

# App Dev

**Stefano Balietti**

Center for European Social Science Research at Mannheim University (MZES)  
Alfred-Weber Institute of Economics at Heidelberg University

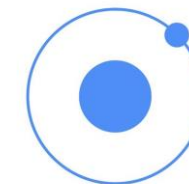
@balietti | stefanobalietti.com | @nodegameorg | nodegame.org



Building Digital Skills: 5-14 May 2021, University of Luzern



Express



# Goals of the Seminar:

1. **Writing and understanding asynchronous code:** event-listeners, remote functions invocation.
2. **Basic front-end development:** HTML, JavaScript, CSS, debugging front-end code.
3. **Introduction to front-end frameworks:** jQuery and Bootstrap
4. **Introduction to back-end development:** NodeJS Express server, RESTful API, Heroku cloud.

# Outputs of the Seminar:

1. **Web app:** in NodeJS/Express.
2. **Chrome extensions:** architecture and examples.
3. **Behavioral experiment/survey:** nodeGame framework.
4. **Mobile development:** hybrid apps with Apache Cordova, intro to Ionic Framework, progressive apps (PWA).

# Your Instructor: Stefano Balietti

<http://stefanobalietti.com>

## Currently

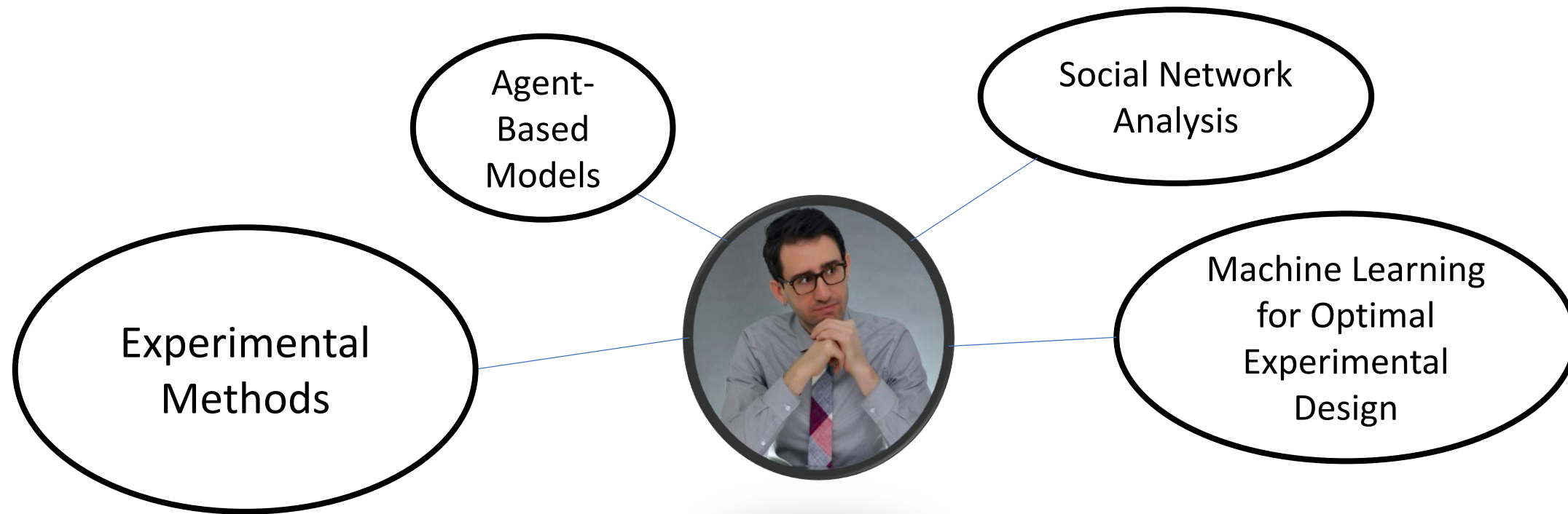
- Fellow in Sociology Mannheim Center for European Social Research (MZES)
- Postdoc at the Alfred Weber Institute of Economics at Heidelberg University

## Previously

- Microsoft Research - Computational Social Science New York City
- Postdoc Network Science Institute, Northeastern University
- Fellow IQSS, Harvard University
- PhD, Postdoc, Computational Social Science, ETH Zurich

# My Methodology

Interface of computer science, sociology, and economics



**ETH** zürich



**HARVARD**  
UNIVERSITY



Microsoft®  
**Research**

# Building Platforms



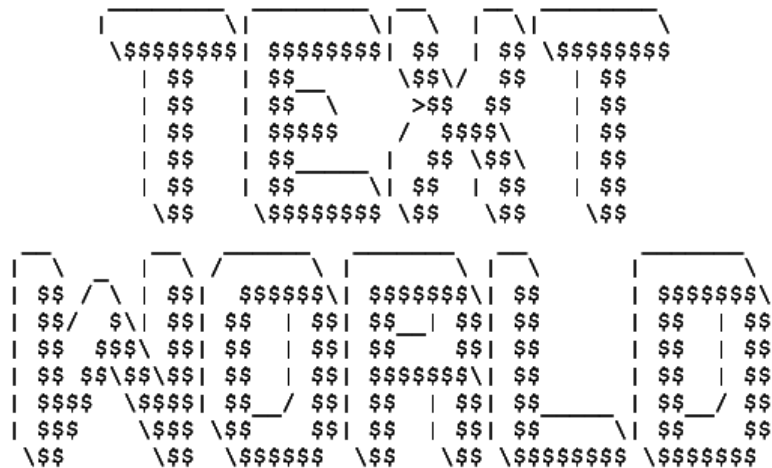
Garch-in-Gretl (GiG) for econometrics Gretl software

~5000 weekly downloads



Patterns Configuration Module for Drupal Web Content Management System

2,622 active users, 30,448 downloads



Fast, scalable JavaScript for large-scale real-time online experiments



v6

[www.nodegame.org](http://www.nodegame.org)



# My Vision

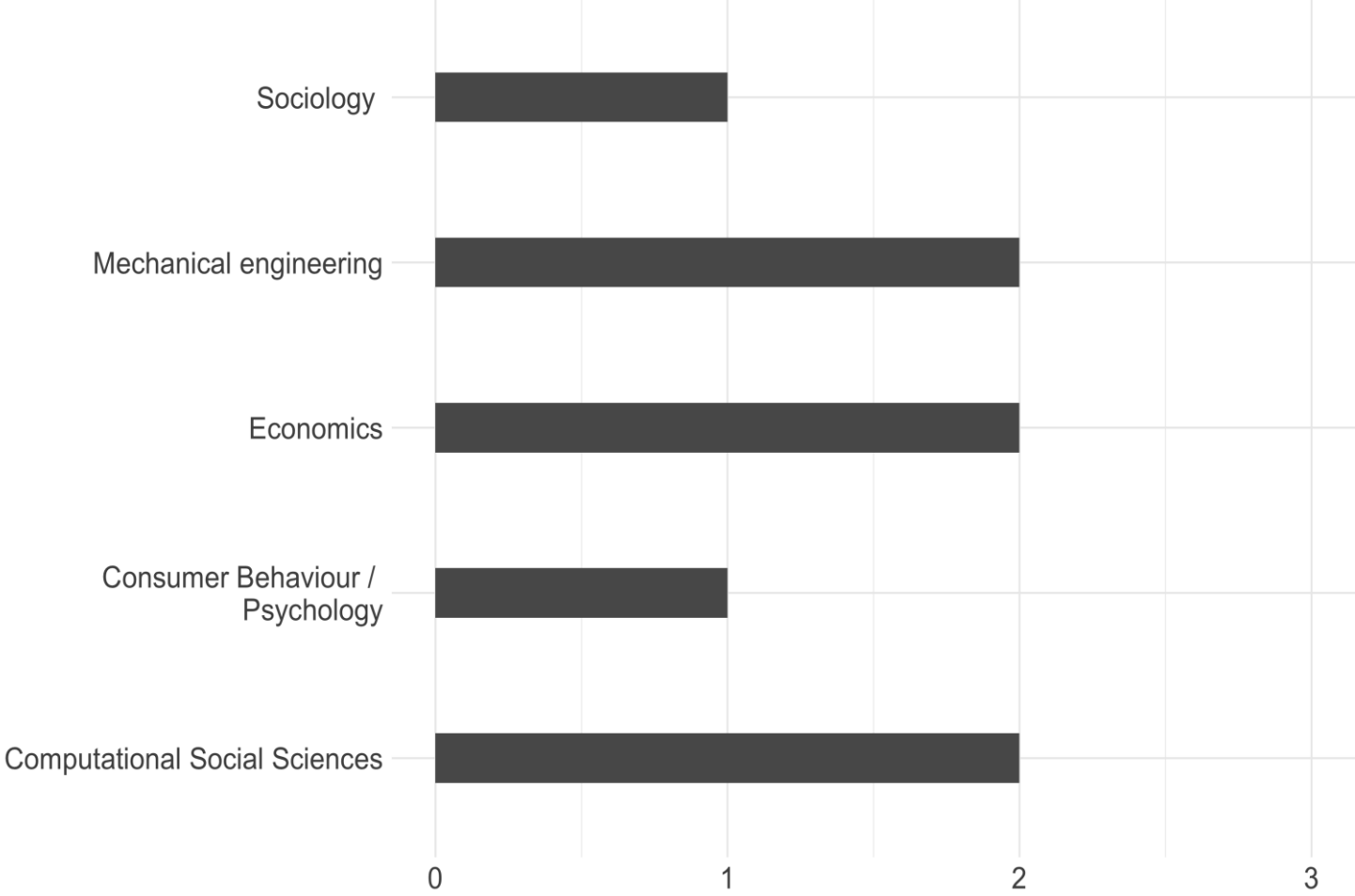


## Simulating Societal Processes in Virtual Labs

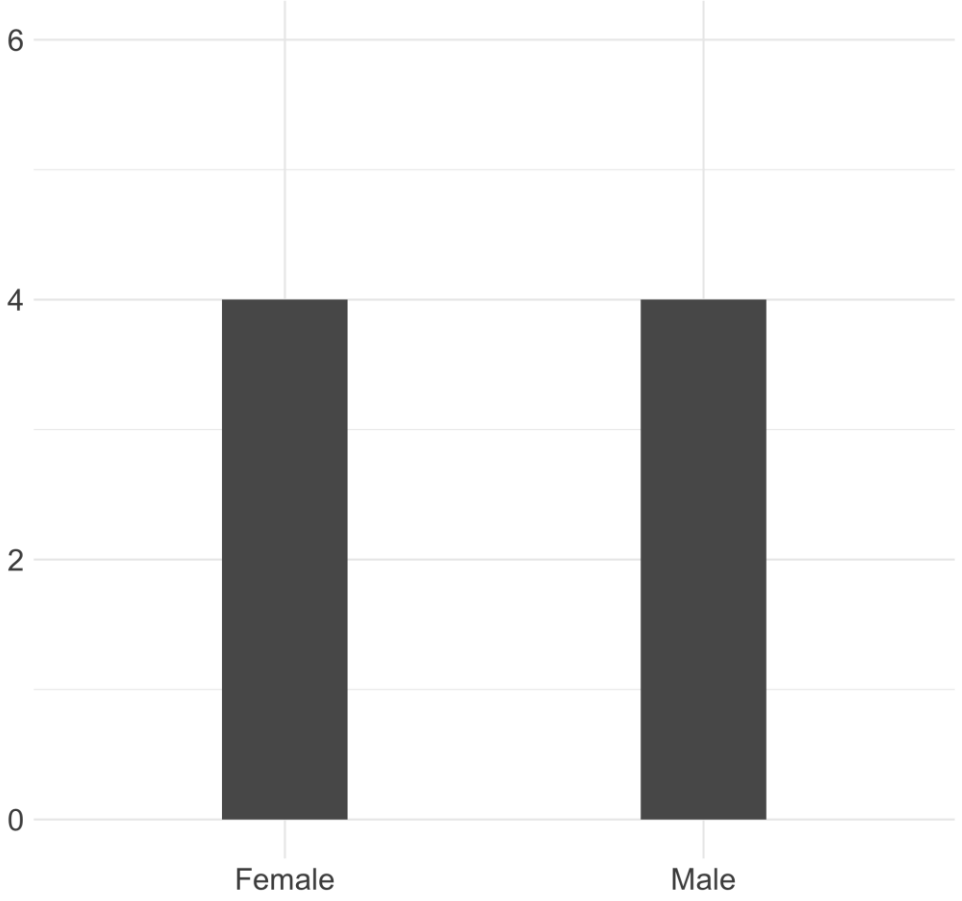
- Consensus, social influence, and polarization
- Group fairness, inequality, redistribution
- Incentives schemes for collective intelligence
- Optimal experimental design

# About You (from web survey)

What is your core discipline?



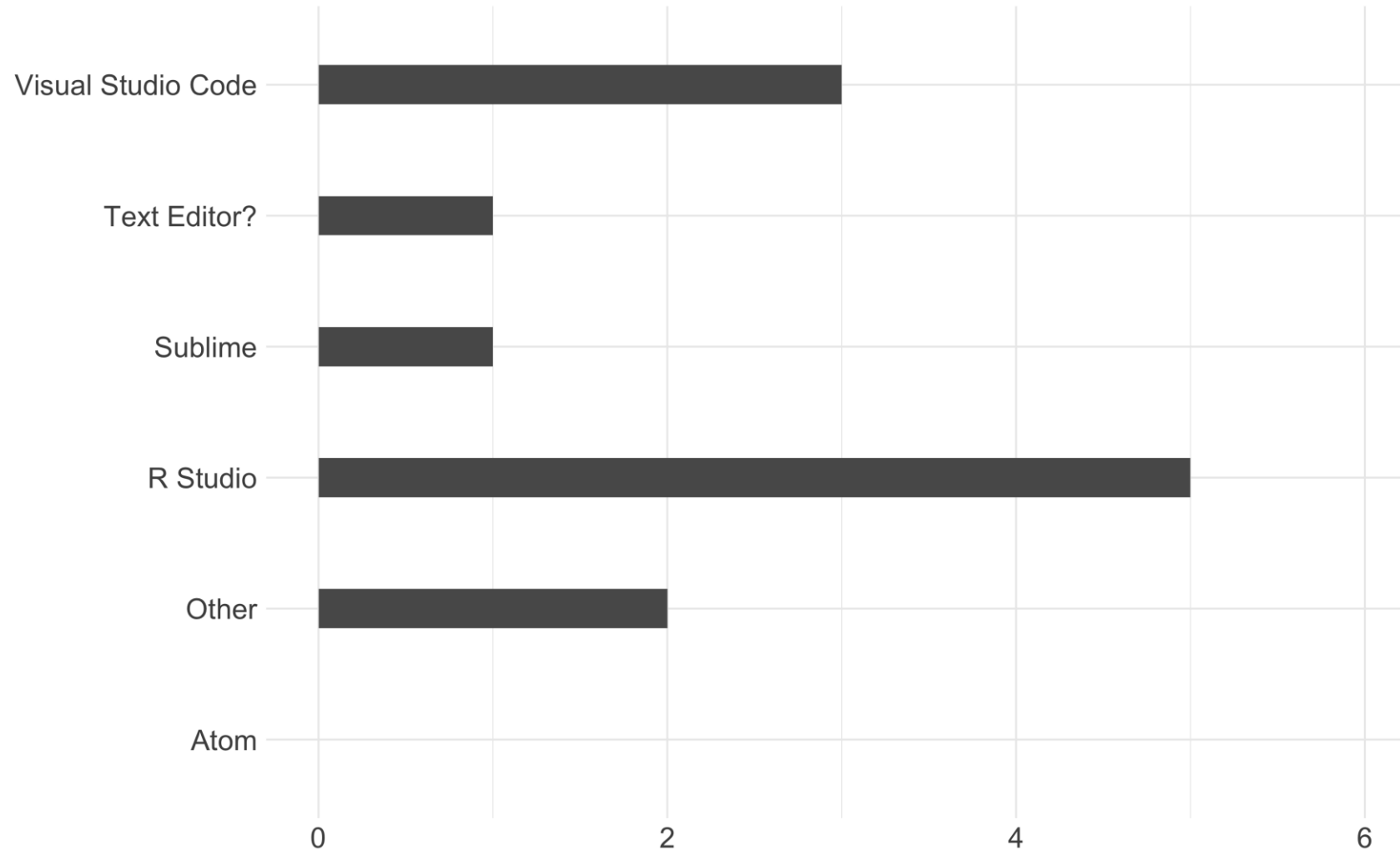
What is your gender?





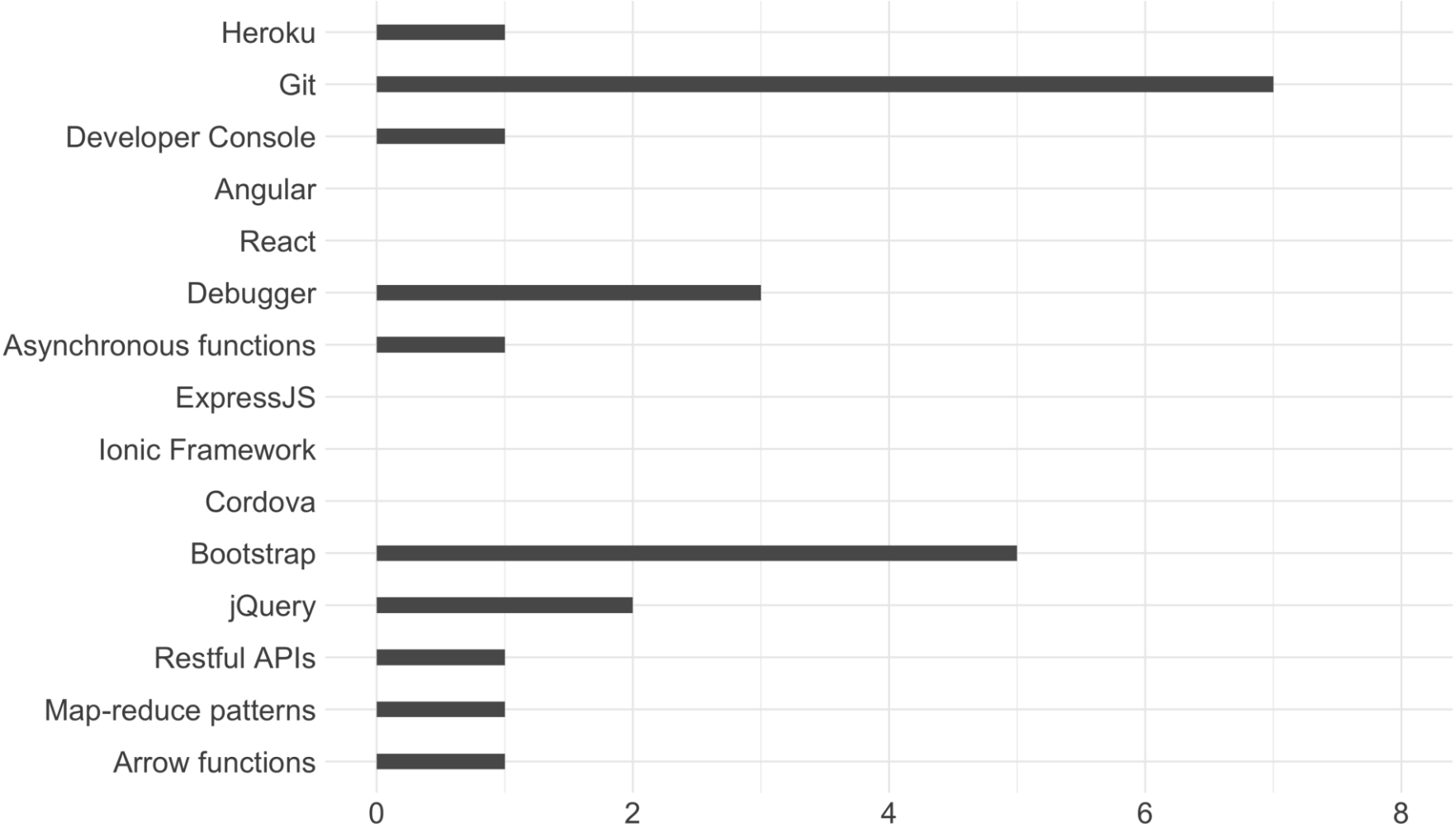
# About You (from web survey)

What text editor do you usually use for programming?



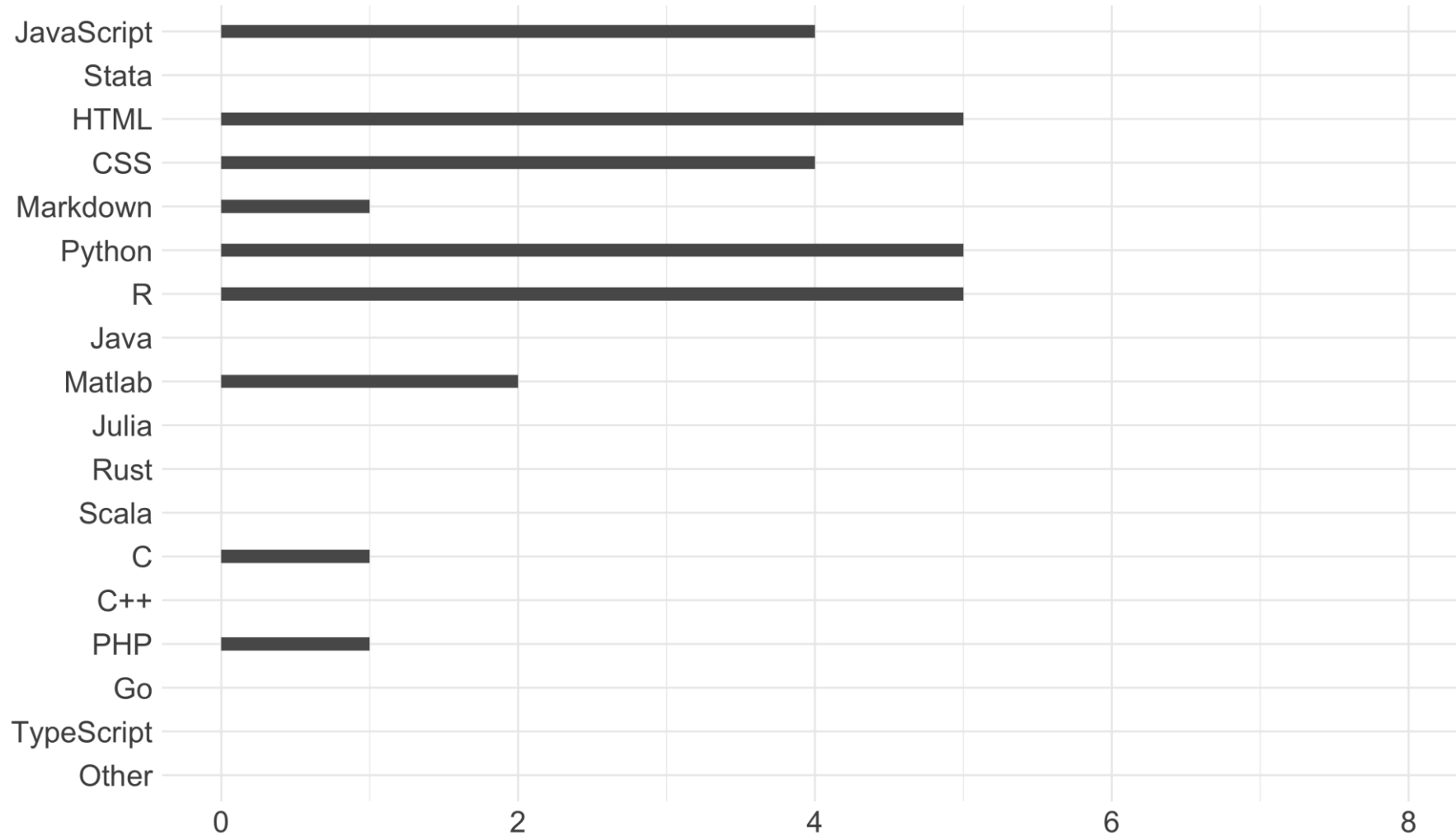
# About You (from web survey)

During your journey in computer programming  
have you ever encountered:



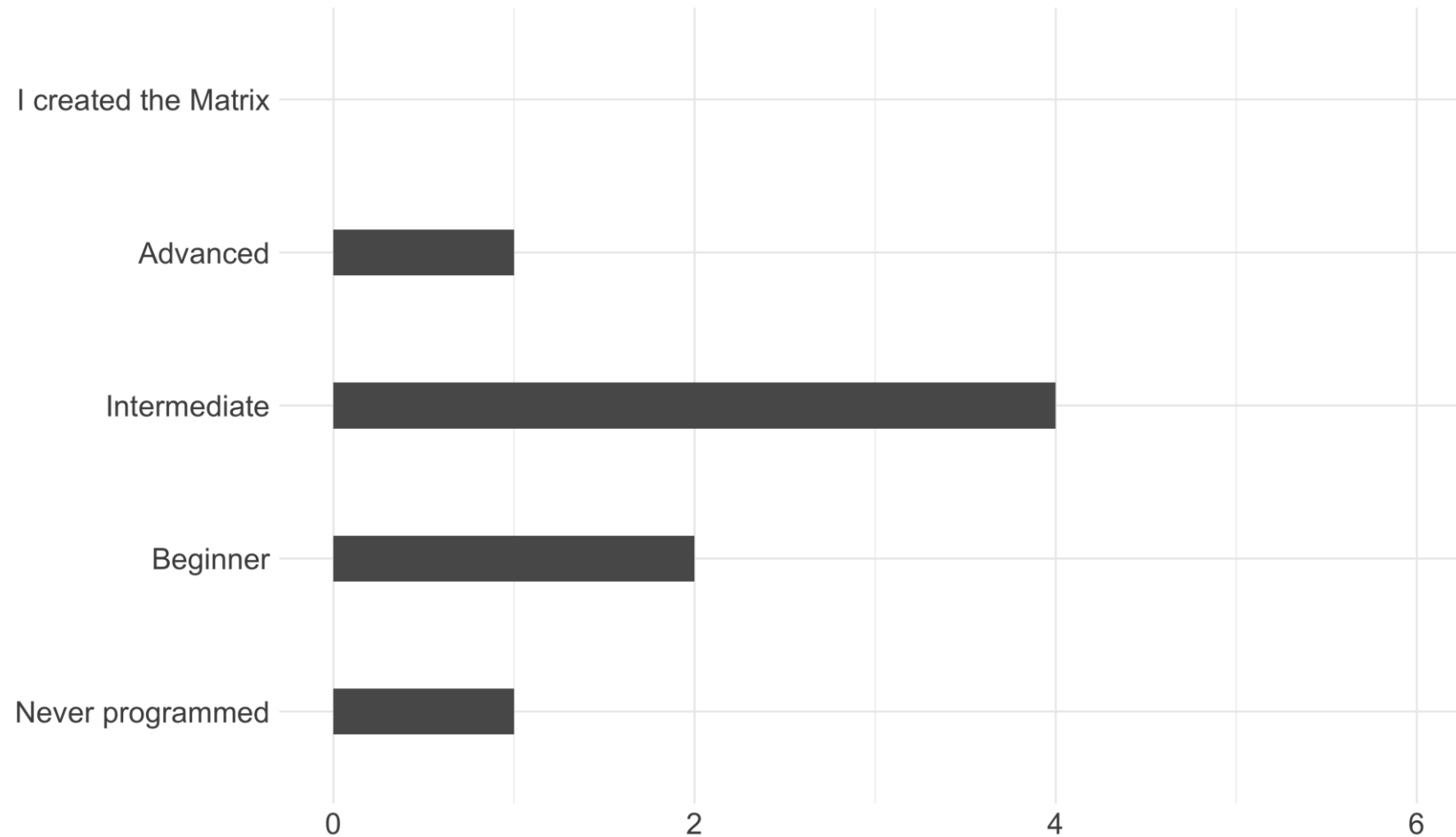
# About You (from web survey)

Which of the following computer languages have you already used?



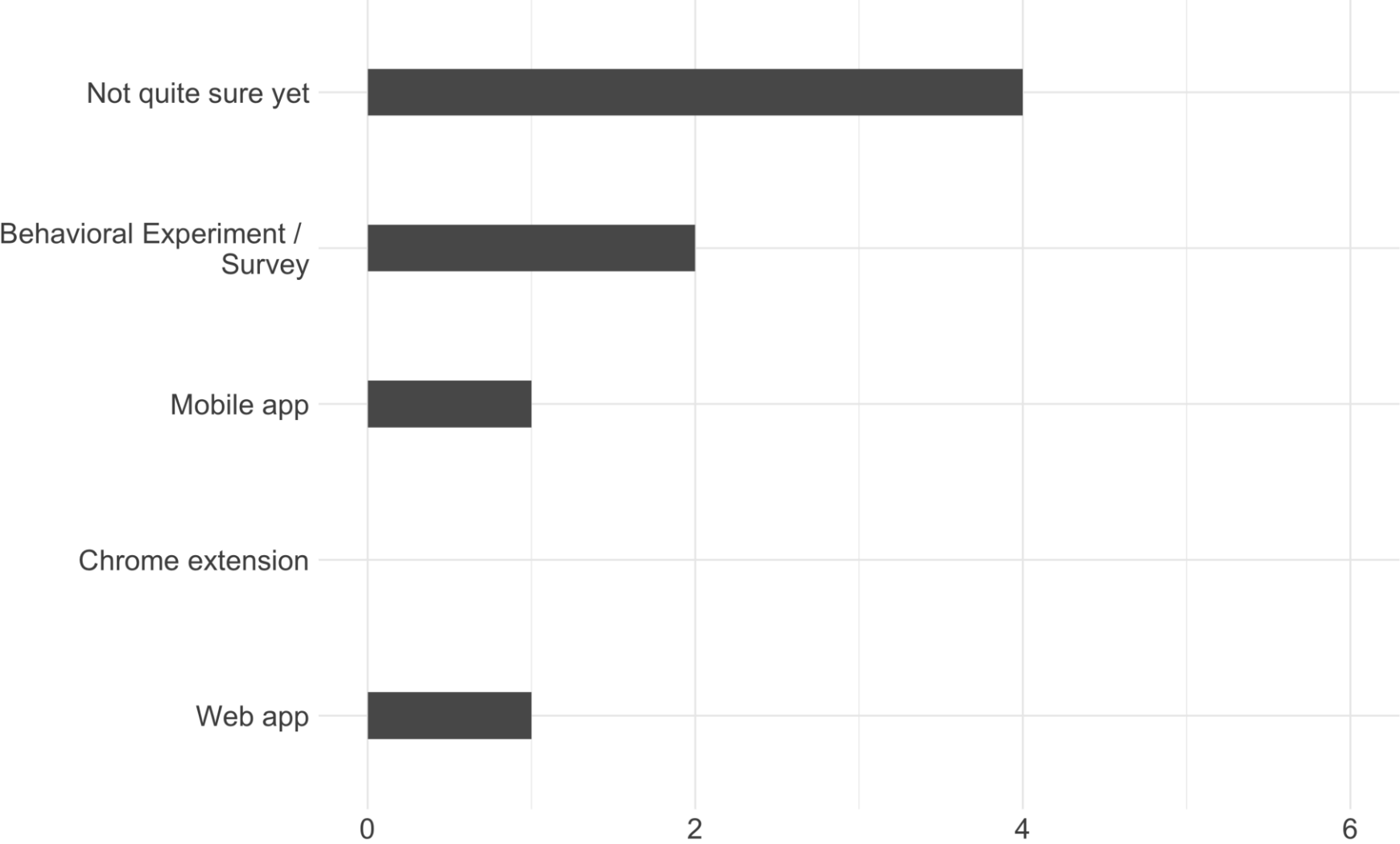
# About You (from web survey)

How skillful of a programmer you are  
in your favorite programming language?



# About You (from web survey)

I would like to create a:



# Approach in This Course

- **Based on previous feedback**, lean slides and focus on exercises to do at your own pace.
- So, I just watch you coding online? That's weird.
- **I will code along** with you at a slow pace, take breaks, stimulate questions.



# How to Get the Most out of This Course

- We will get a solid ground on goals 1-4
- Then pick a project that interests you most.
- No idea? Just do exercises 😊

# How to Get the Most out of This Course

- We will get a solid ground on goals 1-4
- Then pick a project that interests you most.
- No idea? Just do exercises 😊
  
- Exercises marked with **Optional** are *optional*
- Exercises marked with **Bonus** are *optional* and *more complex*
- All exercises have a solution in the *solutions/* folder, but don't look in there too early!

# Prerequisites

- Follow up from the fundamentals of *computer programming course*, so some knowledge of **programming** is expected
- Some knowledge of **JavaScript** is expected

# JavaScript is NOT Java

*"Java is to JavaScript as ham is to hamster." (Jeremy Keith)*



# JavaScript is NOT Java

*"Java is to JavaScript as car is to carpet." (Chris Heilmann)*



**53.12** incl. VAT

[Image source](#)



**€61.39** incl. VAT

[Image source](#)

# JavaScript

- JavaScript was developed in May 1995 by *Brendan Eich* for Netscape Communications Corp
- Was created in **10 days** in order to accommodate the Navigator 2.0 Beta release
- Initially called **Mocha**, later renamed **LiveScript** in September, and later **JavaScript** in the same month





# JavaScript

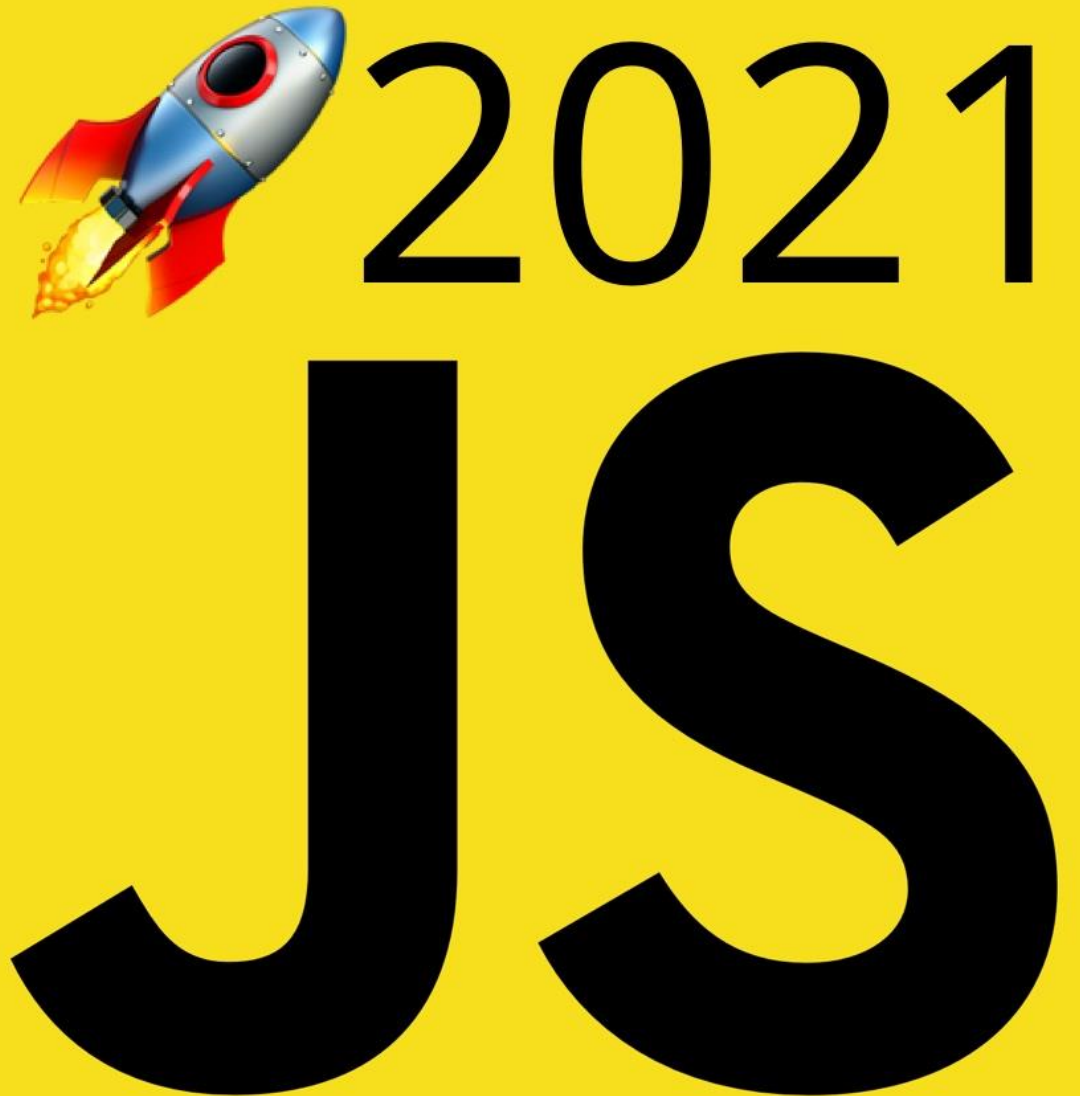
- Microsoft introduced **JScript** as reverse-engineered implementation of Netscape's JavaScript in 1996 in Internet Explorer 3
- In 1996 Netscape submitted JavaScript to European Computer Manufacturers Association (ECMA) to create an industry standard
- In 1997 **ECMAScript** was released
- Between 1997 and 2009 5 standards have been released.
- *July 2015 ECMASCRIPT V6 released.*

# JavaScript Releases

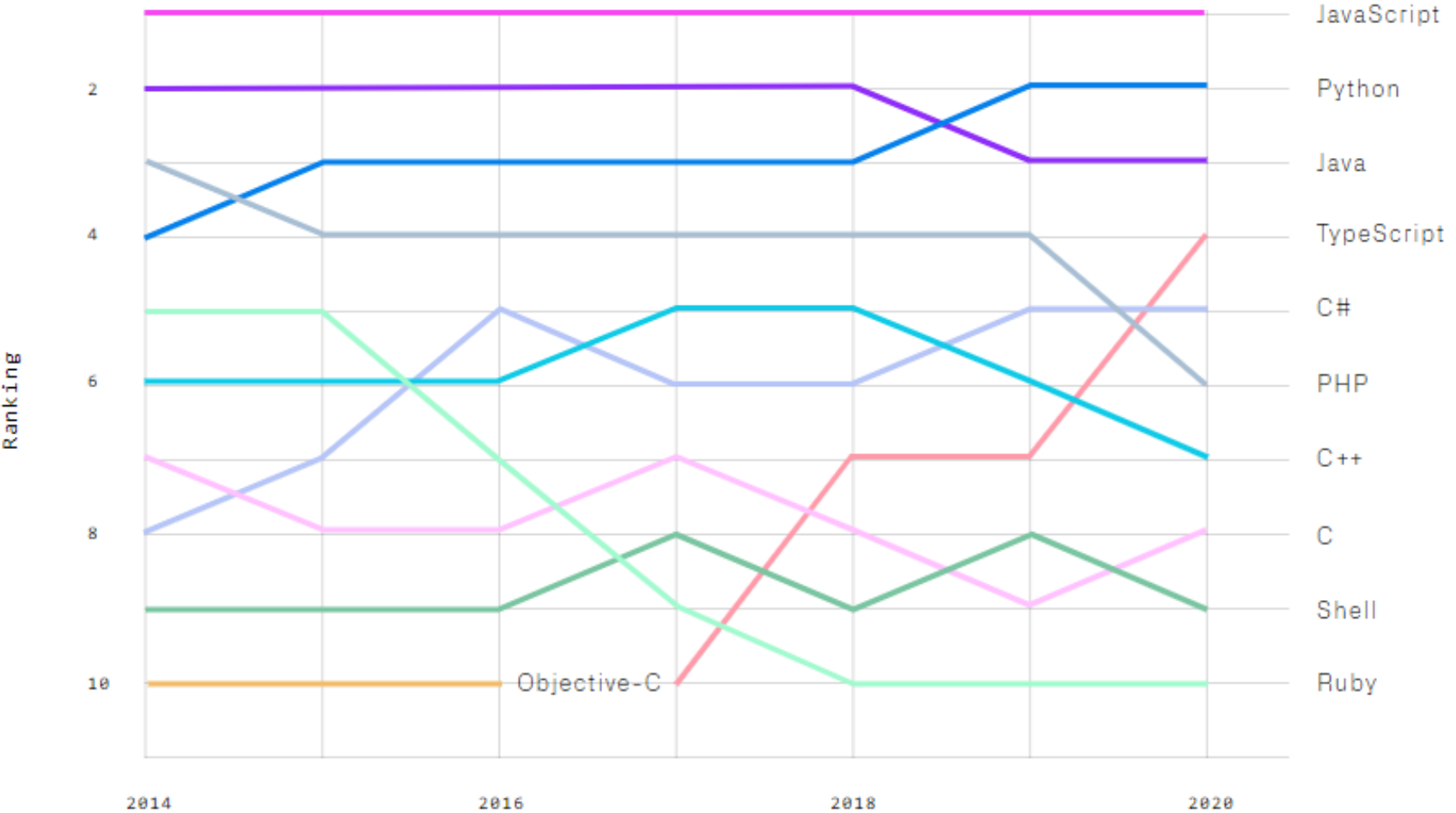
- [ES2016 a.k.a. ES7](#)
- [ES2017 a.k.a. ES8](#)
- [ES2018 a.k.a. ES9](#)
- [ES2019 a.k.a. ES10](#)
- [ES2020 a.k.a. ES11](#)
- [ES2021 a.k.a. ES12](#)

(scheduled for June)

[Image source](#)



# JavaScript is #1 Language on Github



# GitHub.com



Let's look back at the code and communities built on GitHub this year...

Based on the data collection range of October 2019 - September 2020.

56 M+  
total developers on  
GitHub

60 M+  
new repositories created  
in the last year

72 %  
of Fortune 50 companies  
use GitHub Enterprise

1.9 B+  
contributions added  
in the last year

<https://octoverse.github.com/>

# Tentative Schedule

## Goals: May 5<sup>th</sup> – May 7<sup>th</sup>

- Asynchronous code in JavaScript,
- NodeJS and NPM,
- The golden triad of web development: HTML, CSS, and JavaScript (Part 1).
- The golden triad of web development: HTML, CSS, and JavaScript (Part 2),
- Introduction to Web frameworks: JQuery and Bootstrap.
- A simple web app with Express.
- Introduction to the Cordova, PWA, Ionic Framework, Chrome-based browser extensions, and nodeGame framework for behavioral research.

## Outputs: May 12<sup>nd</sup> and May 14<sup>th</sup>

- Targeted material and exercises and custom support for students projects.

# You Get the Certificate If

Attend **all days**.

No problems if you *miss a few hours*.



# Quick Setup Checkpoint

## You have installed

- NodeJS
- Git
- Modern Text Editor (Visual Studio Code or Atom recommended)

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- Git
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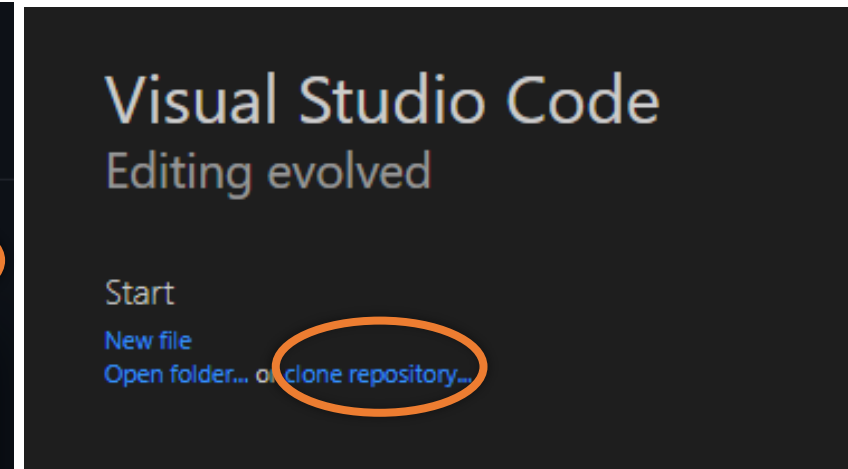
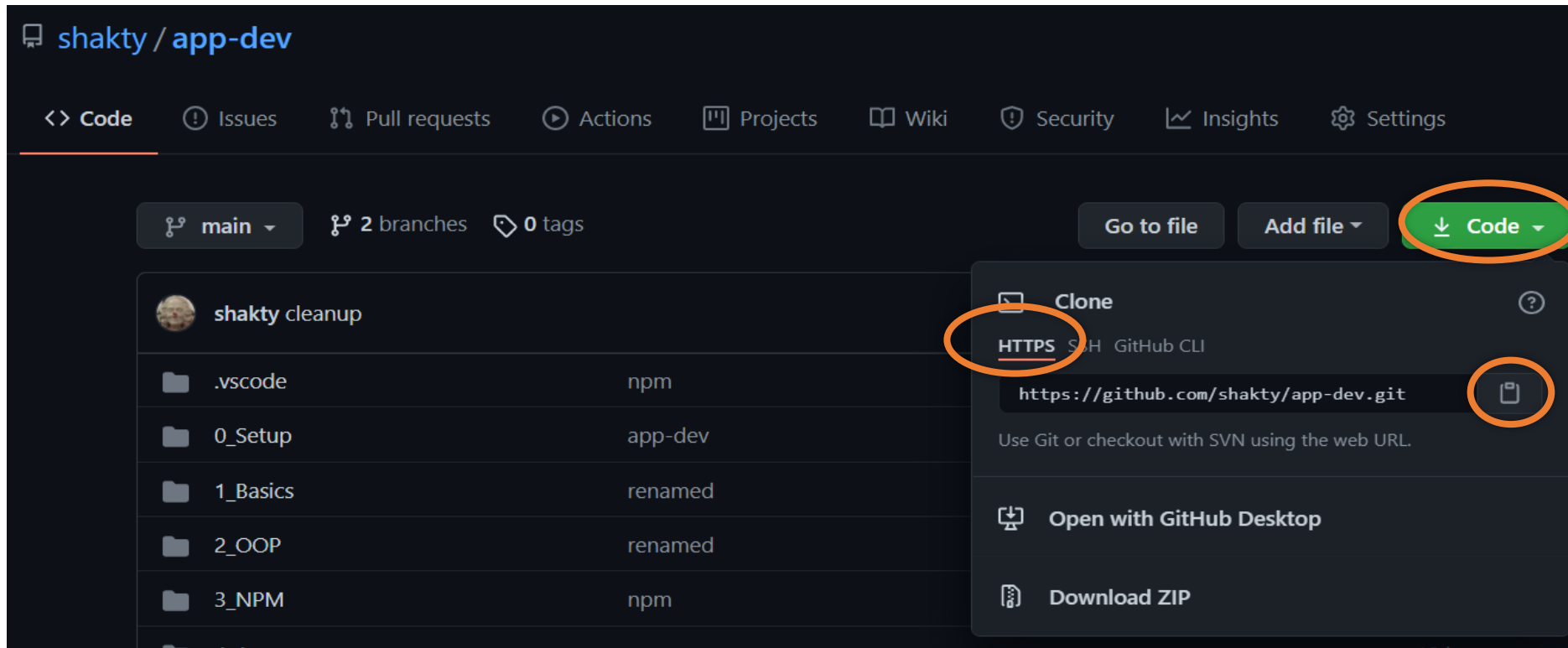
**Fork** the repository of exercises onto your GitHub account

<https://github.com/shakty/app-dev>

**Clone** the forked repository onto your machine

# Forking Instructions

<https://github.com/shakty/app-dev>

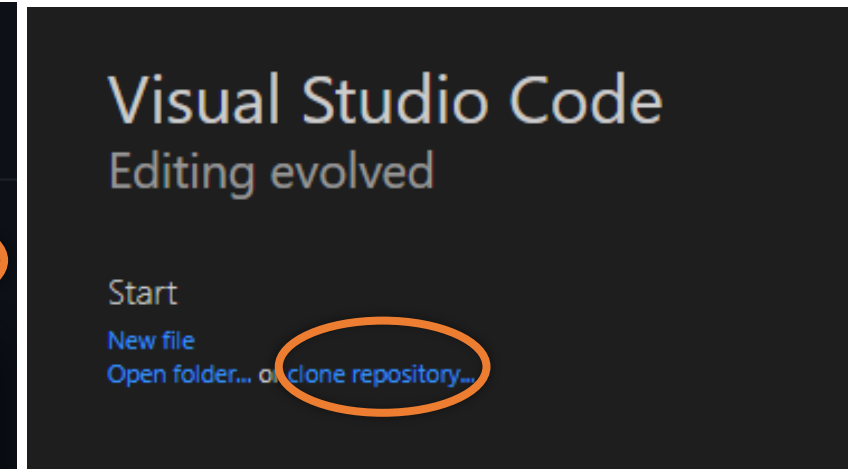
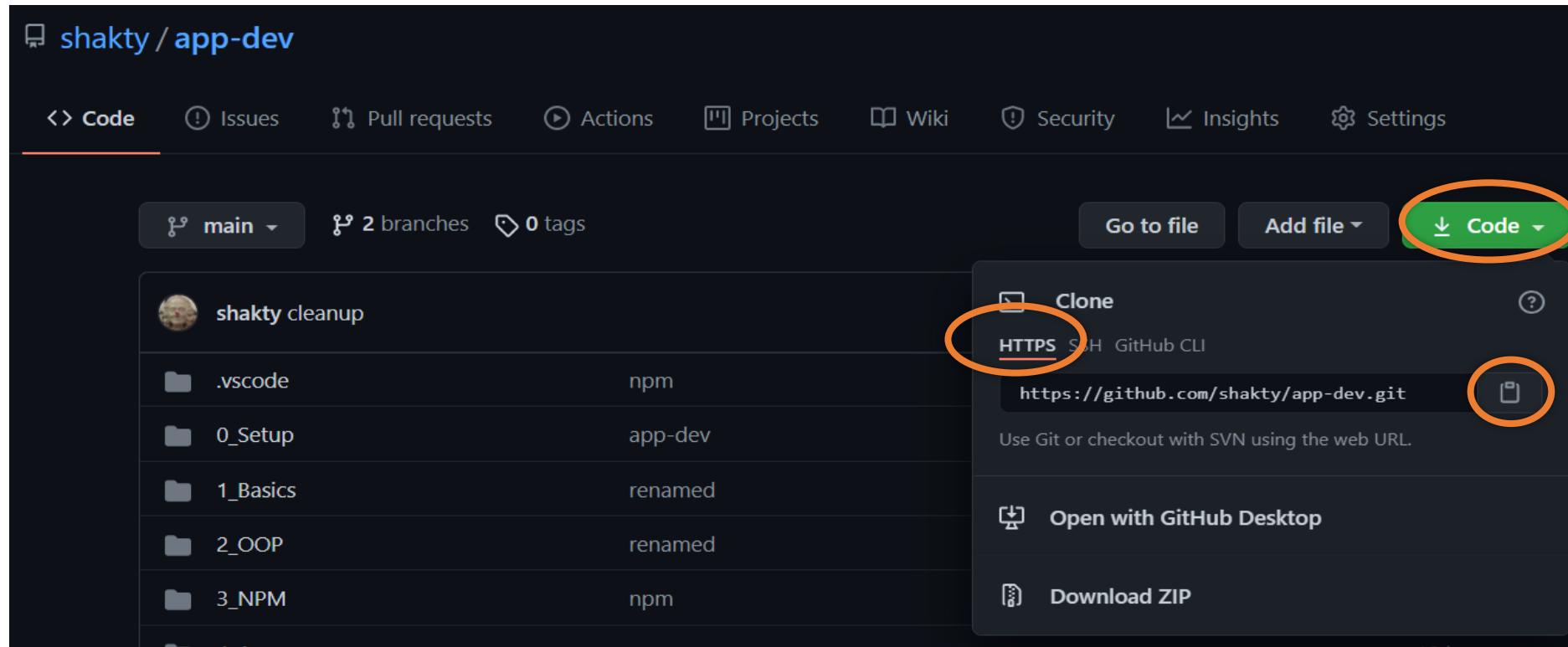


For Atom, I made this video:

<https://www.youtube.com/watch?v=MDU2p9YtvIA>

# Forking Instructions

<https://github.com/shakty/app-dev>



For Atom, I made this video:

<https://www.youtube.com/watch?v=MDU2p9YtvIA>

Do not mix up with spooning :)

# Module 1: NodeJS and NPM



# Module 1: NodeJS and NPM

## Learning Goals

- You should already know some JavaScript, soft reboot
- Search and install NodeJS packages from NPM
- What is the package.json file
- The node\_modules directory
- Load packages into NodeJS programs
- Requiring and exporting local files



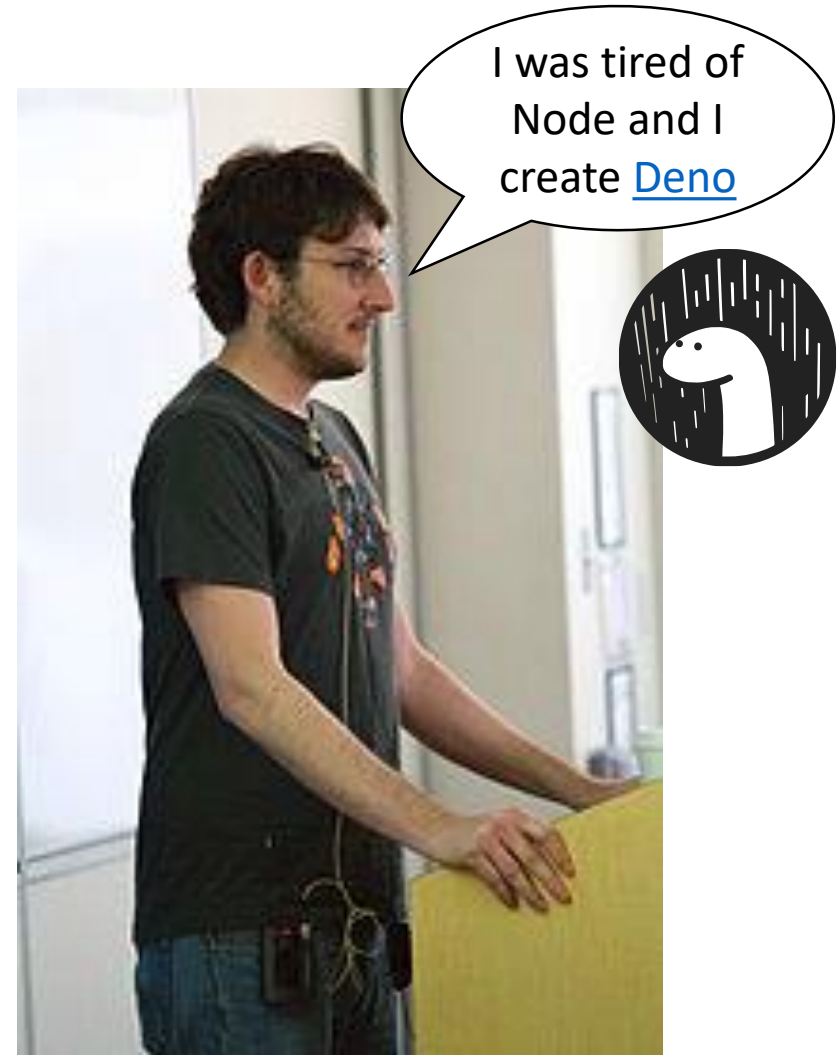
# Node.JS

- **Node.JS** was invented in 2009 by *Ryan Dahl* and other developers working at Joyent
- Combination of Google's V8 JavaScript engine, an event loop, and a low-level I/O API
- **npm**, the node package manager, in 2011
- Versions: 0.10, 0.12, 4.0 ... 16.0!



# Node.JS

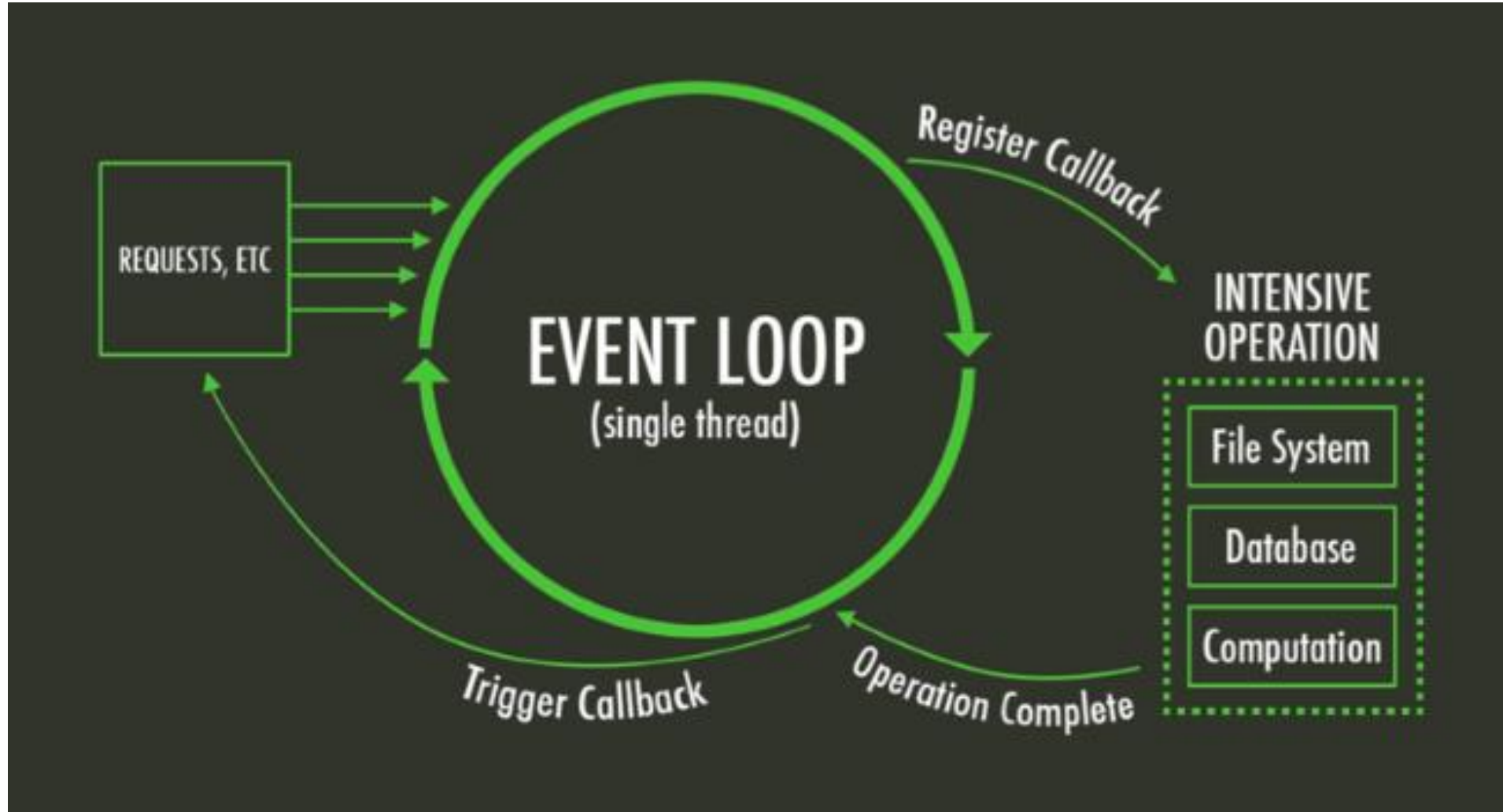
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- Combination of Google's V8 JavaScript engine, an event loop, and a low-level I/O API
- **npm**, the node package manager, in 2011
- Versions: 0.10, 0.12, 4.0 ... 16.0!



# Module 1: References

- <https://nodejs.org/en/>
- <https://www.npmjs.com/>
- <https://docs.npmjs.com/cli/v6/configuring-npm/package-json>
- <https://www.geeksforgeeks.org/node-js-modules/>

# Module 2: Asynchronous Code

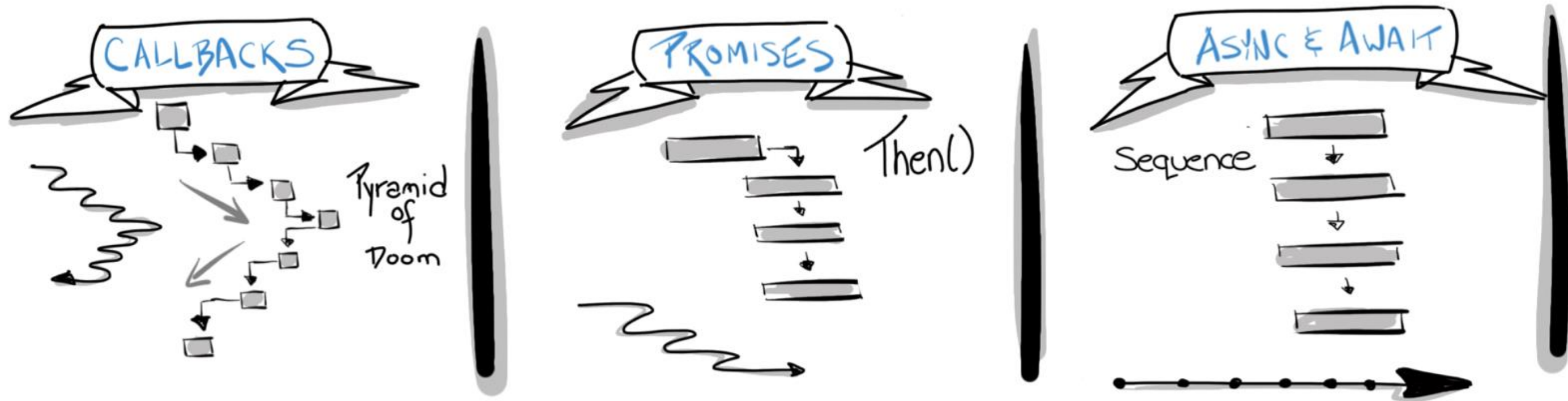


# Module 2: Asynchronous Code

## Learning Goals

- Writing async code with callbacks
- Writing async code with promises
- Writing async code with async/await pattern
- The Bread and Butter of async programming

# Asynchronous Code



# Asynchronous Code

## CALLBACKS

```
if (!empty($_POST)) {
    $msg = '';
    if ($_POST['user_name']) {
        if ($_POST['user_password_new']) {
            if ($_POST['user_password_new'] == $_POST['user_password_repeat']) {
                if (strlen($_POST['user_password_new']) > 5) {
                    if (strlen($_POST['user_name']) < 45 && strlen($_POST['user_name']) > 1) {
                        if (preg_match('/^[a-zA-Z0-9]{2,64}$/i', $_POST['user_name'])) {
                            $user = read_user($_POST['user_name']);
                            if (!isset($user['user_name'])) {
                                if ($_POST['user_email']) {
                                    if (strlen($_POST['user_email']) < 45) {
                                        if (filter_var($_POST['user_email'], FILTER_VALIDATE_EMAIL)) {
                                            create_user();
                                            $_SESSION['msg'] = 'You are now registered so please login';
                                            header('Location: ' . $_SERVER['PHP_SELF']);
                                            exit();
                                        } else $msg = 'You must provide a valid email address';
                                    } else $msg = 'Email must be less than 64 characters';
                                } else $msg = 'Email cannot be empty';
                            } else $msg = 'Username already exists';
                        } else $msg = 'Username must be only a-z, 0-9';
                    } else $msg = 'Username must be between 2 and 64 characters';
                } else $msg = 'Password must be at least 6 characters';
            } else $msg = 'Passwords do not match';
        } else $msg = 'Empty Password';
    } else $msg = 'Empty Username';
    $_SESSION['msg'] = $msg;
    return register_form();
}
```

## PROMISES

Then()

## ASYNC & AWAIT

Sequence

# Module 2: References

- <https://developer.mozilla.org/en-US/docs/Learn/JavaScript/Asynchronous>
- <https://javascript.info/async>



# Module 3: HTML, JS, CSS

**HTML**



**CSS**



**JS**

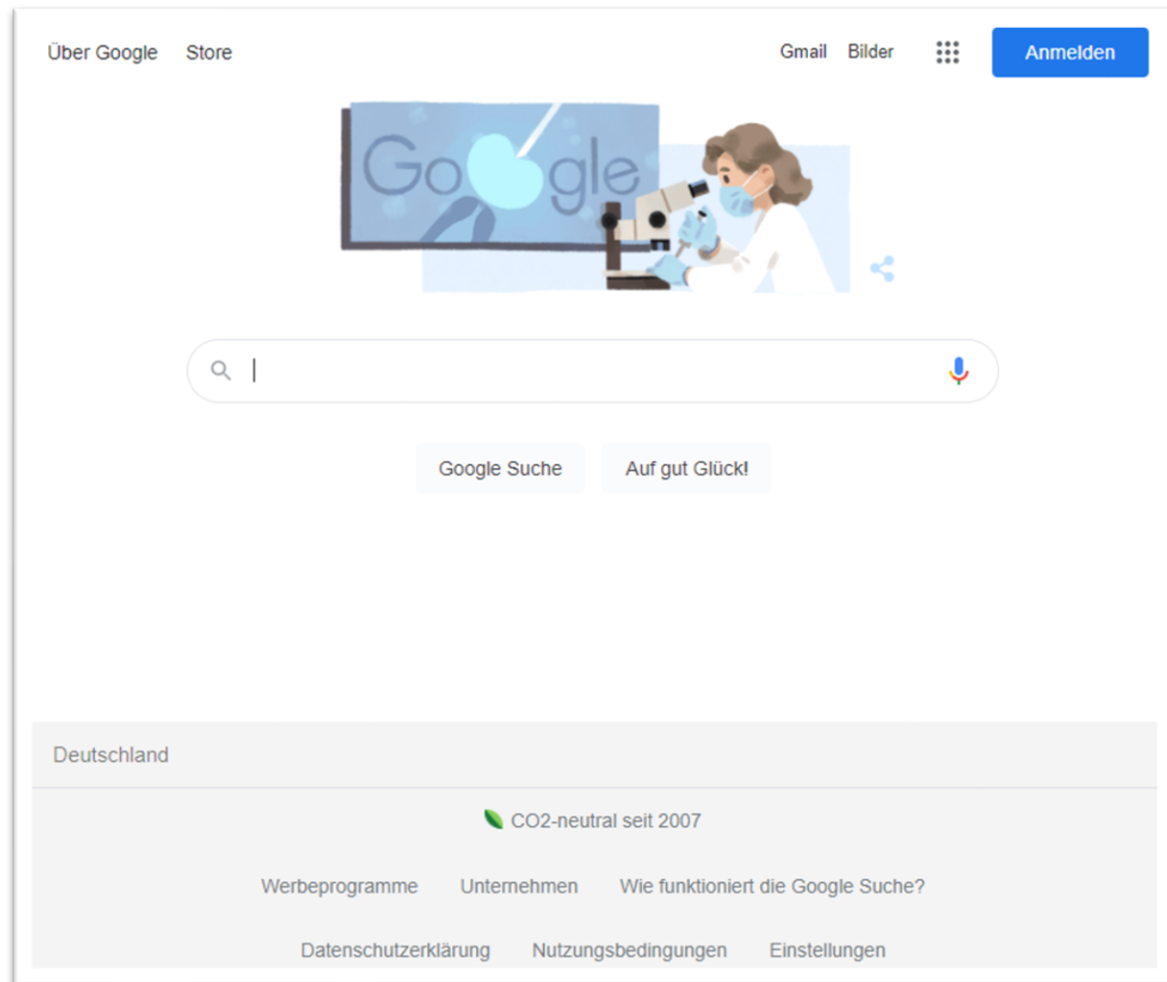


# Module 3: HTML, JS, CSS

## Learning Goals

- Create an **old school** web app to cheer us up in difficult times.
- HTML structures
- *Basic* CSS styling rule
- Add interaction to an HTML page, creating new elements, modifying existing ones
- Debugging front-end code

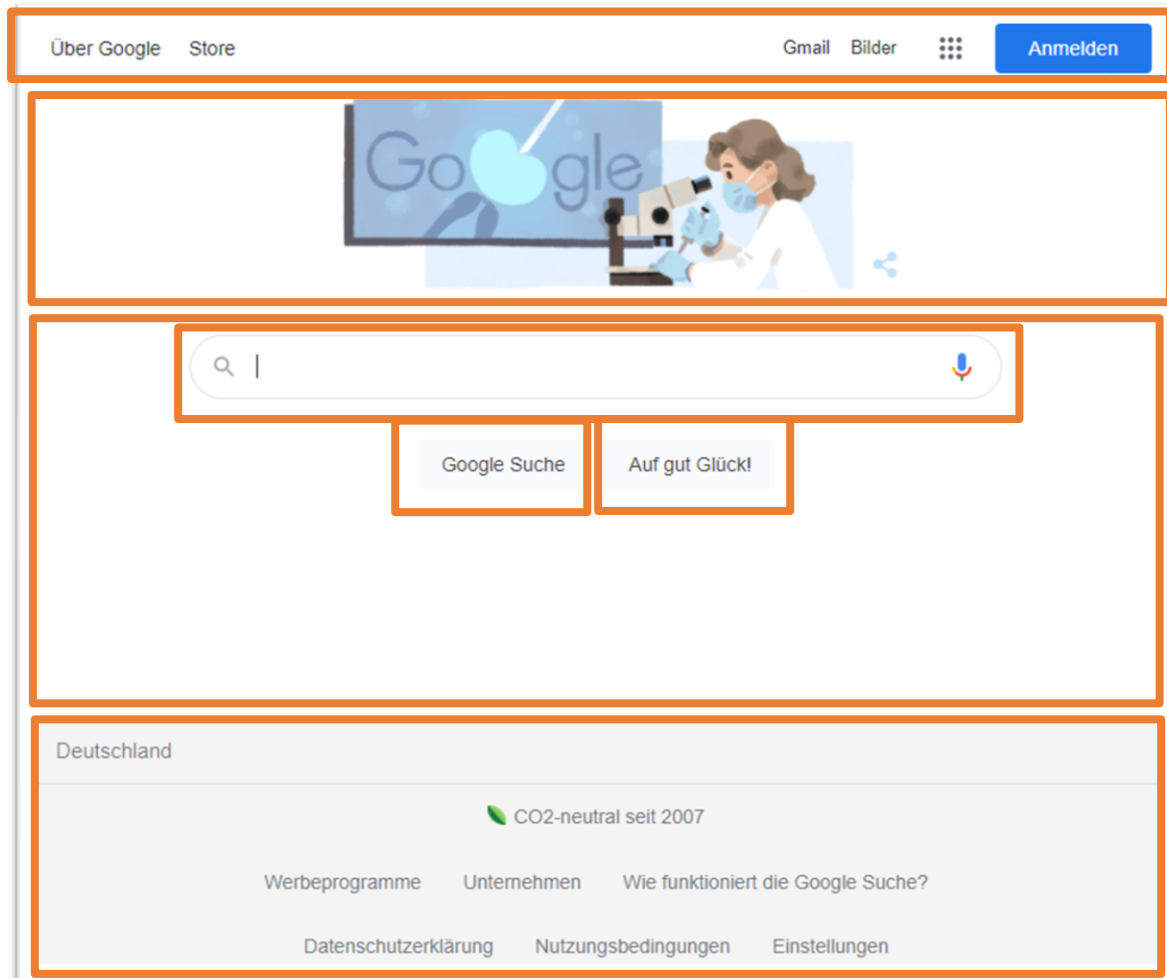
# The Browser: Behind the Scenes



Every web page that we visit is rendered by the browser using a combination of the following three technologies:



# The Browser: Behind the Scenes



Every web page that we visit is rendered by the browser using a combination of the following three technologies:

**HTML**



**CSS**

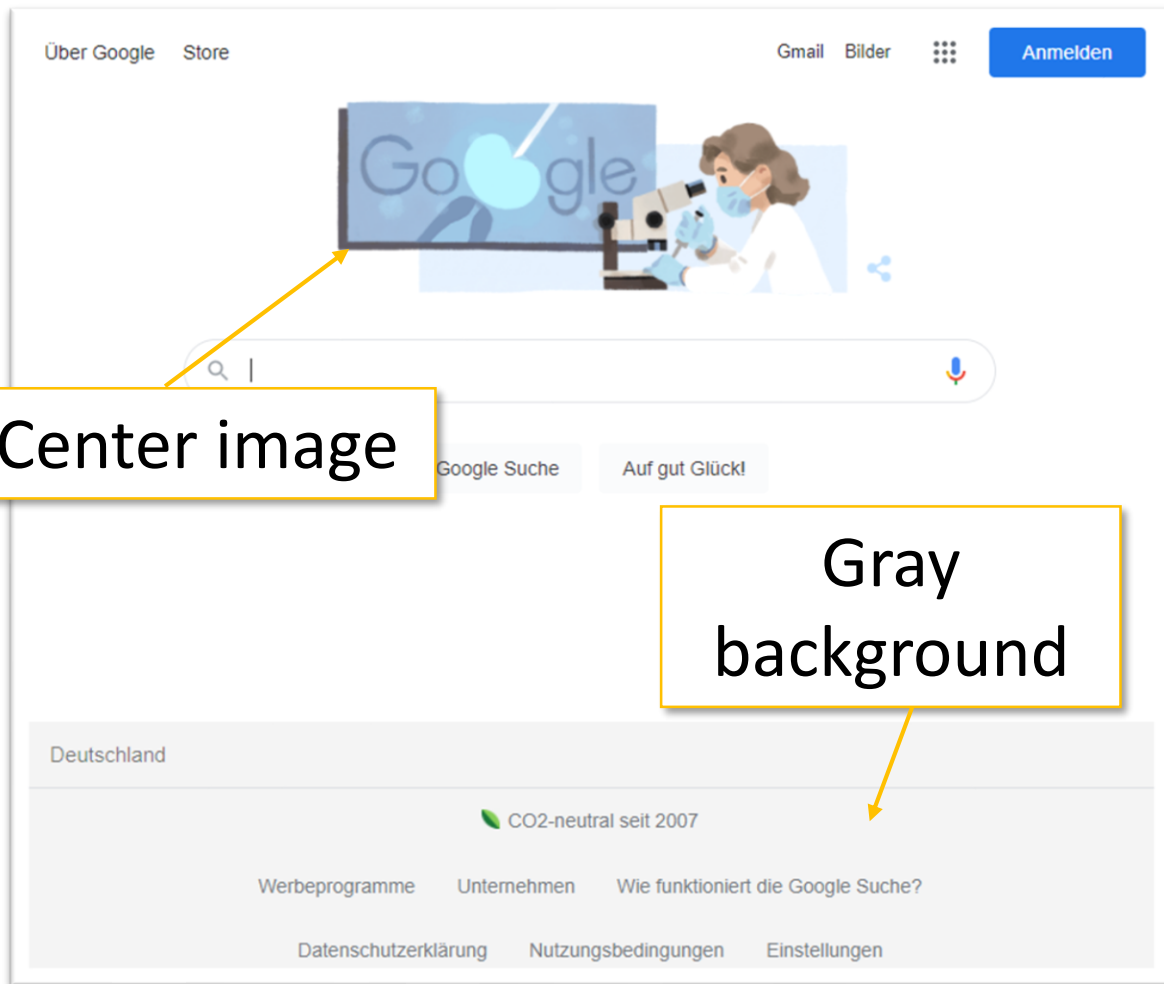


**JS**



**Structure and Content**

# The Browser: Behind the Scenes

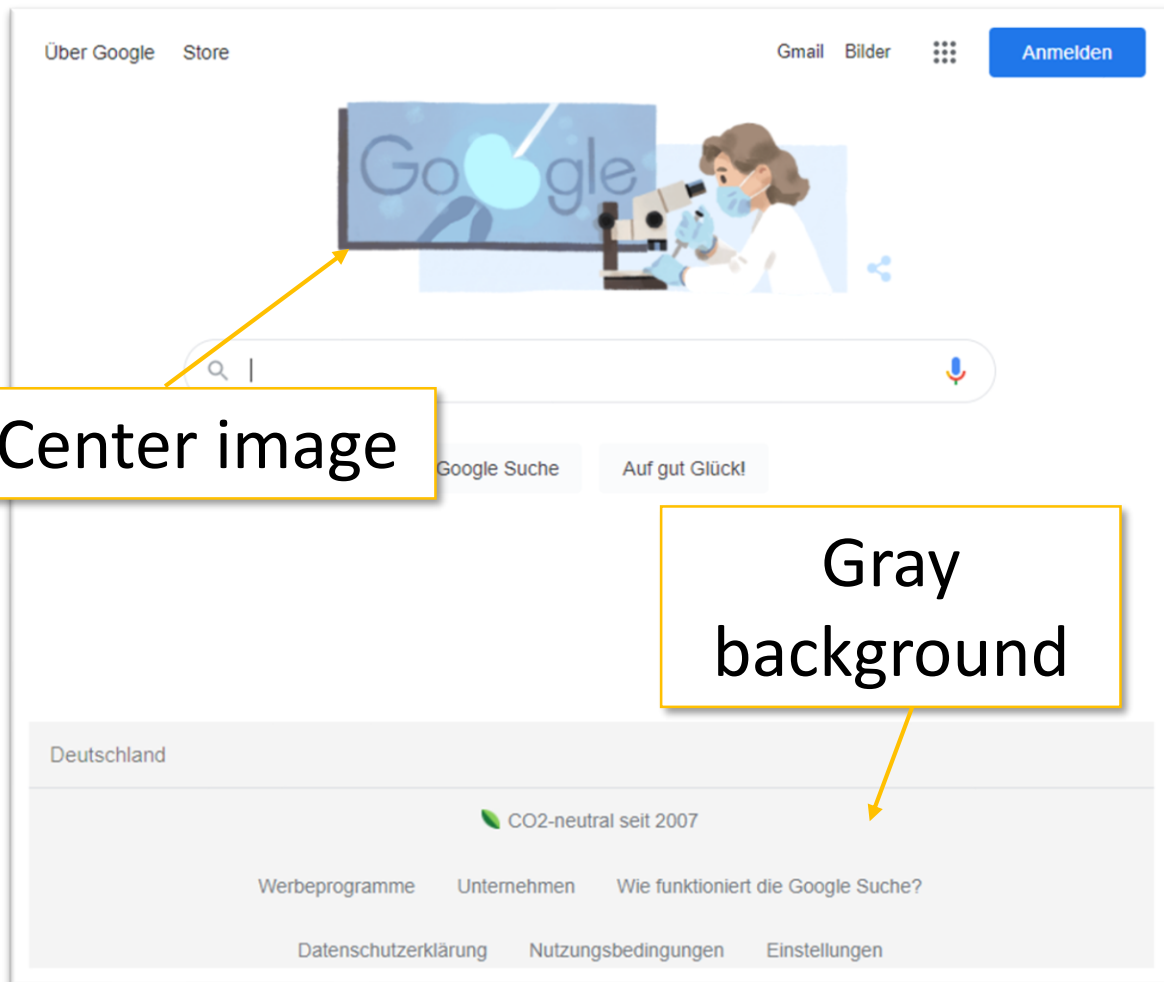


Every web page that we visit is rendered by the browser using a combination of the following three technologies:



**Styling and simple interactions**

# The Browser: Behind the Scenes



Every web page that we visit is rendered by the browser using a combination of the following three technologies:



**Complex interactions,  
communication with remote servers,  
logging, tracking, etc.**

# Some of the HTML Page's Inhabitants



## DOM Tree

```
<HTML>
  <HEAD>
    <LINK>
    <SCRIPT>
  </HEAD>
  <BODY>
  ...
</BODY>
</HTML>
```

## Presentation Tags

```
<P>
<DIV>
<SPAN>
```

## Images and Links

```
<IMG>
<A>
```

## Forms

```
<INPUT>
<TEXTAREA>
```

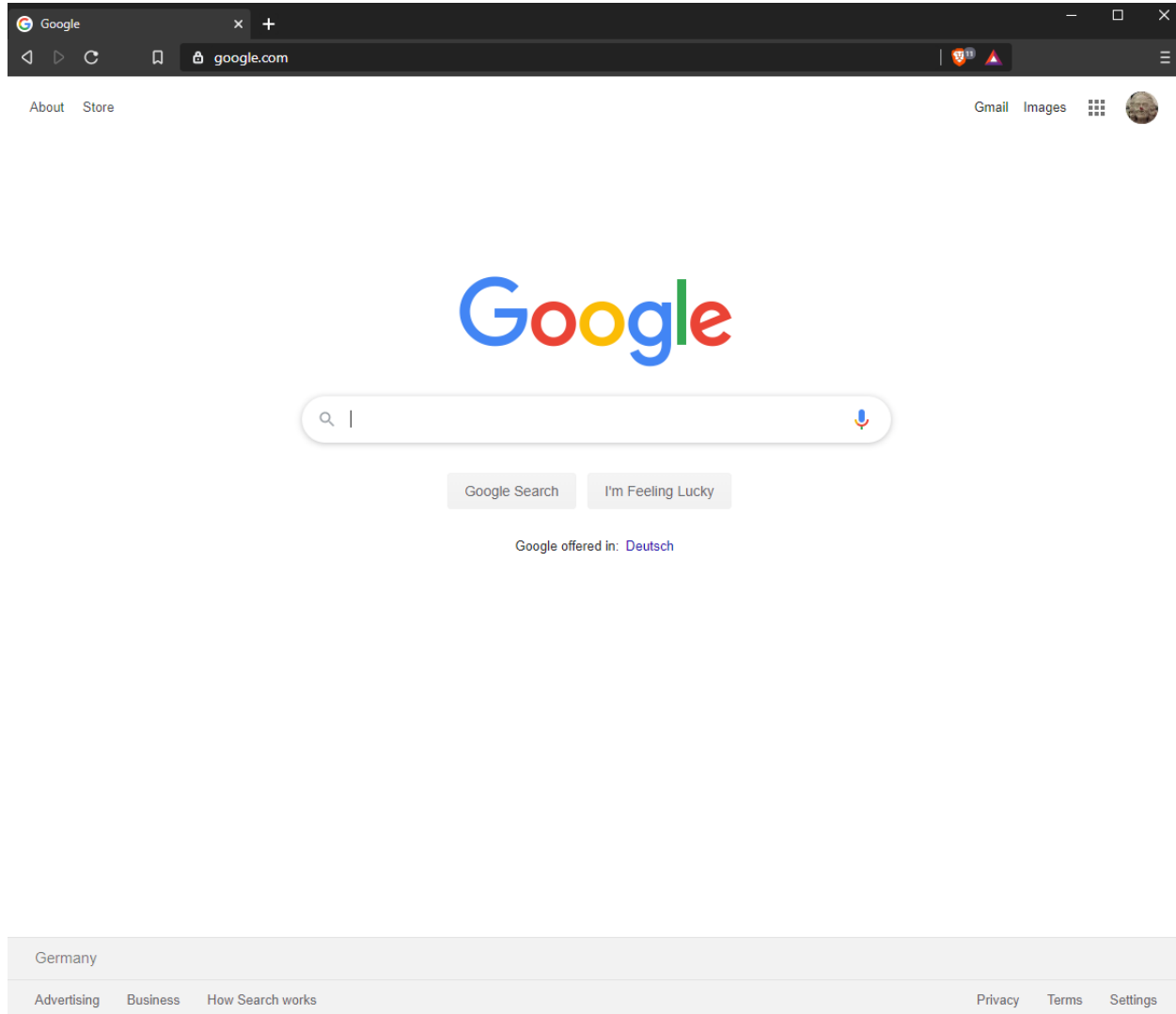
## Attributes

```
<DIV id="header">
<SPAN class="bold">
<IMG SRC="image.jpg" />
<A HREF="newpage.htm">
<INPUT disabled>
```

## CSS Declarations

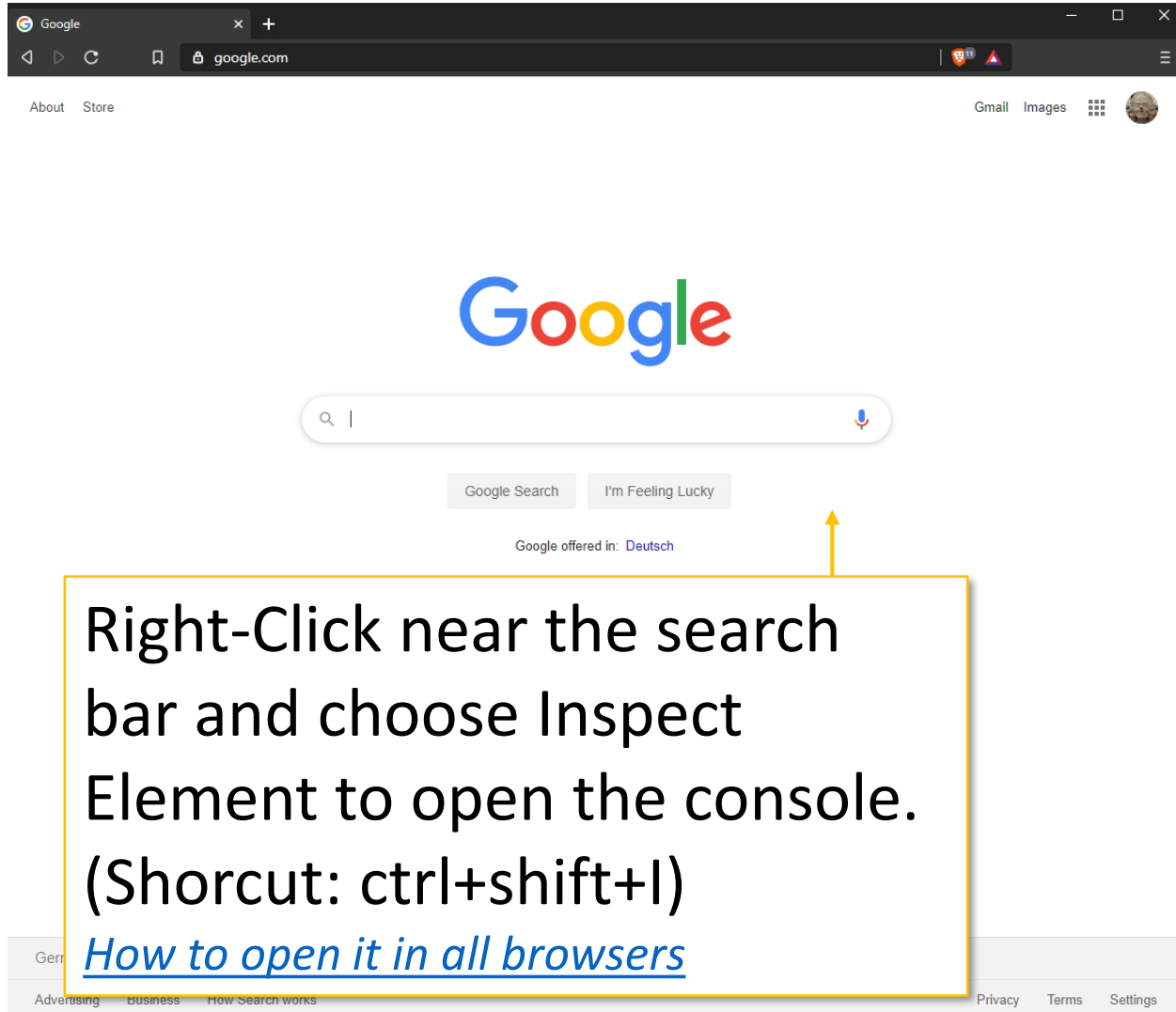
```
.bold { font-weight: bold };
#header { width: 600px };
```

# HTML, CSS, JavaScript





# HTML, CSS, JavaScript



# Developer Tools: Elements

The screenshot displays the Chrome DevTools interface, specifically the Elements panel. The left pane shows the DOM tree with the following structure:

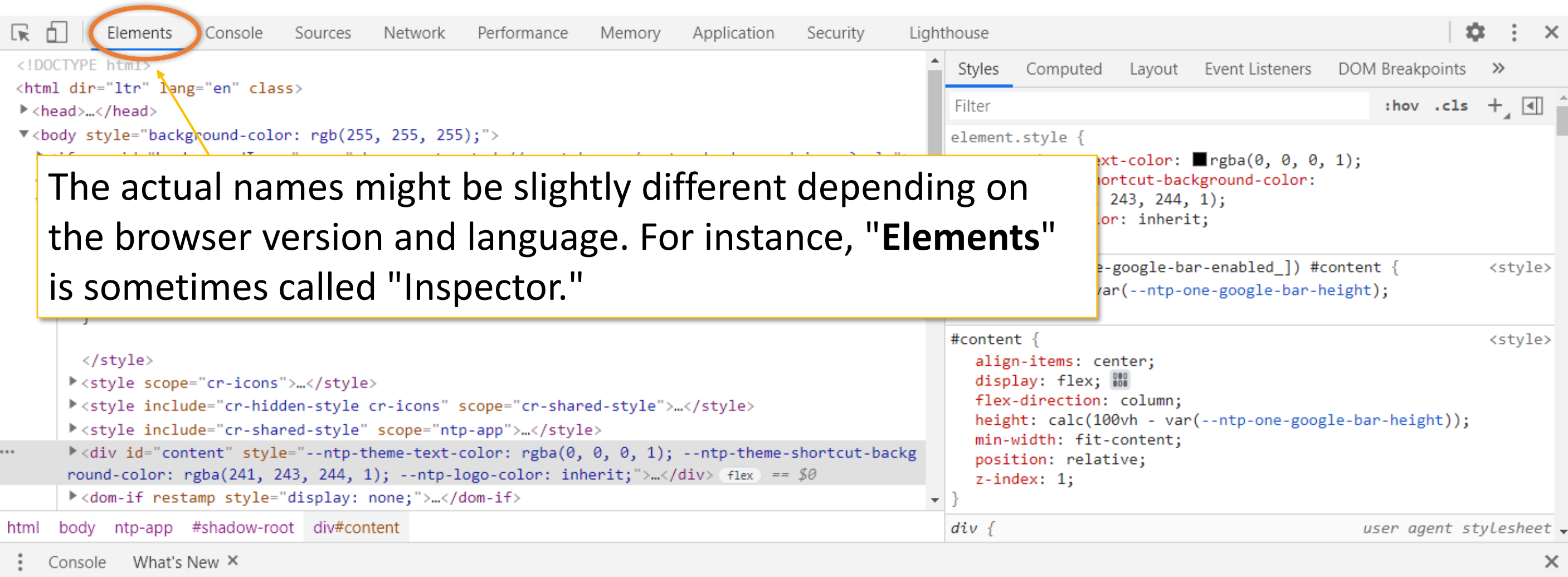
```
<!DOCTYPE html>
<html dir="ltr" lang="en" class>
  <head>...</head>
  <body style="background-color: rgb(255, 255, 255);">
    <iframe id="backgroundImage" src="chrome-untrusted://new-tab-page/custom_background_image?url=">...
  </iframe>
    <ntp-app iframe-one-google-bar-enabled_ promo-and-modules-loaded_>
      <#shadow-root (open)>
        <!--_html_template_start_-->
        <style scope="cr-hidden-style">[hidden], :host([hidden]) {
          display: none !important;
        }
        </style>
        <style scope="cr-icons">...</style>
        <style include="cr-hidden-style cr-icons" scope="cr-shared-style">...</style>
        <style include="cr-shared-style" scope="ntp-app">...</style>
        <div id="content" style="--ntp-theme-text-color: rgba(0, 0, 0, 1); --ntp-theme-shortcut-backg
round-color: rgba(241, 243, 244, 1); --ntp-logo-color: inherit;">...</div> flex == $0
        <dom-if restamp style="display: none;">...</dom-if>
      </#shadow-root>
    </ntp-app>
  </body>
</html>
```

The right pane shows the CSS styles for the selected element, `div#content`. The styles are:

```
element.style {
  --ntp-theme-text-color: rgba(0, 0, 0, 1);
  --ntp-theme-shortcut-background-color:
    rgba(241, 243, 244, 1);
  --ntp-logo-color: inherit;
}
:host([iframe-one-google-bar-enabled_]) #content {
  padding-top: var(--ntp-one-google-bar-height);
}
#content {
  align-items: center;
  display: flex;
  flex-direction: column;
  height: calc(100vh - var(--ntp-one-google-bar-height));
  min-width: fit-content;
  position: relative;
  z-index: 1;
}
div {
  user agent stylesheet
```

The breadcrumb at the bottom of the Elements panel reads: `html > body > ntp-app > #shadow-root > div#content`.

# Developer Tools: Elements

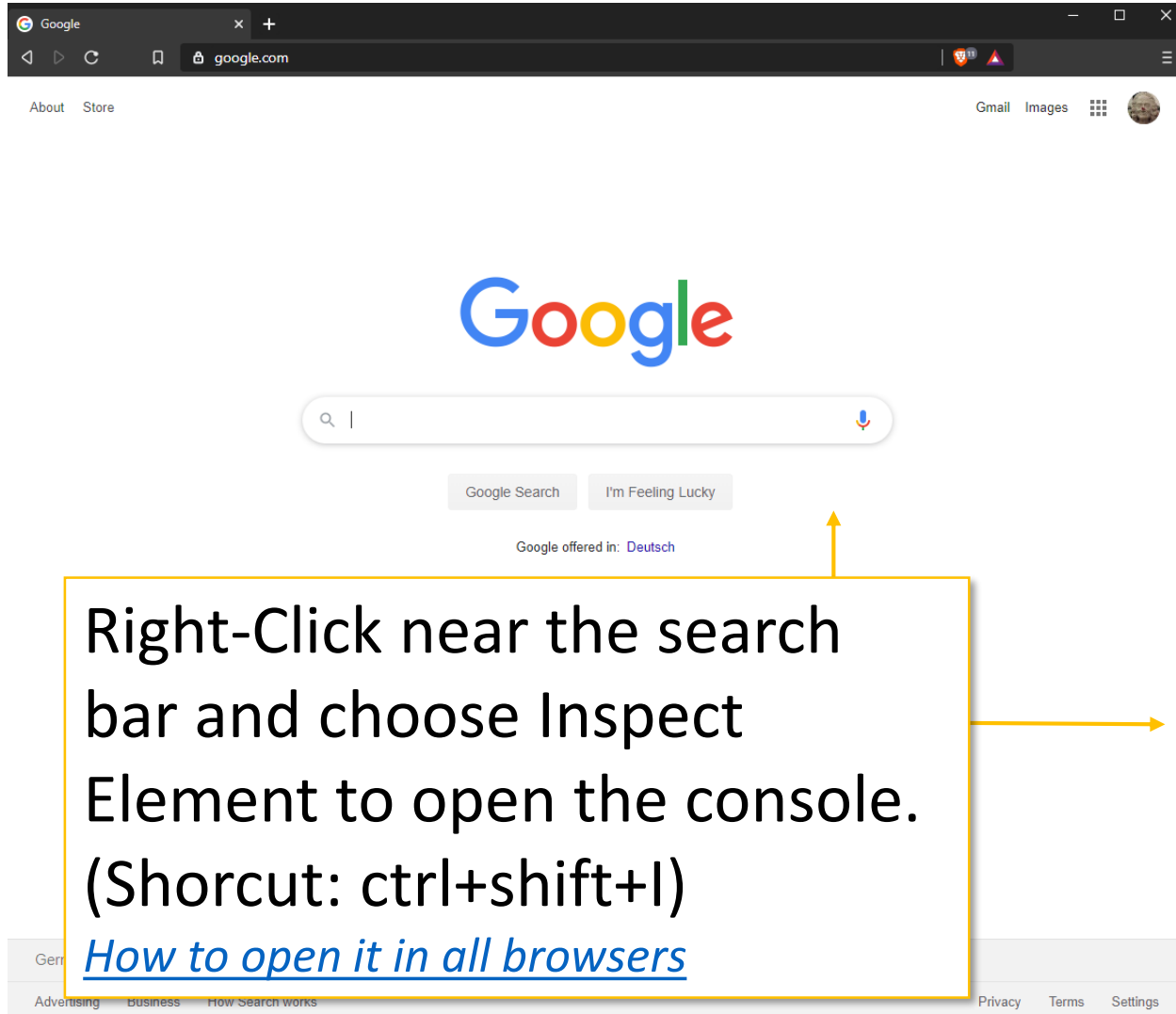


The screenshot shows the Chrome DevTools interface. The 'Elements' tab is selected and circled in orange. A yellow arrow points from the text box to the 'Elements' tab. The DOM tree on the left shows the document structure, with the selected element being a `div` with `id="content"`. The 'Styles' panel on the right shows the default user agent styles for the `div` element, such as `display: flex` and `flex-direction: column`. A text box is overlaid on the screenshot, containing the following text:

The actual names might be slightly different depending on the browser version and language. For instance, "**Elements**" is sometimes called "Inspector."

The actual names might be slightly different depending on the browser version and language. For instance, "**Elements**" is sometimes called "Inspector."

# HTML, CSS, JavaScript



Right-Click near the search bar and choose Inspect Element to open the console. (Shortcut: ctrl+shift+I)

[How to open it in all browsers](#)

```
..<!doctype html> == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-DE">
  <head>_</head>
  <body jsmodel="" class="hp vasq big" id="gsr">
    <style>_</style>
    <style data-jiis="cc" id="gstyle">_</style>
    <style>_</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info"></div>
      <div id="cst">_</div>
      <style>_</style>
      <div id="gb" class="gb_Sf">_</div>
      <div class="jhp big" id="searchform">_</div>
      <dialog class="spch-dlg" id="spch-dlg">_</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u="0" jsdata="C4mkuf;;BgdNvo" jsaction="rcuQ6b:npT2md"></div>
      <div jscontroller="WgDvvc" jsdata="hE2vdf;;BgdNvs" jsaction="rcuQ6b:npT2md"></div>
    <div class="content" id="main">
      <span class="ctr-p" id="body">
        <center>
          <div id="lga">_</div>
          <div style="height:118px"></div>
          <div id="prm-pt" style="margin-top:12px">_</div>
        </center>
      </span>
      <div class="ctr-p" id="footer">_</div>
      <div id="footc">_</div>
      <div id="lb"></div>
    </div>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
    <div class="gb_xa"></div>
    <style>_</style>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
  </div>
  <textarea class="csi" name="csi" style="display:none"></textarea>
  <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
  <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJ0W6yTZw.L.W.O/m=Fk...NChbE6QAQ/d=1/dg=2/br=1/ct=zgms/rs=ACT90oGATnID2W4-Cd5Wk5mwi4CeFK6yfw"></script>
  <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJ0W6yTZw.L.W.O/am=A...bd,async,dvl,fEVMic,foot,lu,m,mUpTid,mu,sb_wiz,sf,sonic,spch,xz7cCd?xjs=s1" async gapi_processed="true"></script>
  <iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display: none;">_</iframe>
</body>
</html>
```

# HTML, CSS, JavaScript

## DOM Tree

```
<HTML>
  <HEAD>
    <LINK>
    <SCRIPT>
  </HEAD>
  <BODY>
    ...
  </BODY>
</HTML>
```

The screenshot shows a web browser displaying the Google homepage. The source code is visible on the right side of the browser window. The `<body>` tag is circled in orange, and the `</html>` tag is also circled in orange. The DOM tree is visible on the right side of the source code view.

What is inside the `<BODY>` tags is rendered into the page.

Germany

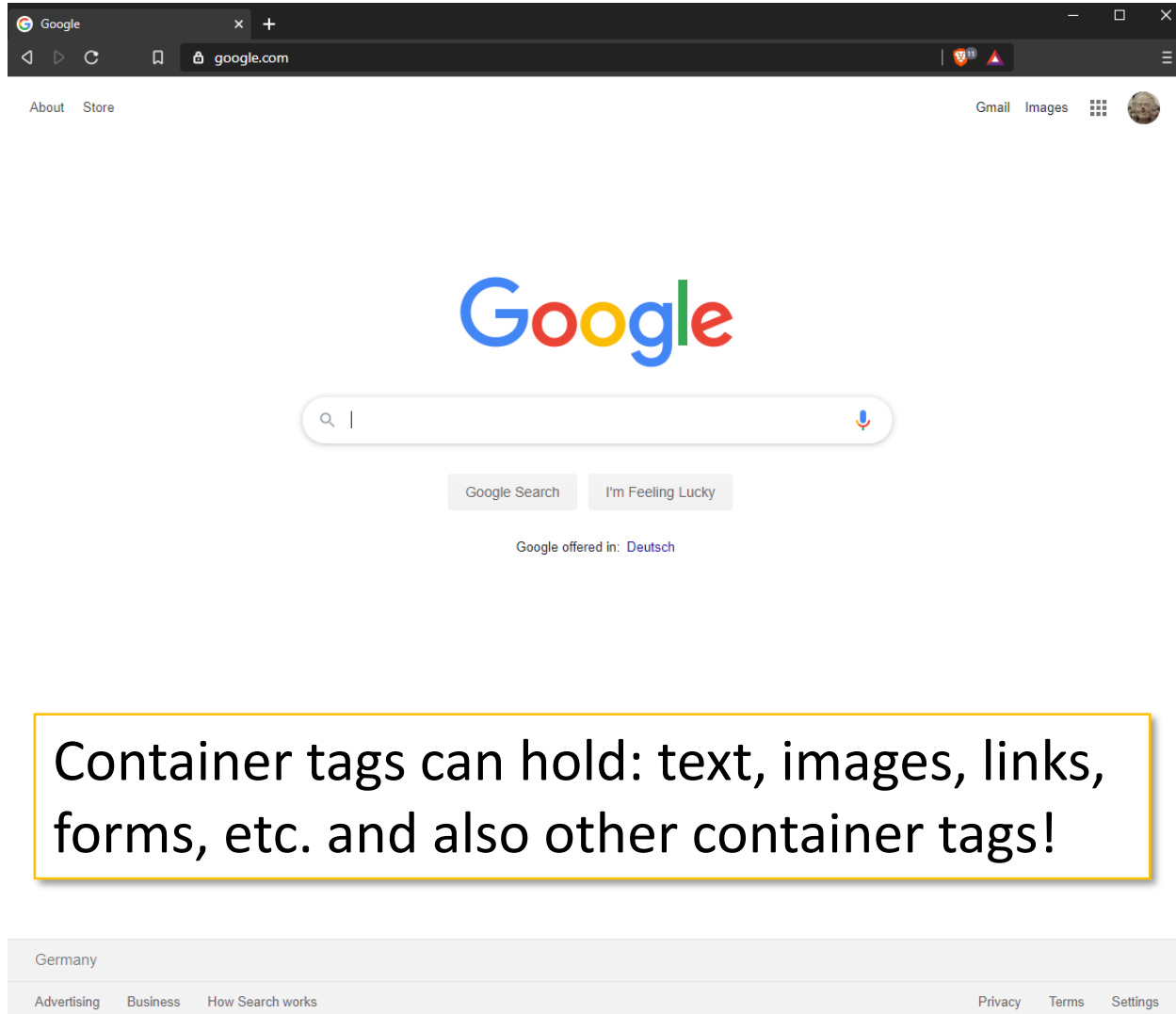
Advertising Business How Search works

Privacy Terms Settings

# HTML, CSS, JavaScript

## Container Tags

<P>  
<DIV>  
<SPAN>



```
!doctype html == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-DE">
  <head>...</head>
  <body jsmodel=" " class="hp vasq big" id="gsr">
    <style>...</style>
    <style data-jiis="cc" id="gstyle">...</style>
    <style>...</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info">...</div>
      <div id="cst">...</div>
      <style>...</style>
      <div id="gb" class="gb_Sf">...</div>
      <div class="jhp big" id="searchform">...</div>
      <dialog class="spch-dlg" id="spch-dlg">...</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u="0" jsdata="C4mkuf;;BgdNvo" jsaction="rcuQ6b:npT2md">...</div>
      <div jscontroller="WgDvvc" jsdata="hE2...;;BgdNvs" jsaction="rcuQ6b:npT2md">...</div>
      <div class="content" id="main">
        <span class="ctr-p" id="body">
          <center>
            <div id="lga">...</div>
            <div style="height:118px">...</div>
            <div id="prm-pt" style="margin-top:12px">...</div>
          </center>
        </span>
        <div class="ctr-p" id="footer">...</div>
        <div id="footc">...</div>
        <div id="lb">...</div>
      </div>
      <script nonce="26x2AHsATpEG8PX+0mgVtA==">...</script>
      <div class="gb_xa">...</div>
      <style>...</style>
      <script nonce="26x2AHsATpEG8PX+0mgVtA==">...</script>
      </div>
      <textarea class="csi" name="csi" style="display:none">...</textarea>
      <script nonce="26x2AHsATpEG8PX+0mgVtA==">...</script>
      <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q,0/ck=xjs.s.W0cJoh6yTZw.L.W.O/m=Fk...NChbE6QAQ/d=1/dg=2/br=1/ct=zgms/rs=ACT90oGATnID2W4-
Cd5Wk5mwi4CeFK6yfw">...</script>
      <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q,0/ck=xjs.s.W0cJoh6yTZw.L.W.O/am=A_
bd,async,dvl,fEVMic,foot,lu,m,mUpTid,mu,sb_wiz,sf,sonic,spch,xz7cCd?xjs=s1" async gapi_processed="true">...</script>
      <iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display:none;">...</iframe>
    </body>
  </html>
```

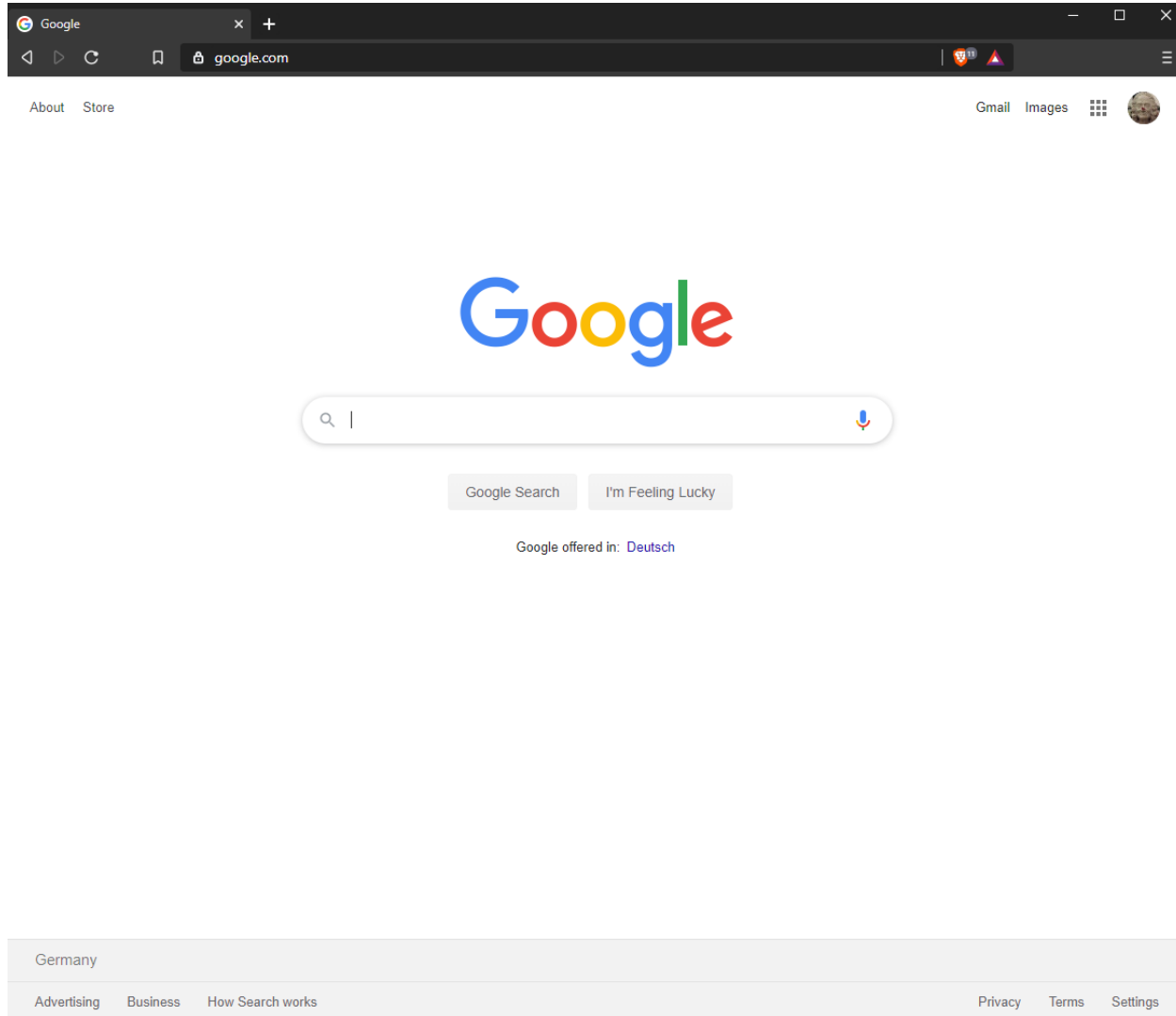
Container tags can hold: text, images, links, forms, etc. and also other container tags!

<https://stackoverflow.com/questions/30879707/why-is-a-div-called-a-div-why-is-a-span-called-a-span>

# HTML, CSS, JavaScript

## Style Tags

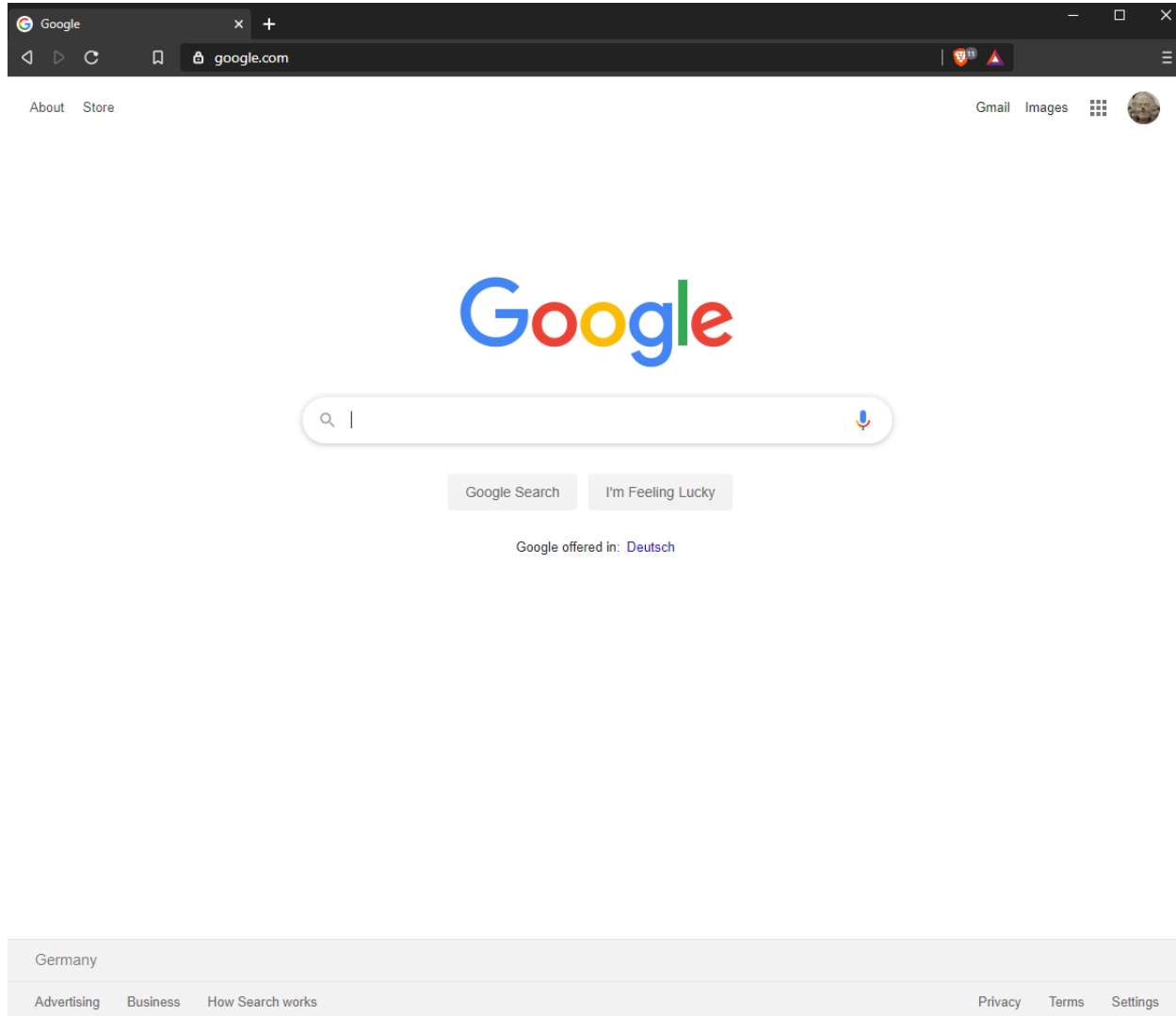
<STYLE>  
<LINK>



```
..<!doctype html> == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-DE">
  <head>_</head>
  <body jsmodel=" " class="hp_vase_h...>
    <style>_</style>
    <style data-jiis="cc" id="gstyle">_</style>
    <style>_</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info"></div>
      <div id="cst">_</div>
      <style>_</style>
      <div id="gb" class="gb_Sf">_</div>
      <div class="jhp big" id="searchform">_</div>
      <dialog class="spch-dlg" id="spch-dlg">_</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u="0" jsdata="C4mkuf;;BgdNvo" jsaction="rcuQ6b:npT2md"></div>
      <div jscontroller="WgDvvc" jsdata="hE2vdf;;BgdNvs" jsaction="rcuQ6b:npT2md"></div>
    <div class="content" id="main">
      <span class="ctr-p" id="body">
        <center>
          <div id="lga">_</div>
          <div style="height:118px"></div>
          <div id="prm-pt" style="margin-top:12px">_</div>
        </center>
      </span>
      <div class="ctr-p" id="footer">_</div>
      <div id="footc">_</div>
      <div id="lb"></div>
    </div>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
    <div class="gb_xa"></div>
    <style>_</style>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
  </div>
  <textarea class="csi" name="csi" style="display:none"></textarea>
  <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
  <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJ0W6yTZw.L.W.0/m=Fk...NChbE6QAQ/d=1/dg=2/br=1/ct=zgms/rs=ACT90oGATnID2W4-
Cd5Wk5mwi4CeFK6yfw"></script>
  <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJ0W6yTZw.L.W.0/am=A_
bd,async,dvl,fEVMic,foot,lu,m,mUpTid,mu,sb_wiz,sf,sonic,spch,xz7cCd?xjs=s1" async gapi_processed="true"></script>
  <iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display: none;">_</iframe>
</body>
</html>
```



# HTML, CSS, JavaScript

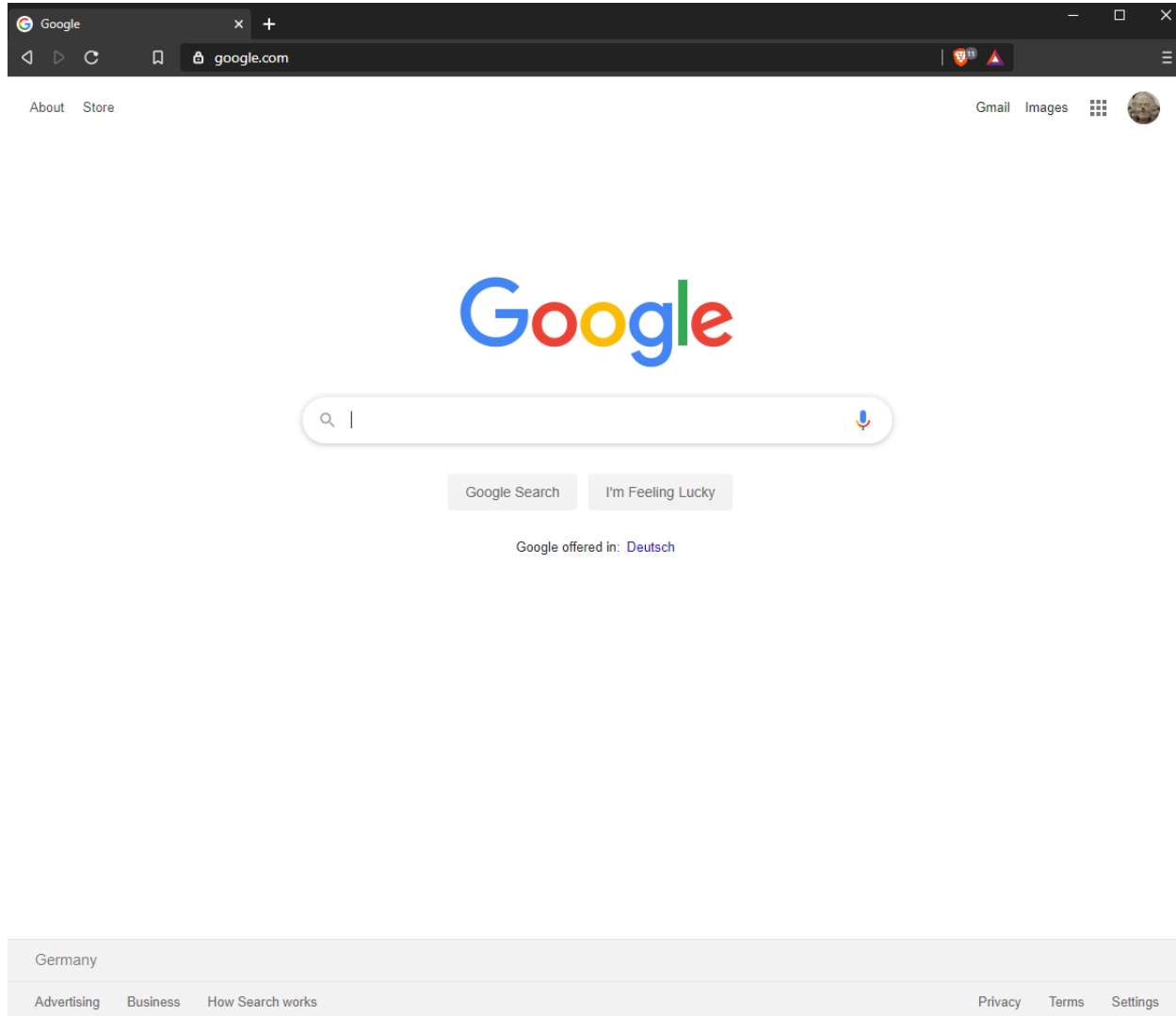


```
..<!doctype html> == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-DE">
  <head>_</head>
  <body jsmodel=" " class="hp vasq big" id="gsr">
    <style>_</style>
    <style data-jiis=" " >_</style>
    <style>_</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info"></div>
      <div id="cst">_</div>
      <style>_</style>
      <div id="gb" class="gb_Sf">_</div>
      <div class="jhp big" id="searchform">_</div>
      <dialog class="spch-dlg" id="spch-dlg">_</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u...>_</div>
      <div jscontroller="WgDvvc" jsdata="hE2vdf;BgdNvs" jsa...>_</div>
      <div class="content" id="main">
        <span class="ctr-p" id="body">
          <center>
            <div id="lga">_</div>
            <div style="height:118px"></div>
            <div id="prm-pt" style="margin-top:12px">_</div>
          </center>
        </span>
        <div class="ctr-p" id="footer">_</div>
        <div id="footc">_</div>
        <div id="lb"></div>
      </div>
      <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
      <div class="gb_xa"></div>
      <style>_</style>
      <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
    </div>
    <textarea class="csi" name="csi" style="display:none"></textarea>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">_</script>
    <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q,0/ck=xjs.s.W0cJoh6yTZw.L.W.0/m=Fk...NChbE6QAQ/d=1/dg=2/br=1/ct=zgms/rs=ACT90oGATnID2W4-
Cd5Wk5mwi4CeFK6yfw"></script>
    <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q,0/ck=xjs.s.W0cJoh6yTZw.L.W.0/am=A...
bd,async,dvl,fEVMic,foot,lu,m,mUpTid,mu,sb_wiz,sf,sonic,spch,xz7cCd?xjs=s1" async gapi_processed="true"></script>
    <iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display: none;">_</iframe>
  </body>
</html>
```

Style rules can be added at different levels and even on the element itself. JavaScript can change those rules programmatically.

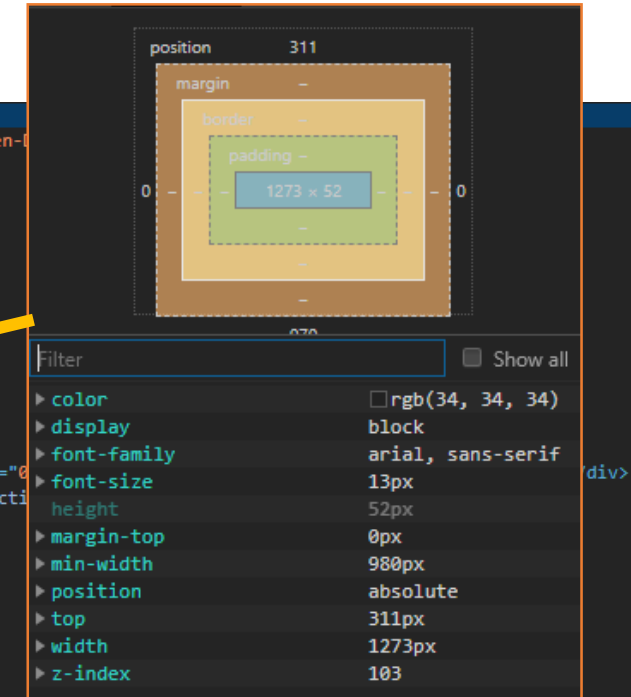


# HTML, CSS, JavaScript



```
..<!doctype html> == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-
  <head>...</head>
  <body jsmodel=" " class="hp vasq big" id="gsr">
    <style>...</style>
    <style data-jiis="cc" id="gstyle">...</style>
    <style>...</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info"></div>
      <div id="cst">...</div>
      <div id="go" class="gs Sf">...</div>
      <div class="jhp big" id="searchform">...</div>
      <dialog class="spch-dlg" id="spch-dlg">...</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u="0">...</div>
      <div jscontroller="WgDvvc" jsdata="hE2vdf;;BgdNvs" jsacti
    <div class="content" id="main">
      <span class="ctr-p" id="body">
        <center>
          <div id="lga">...</div>
          <div style="height:118px">...</div>
          <div id="prm-pt" style="margin-top:12px">...</div>
        </center>
      </span>
      <div class="ctr-p" id="footer">...</div>
      <div id="footc">...</div>
    </div>
  </body>
</html>
```

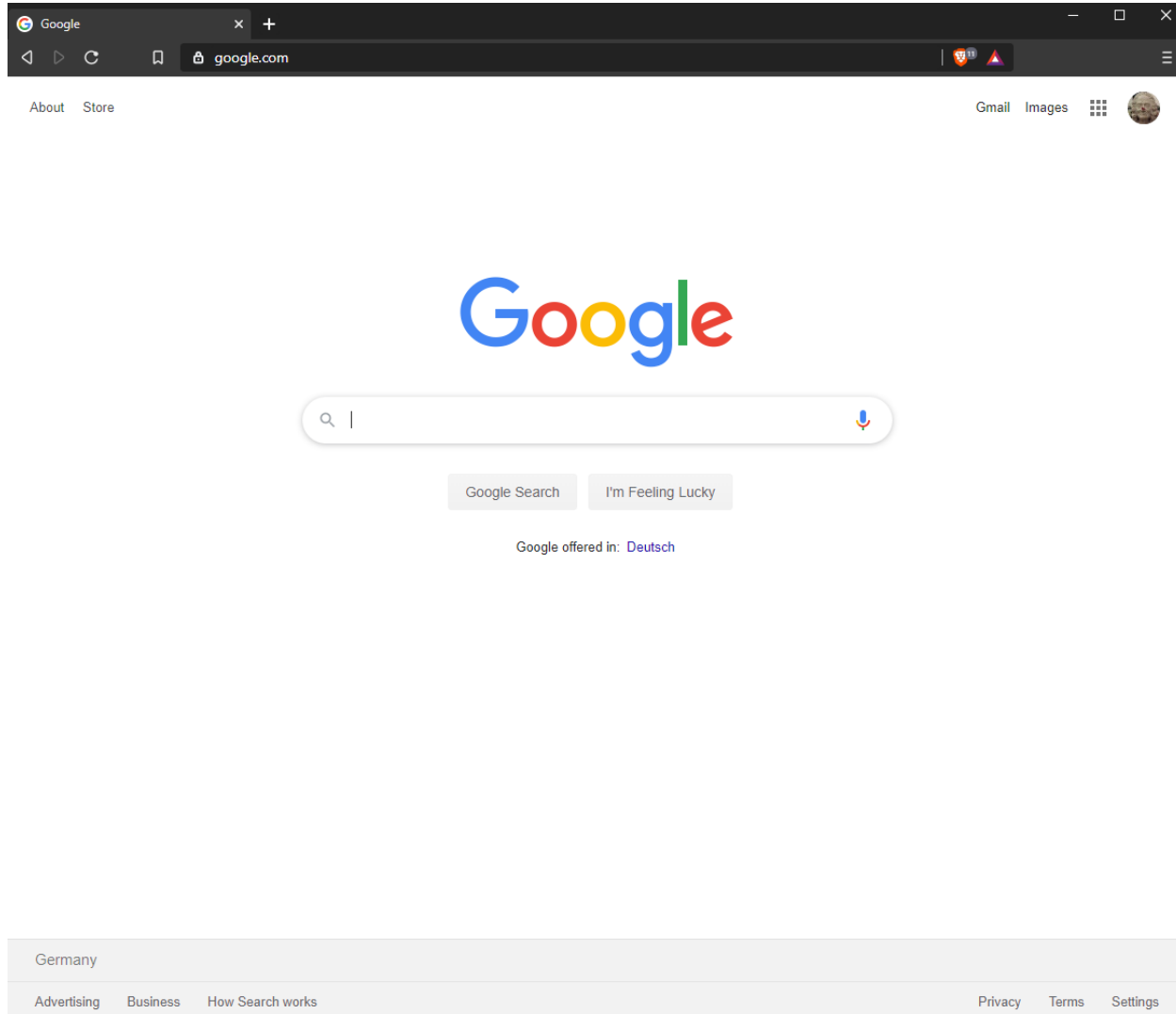
## CSS (Cascading Style Sheets)



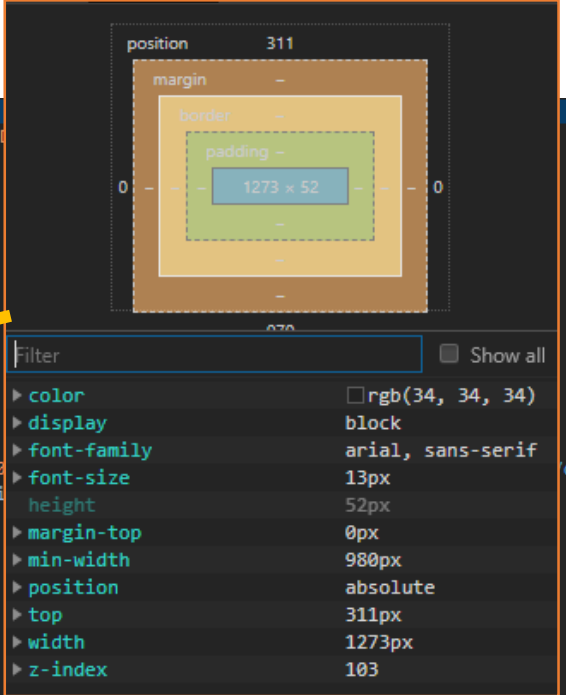
The term "**cascading**" means that you can add multiple style sheets, and the order *matters*: each style sheets extends (or overwrites) style rules defined by previous style sheets.

# HTML, CSS, JavaScript

## CSS (Cascading Style Sheets)



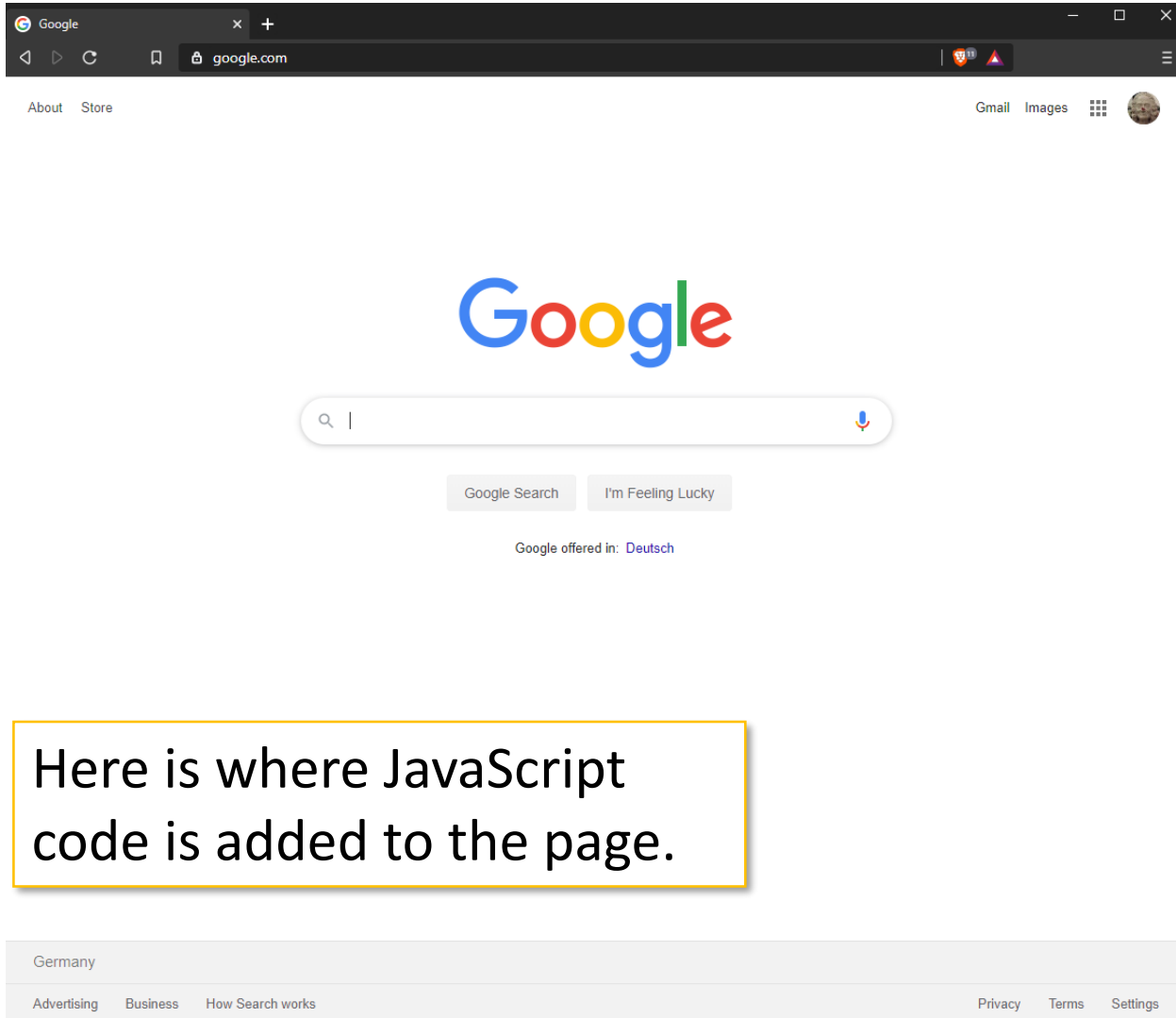
```
..<!doctype html> == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-
  <head>...</head>
  <body jsmodel=" " class="hp vasq big" id="gsr">
    <style>...</style>
    <style data-jiis="cc" id="gstyle">...</style>
    <style>...</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info"></div>
      <div id="cst">...</div>
      <div id="go" class="gs Sf">...</div>
      <div class="jhp big" id="searchform">...</div>
      <dialog class="spch-dlg" id="spch-dlg">...</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u="0">...</div>
      <div jscontroller="WgDvvc" jsdata="hE2vdf;BgdNvs" jsacti
    <div class="content" id="main">
      <span class="ctr-p" id="body">
        <center>
          <div id="lga">...</div>
          <div style="height:118px">...</div>
          <div id="prm-pt" style="margin-top:12px">...</div>
        </center>
      </span>
      <div class="ctr-p" id="footer">...</div>
      <div id="footc">...</div>
    </div>
  </body>
</html>
```



What is displayed above is the final cascade of all the CSS rules for the element with classes "jhp" and "big", and with id "searchform".

```
...</script>
<script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJoh6yTZw.L.N.O/am=A_
bd,async,dvl,fEVMic,foot,lu,m,mUpId,mu,sb_wiz,sf,sonic,spch,xz7cCd?xjs=s1" async gapi_processed="true"></script>
<iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display: none;"></iframe>
</body>
</html>
```

# HTML, CSS, JavaScript

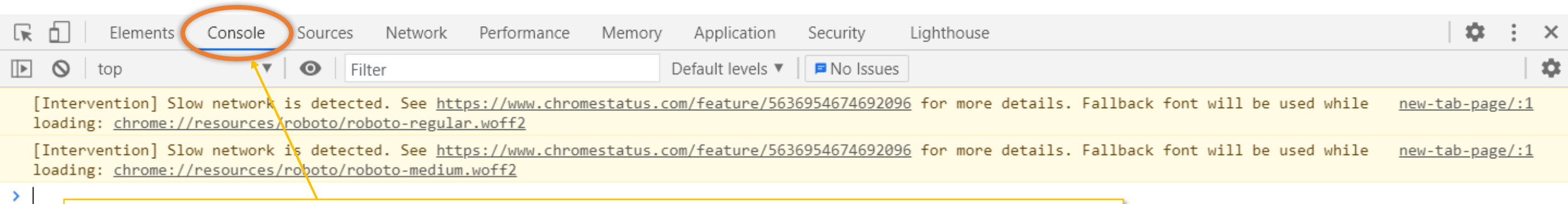


Here is where JavaScript code is added to the page.

```
..<!doctype html> == $0
<html itemscope itemtype="http://schema.org/WebPage" lang="en-DE">
  <head>...</head>
  <body jsmodel="" class="hp vasq big" id="gsr">
    <style>...</style>
    <style data-jiis="cc" id="gstyle">...</style>
    <style>...</style>
    <div class="ctr-p" id="viewport">
      <div id="doc-info"></div>
      <div id="cst">...</div>
      <style>...</style>
      <div id="gb" class="gb_Sf">...</div>
      <div class="jhp big" id="searchform">...</div>
      <dialog class="spch-dlg" id="spch-dlg">...</dialog>
      <div jscontroller="fEVMic" style="display:none" data-u="0" jsdata="C4mkuf;;BgdNvo" jsaction="rcuQ6b:npT2md"></div>
      <div jscontroller="WgDvvc" jsdata="hE2vdf;;BgdNvs" jsaction="rcuQ6b:npT2md"></div>
    <div class="content" id="main">
      <span class="ctr-p" id="body">
        <center>
          <div id="lga">...</div>
          <div style="height:118px"></div>
          <div id="prm-pt" style="margin-top:12px">...</div>
        </center>
      </span>
      <div class="ctr-p" id="footer">...</div>
      <div id="footc">...</div>
      <div id="lb"></div>
    </div>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">...</script>
    <div class="gb_xa"></div>
    <style>...</style>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">...</script>
    <div class="csi">...</div>
    <script nonce="26x2AHsATpEG8PX+0mgVtA==">...</script>
    <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJ0W6yTZw.L.W.O/m=Fk...NChbE6QAQ/d=1/dg=2/br=1/ct=zgms/rs=ACT90oGATnID2W4-Cd5Wk5mwi4CeFK6yfw"></script>
    <script src="/xjs/_/js/k=xjs.s.en_GB.N-EDq1FHW8Q.0/ck=xjs.s.W0cJ0W6yTZw.L.W.O/am=A...bd,async,dvl,fEVMic,foot,lu,m,mUpTid,mu,sb_wiz,sf,sonic,spch,xz7cCd?xjs=s1" async gapi_processed="true"></script>
    <iframe src="https://clients5.google.com/pagead/drt/dn/" aria-hidden="true" style="display: none;">...</iframe>
  </body>
</html>
```

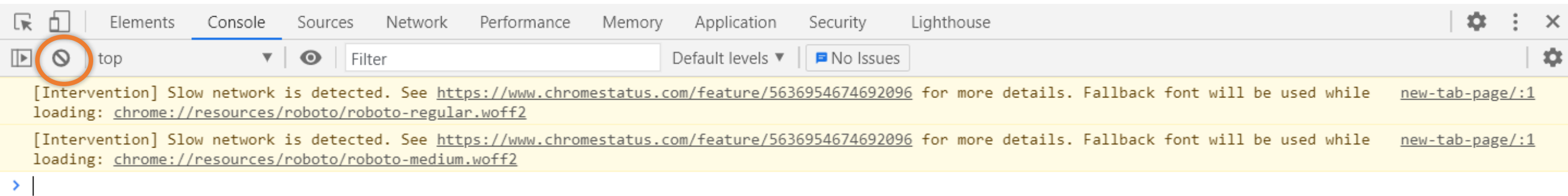
**Script Tags**  
**<SCRIPT>**

# Developer Tools: Console



Switch to the console tab. We can try JS commands in here.

# Developer Tools: Console



Clear any pre-existing output: click on the button or type: `clear()`

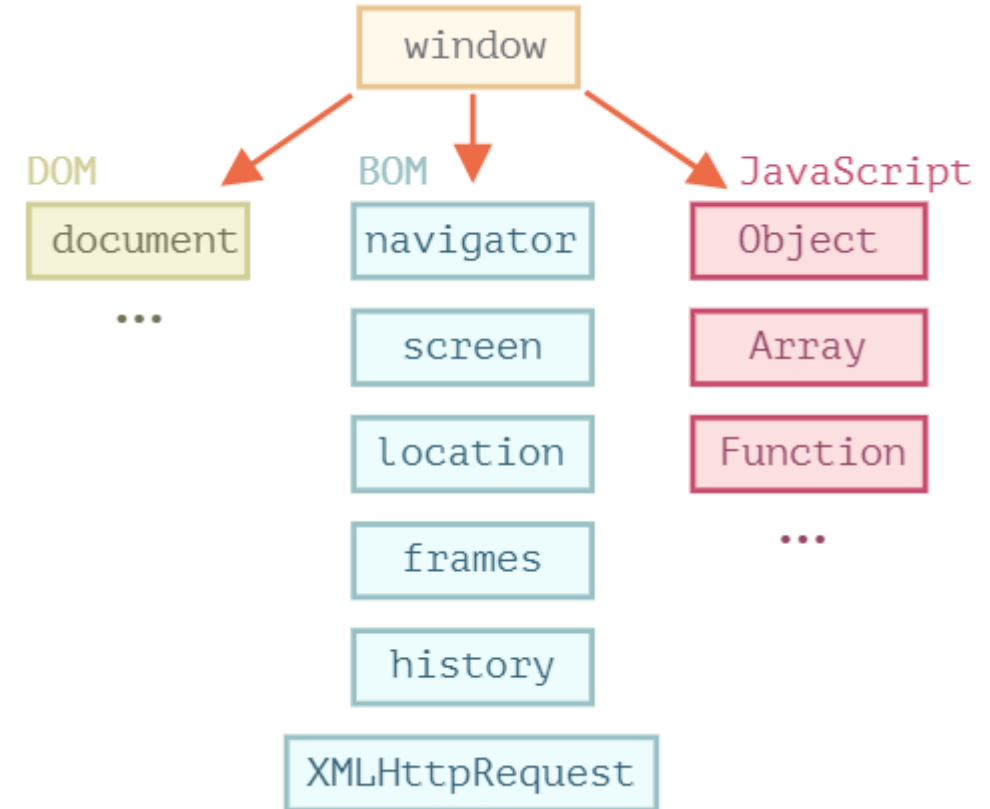
Then, write something of your own with `console.log()`

```
console.log('Hello World');
```

# What Can JS in the Browser do?

Every JS object in the browser is child of the `window` object, including:

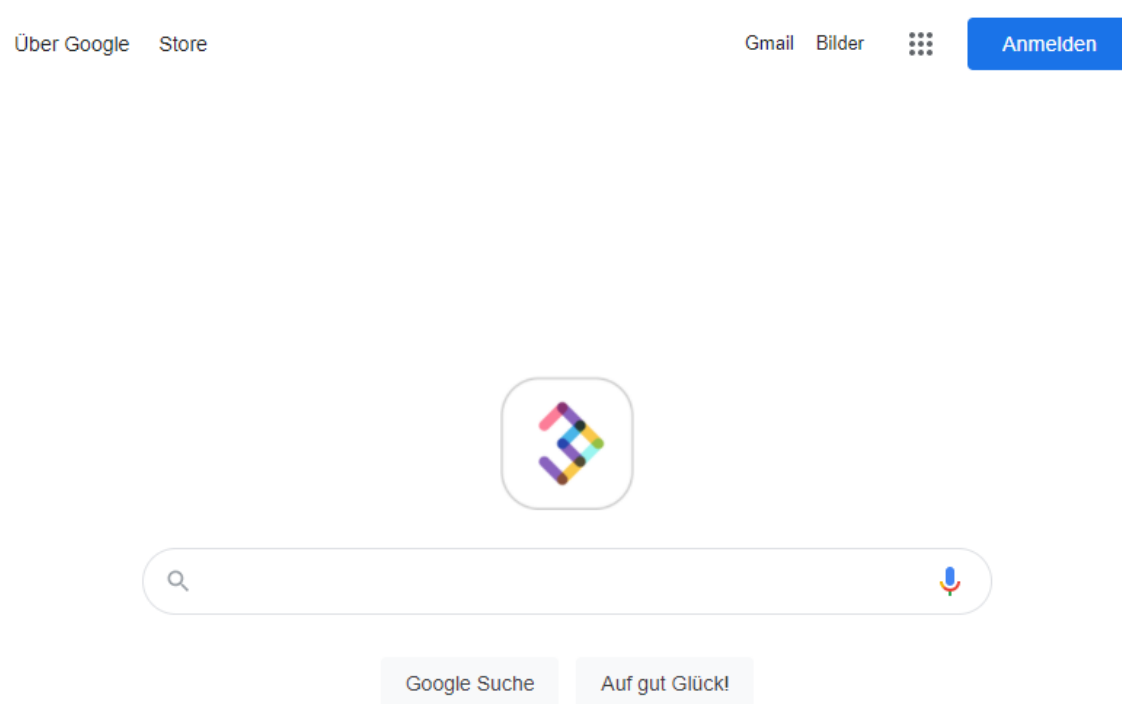
1. DOM (Document Object Model) objects (i.e., all things displayed on the page) exposed through the `document` object
2. Extra info and methods about the browser itself
3. JavaScript language itself



# Hands On: Messing Around with Google.Com



Go to Google.com, open DevTools and change the logo to something else.



```
Elements Console Sources Network Performance Memory Application Security Lighthouse
<!DOCTYPE html>
<html itemscope itemtype="http://schema.org/WebPage" lang="de">
  <head>_</head>
  <body jsmodel="TvHxbe" jsaction="YUC7He:.CLIENT;IVKtfe:.CLIENT;HiCeld:.CLIENT;KsNBn:.CLIENT;sbTXnb:.CLIENT;xjhtIf:.CL
  IENT;O2vyse:.CLIENT;Ez7VMc:.CLIENT;qqf0n:.CLIENT;me3ike:.CLIENT;IrMywb:.CLIENT;Z94jBf:.CLIENT;A8708b:.CLIENT;Ycfj:.CLIE
  NT;A6SDqe:.CLIENT;LjVEjd:.CLIENT;VM8bg:.CLIENT;hWT9Jb:.CLIENT;wCulwe:.CLIENT;NTJodf:.CLIENT;szjOR:.CLIENT;PY1zjf:.CLIE
  NT;wnJTPd:.CLIENT;JL9Qdc:.CLIENT;kwLxhc:.CLIENT;qGMTIf:.CLIENT" class="vsc-initialized">
    <style data-impl="1620130664920">_</style>
    <div class="L3eUgb" data-hveid="1">_</div>
    <div class="o3j99 nixJcf Ne6nsd">_</div>
    <div class="o3j99 LLD4me yr19Zb LS80J">_</div>
    <style data-impl="1620130664920">_</style>
    <div class="k1zIA r5k4se">
      <style data-impl="1620130664920">_</style>
       == $0
    </div>
    </div>
    <div class="o3j99 ikrT4e om7nvf">_</div>
    <div class="o3j99 qarstb">_</div>
    <div class="o3j99 c93Gbe">_</div>
  </div>
  <div class="Fgvjgc">_</div>
  <textarea class="csi" name="csi" style="display:none"></textarea>
  <script nonce="aaBNH3ayHG5VNCBxjHUKWw==">_</script>
  <div class="gb_Hd">Google-Apps</div>
  <script src="/xjs/_/js/k=xjs.s.de.bQvA.j30jHg.O/ck=xjs.s.pjQc.rGawX4.L.W.O/am=gIETI_u,aa,abd,async,dvl,fEVMic,ifl,mu
  pTid,mu,sb,wiz,sf,sonic,spch,xz7ccD?xjs=s1" nonce="aaBNH3ayHG5VNCBxjHUKWw==" async gapi_processed="true"></script>
  <script src="/xjs/_/js/k=xjs.s.de.bQvA.j30jHg.O/ck=xjs.s.pjQc.rGawX4.L.W.O/am=gIETI_/ed=1/dg=2/br=1/rs=ACT90e2HxwE1
  rFEG1w7ZRdN-U-RfikkkA/m=HEyn5c2?xjs=s2" nonce="aaBNH3ayHG5VNCBxjHUKWw==" async></script>
  <script src="/xjs/_/js/k=xjs.s.de.bQvA.j30jHg.O/ck=xjs.s.pjQc.rGawX4.L.W.O/am=gIETI_/ed=1/dg=2/br=1/rs=ACT90e2HxwE1
  rFEG1w7ZRdN-U-RfikkkA/m=wkrYee?xjs=s2" nonce="aaBNH3ayHG5VNCBxjHUKWw==" async></script>
  </body>
</html>
```

# Hands On: Messing Around with Google.Com



Let's manipulate the page elements programmatically:

```
// Locate the HTML element with given id.  
let logo = document.getElementById("logo");
```

If Google shows a special logo, you should check the DOM for the right ID/class. For instance, this command might be an alternative:

```
let logo = document.querySelector('.InXdpd');
```



# Hands On: Messing Around with Google.Com



Changes in the Inspector are immediately reflected on the page.

For example, if add a rule:

"display: none"

the selected element will be hidden in the page.

A screenshot of the Chrome DevTools Inspector. The top section shows the HTML tree with the <body> element selected and highlighted in blue. Below the HTML tree, the breadcrumb 'html > body' is visible. The bottom section shows the 'Rules' tab, with a filter for 'element' and a rule 'display: none;' applied to the selected element. The 'Computed' tab shows the 'display: none;' rule applied to the body element. The 'Changes' tab shows the 'display: none;' rule applied to the body element. The 'Fonts' and 'Animations' tabs are also visible. The 'Filter Styles' section shows ':hov .cls' and a plus sign icon. The 'element' rule is shown with 'display: none;' and the 'body' rule is shown with 'overflow-x: hidden;'.

```
Search HTML
lang= en data-ll= lang > event
▶ <head> ... </head>
▼ <body style="display: none;"> event
  ▶ <iframe id="3pCheckIframeId" src="https://static01.nyt.com/ads/tpc-check.html" style="display: none;" width="0" height="0"> ... </iframe>
  ▶ <div id="app"> ... </div>
  ▶ <script> ... </script>
html > body
Rules Layout Computed Changes Fonts Animations
Filter Styles :hov .cls +
element { inline
  display: none;
}
body { global-42db6c8821fec0e2b3837b2ea2ece8fe.css:313
  overflow-x: hidden;
}
```

# Hands On: Messing Around with Google.Com



Go to Google.com and manipulate the page elements programmatically:

```
// Locate the HTML element holding with given id.  
var logo = document.getElementById("logo");
```



**How to change the image displayed?**

# Hands On: Messing Around with Google.Com



Go to Google.com and manipulate the page elements programmatically:

```
// Locate the HTML element holding with given id.  
var logo = document.getElementById("logo");
```



**How to change the image displayed?**

**DOM objects are glorified JavaScript objects with properties and methods. The browser reads those properties and displays them accordingly.**

# Hands On: Messing Around with Google.Com



Go to Google.com and manipulate the page elements programmatically:

```
// Locate the HTML element holding with given id.  
var logo = document.getElementById("logo");  
// Change one of its attributes (pick any image you like).  
logo.srcset = "https://nodegame.org/images/Logo_Square_with_dots.png";
```

Google does thousands of A/B testing, so the exact name of the property might be slightly different from mine. If not working, try setting `srcset` to null, and set the property `src`.

# Hands On: Messing Around with Google.Com



Go to Google.com and manipulate the page elements programmatically:

```
// Locate the HTML element holding with given id.
var logo = document.getElementById("hplogo");
// Change one of its attributes (pick any image you like).
logo.srcset = "https://nodegame.org/images/Logo_Square_with_dots.png";
// Defines an onclick event-handler (anonymous function).
logo.onclick = function() {

    Let's do Something Here!

};
```

# Hands On: Messing Around with Google.Com



Go to Google.com and manipulate the page elements programmatically:

```
// Locate the HTML element holding with given id.
var logo = document.getElementById("hplogo");
// Change one of its attributes (pick any image you like).
logo.srcset = "https://nodegame.org/images/Logo_Square_with_dots.png";
// Defines an onclick event-handler (anonymous function).
logo.onclick = function() {
    // Redirect to a new page using the location object.
    window.location.href = "https://nodegame.org";
};
```

# Test in Mobile View

A screenshot of the Chrome DevTools interface. The left pane shows a mobile view of the Google homepage, with the browser address bar displaying 'Pixel 2', '411 x 731', '100%', and 'No throttling'. The right pane shows the 'Elements' tab with a tree view of the page's DOM. Three orange circles highlight the 'Pixel 2' dropdown, the mobile view icon, and the 'Elements' tab. The DOM tree shows the following structure:

```
<!DOCTYPE html>
<html dir="ltr" lang="en" class>
  <head>...</head>
  <body style="background-color: rgb(255, 255, 255);">
    <iframe id="backgroundImage" src="chrome-untruste...
    <ntp-app iframe-one-google-bar-enabled_promo-and...
      <#shadow-root (open)>
        <!--_html_template_start-->
        <style scope="cr-hidden-style">[hidden], :host
          display: none !important;
        </style>
        <style scope="cr-icons">...</style>
        <style include="cr-hidden-style cr-icons" scop...
        <style include="cr-shared-style" scope="ntp-ap...
        <div id="content" style="--ntp-theme-text-colc...
          p-theme-shortcut-background-color: rgba(241, 24...
          or: inherit;"> flex
            <ntp-iframe id="oneGoogleBar" src="chrome-un...
              _google-bar?paramsencoded=" style="clip-path:...
              h"); z-index: 1000;">...</ntp-iframe>
            <dom-if style="display: none;">...</dom-if>
            <!-- TODO(crbug.com/1168361): Instead of hid...
              it would
              be nicer to use a dom-if. However, th...
            StartupBrowserCreatorPickerNoParamsTest.Show...
              on
              the msan builder. See crbug.com/11696...
            <ntp-logo id="logo"> flex
              <#shadow-root (open)>
                <!--_html_template_start-->
                <style scope="cr-hidden-style">[hidden]
```

# JavaScript: Creating new Elements



```
// Create a new DIV element.  
let myDiv = document.createElement("div");
```



# JavaScript: Creating new Elements



```
// Let's clear the page.  
document.body.innerHTML = '';
```

# JavaScript: Creating new Elements



```
// Create a new DIV element.  
let myDiv = document.createElement("div");  
  
// Add something inside.  
myDiv.innerHTML = 'I am cool div.';
```

# JavaScript: Creating new Elements



```
// Create a new DIV element.  
let myDiv = document.createElement("div");  
  
// Add something inside.  
myDiv.innerHTML = 'I am cool div.';  
  
// Add the element to the page.  
document.body.appendChild(myDiv);
```

# SPAN vs DIV



```
// Add a SPAN element inside our DIV.  
let mySpan = document.createElement("span");
```

# SPAN vs DIV



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```

**Note!** `<p>` and `<div>` are "block" elements, while `<span>` is an inline element. *What does it mean?* If you append several `<span>` elements, they will be displayed one *next to* the other; if you append several `<div>` elements they will be displayed one *below* the other. So, generally `<SPAN>` elements are nested inside `<DIV>`, and not vice versa.

# SPAN vs DIV



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```

**Note!** `<p>` and `<div>` are "block" elements, while `<span>` is an inline element. *What does it mean?* If you append several `<span>` elements, they will be displayed one *next to* the other; if you append several `<div>` elements they will be displayed one *below* the other. So, generally `<SPAN>` elements are nested inside `<DIV>`, and not vice versa.



**However, did you know that you can change this behavior with a CSS "display" rule?**

# SPAN vs DIV



```
// Add a SPAN element inside our DIV.  
let mySpan = document.createElement("span");  
  
// Add something inside.  
mySpan.innerHTML = 'I am a child of myDiv.';
```

# SPAN vs DIV



```
// Add a SPAN element inside our DIV.  
let mySpan = document.createElement("span");  
  
// Add something inside.  
mySpan.innerHTML = 'I am a child of myDiv.';  
  
// Add the element to the page.  
myDiv.appendChild(mySpan);
```

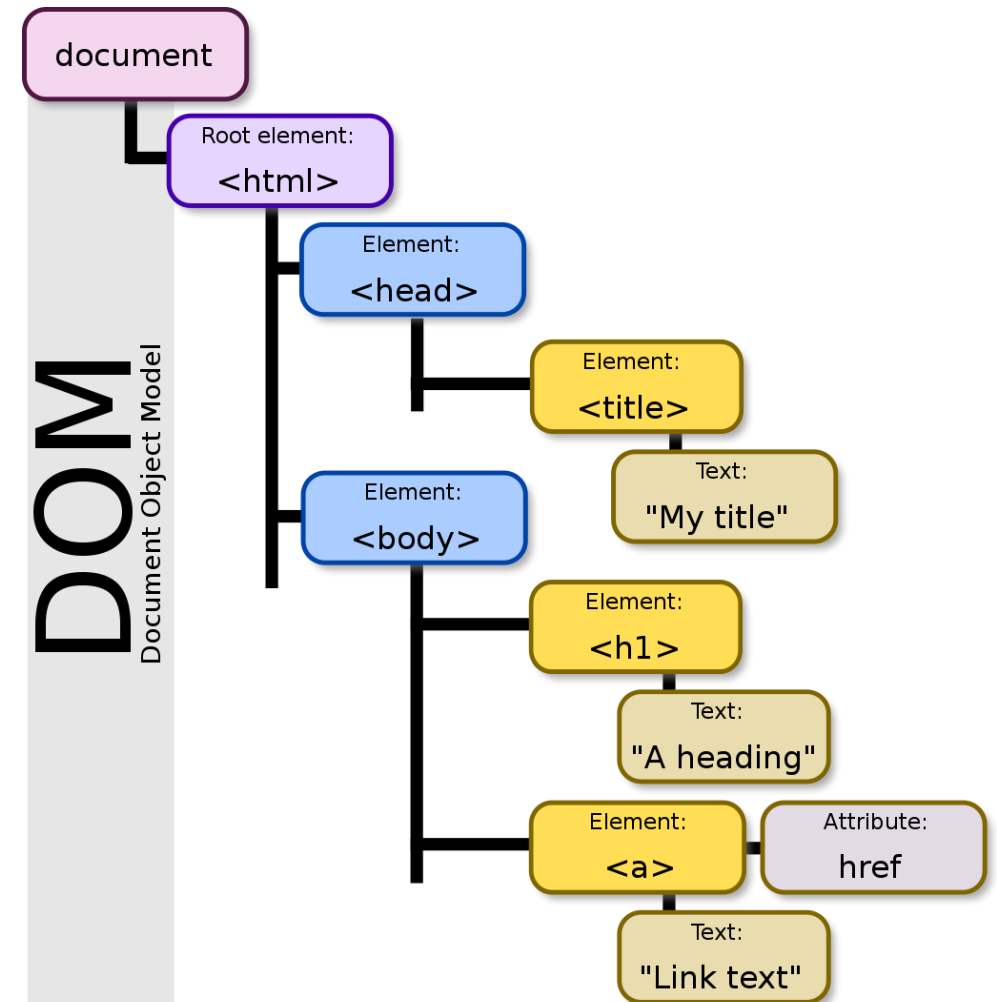


# More on appendChild



Every element in the DOM tree has a "parent" element and might have one or more "children" elements.

`appendChild` is a method available in every HTML element to add a *new* element **at the bottom** of the list of its children.



# More on appendChild

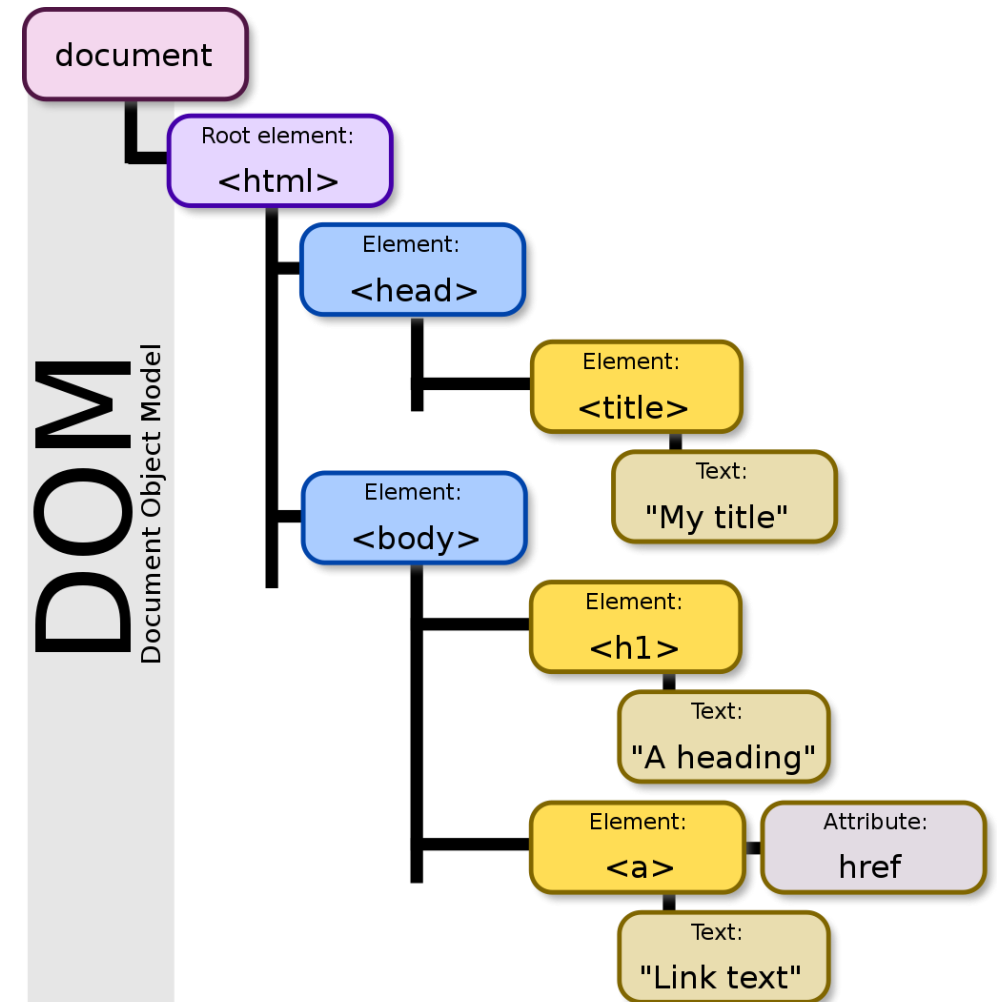


Every element in the DOM tree has a "parent" element and might have one or more "children" elements.

`appendChild` is a method available in every HTML element to add a *new* element **at the bottom** of the list of its children.



**Bonus question. What happens if you append an element that is already appended somewhere in the DOM under a new parent?**



# Module 4: References

- <https://www.stefanobalietti.com/teaching/programming-fundamentals/>
- <https://javascript.info/>
- <https://developer.mozilla.org/en-US/docs/Web>
- <https://css-tricks.com/>
- <https://www.w3schools.com/html/>
- <https://www.w3schools.com/css/>

# Module 4: jQuery



[Image source](#)



[Image source](#)

# Module 4: jQuery

## Learning Goals

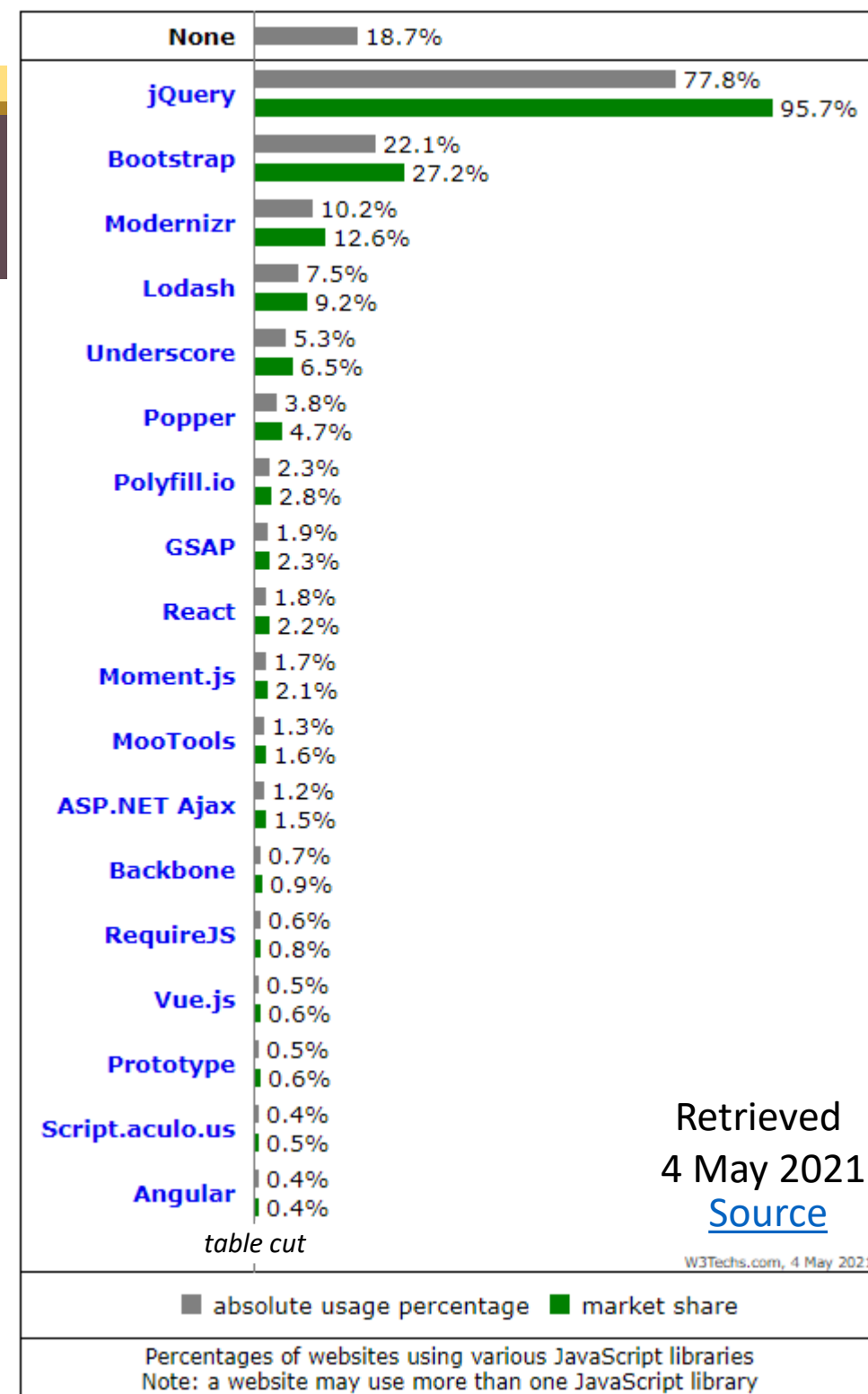
- Learn how to import and use jQuery
- Select elements
- Perform simple animations

# Module 4: jQuery

- **Free and open source** JS library to simplify:
  - DOM traversal and manipulation,
  - event handling,
  - CSS animation,
  - Ajax requests.

# Module 4: jQuery

- **Free and open source JS library to simplify:**
  - DOM traversal and manipulation,
  - event handling,
  - CSS animation,
  - Ajax requests.
- Most widely deployed JS library, 3 to 4 times more usage than any other JS library



# Module 4: jQuery

- Easy to use
- Easy to embed



# Module 4: jQuery

- Easy to use
- Easy to embed

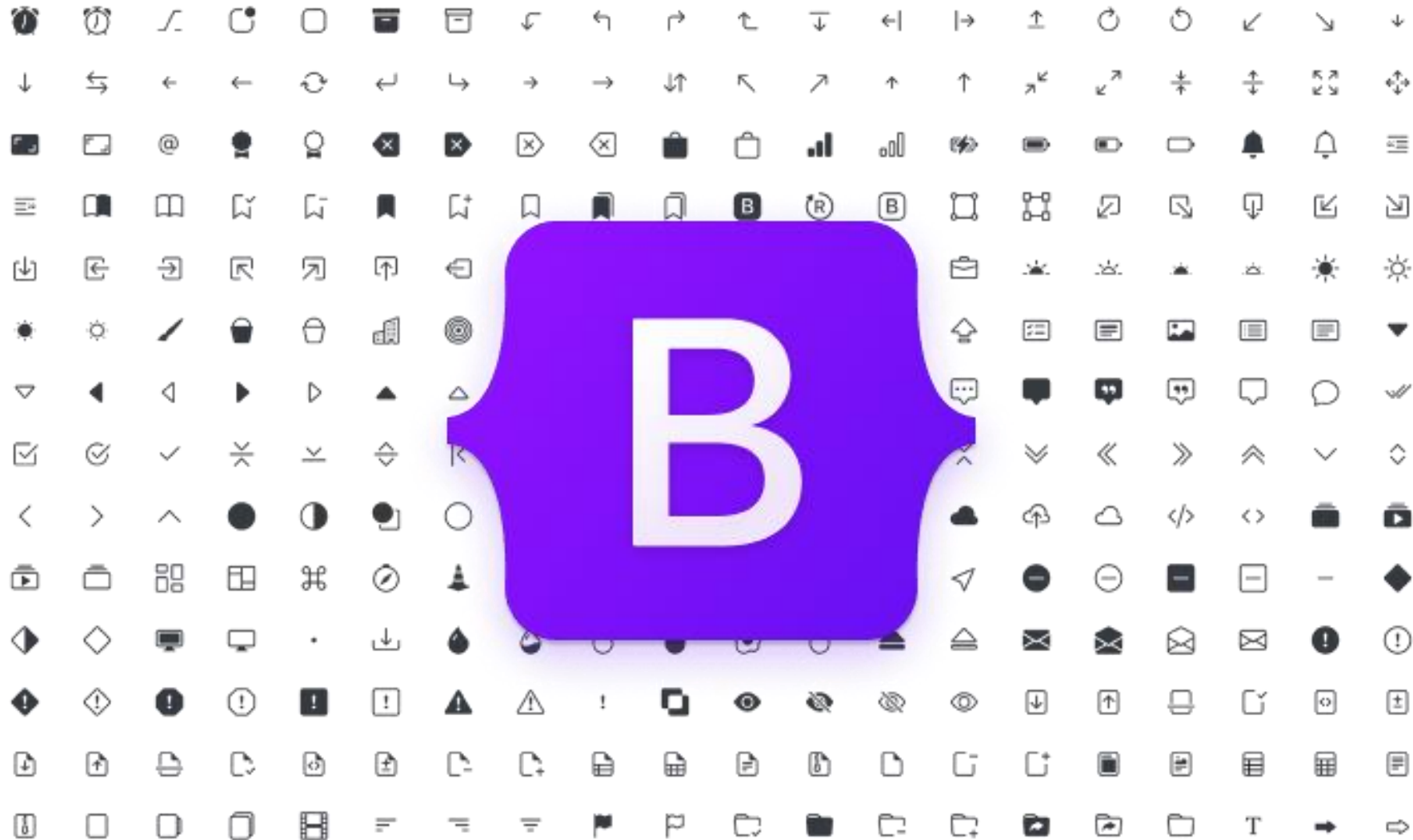
**But,**

- relatively slow
- Not a framework to build large, complex apps, such as Vue, Angular, or React

# Module 4: References

- <https://jquery.com/>
- <https://github.com/jquery/jquery>
- <https://www.w3schools.com/jquery/>
- <https://polyfill.io/>

# Module 5: Bootstrap



[Image source](#)

# Module 5: Bootstrap

## Learning Goals

- Improve the **old school** web app to cheer us up in difficult times.
- Include bootstrap CSS and JS in your app
- Understand grid layouts
- Understand and use Bootstrap components

# Module 5: Bootstrap

- Free and open-source mobile-first front-end web development framework.
- It contains CSS- and (optionally) JavaScript-based design templates for:
  - typography,
  - forms,
  - buttons,
  - navigation,
  - ...
- With over 150k stars is in the top-ten of [most starred](#) GitHub projects

# Module 5: Bootstrap

- Current stable version is **v4**: uses jQuery for JS animations
- Soon-to-be-released **v5**: replaces jQuery with vanilla JS
- Great documentation

# A responsive site should adapt to the container



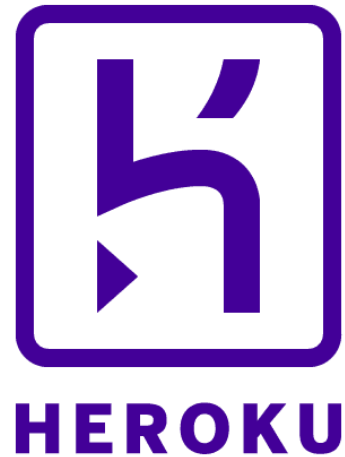
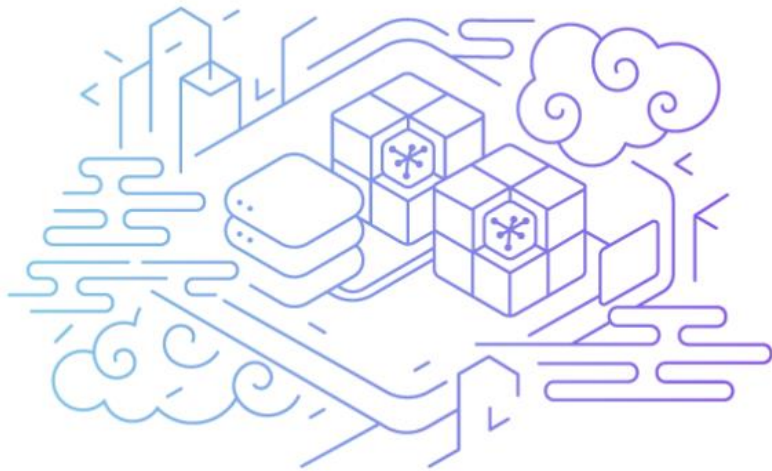
[Image source](#)

# Module 5: Resources

- <https://getbootstrap.com/>
- <https://getbootstrap.com/docs/4.6/getting-started/introduction/>
- <https://github.com/twbs/bootstrap>
- <https://www.ipraxe.com/blog/bootstrap-5-whats-new-whats-changed/>



# Module 6: Web Server



Express 4.17.1

Fast, unopinionated,  
minimalist web framework for  
Node.js

# Module 6: Web Server

## Learning Goals

- Setup the **ExpressJS** server in NodeJS
- Understanding middleware
- Creating custom routes and password protected routes
- Creating RESTful APIs
- Upload your server on the **Heroku** cloud

# Module 6: Web Server

- **Express JS** provides a minimalistic and fast web server API to server static assets and templates
- Express JS is the most installed server in NodeJS ecosystem (can be used in production in tandem with the NginX server---not covered here)
- **Heroku** is a cloud platform *as a service* supporting several programming languages.
- Heroku focuses on **apps** and provides the backend infrastructure to run them.

# Module 5: Resources

## Learning Goals

- <https://expressjs.com/>
- <https://expressjs.com/en/4x/api.html>
- <https://scotch.io/tutorials/whats-new-in-expressjs-5-0>
- <https://www.geeksforgeeks.org/different-servers-in-node-js/>
- <https://javascript.plainenglish.io/fastify-express-benchmark-4c4aebb726d6>
- <https://www.heroku.com>