# Online Multimedia

Winter Semester 2019/20

Tutorial 04 – Web Components

# Today's Agenda

- Quicktest
- Web Components
- Roundup Quiz

# It‘s Quicktest time!

# Imperative vs. Declarative

Imperative: Specify ***how*** to do something
Declarative: Specify ***what*** should be done
other definition: a programming paradigm that expresses the logic of a computation without describing its control flow

Often (not always), you'll find these concepts alongside declarative programming

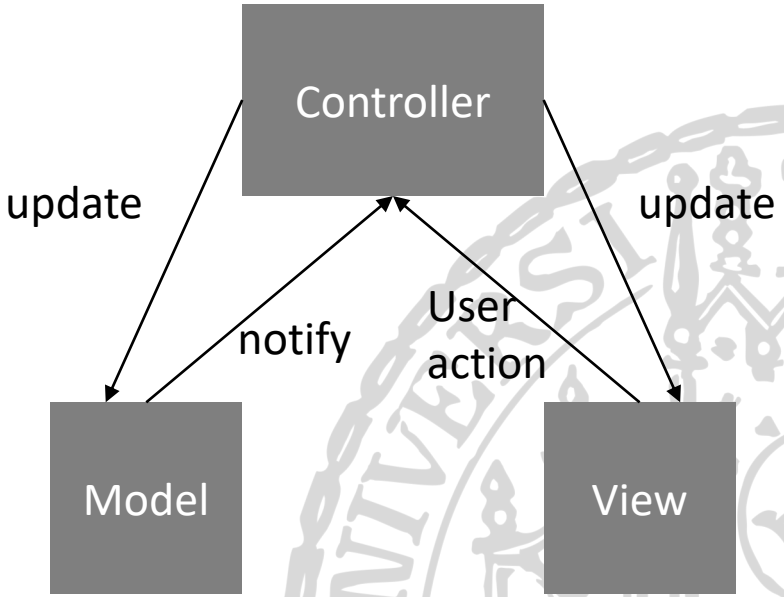
- Functional programming
- Reactive programming
- Databinding

http://latentflip.com/imperative-vs-declarative/

# Rendering

- Model
  Data (e.g. todo-list items)
- View
  Graphical Interface (e.g. webpage)
- Controller
  Defines behavior (e.g. events)

- Often imperative




Adapted from Jake Archibald's Talk: In The Loop

# Breakout: Code-Along MVC

- Let’s create a UI that follows an MVC pattern.
- Using TypeScript
- Imperative Programming Style.
- use the breakout skeleton from GitHub

# Notes on the Breakout

- The MVC Pattern makes sense for bigger applications (not so much for our example).
  - State managers are a viable solution
  - “Data binding” can turn MVC into a MVVM pattern (Model View Viewmodel)
- Even for such a small example, the amount of code is vast.
  - we need something slimmer and directly understandable

Adapted from Jake Archibald’s Talk: In The Loop

# **Goal:** Reusable, Declarative Components

```
<body>
  <header><h1>Counter MVC</h1></header>
  <my-counter></my-counter>
</body>
```

# Web Components

# Web Components

- Approach to more declarative web programming style.
- Goal: re-use “things”, that we would have to write over and over (reducing boilerplate code on the web)
- Driven by Google, Mozilla, Vaadin and many more.
- Concepts:
  - Custom Elements
  - HTML Imports
  - Templates
  - Shadow DOM

Image: http://webcomponents.org/

# Web Components

## Custom Elements

```
<my-element></my-element>
```

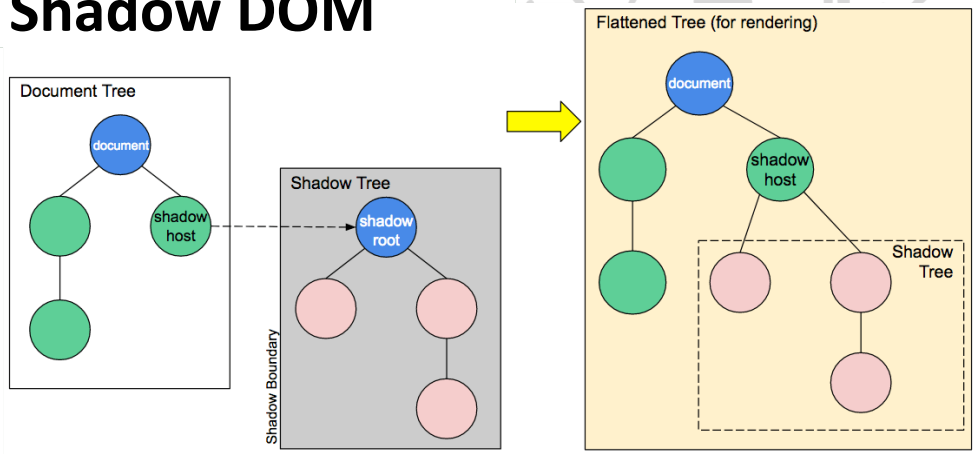
## HTML Templates

```
<template>
  This content is rendered
  later on.
</template>
```

## HTML Imports

```
<link rel="import"
  href="my-code.html">
```

## Shadow DOM




https://mdn.mozillademos.org/files/15788/shadow-dom.png

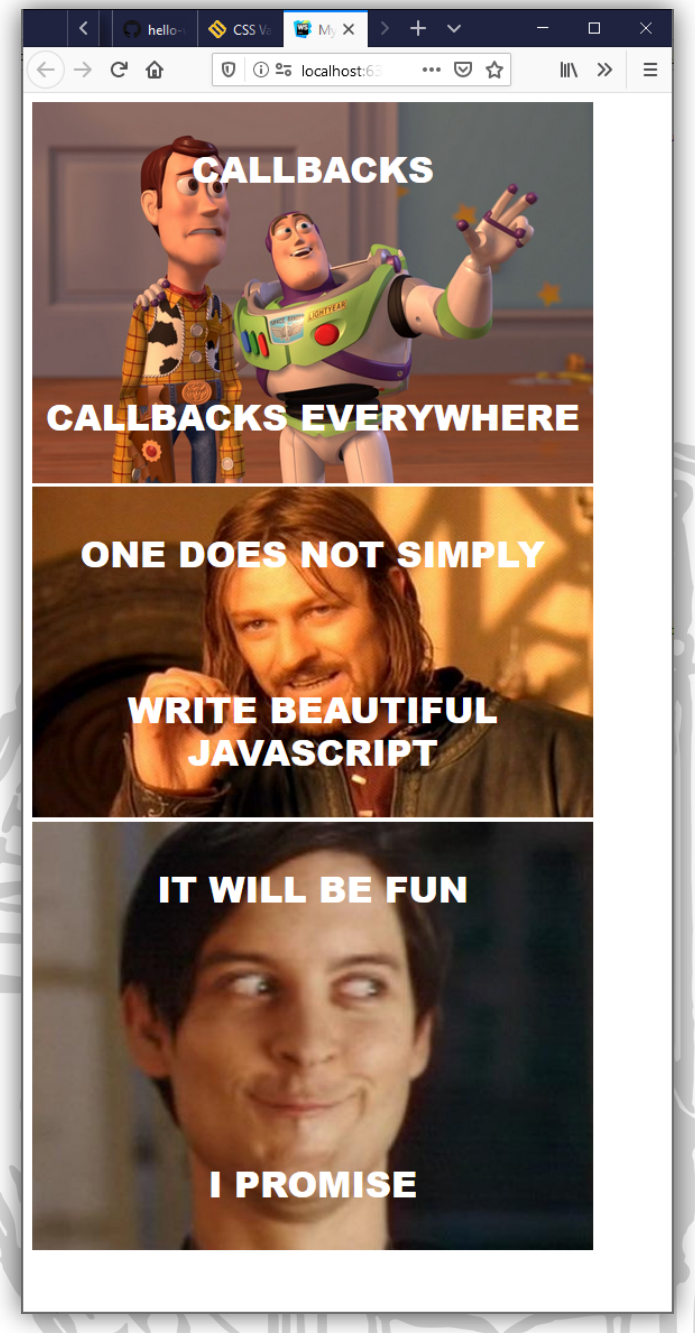
# Web Components and Custom Elements

- Advantages:
  - More declarative approach than using nested classes etc.
  - Encapsulation
  - Separation of concerns
  - Readable

# Without Custom Elements

**Duplicate Code!**

```html
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <title>My Memes</title>
<style>
…
</style>
</head>
<body>
    <div class="meme">
        <img src="https://imgflip.com/s/meme/X-X-Everywhere.jpg"/>
        <p class="caption captionTop">CALLBACKS</p>
        <p class="caption captionBottom">CALLBACKS EVERYWHERE</p>
    </div>
    <div class="meme">
        <img src="https://imgflip.com/s/meme/One-Does-Not-Simply.jpg"/>
        <p class="caption captionTop">ONE DOES NOT SIMPLY</p>
        <p class="caption captionBottom">WRITE BEAUTIFUL JAVASCRIPT</p>
    </div>
    <div class="meme">
        <img src="https://imgflip.com/s/meme/Spiderman-Peter-Parker.jpg"/>
        <p class="caption captionTop">IT WILL BE FUN</p>
        <p class="caption captionBottom">I PROMISE</p>
    </div>
</body>
</html>
```




meme-component/my-memes.html

# With Custom Elements

```html
<!doctype html>
<html>
<head>

    <meta charset="utf-8">
    <title>My Memes</title>

    <!-- Imports polyfill -->
    <script src="webcomponents.min.js"></script>


    <!-- Imports custom element -->
    <link rel="import" href="my-meme.html">

</head>
<body>

    <!-- Runs custom element -->
    <my-meme captionTop="JAVASCRIPT" captionBottom="JAVASCRIPT EVERYWHERE"
            memeTemplateUrl="https://imgflip.com/s/meme/X-X-Everywhere.jpg"></my-meme>

    <my-meme captionTop="ONE DOES NOT SIMPLY" captionBottom="WRITE BEAUTIFUL JAVASCRIPT CODE"
            memeTemplateUrl="https://imgflip.com/s/meme/One-Does-Not-Simply.jpg"></my-meme>

    <my-meme captionTop="IT WILL BE FUN" captionBottom="I PROMISE"
            memeTemplateUrl="https://imgflip.com/s/meme/Spiderman-Peter-Parker.jpg"></my-meme>

</body>
</html>
```

load Polyfill

Import your element

Use it!

meme-component-custom-element/index.html

Inspired by: https://github.com/webcomponents/hello-world-element

# With Custom Elements

```
<template> <!-- Defines element markup -->
    <img src=""/>
    <p class="caption captionTop"></p>
    <p class="caption captionBottom"></p>
    <style>…</style>
</template>
```

```
<script>
(function(window, document, undefined) {

  // … some code to initialize your element goes here

})(window, document);
</script>
```

meme-component-custom-element/my-meme.html

Inspired by: https://github.com/webcomponents/hello-world-element

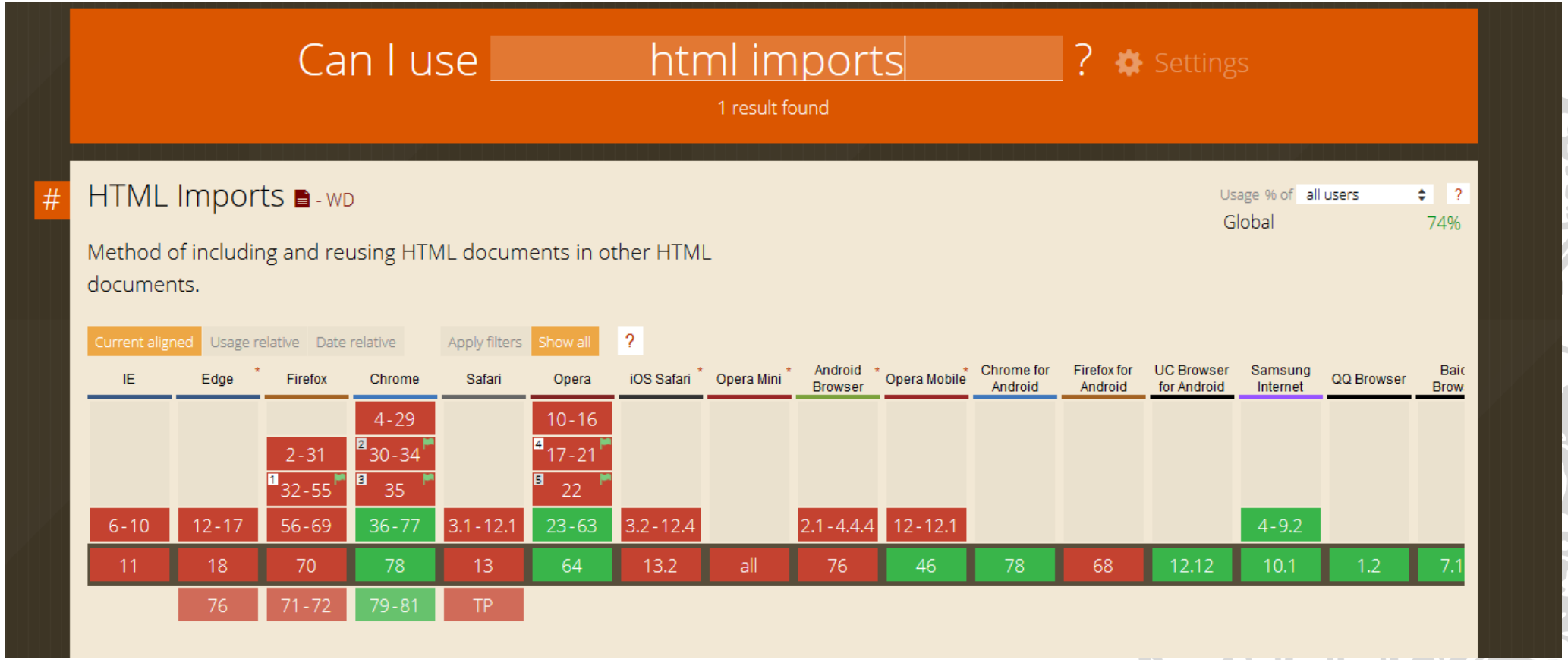
# Polyfills

- Not all browsers support web components yet
- A **Polyfill** is a script that implements a workaround, to support new features in web browsers that do not support that feature.

```
<!-- Imports polyfill -->
<script src="webcomponents.min.js"></script>
```

Script source: https://www.webcomponents.org/polyfills

# Can I Use … ?




www.caniuse.com

# Shadow DOM

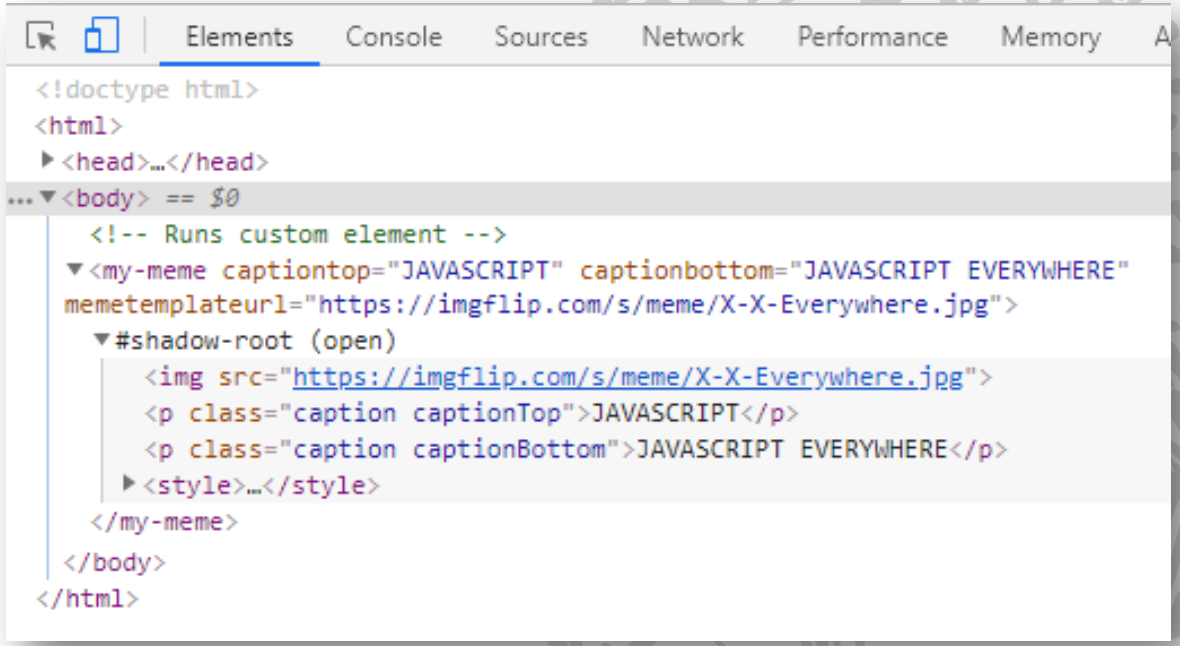
- Include DOM elements into the rendering, but not into the main document
- Hides implementation details => **encapsulation**

What's visible in the main document:

```
<body>

    <my-meme captionTop="JAVASCRIPT" captionBottom="JAVASCRIPT EVERYWHERE"
             memeTemplateUrl="https://imgflip.com/....jpg"></my-meme>
</body>
</html>
```

What the browser renders:



# What it really looks like…

```
<template> <!-- Defines element markup -->
    <img src=""/>
    <p class="caption captionTop"></p>
    <p class="caption captionBottom"></p>
    <style>…</style>
</template>

<script>
(function(window, document, undefined) {
var thatDoc = document;
var thisDoc =  (thatDoc._currentScript || thatDoc.currentScript).ownerDocument;

var template = thisDoc.querySelector('template').content;
var MyElementProto = Object.create(HTMLElement.prototype);

    MyElementProto.createdCallback = function() {

        var shadowRoot = this.createShadowRoot();
        var clone = thatDoc.importNode(template, true);
        shadowRoot.appendChild(clone);


 …     // same for captionBottom and memeTemplateUrl
        if (this.hasAttribute('captionTop')) {
            var captionTop = this.getAttribute('captionTop');
            this.setCaptionTop(captionTop);
        }
 …
};

    // Sets new value to the attributes
    MyElementProto.setCaptionTop = function(val) {
        this.captionTop = val;
        this.captionTopParagraph = shadowRoot.querySelector('p.captionTop‘);
        this.captionTopParagraph.textContent = this.captionTop;
    };
 …     // same for captionBottom and memeTemplateUrl

    window.MyElement = thatDoc.registerElement('my-meme‘, {
        prototype: MyElementProto
    });
})(window, document);
</script>
```

Get references to
- The importer (index.html)
- The importee (my-meme.html)

Create a new DOM object, extending prototype

Create Shadow DOM

Access attribute values of <my-meme> declaration

Callback executed when instance of the element is created

Get reference to sub-element in Shadow DOM, and set content

Register <my-meme> in the main document

# Breakout #2

The counter app again:

- Use the your solution of the first breakout, or breakout1-solution from GitHub
- Encapsulate the counter card into a web component

- Since modules have to be loaded with CORS, you'll need a simple HTTP server, e.g. via `npm install -g http-server` `http-server`

# How to use Web Components in Practice

- Lots of code for a simple functionality

- So of course there are useful libraries and frameworks for that!
- Different “Flavors”:
  - ReactJS
  - Angular
  - Polymer

# Roundup Quiz

1. Which of these are (mostly) imperative, which are declarative languages:
    1. HTML
    2. JavaScript
    3. Java
    4. SQL
    5. TypeScript
2. What is a Polyfill for?
3. Which 4 concepts do WebComponents encompass?