const coords = [51, 6];

// Extract second argument only
const [, lng] = coords;

console.log(lng)
// => 6
```

Task

Destructuring

Functions

Functions - JavaScript

Function expression

```
const showAlert = function() {
    alert('Hello!');
};
```

Functions - JavaScript

JavaScript Functions are “First-Class Citizens”

```
// Provide anonymous functions as arguments
http.get(url, function() { alert('Hello!'); });

// Provide named functions as arguments
const showAlert = function alert() { alert('Hello!'); };

http.get(url, showAlert);
```

Function statement

Function statement (hoisted to top of file)

```
// Can call sayHello before it's defined (thanks to hoisting)
alert(sayHello());

// function statement
function sayHello() {
  return "Hello, world!";
};
```

Arrow Function Expression (aka lambda function)

=>

Arrow function expression

Concept

```
// function keyword
const add = function add(one, two) { return one + two };

// Fat-arrow function
const add = (one, two) => { return one + two };

// Implicit return
const add = (one, two) => one + two;
```

Arrow function expression (Benefits)

Not need of braces around single parameters.

```
const square = n => n * n;

// const square = function (n) { return n * n; };
```

Arrow function expression

Use *curly braces* and *return* if you have multiple lines

```
const even = n => {
  const rest = n % 2;

  return rest === 0;
};
```

```
// const even = function(n) {
//   const rest = n % 2;
//
//   return rest === 0;
// };
```

Arrow function expression

Use round *braces* and *curly braces* if you wanna return an object.

```
const person = () => ({
  firstName: 'John',
  lastName: 'Doe',
});
```

```
// const person = function() {
//   return {
//     firstName: 'John',
//     lastName: 'Doe',
//   };
// };
```

Arrays methods

Arrays

Arrays are ordered - objects are not!

```
const myArray = ['a','b'];

console.log(myArray[0]); // a
```

Arrays - Iterators

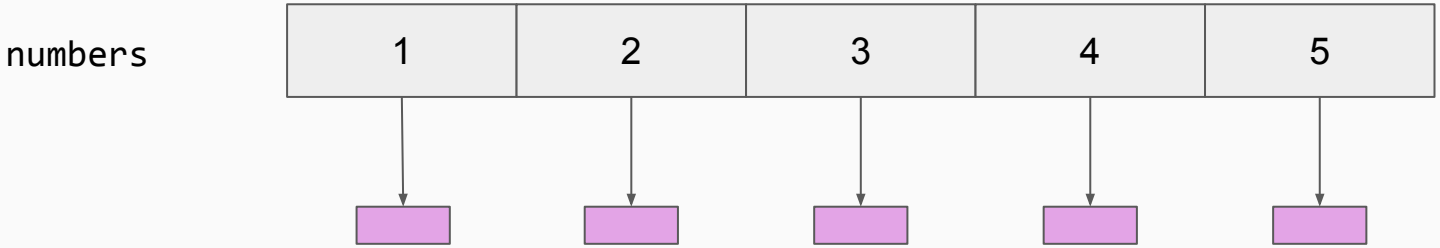
With a for and a for...of loop you have the opportunities to **`break`** or **`continue`** the loop and exit the surrounding function with **`return.`**

```
const names = ['Hanni', 'Nanni'];

for (let i = 0; i < names.length; i++) {
    console.log(names[i]);
}

for (let name of names) {
    console.log(name)
}
```

Arrays - Iterators

Array.forEach()

```
const myArray = [1,2,3,4,5];
myArray.forEach(elem => console.log(elem));
```

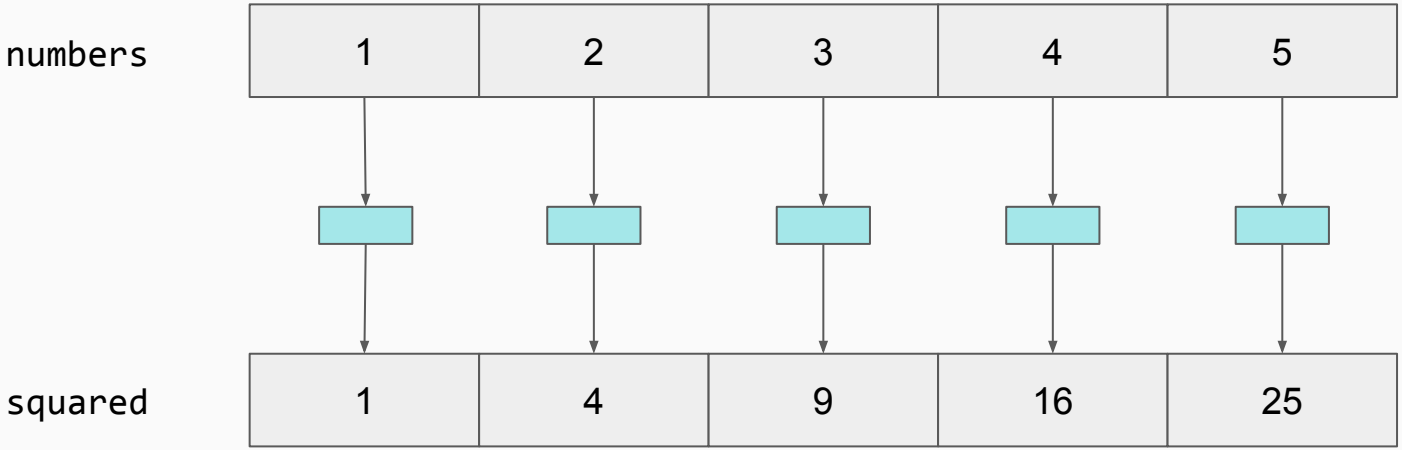


Arrays - Transformations

Array.map()

```
const numbers = [1, 2, 3, 4, 5];
const squared = numbers.map(num => num * num);
// squared is [1, 4, 9, 16, 25]
```

Transforming an array

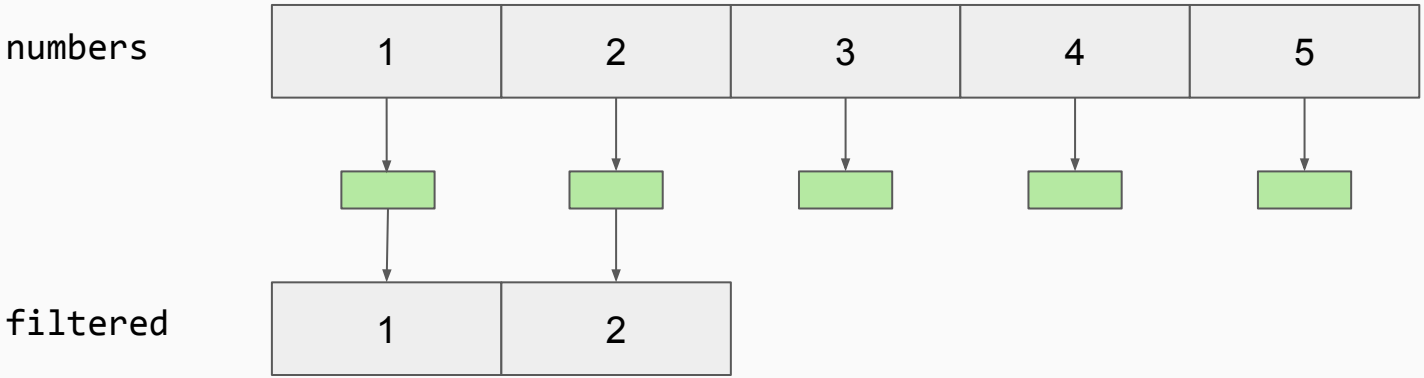


Arrays - Transformations

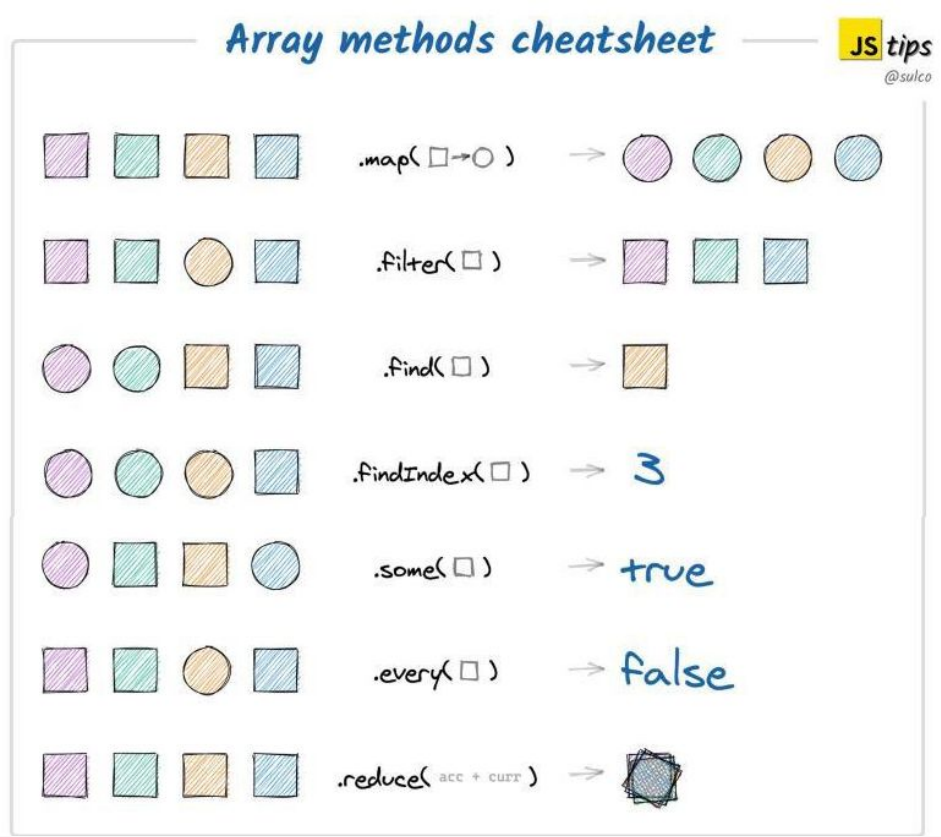
Array.filter()

```
const numbers = [1, 2, 3, 4, 5];
const filtered = numbers.filter(num => num < 3);
// filtered is [1, 2]
```

Filtering an array



Arrays - Transformations



Task

Executing Functions Directly & Indirectly

Task

map()

Task

Arrow Functions and reduce

Template Literals (template strings)

Template Literals

Simple template literals

```
const singleLine = `My first template string`; // single line
const multiLine = `<span>
    My first multiline template string!
  </span>`; // multiline
```

Template Literals

Variables in template literals

```
const lastName = 'Eich';
const name = `Brendan ${lastName}`; // single line
// Brendan Eich

const multiLineString = `<span>
    My name is ${name}!
  </span>`; // multiline

// <span>
//   My name is Brendan Eich!
// </span>
```

Template Literals

Expressions in template literals

```
const active = true;
const name = `Is active: ${active ? 'Yes' : 'No'}!`;
// Is active: Yes!

function isActive() {
   return 'No';
}
const name = `Is active: ${isActive()}!`;
// Is active: No!
```

Modules in JavaScript

Modules - General

- organize code
- split the application into multiple files
- solve a specific problem/deal with a specific topic
- share functionalities between modules

Named Export

You can export functions, objects, or primitive values from the module so they can be used by other programs with the import statement.

```
// foo.js
export myFunction;
export const foo = Math.sqrt(2);
export const MY_CONSTANT = 'MY_CONSTANT';

// bar.js
import { myFunction, foo } from './foo'; // names must match!
```

Default Export

You can have multiple named exports per module but **only one default export**.

```
// foo1.js
export default class { /* … */ };

// foo2.js
class MyClass { /* … */ };
export default MyClass;

// bar.js
import ImportWithAnyName from './foo1';
import ImportWithAnyOtherName from './foo2';
```

Renaming

You can rename an export when importing it.

```
// foo.js
export myValue = 123;

// bar.js
import { myValue as differentName } from './foo';
```

Import entire module's contents

<code>

This inserts myModule into the current scope, containing all the exports from the module in the file my-module.js.

```
import * as myModule from 'my-module.js';

myModule.importedFunction();
console.log(myModule.IMPORTED_CONSTANT);
```

Task

Modules

Equality operator

Check for value (in)equality

<code>

```
const a = 'test';
const b = 'test';
const c = 'test2';

a == b
a != c

const num1 = 1;
const num2 = 1;
const num3 = 2;

num1 == num2
num1 != num3
```

Check for value AND type (in)equality

<code>

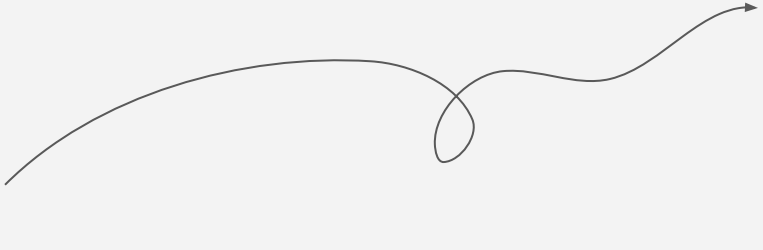
```
const a = '1';
const b = '1';
const c = '2';

a === b
a !== c

const num1 = '2';
const num2 = '2';
const num3 = 2; ⚡

num1 === num2
num1 !== num3 ⚡
```

Always prefer === and !==

- Forces you to write better code (typesafe)
- Clearer intentions
- Especially when working with user input

Object (in)equality


```
const car = {
  brand: 'Ford'
};

const car2 = {
  brand: 'Ford'
};

car == car2 ⚡
car === car2 ⚡
```



The objects are *visually* equal, but unequal when comparing like that

Object (in)equality

<code>

```
const car = {
  brand: 'Ford'
};

const car2 = car;

car == car2
car === car2
```

Array (in)equality

<code>

```
const a = ['a','b'];

const b = ['a','b'];

a == b ⚡
a === b ⚡
```

Beware of Objects & Arrays (in)equality

- Even if the values are kind of equal to us humans, equality behaves differently
- Different storing technique in memory
- We will come back to this later 👋

Falsy / Truthy Values

Falsy and Truthy Values

<code>

```
const framework = 'vue';

if (framework === 'vue') {...}
```

`true` aka boolean

Falsy and Truthy Values

<code>

```
const framework = 'vue';
```

value is a `string`

```
if (framework) {...}
```

Falsy and Truthy Values

<code>

```
const framework = 'vue';
```

value is a `string`

```
if (framework) {...}
```

JavaScript tries to coerce values to a Boolean value if required

Type coercion

	Coerced value	
`0`	`false`	falsy
Any other number (incl. negative)	`true`	truthy
`''` (empty string)	`false`	falsy
Any other non-empty string	`true`	truthy
`{}`, `[]` & all other objects and arrays (even empty)	`true`	truthy
`null`, `undefined` and `NaN`	`false`	falsy

Falsy and Truthy Values

- JavaScript conditions work with booleans → `true` / `false`
- If an operation needs a boolean, JavaScript coerces the value into a boolean
- “Converting without really converting”
- The values which are coerced to true are called truthy, the other ones are called falsy

Nullish Values

- Nullish is a more specific falsy value
- `null` and `undefined` are considered nullish

Nullish coalescing

Nullish coalescing

- `??` is the third logical operator in JavaScript (next to `&&` and `||`).
- Is a new one and has seen the light of the day with ES2020 (June 2020).
- Checks if a value is nullish instead of falsy (like the AND- and OR-Operator).
  - If so, returns the value on the right hand side.
  - Otherwise returns the value on the left hand side.

Nullish coalescing

<code>

```
1         ?? "Workshops.de";     // Result is: 1
42        ?? "Workshops.de";     // Result is: 42
true      ?? "Workshops.de";     // Result is: true
false     ?? "Workshops.de";     // Result is: false
0         ?? "Workshops.de";     // Result is: 0
""        ?? "Workshops.de";     // Result is: ""

null      ?? "Workshops.de";     // Result is: Workshops.de
undefined ?? "Workshops.de";     // Result is: Workshops.de
```

Source: https://reactjs.de/artikel/nullish-coalescing-operator/

Nullish coalescing vs logical OR ||

<code>

```
1           ?? "Default";   // 1          ✅
42          ?? "Default";   // 42         ✅
true        ?? "Default";   // true       ✅
""          ?? "Default";   // ""         ✅

null        ?? "Default";   // Default    ✅
undefined   ?? "Default";   // Default    ✅
```

👍

```
1           || "Default";   // 1          ✅
42          || "Default";   // 42         ✅
true        || "Default";   // true       ✅
""          || "Default";   // Default    ✅

null        || "Default";   // Default    ✅
undefined   || "Default";   // Default    ✅
```

🤔

Nullish coalescing vs logical OR ||

This new operator should be the first choice to check for *nullish* values. Do not longer use the OR-Operator for this kind of checks.

```
0         ?? "Default";   // 0          ✅
false     ?? "Default";   // false      ✅
```

```
0         || "Default";   // Default    ❌
false     || "Default";   // Default    ❌
```

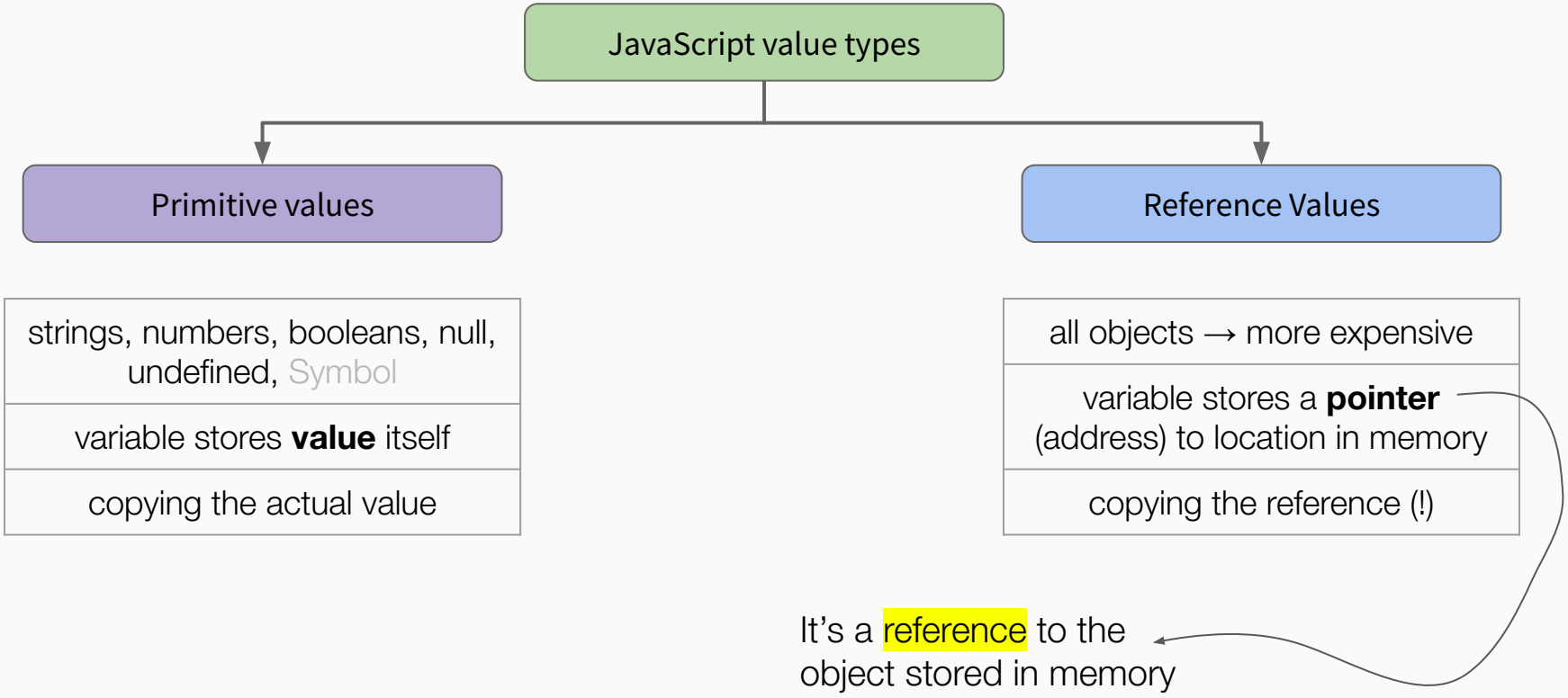
👍 😱

Task

Remove falsy values from a given array

Passing variables in JavaScript

Primitive vs Reference values



Primitive values - copy by value


```
let framework = 'vue';

let anotherFramework = framework; // vue

framework = 'react';

console.log(anotherFramework); // vue
```

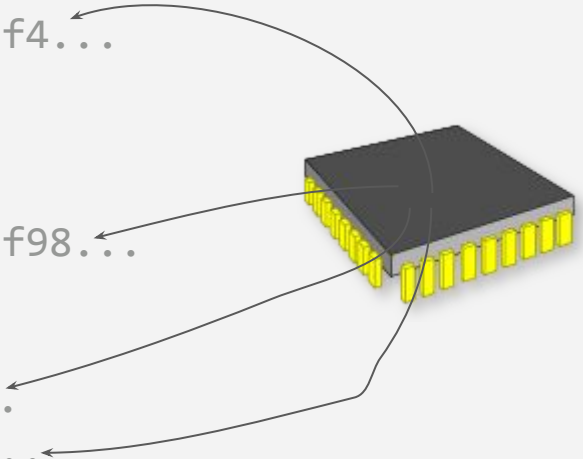
Reference values - copy by value

Be careful here, we are only copying the **reference**, not the actual value

```
let car = {
  brand: 'Ford'
};

let car2 = car; // { brand: 'Ford' }

car.model = 'Mustang';

console.log(car2); // { brand: 'Ford', model: 'Mustang' }
```

Object (in)equality


```
const car = {
  brand: 'Ford'       // value of car is 0ddaf4...
};

const car2 = {
  brand: 'Ford'       // value of car2 is 5f9f98...
};

car == car2 ⚡       // 0ddaf4... != 5f9f98...
car === car2 ⚡      // 0ddaf4... !== 5f9f98...
```



Objects & Arrays deep (in)equality

- Use recursive equality algorithm
- Objects have to be compared by their properties
- Write your own logic or use third party libraries
- i.e. lodash's isEqual function

Passing variables in JavaScript

- All function arguments are always passed by value
- JavaScript copies values of the variables into local variables
- Changes to local variables will not be reflected outside the function
- But primitive and reference values behave different (somehow)

Primitive values - pass by value

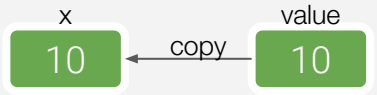
<code>

```
function addOne(x) {
    x = x + 1;
}

const value = 10;

addOne(value);

console.log(value);
```

Primitive values - pass by value

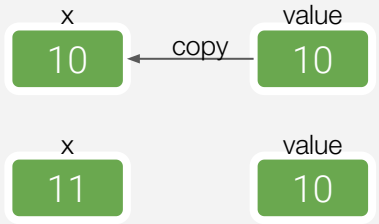
<code>

```
function addOne(x) {
    x = x + 1;
}

const value = 10;

addOne(value);

console.log(value);
```



Primitive values - pass by value

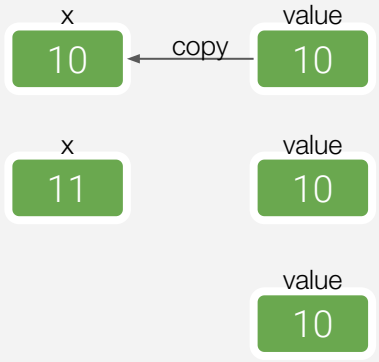

```
function addOne(x) {
    x = x + 1;
}

const value = 10;

addOne(value);

console.log(value);
```



Primitive values - pass by value

<code>

```
function addOne(x) {
    x = x + 1;
}

const value = 10;

addOne(value);

console.log(value);
```



Reference values - pass by reference

<code>

```
function setActive(obj) {
    obj.active = true;
}

const state = {
  active: false
};

setActive(state);
```

Reference values - pass by reference

<code>

```
function setActive(obj) {
    obj.active = true;
}

const state = {
  active: false
};

setActive(state);
```

Reference values - pass by reference

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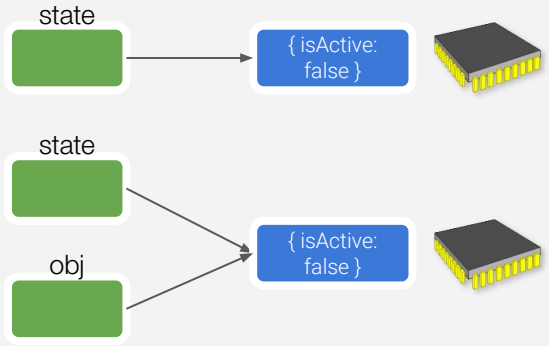


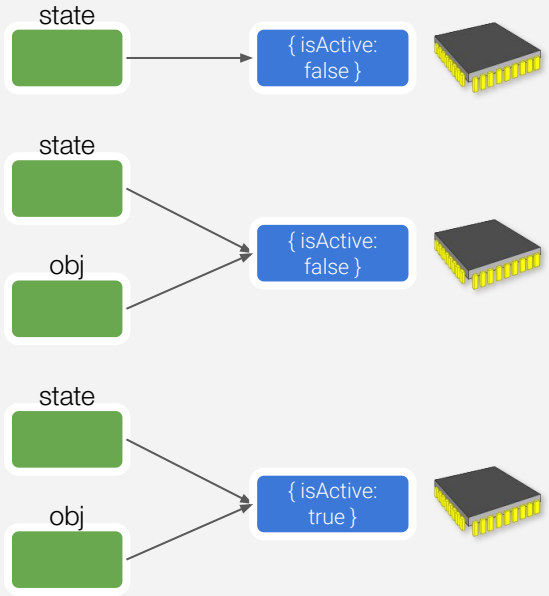
Reference values - pass by reference

<code>

```
function setActive(obj) {
    obj.active = true;
}

const state = {
  active: false
};

setActive(state);
```



Promises

The Promise object represents the eventual completion of an asynchronous operation, and its resulting value.

Why not “simple” callbacks?

Callbacks

A callback can be called asynchronously.

```
http(url, response => {
  user = response.data.user;
}); // http() is async / non-blocking!

user; // undefined
```

Callback problems

1. Callback nesting → The Pyramid of Doom

```
http(url, response => {
    performOperation(response.data.user, result => {
        calc(result, calcResult => {
            doSomething(calcResult, () => {
                // ...
            });
        });
    });
});
```

Callback problems

2. Error handling → Catch errors in every block?

```
http(url, (err, response) => {
    if (err) ...
    performOperation(response.data.user, (err, result) => {
        if (err) ...
        calc(result, (err, calcResult) => {
           if (err) ...
            doSomething(calcResult, () => {
                // ...
            });
        });
    });
});
```

Callback problems

2. Error handling → try-catch error handling doesn't work!

```
const asyncFn = () => {
    setTimeout(() => {
        console.log('doSomethingAsync() called!');
        throw new Error('Something went wrong!');
    }, 1000);
};

try {
    asyncFn();
} catch(e) {
    // This won't catch the error thrown in asyncFn()!
}
```

Callback problems

3. Synchronizing multiple callbacks

```
const api1 = http.get(url, () => {
    // ...
})

const api2 = http.get(url, () => {
    // ...
})

// How to wait for both?
```

Callback problems

<code>

4. Separation of Concerns

```
http.get(url, data => {
    updateGui(data);
    logRequest(data);
    // ...
})
```

Promises to the rescue

Promises

Success and error semantics via `then()` and `catch()`

```
promise.then(successFn).catch(errorFn)
```

Promises

- Read-only view to a **single** future value
- **Not lazy:** As soon as the JavaScript Interpreter sees a promise declaration, it immediately executes its implementation synchronously. Even though it will get settled eventually (resolved or rejected).
- Immutable and **un-cancellable**. Your promise will be resolved **or** rejected once.

Promises

Simple example: async operation with callbacks

```
const setTimer = (duration, callbackFn) => {
    setTimeout(() => {
        callbackFn('Done!');
    }, duration * 1000);
};

setTimer(14, (message) => {
    console.log(message); // Done!
});
```

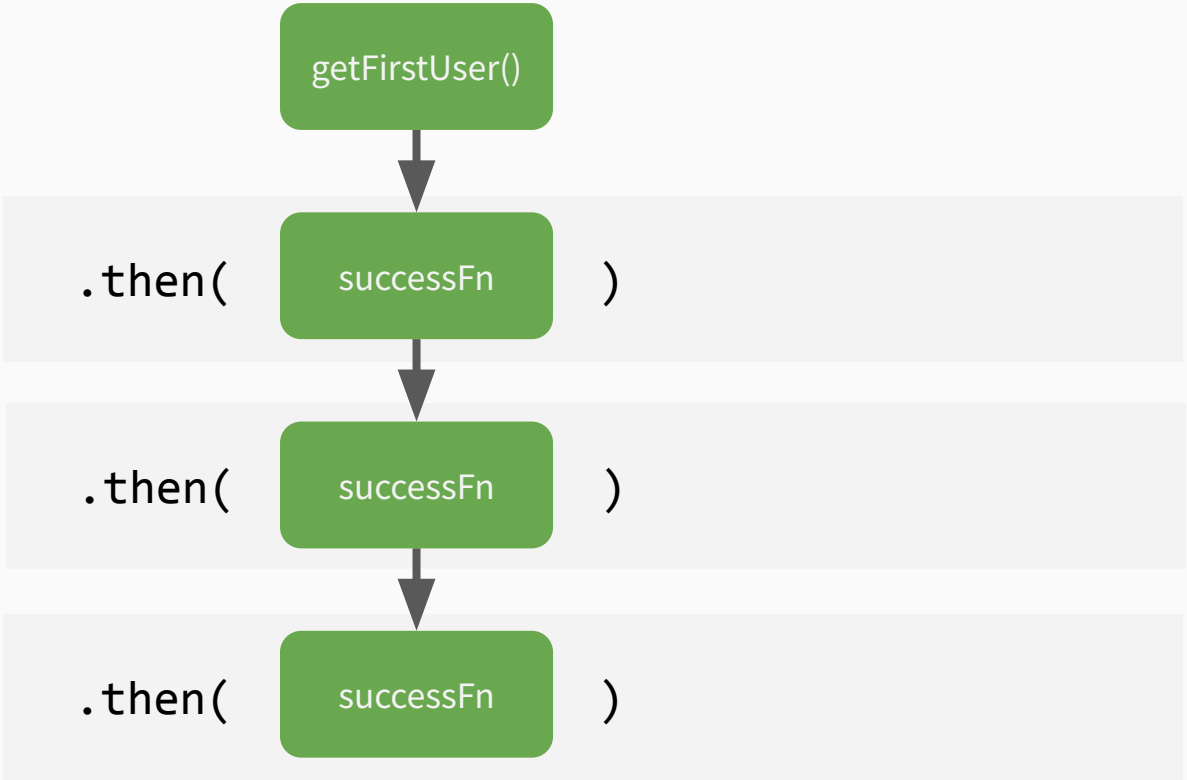
Promises

Simple example: Async operation with Promise (transformed)

```
const setTimer = (duration) => {
    return new Promise((resolve, reject) => {
        setTimeout(() => {
            resolve('Done!');
        }, duration * 1000);
    });
};

setTimer(14).then((message) => {
    console.log(message); // Done!
});
```

Promises - Success flow



Promises

Avoid pyramid of doom

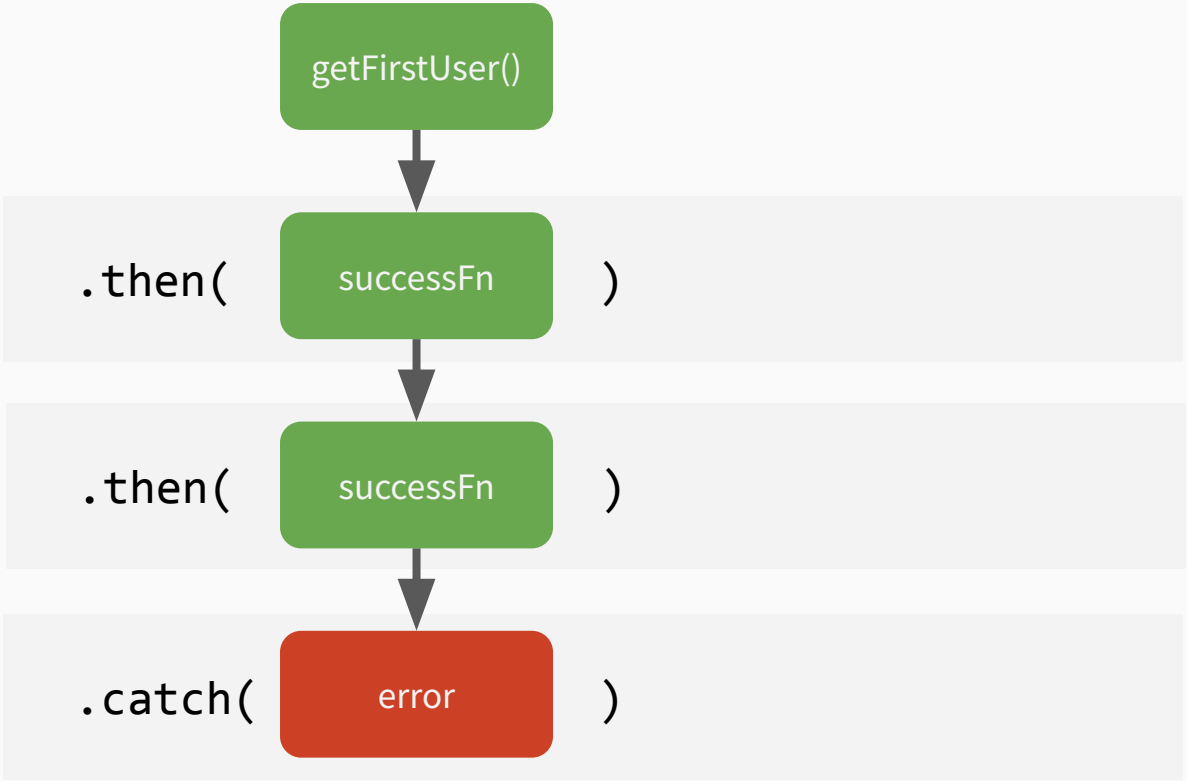
```
api.getFirstUser() // returns a promise
  .then(response => {
    return response.data.user;
  }) // a new resolved promise with value
  .then(user => {
    return api.getUserBooks(user.id) // returns a new promise
  })
```

Promises

Downstream value and catch errors in a single handler

```
api.getFirstUser(url)
.then(response => {
    return response.data.user;
})
.then(() => throw new Error('An error!!!'))
.then(calc) // doesn't handle an error
.then(doSomething)
.catch(error => { // catches all previously occurred errors
    console.log('An error occurred!', error);
});
```

Promises - Success flow

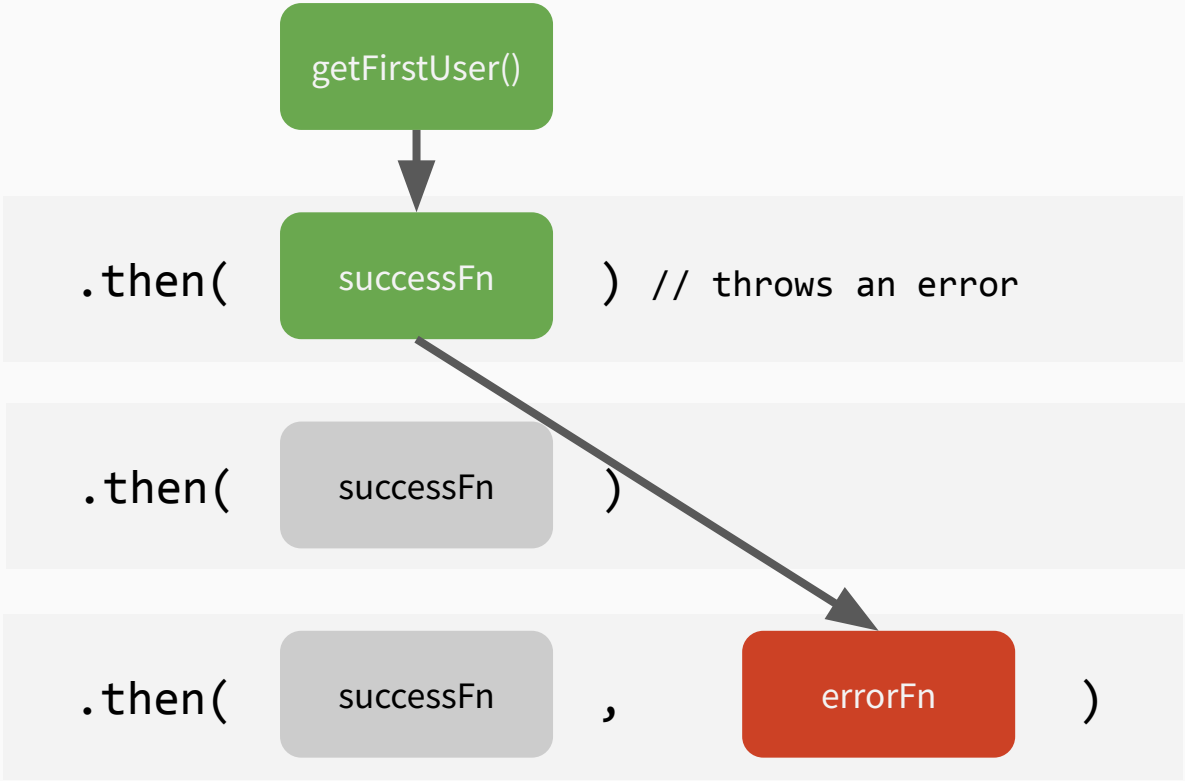


Promises

Downstream value and error propagation

```
api.getFirstUser(url)
.then(response => {
    return response.data.user;
})
.then(() => throw new Error('An error!!!'))
.then(calc) // doesn't handle an error
.then(doSomething, error => {
    console.log('An error occurred!', error);
});
```

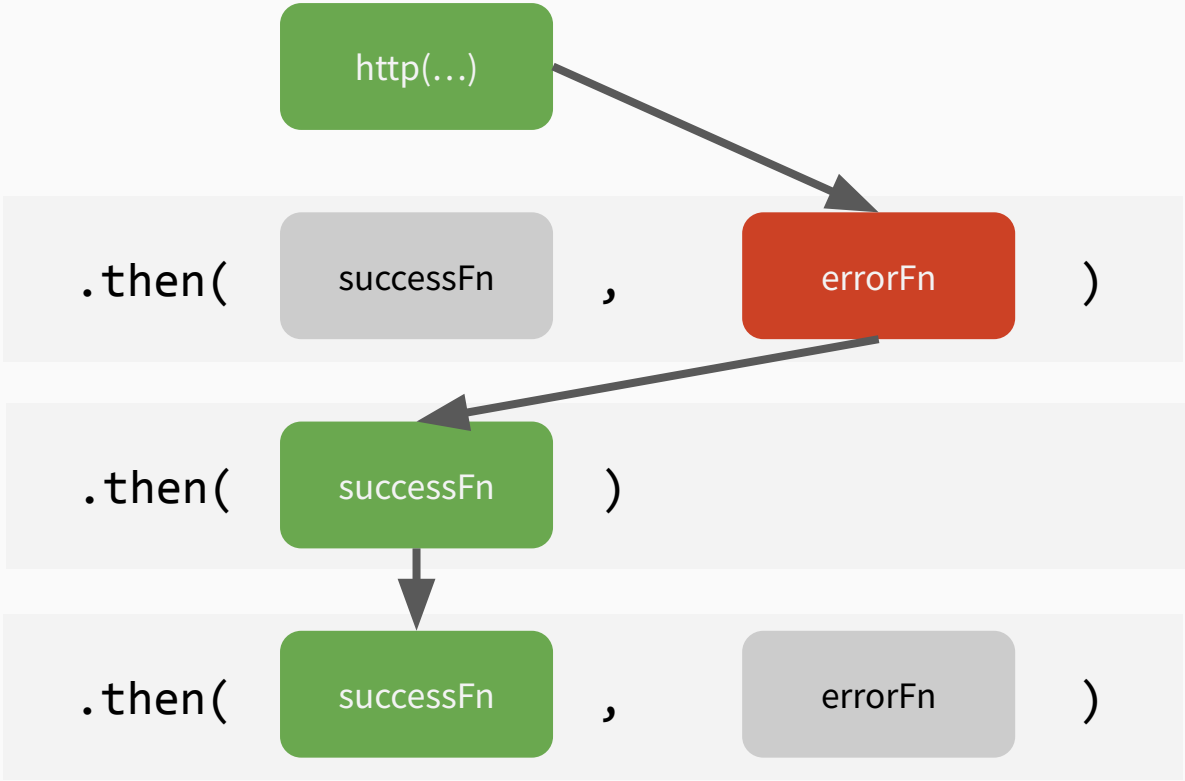
Promises - Error flow



Promises

- Errors and rejections can be handled
- E.g. an API that has a mirror
- You can recover from errors

Promises - Recovery flow



Promises

You can synchronize multiple promises easily

```
const api1 = http.get('/api1'); // returns a promise
const api2 = http.get('/api2'); // returns a promise

Promise.all([api1, api2])
  .then([result1, result2] => {
    return ...
  })
  .then(anotherTransform)
```

Promises

Promises can separate your concerns

```
const api = http.get(url)
api
  .then(updateGui)
  .then(logRequest)

// api.then(updateGui)
// api.then(logRequest)
```

Task

Promises

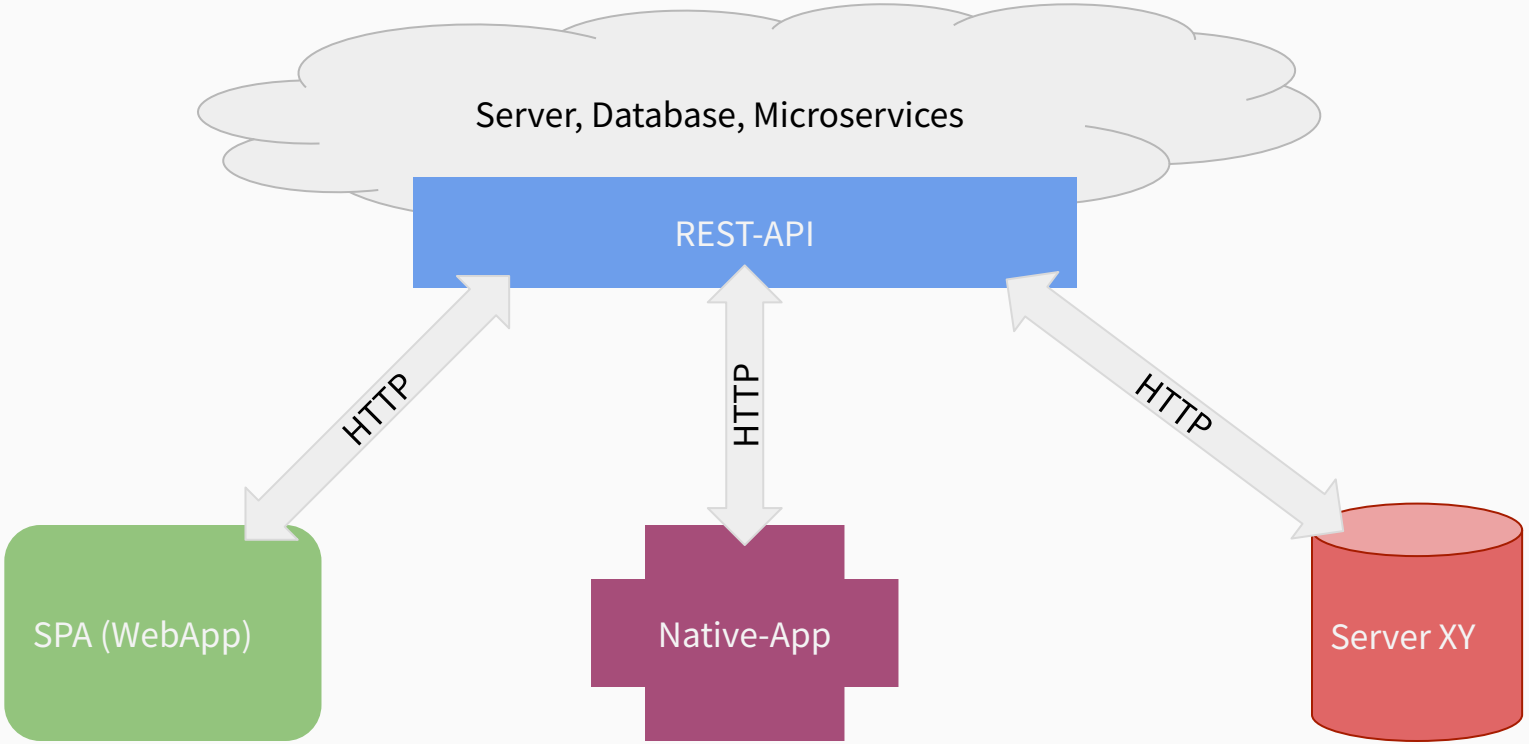
Async data fetching

Load data from an API via HTTP

Why / What you'll learn

- Your data isn't stored locally
  - Multiple clients
  - Huge amount of data
- Communication via HTTP/S (REST/CRUD)
- Different ways to get data from an API

Using a Rest API



Basic CRUD Service

http://localhost:4730

```
POST   /books          // Create a new book
GET    /books          // Read all books
PUT    /books/:isbn    // Update a book by ISBN
DELETE /books/:isbn    // Delete a book by ISBN
GET    /books/:isbn    // Read a specific book by ISBN
```

Using Fetch

- Fetch is a modern concept equivalent to XMLHttpRequest.
- The API is completely Promise-based.

Request an API via Fetch

One argument as a string results in a GET request to this URL

```
return fetch(URL)
      .then(response => response.json())
```

Request an API via Fetch

Request interface allows more detailed control of a resource request

```
const request = new Request(URL, {
  headers: {
    'Accept': 'application/json',
    'Content-Type': 'application/json'
  },
  method : 'PUT',
  body   : JSON.stringify(aJavaScriptObject)
});

return fetch(request)
  .then(response => response.json());
```

Using async and await

Instead of chaining then you also could use async/wait

```
const fetchData = async () => {
    const response = await fetch('http://localhost:4730/books')
    const result = await response.json();
    // do something with result
}
```

Task: Test your knowledge

We teach.

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