

03 – Hypertext Markup Language

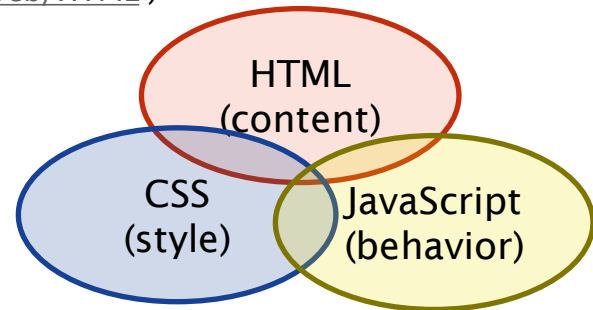
Web Technology Project (International Computer Science)

Summer semester 2025

Prof. Dr. Felix Schwägerl

Key Facts

- HTML is the most basic building block of web pages.
 - It defines the *meaning* and *structure* of web *content*.
- *Hypertext* refers to *links* that connect webpages to one another.
- *Markup* is used to annotate text, images, and other content for display in a browser.
- HTML is almost never used alone. It is extended by two key technologies:
 - CSS (chapter 04): appearance and presentation
 - JavaScript (chapter 05): interaction and behavior
- HTML has a complicated history. The web is full of outdated examples and tutorials.
- Current standard: HTML5 (<https://www.w3.org/TR/2011/WD-html5-20110405/>)
- Recommended documentation:
MDN (<https://developer.mozilla.org/en-US/docs/Web/HTML>)



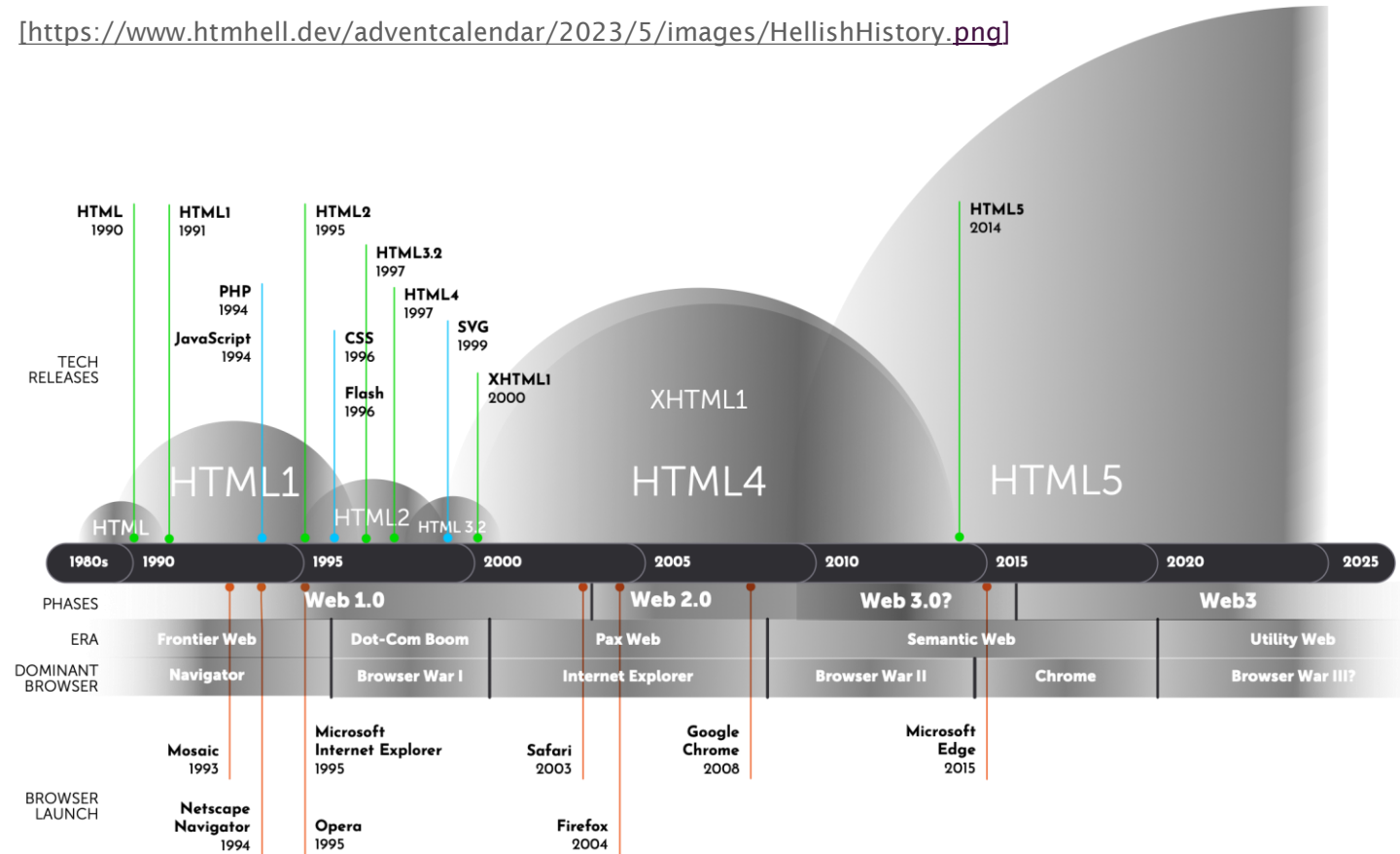
HTML is an evolving language with a complicated history.

- **Early Beginnings (1991):** HTML was created by Tim Berners-Lee to share documents over the World Wide Web.
- **HTML 2.0 (1995):** The first standardized version of HTML, officially formalizing its syntax.
- **HTML 3.2 (1997):** Introduced features like tables, scripting, and stylesheets, expanding HTML's functionality.
- **HTML 4.01 (1999):** Standardized HTML further, focusing on accessibility and separating content from presentation (CSS).
- **XHTML (2000s):** A stricter version of HTML, designed to be more XML-compliant, aiming for cleaner code.
- **HTML5 (2014):** Major update, added native support for audio, video, local storage, and more interactive features.
- **Mobile Optimization (2010s):** HTML5 catered to mobile-first design, revolutionizing responsive web development.
- **Ongoing Evolution:** HTML continues to evolve with modern web technologies, ensuring accessibility, performance, and rich user experiences.

[ChatGPT1]

Evolution of the web and browser wars

[<https://www.htmhell.dev/adventcalendar/2023/5/images/HellishHistory.png>]



HTML

Content elements of the page, e.g.,

- Headings
- Texts, lists, tables
- Images, links
- Navigation structure
- Forms

→ *What* is presented?

Main heading in my document

Look Ma, I am coding HTML



CSS

Instructions for formatting HTML elements, e.g.,

- Colors, fonts
- Text size, emphasis (e.g., bold, italics)
- Layout (e.g., grid, flow)
- Responsive design: adapt to different device types and sizes (e.g., desktop vs. mobile)

→ *How* is it presented?

Main heading in my document

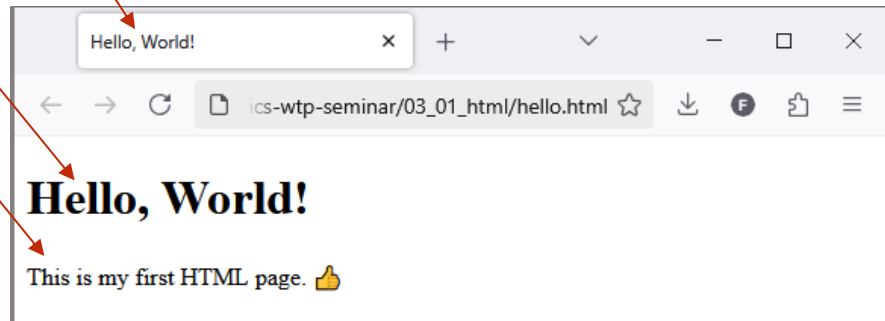
Look Ma, I am coding HTML



```
<!DOCTYPE html>
<html lang="en">
  <head>
    <meta charset="utf-8" />
    <meta name="viewport" content="width=device-width"/>
    <title>Hello, world!</title>
  </head>
  <body>
    <!-- only the body is actually rendered -->
    <h1>Hello, world!</h1>
    <p>This is my first HTML page. 🍌</p>
  </body>
</html>
```

*head (meta
information)*

*body
(content)*



HTML is based on the meta-format XML.

element

`<h1>Hello, world!</h1>`

opening tag *character data* *closing tag*

attribute

`<html lang="en"> ... </html>`

`<!DOCTYPE html>`

preamble (disable compatibility mode)

element { `<body>`
 `<h1>...</h1>`
 `<p>...</p>`
 `</body>` } *children*

*element (abbreviated notation;
no character data, no children)*

`<meta charset="utf-8"/>`

`<!-- not rendered -->`

comment

IntelliJ renders and validates your HTML as you edit it.

```
<> hello.html x
1  <!DOCTYPE html>
2  <hmtl lang="en">
3    <hedd>
4      <meta http-equiv="Content-Type"
5        content="text/html; charset=uftl-8"/>
6      <title>Hello, World!</title>
7    </hedd>
8    <body>
9      <!-- only the body is actually rendered -->
10     <h1>Hello, world!</h1>
11     <p>This is my 2nd HTML page. 🍌</p>
12
```

Preview of hello.html x

Hello, World!

This is my 2nd HTML page. 🍌

- This example contains many different errors.
 - Misspelled tags, missing closing tags
- In contrast to compilers of programming languages, browsers are very *lenient* in interpreting HTML.
 - Pro: HTML (and CSS and JavaScript) errors are mostly not fatal.
 - Con: Validation errors remain undetected → different behavior e.g., based on browsers

[PicoCSS 2025]

Pico

A class-less example, without dependencies.

- [Auto](#)
- [Light](#)
- [Dark](#)

Preview

Sed ultricies dolor non ante vulputate hendrerit. Vivamus sit amet suscipit sapien. Nulla iaculis eros a elit pharetra eg

First name Email address

☐ I agree to the [Privacy Policy](#).

Typography

Aliquam lobortis vitae nibh nec rhoncus. Morbi mattis neque eget efficitur feugiat. Vivamus porta nunc a erat mattis.

"Maecenas vehicula metus tellus, vitae congue turpis hendrerit non. Nam at dui sit amet ipsum cursus ornare."
- *Phasellus eget lacinia*

Lists

- Aliquam lobortis lacus eu libero ornare facilisis.
- Nam et magna at libero scelerisque egestas.
- Suspendisse id nisl ut leo finibus vehicula quis eu ex.
- Proin ultricies turpis et volutpat vehicula.

Inline text elements

[Link](#)

Bold

Italic

Pico

A class-less example, without dependencies.

[Auto](#) [Light](#) [Dark](#)

Preview

Sed ultricies dolor non ante vulputate hendrerit. Vivamus sit amet suscipit sapien. Nulla iaculis eros a elit pharetra egestas.

First name

Email address

☐ I agree to the [Privacy Policy](#)

Typography

Aliquam lobortis vitae nibh nec rhoncus. Morbi mattis neque eget efficitur feugiat. Vivamus porta nunc a erat mattis, mattis feugiat t
sed tristique felis.

"Maecenas vehicula metus tellus, vitae congue turpis hendrerit non. Nam at dui sit amet ipsum cursus ornare."
- *Phasellus eget lacinia*

Lists

- Aliquam lobortis lacus eu libero ornare facilisis.
- Nam et magna at libero scelerisque egestas.
- Suspendisse id nisl ut leo finibus vehicula quis eu ex.
- Proin ultricies turpis et volutpat vehicula.

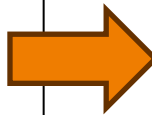
Inline text elements

[Link](#)

Bold

Italic

Underline



- Only difference: Reference to *stylesheet* in metadata
- CSS to be discussed in section 04

<[link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/@picocss/pico@2.1.1/css/pico.classless.min.css"](https://cdn.jsdelivr.net/npm/@picocss/pico@2.1.1/css/pico.classless.min.css)>

Six levels of headings are pre-defined.

```
<body>
  <h1>The world</h1>
  <p>Population: 8.16 billion</p>
  <h2>Europe</h2>
  <p>Population: 742 million</p>
  <h3>Germany</h3>
  <p>Population: 83.3 million</p>
  <h4>Bavaria</h4>
  <p>Population: 13.2 million</p>
  <h5>Upper Palatinate</h5>
  <p>Population: 1,141,561</p>
  <h6>Regensburg</h6>
  <p>Population: 179,090</p>
</body>
```

- Headings should always start at `<h1>` level and reflect nesting directly.
- Text should be contained by flow elements, e.g., Paragraphs (`<p>`).
- The line break (`
`) should not be used as a replacement for characters

The world

Population: 8.16 billion

Europe

Population: 742 million

Germany

Population: 83.3 million

Bavaria

Population: 13.2 million

Upper Palatinate

Population: 1,141,561

Regensburg

Population: 179,090

Use *semantic markup* for adding emphasis to texts.

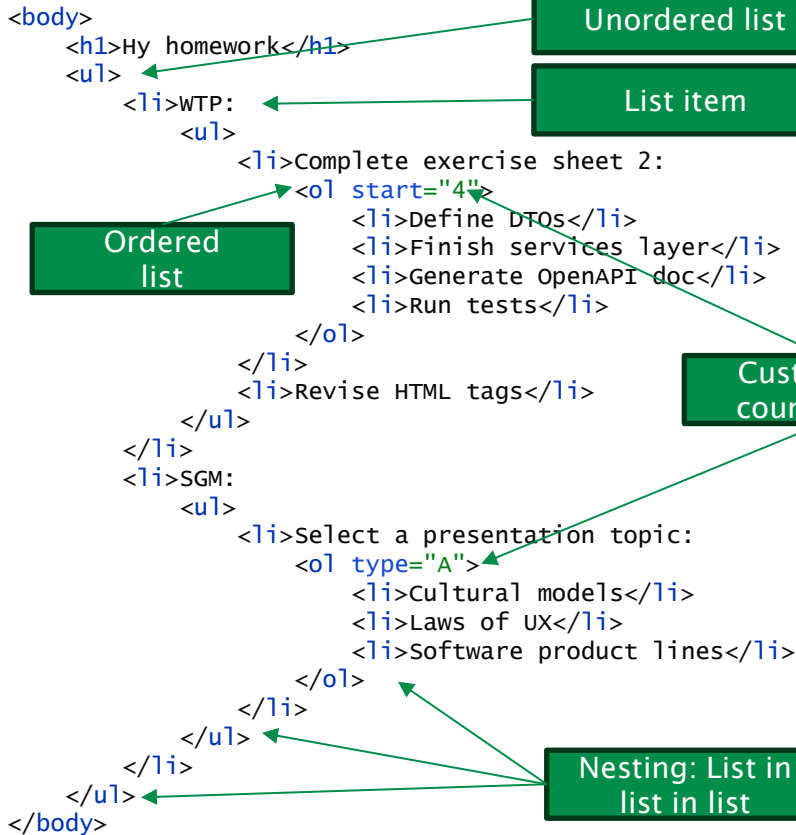
`<p>It is out of question that
<abbr title="HTML" data-tooltip="Hypertext Markup Language">HTML</abbr>
is to the web what H₂O
is for life.`

For `<mark>`highlighting`</mark>` parts of a text,
``direct```<ins>`semantic`</ins>`
formatting should be used. Press
`<kbd>`Ctrl+Shift+I`</kbd>` to inspect the HTML
`<code>``<`body`>``</code>` in the source
code`^{`TM`}` of this `<small>`tiny
contribution`</small>` to the internet.

It is **out of question** that HTML is to the web what H₂O is for *life*. For **highlighting** parts of a text, direct semantic formatting should be used. Press Ctrl+Shift+I to inspect the HTML `<body>` in the source codeTM of this tiny contribution to the internet.

For historical reasons, HTML also offers direct formatting (intermixing form and content!)

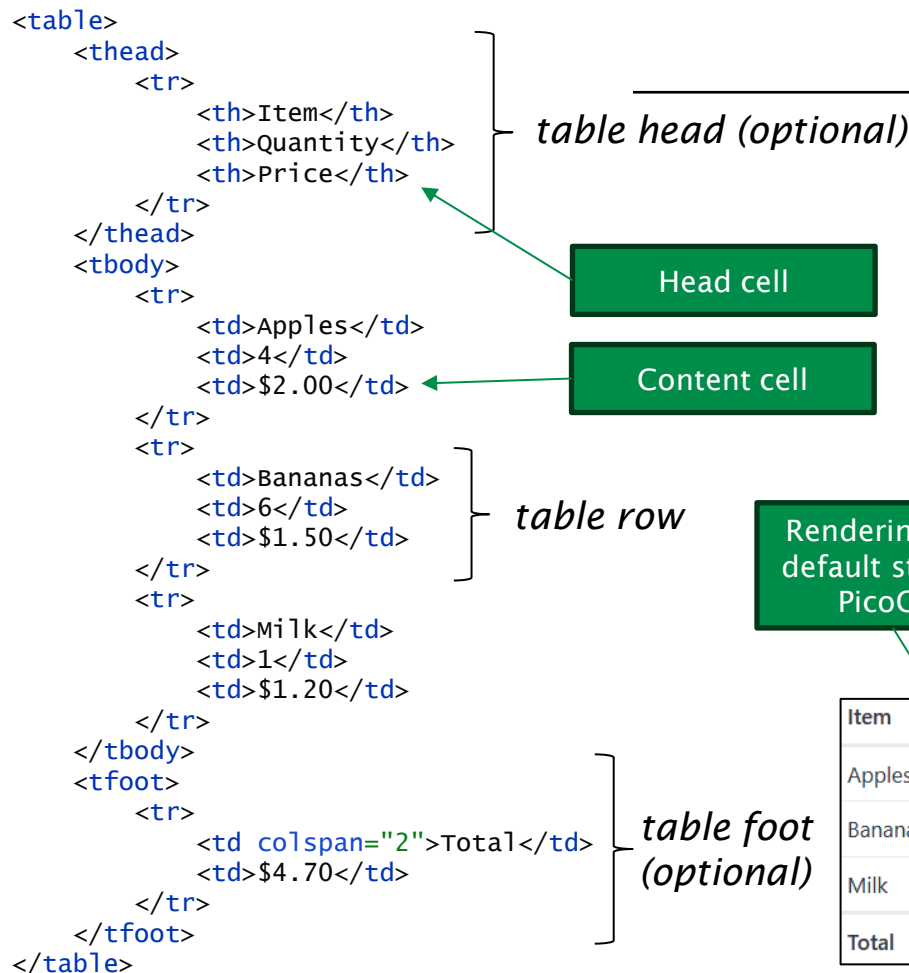
- E.g., `<i>` for italic, `` for bold, and for `<u>` underlined text.
- Instead, use **CSS** (→) to change the style of emphasized/highlighted text if required.



Hy homework

- WTP:
 - Complete exercise sheet 2:
 4. Define DTOs
 5. Finish services layer
 6. Generate OpenAPI doc
 7. Run tests
 - Revise HTML tags
- SGM:
 - Select a presentation topic:
 - A. Cultural models
 - B. Laws of UX
 - C. Software product lines

- When no head and/or foot is required, the surrounding `<tbody>` element can be omitted, too.

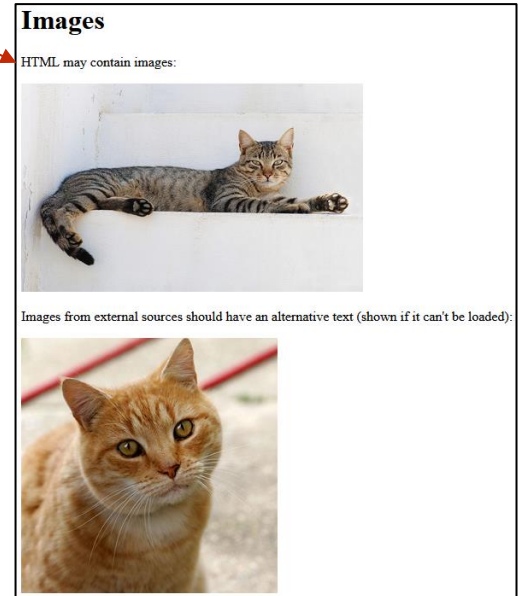


Item	Quantity	Price
Apples	4	\$2.00
Bananas	6	\$1.50
Milk	1	\$1.20
Total		\$4.70

Item	Quantity	Price
Apples	4	\$2.00
Bananas	6	\$1.50
Milk	1	\$1.20
Total		\$4.70

```
<body>
  <h1>Images</h1>
  <p>HTML may contain images:</p>
  
  <p>Images from external sources should have an alternative text (shown if it can't be loaded):</p>
  

  <h2>Figures</h2>
  <p>The <code><figure></code> element allows to add figure captions:</p>
  <figure>
    
    <figcaption>
      &copy; National Geographic
    </figcaption>
  </figure>
</body>
```



Links transform markup into hypertext.

- Almost anything can be an *anchor* (<a>), which includes a *hyper-reference* (href).

```
<body>
  <h1>Text links</h1>
  <p>We can have <a href="#">Links</a> everywhere. <code>href="#"</code> stays on the same page.</p>
  <ul>
    <li><a href="#image-links">Go to a different section on the same page.</a></li>
    <li><a href="images.html">Go to a different page on the same site.</a></li>
    <li><a href="images.html" target="_blank">Open link target in a new tab.</a></li>
    <li><a href="images.html" download="images.html">Download the link target.</a></li>
    <li><a href="https://www.duckduckgo.com">Follow an external link to search on the web.</a></li>
    <li><a href="mailto:felix.schwaegerl@oth-regensburg.de">Email your prof.</a></li>
    <li><a href="tel:+4994194370279">Give your prof a phone call.</a></li>
  </ul>

  <h1 id="image-links">Image links</h1>
  <a href="https://www.nationalgeographic.com/premium/article/cats-facial-expressions-pets-behavior">
    
  </a>
</body>
```

Text links

We can have Links everywhere. href="#" stays on the same page.

- [Go to a different section on the same page.](#)
- [Go to a different page on the same site.](#)
- [Open link target in a new tab.](#)
- [Download the link target.](#)
- [Follow an external link to search something on the web.](#)
- [Email your prof.](#)
- [Give your prof a phone call.](#)

Image links



```

<body>
<div>
  <h1>Healthy Eating Tips for a Balanced Life</h1>
  <div id="navigation">
    <ul><li><a href="#section1">Introduction</a></li>
      <li><a href="#section2">Key Benefits</a></li></ul>
    </div>
  </div>
<div>
  <div>
    <h2>Why Healthy Eating Matters</h2>
    <p>Published <span id="date">March 27, 2025</span>
      by <span class="author">Jane Doe</span></p>
  </div>
  <div class="section" id="section1">
    <h3>Introduction to Healthy Eating</h3>
    <p>Healthy eating is essential for maintaining good health ...p>
  </div>
  <div class="section" id="section2">
    <h3>Key Benefits of Eating Healthy</h3>
    <ul>
      <li>Improved digestion</li>...
    </ul>
  </div>
</div>
<div>
  <p>&copy; 2025 <span class="author">Jane Doe</span>'s
    <span id="blog-title">Healthy Living Blog</span></p>
</div>
</body>

```

- While divs are *block* elements, spans are *inline*.
- Divs and spans can be *styled* individually with CSS based on *IDs* and *classes* (→ section 04)
- They are semantically neutral. If possible, replace with more concrete *semantic elements*, e.g. **article**, **section**, **header**, **nav**, **aside**, **footer** (→ following slides)

Healthy Eating Tips for a Balanced Life

- [Introduction](#)
- [Key Benefits](#)

Why Healthy Eating Matters

Published March 27, 2025 by Jane Doe

Introduction to Healthy Eating

Healthy eating is essential for maintaining good health and well-being. It provides the body with essential nutrients, helps prevent diseases, and supports physical and mental functions.

Key Benefits of Eating Healthy

- Improved digestion
- Increased energy levels
- Stronger immune system
- Better mental clarity

© 2025 Jane Doe's Healthy Living Blog


```

<body>
  <h1>Inline Navigation</h1>
  <nav>
    <a href="headings.html">Headings</a> &bull;
    <a href="links.html">Links</a> &bull;
    <a href="#">Navigation</a>
  </nav>

  <h1>List Navigation</h1>
  <nav>
    <ul>
      <li><a href="headings.html">Headings</a></li>
      <li><a href="links.html">Links</a></li>
      <li><a href="#">Navigation</a></li>
    </ul>
  </nav>

  <h1>Image Navigation</h1>
  <nav>
    <p>Follow us:</p>
    <a href="https://signal.org"></a>
    <a href="https://joinmastodon.org"></a>
    <a href="https://discord.com"></a>
  </nav>
</body>

```

Inline Navigation

[Headings](#) • [Links](#) • [Navigation](#)

List Navigation

- [Headings](#)
- [Links](#)
- [Navigation](#)

Image Navigation

Follow us:



Healthy Eating Tips for a Balanced Life

[Introduction](#) [Key Benefits](#) [Quick Tips](#)

Why Healthy Eating Matters

Published on March 27, 2025, by Jane Doe

Introduction to Healthy Eating

Healthy eating is essential for maintaining good health and well-being. It provides the body with essential nutrients, helps prevent diseases, and supports physical and mental functions.

Key Benefits of Eating Healthy

- Improved digestion
- Increased energy levels
- Stronger immune system
- Better mental clarity

Quick Tips for a Balanced Diet

- Eat a variety of fruits and vegetables daily.
- Limit processed foods and sugar intake.
- Stay hydrated by drinking plenty of water.
- Choose whole grains over refined ones.

Extra Tip: Eating Seasonally

Eating seasonal fruits and vegetables not only provides your body with the best nutrients at the right time of year but also supports local farmers and the environment.

Stay healthy and happy!

Here we cheated with CSS to make the aside flow right

```
<body>
<header>
  <h1>Healthy Eating Tips for a Balanced Life</h1>
  <nav><ul>
    <li><a href="#section1">Introduction</a></li> ...
  </ul></nav>
</header>
<main> <article>
  <header>
    <h2>Why Healthy Eating Matters</h2>
    <p>Published on March 27, 2025, by Jane Doe</p>
  </header>
  <section id="section1">
    <h3>Introduction to Healthy Eating</h3>
    <p>Healthy eating is essential ...</p>
  </section>
  <aside>
    <h4>Extra Tip: Eating Seasonally</h4>
    <small>Eating seasonal ...</small>
  </aside>
  <section id="section2">
    <h3>Key Benefits of Eating Healthy</h3>
    <ul> <li>Improved digestion</li> ... </ul>
  </section>
  <section id="section3">
    <h3>Quick Tips for a Balanced Diet</h3>
    <ul> <li>Eat a variety ... </li> ... </ul>
  </section>
  <footer>
    <p>Stay healthy and happy!</p>
  </footer>
</article> </main>
<footer>
  <p>&copy; 2025 Healthy Living Blog</p>
</footer>
</body>
```

[ChatGPT3]

```
<section id="accordions">
  <h2>Accordions</h2>
  <details>
    <summary>Accordion 1</summary>
    <p>Lorem ipsum dolor ... </p>
  </details>
  <details open>
    <summary>Accordion 2</summary>
    <ul>
      <li>Vestibulum ...</li>
      ...
    </ul>
  </details>
</section>
```

► Accordion 1

▼ Accordion 2

- Vestibulum id elit quis massa interdum sodales.
- Nunc quis eros vel odio pretium tincidunt nec quis neque.
- Quisque sed eros non eros ornare elementum.
- Cras sed libero aliquet, porta dolor quis, dapibus ipsum.



Open 1,
close 2

- Like most semantic elements, **details** has been added in HTML5.
- Opening and closing parts of texts
- In closed state, only **summary** is displayed.
- Simple user interaction without JavaScript

▼ Accordion 1

Lorem ipsum dolor sit amet, consectetur urna diam, tincidunt nec porta sed, auctor ut orci consequat, vitae tempus quam con ipsum. Aliquam eu posuere orci. Nulla hendrerit, in facilisis elit sollicitudin. M dictum tristique elit auctor quis. Maecenas sit amet, congue turpis.

► Accordion 2

Contact Us

Contact data:

Full Name:

Email Address:

Password:

Age:

Phone Number:

Date of Birth:

Preferred Contact Method:

☒ Email ☐ Phone

Subscribe to Newsletter: ☐

Upload Your Resume (PDF only): No file selected.

Message:

```

<body>
<h1>Contact Us</h1>
<form>
  <fieldset>
    <legend>Contact data:</legend>
    <div><label for="name">Full Name:</label>
    <input type="text" id="name" name="name"
      placeholder="Your Name" required></div>
    <div><label for="email">Email Address:</label>
    <input type="email" id="email" name="email"
      placeholder="Your Email" required></div>
    <div><label for="password">Password:</label>
    <input type="password" id="password" name="password"></div>
    <div><label for="age">Age:</label>
    <input type="number" id="age" name="age"
      min="18" max="100" required></div>
    <div><label for="phone">Phone Number:</label>
    <input type="tel" id="phone" name="phone"
      placeholder="+12345678"></div>
    <div><label for="dob">Date of Birth:</label>
    <input type="date" id="dob" name="dob" required></div>
  </fieldset>

  <fieldset>
    <legend>Preferred Contact Method:</legend>
    <input type="radio" id="emailContact" name="contactMethod" value="email" checked>
    <label for="emailContact">Email</label>
    <input type="radio" id="phoneContact" name="contactMethod" value="phone">
    <label for="phoneContact">Phone</label>
  </fieldset>

  <div><label for="subscribe">Subscribe to Newsletter:</label>
  <input type="checkbox" id="subscribe" name="subscribe" value="yes"></div>
  <div><label for="resume">Upload Your Resume (PDF only):</label>
  <input type="file" id="resume" name="resume" accept=".pdf"></div>
  <div><label for="message">Message:</label>
  <textarea id="message" name="message" rows="2" cols="60" placeholder="Your Message" required></div>
  <div><button>Submit</button></div>
</form></body>

```

FAQs for the example

- Which of the HTML elements are actually required?
 - `fieldset`, `legend` and `label` are for grouping and additional descriptions
 - The `for` attribute of a `label` connects it to the `input` with corresponding `id`.
 - The `name` attribute of an `input` addresses the input data in the submitted content.
 - `fieldsets` are optional.
- How can we style the form to look more attractive?
→ chapter 04 (CSS)
- What happens when clicking a button?
 - Validation: if a required field is not filled, the field gets highlighted and an error message is shown.
 - Submission: The standard behavior in HTML is a POST request to the current page URL, where the entered values are submitted as `application/x-www-form-urlencoded` data.
 - Modern web applications disable the standard behavior and define a JavaScript method instead. This usually transmits the input data to an API using a dynamic web request (XHR).

Contact Us

Contact data:

Full Name:

Email Address:

Password:

Age:

Phone Number:

Date of Birth:

Preferred Contact Method:

☒ Email ☐ Phone

Subscribe to Newsletter:

☐

Upload Your Resume (PDF only):

No file selected.

Message:

```

<body>
  <main>
    <h1>My background website</h1>
    <p>Lorem ipsum ...</p>
    
  </main>
  <dialog open>
    <h1>Error</h1>
    <form method="dialog">
      <p>An error occurred while showing an error.</p>
      <label for="complain">
        I want to file a complaint:
        <input type="checkbox" id="complain",
              name="complain" value="no"/></label>
      <p>...<a href="#">legal notice</a>.</p>
      <button>Cancel</button>
      <button>OK</button>
    </form>
  </dialog>
</body>

```

- By default, dialogs are just rendered as `div` with some special display properties (e.g., centered)
- They are only visible if the `open` attribute is set.
 - The value is usually controlled by JavaScript.
 - When a button included in a `form` `method="dialog"` is clicked, the default behavior closes the dialog and submits data via POST.

My background website

Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet. Lorem ipsum dolor sit amet, consetetur sadipscing elitr, sed diam nonumy eirmod tempor invidunt ut labore et dolore magna aliquyam erat, sed diam voluptua. At vero eos et accusam et justo duo dolores et ea rebum. Stet clita kasd gubergren, no sea takimata sanctus est Lorem ipsum dolor sit amet.



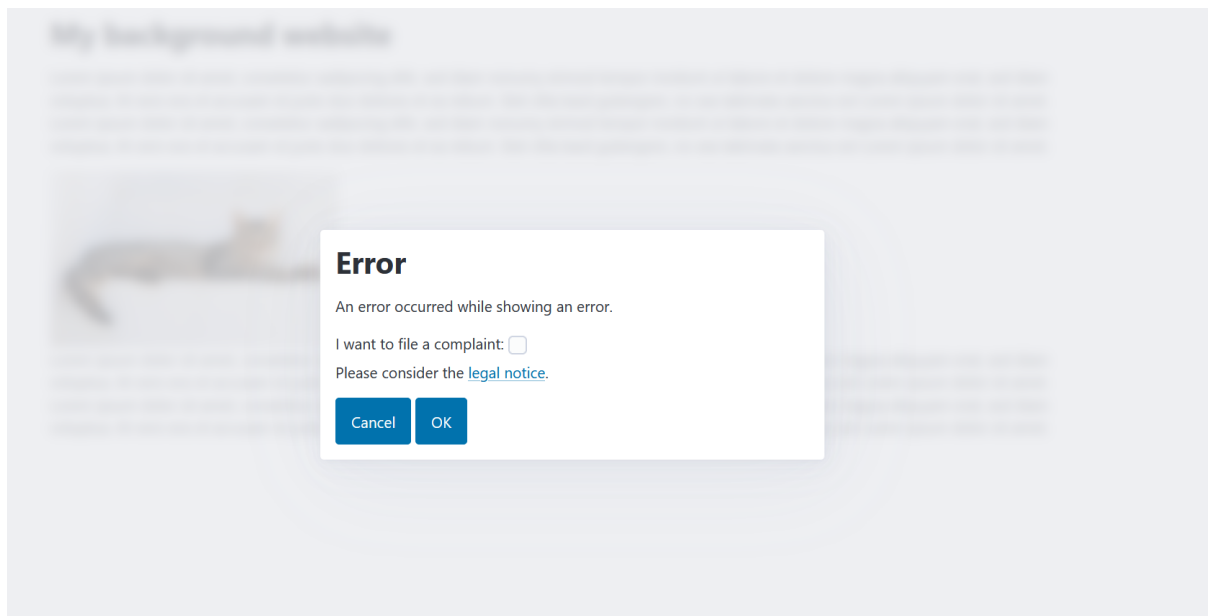
Error

An error occurred while showing an error.

I want to file a complaint: ☐

Please consider the [legal notice](#).

- The default behavior is usually replaced with HTML.
- CSS is used to display the dialog in a *modal* way (i.e., centered and in front of the actual website)
- E.g., using TinyCSS:



An iframe embeds another document into our current HTML.

```
<body>
<main>
  <article>
    <h1>My home town Regensburg</h1>
    <p>These are the main sights:</p>
    <iframe width="800" height="400"
      src="https://en.wikipedia.org/wiki/Regensburg#Main_sights">
    </iframe>
    <p>And this is how you can get there:</p>
    <iframe width="425" height="350"
      src="https://www.openstreetmap.org/export/embed.html?...">
    </iframe><br/>
    <small><a href="https://www.openstreetmap.org/?#map=12/49...">
      View Larger Map</a></small>
  </article>
</main>
</body>
```

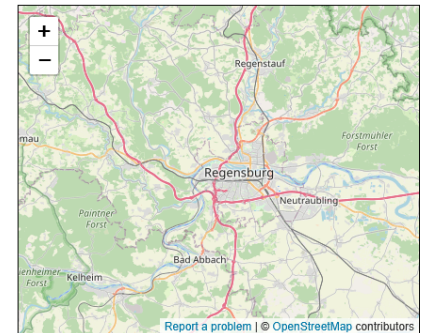
- Not all HTML pages are suited for embedding.
 - Designed for full screen
 - Login issues, cross-site-scripting security mechanisms
- Usually, websites that intend to be embedded offer to generate HTML snippets.

My home town Regensburg

These are the main sights:

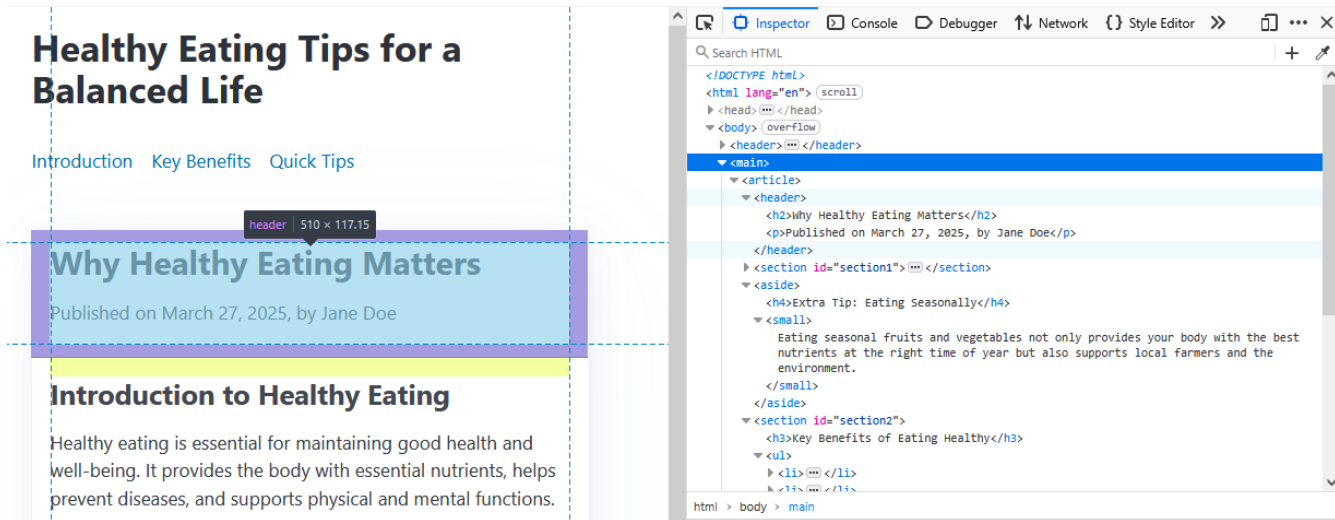


And this is how you can get there:



The browser parses the HTML into a DOM and renders it.

- The DOM is a tree structure containing all document elements and their properties.
 - In static web applications, the DOM reflects the initial HTML directly.
- Using JavaScript, the DOM may be *inspected* and *manipulated*.
 - Modern web frameworks heavily rely on DOM manipulation, so the initial HTML has almost nothing to do with the DOM rendered by the browser. (→ chapter 06)
- The current DOM can be inspected using Browser console:



- [Mozilla 2025] Mozilla Developer Network (MDN): HTTP web docs, <https://developer.mozilla.org/en-US/docs/Web/HTTP>
- [PicoCSS 2025] PicoCSS documentation, <https://picocss.com/docs>
- [ChatGPT1] ChatGPT (<https://chatgpt.com/>) with prompt: “Generate a 8 bullet point summary about the history of HTML. It should fit one PowerPoint slide nicely”
- [ChatGPT2] ChatGPT (<https://chatgpt.com/>) with prompt: “generate a minimum example of a HTML table, including table heads and foot. Use a daily-life example instead of abstract contents”
- [ChatGPT3] ChatGPT (<https://chatgpt.com/>) with prompt: “Generate a HTML example using the semantic elements article, section, and aside reasonably. Use a small but interesting real-life example.”
- [ChatGPT4] ChatGPT (<https://chatgpt.com/>) with prompt: “Generate a HTML form example including the ten most important types of input. Use a small but interesting real-life example.”