UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

WEB TECHNOLOGIES — LECTURE 04

CSS: LAYOUTS, RESPONSIVE DESIGN

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PREVIOUSLY, ON WEB TECHNOLOGIES

In the last lecture, we have learned:

- What **CSS** is and how to include it in HTML documents
- Some basic **styling properties** (`color`, `background`, `font-style`, …)
- Selectors
- The Cascade algorithm
- Inheritance

CSS SIZING UNITS

CSS SIZING UNITS OVERVIEW

Some CSS properties can be used to change the **size** of elements or their box model properties:

- **width**, **height**, **font-size**, **margin**, **padding**, **border**, …

When sizing elements in CSS it possible to use:

- **Absolute** lengths
- **Relative** lengths (depend on other sizes, i.e.: font or viewport sizes)

CSS: ABSOLUTE SIZING UNITS

- Absolute lengths are defined by using a number and one of the supported length units

```
div {
  background: red;
  width: 2.54cm; /* centimeters */
  height: 1in;   /* inches */
  border: 2mm solid black; /* millimiters */
  color: white;
  font-size: 24px; /* pixels */
}
```

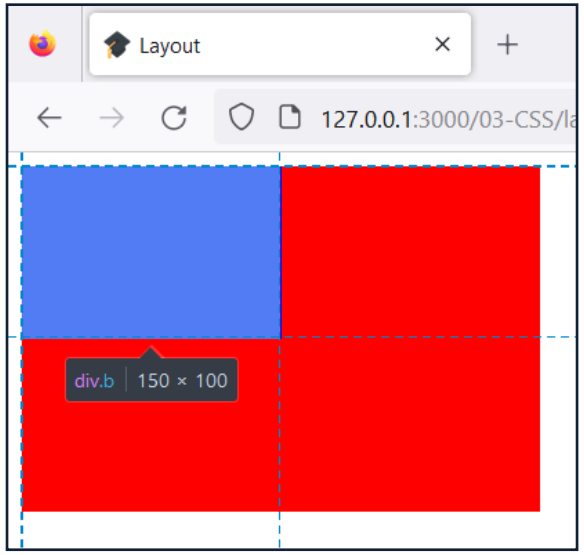
```
<div>hello</div>
```

CSS: PERCENTAGE SIZING

- Percentages define sizes as relative to the parent elements
- They can be used with many properties, including:
  - width, height, font-size, margin, padding, …

```
.a {
  width: 300px; height: 200px;
  background: red;
}
.b {
  width: 50%; /*150px*/
  height: 50%; /*100px*/
  background: blue;
}
```

```
<div class="a">
  <div class="b"></div>
</div>
```



CSS: RELATIVE SIZING UNITS (FONTS)

Font size-relative units include:

- em: **1em** represents the current font-size. **1.5em** is 50% larger than the current font-size. Historically, in typography, font size was derived from the width of the capital “M”, hence the name of the unit “em”.
- rem: **1rem** represents the font-size computed at the root element (default 16px)

```
p {
  font-family: sans-serif;
  font-size: 1.5rem;
}
span {
  font-size:1.5em;
}
```

```
<p>HELLO<span>SIZES</span></p>
```

CSS: RELATIVE SIZING UNITS (VIEWPORT)

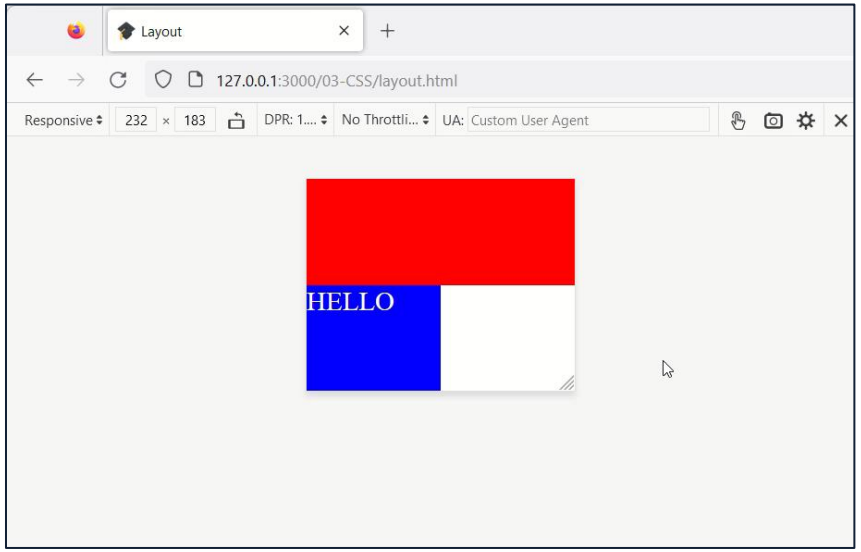
The **viewport** is the browser window.

Viewport-relative size units include:

- vw: **1vw** represents 1% of the width of the current viewport.
- vh: **1vh** represents 1% of the height of the current viewport.

```
div {height: 50vh;}
.a {background: red;}
.b{
  background: blue; color: white;
  width: 50vw;font-size:10vw;
}
```

```
<div class="a"></div>
<div class="b">HELLO</div>
```

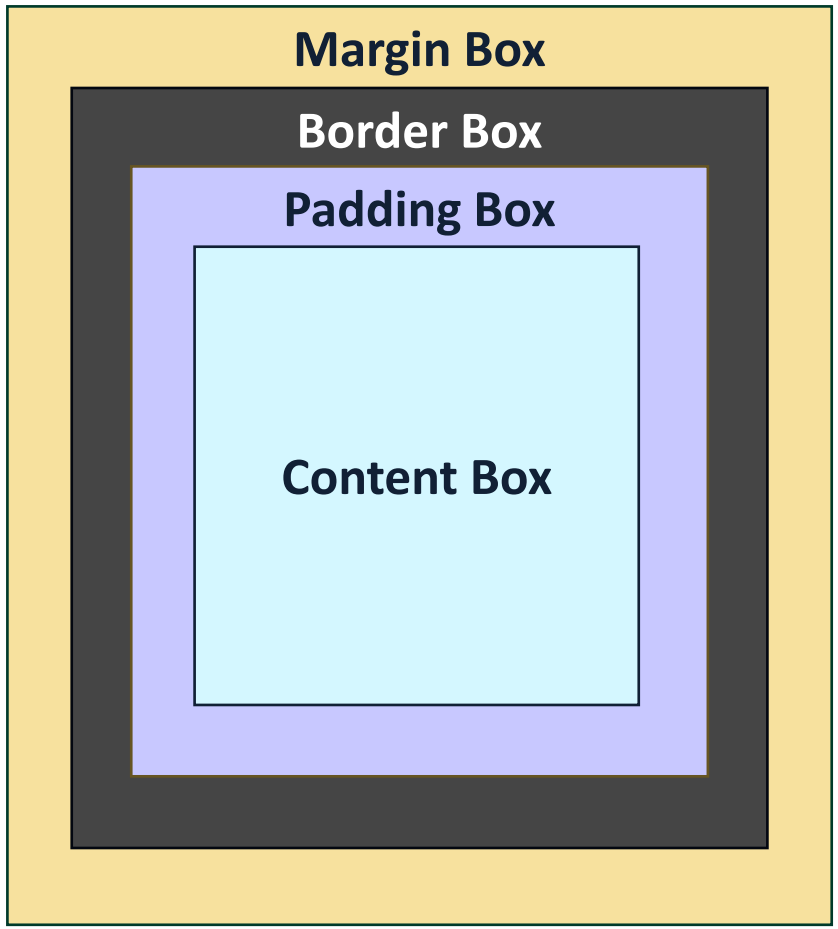


LAYOUTS

THE BOX MODEL

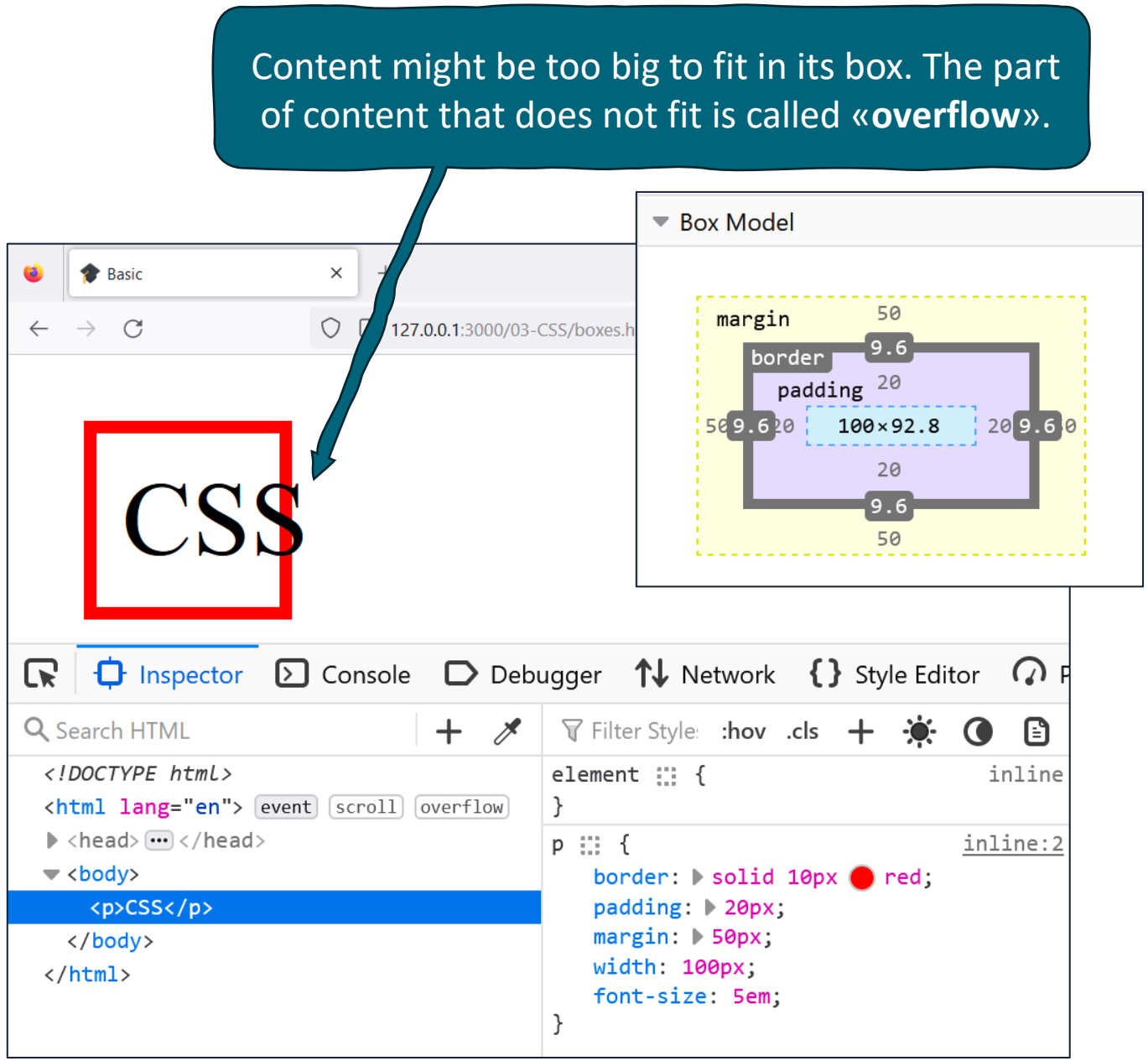
- **Every HTML element** is a **box**
- Boxes are made up of distinct areas

- **Content box** is where the children of the element live
- **Padding** («inner spacing») separates the content box from the border
- **Border** is the boundary of elements
- **Margin** creates space around elements



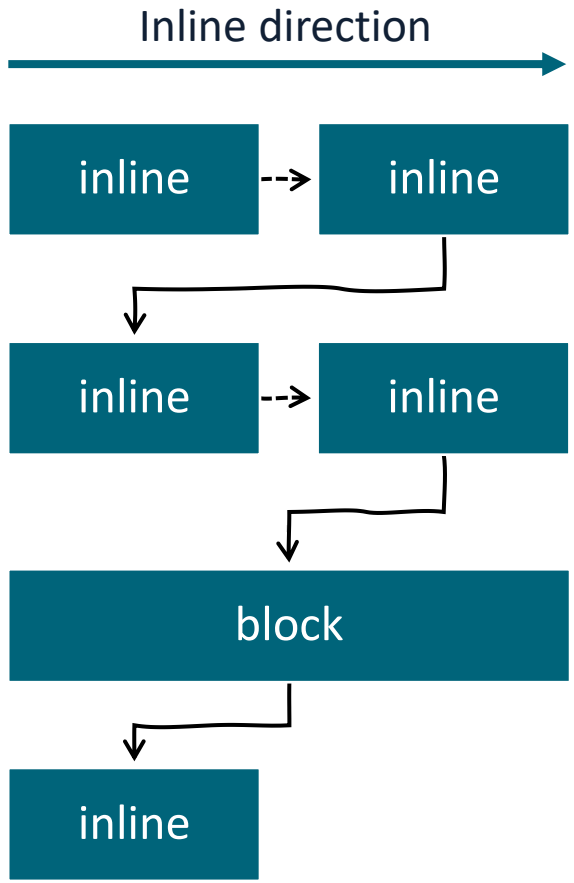
THE BOX MODEL

- The size of each area can be defined using CSS declarations
- The behaviour and appearence of boxes is determined by their:
  - **Layout mode**
  - **Content**
  - **Box model properties**



CSS FLOW LAYOUT

- By default, boxes are displayed using the **flow layout** (a.k.a. **normal flow**)
- **Inline** elements display in the inline direction
- **Block** elements display one after another

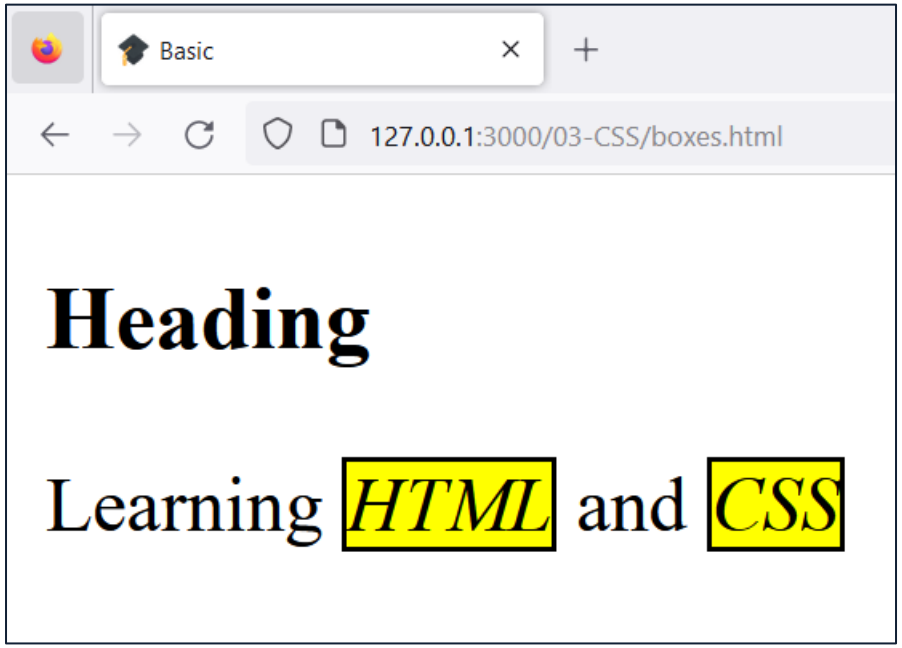


THE DISPLAY PROPERTY: INLINE

- `display: inline` positions the box next to the previous one in the inline direction, like words in a sentence
- Anchors **<a>**, **** and **** are typically displayed inline in default user agent styles

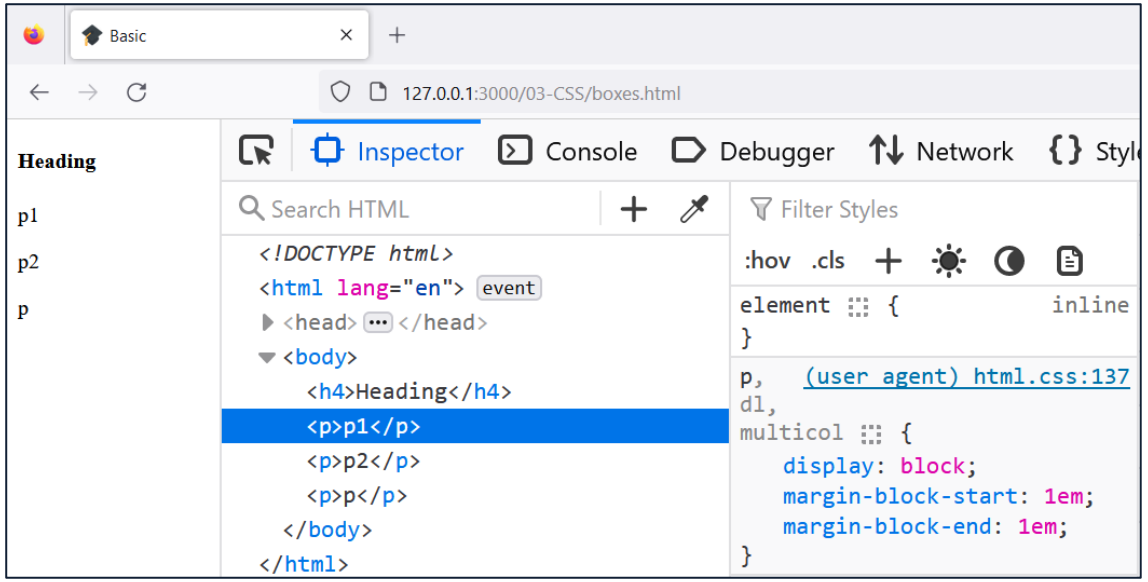
```
em {
  display: inline; /* default */
  background: yellow; border: 1px solid;
  width: 50px; height: 50px; /* ignored */
}
```

```
<h3>Heading</h3>
<p>
  Learning <em>HTML</em> and <em>CSS</em>
</p>
```

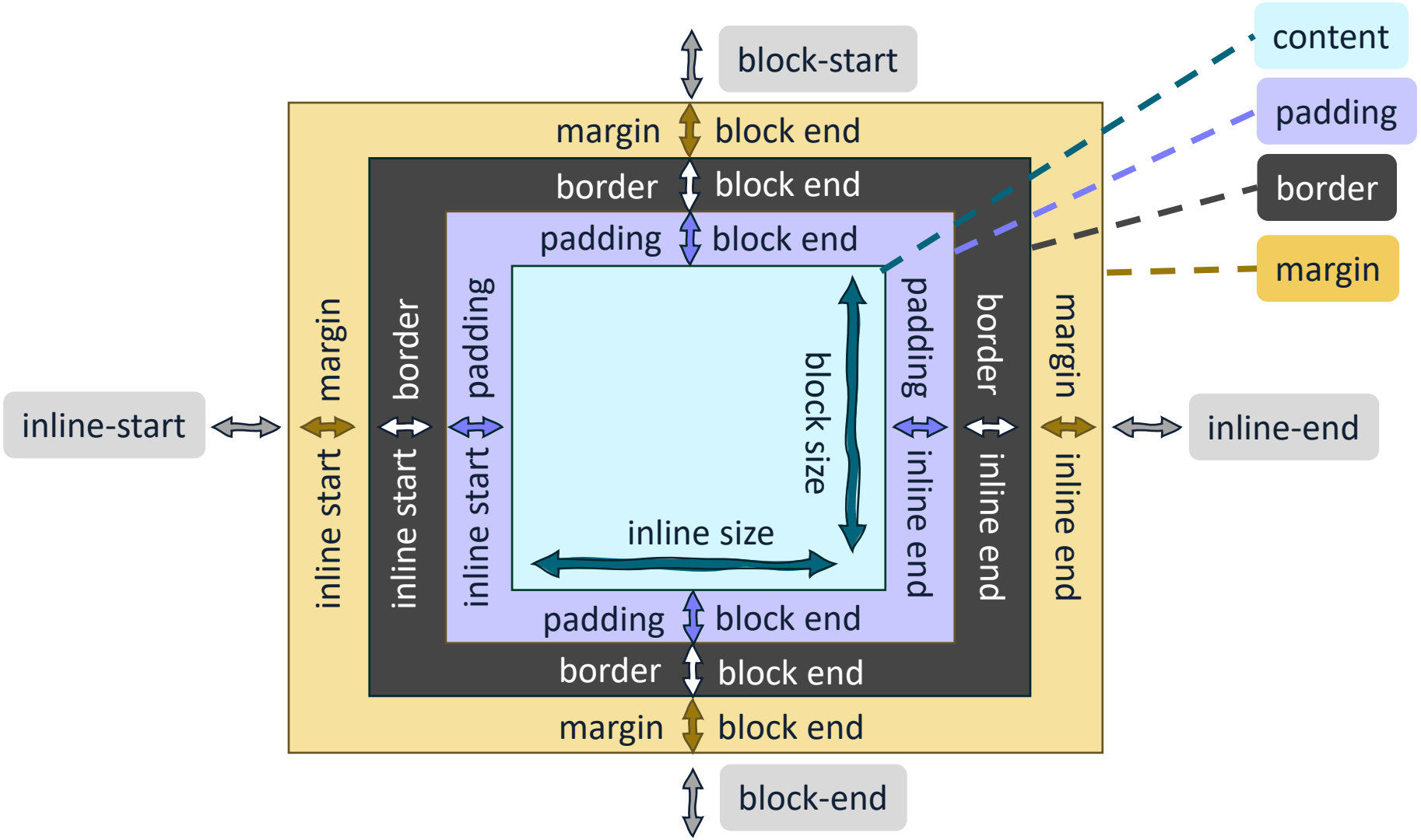


THE DISPLAY PROPERTY: BLOCK

- `display: block` positions the box on a **new**, **dedicated** line
- Paragraphs **<p>** and headings **<hx>** are typically displayed as blocks in default user agent styles
- Unless specified otherwise, blocks expand to the **entire size** of the inline dimension



THE BOX MODEL

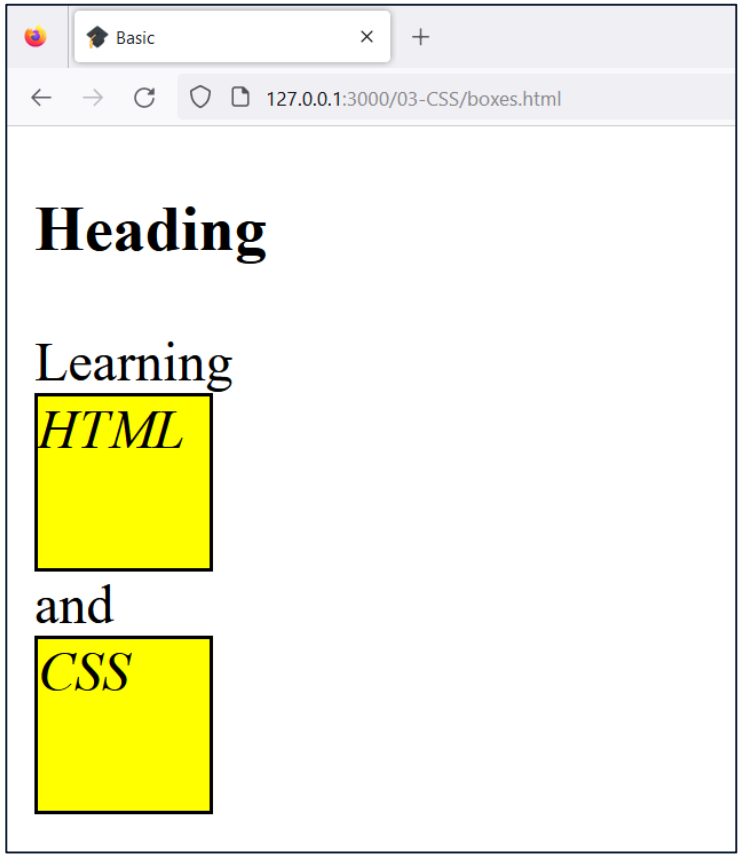


THE DISPLAY PROPERTY: INLINE VS BLOCK

- What happens if we use display `display: block` on the ****s?

```
em {
  display: block;
  background: yellow;
  border: 1px solid;
  width: 50px; height: 50px;
}
```

```
<h3>Heading</h3>
<p>
  Learning <em>HTML</em> and <em>CSS</em>
</p>
```

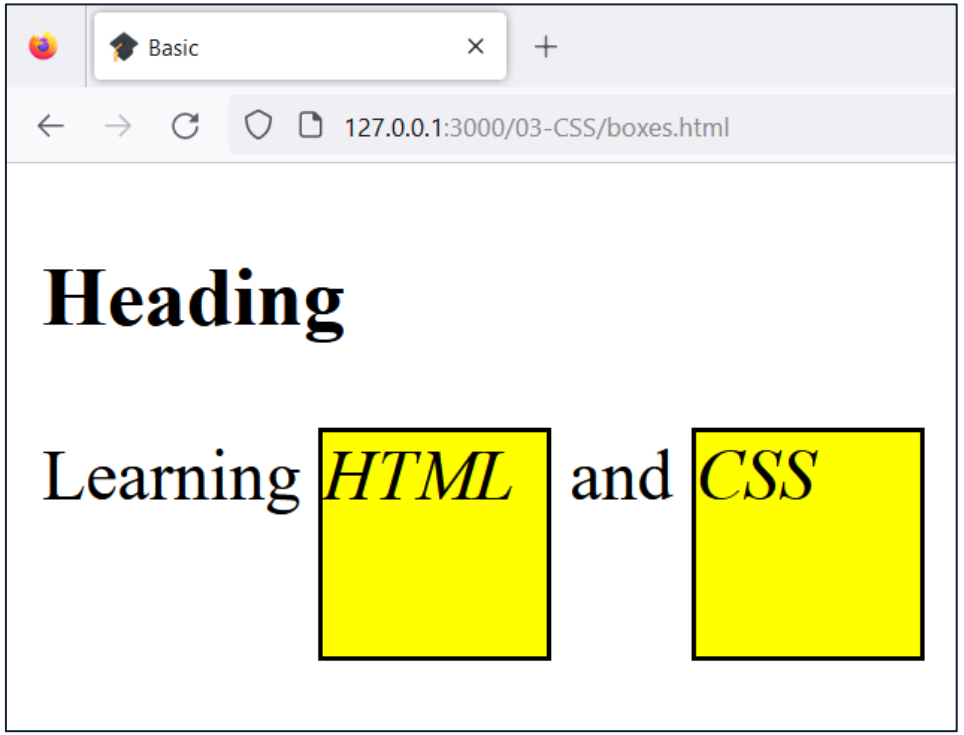


THE DISPLAY PROPERTY: INLINE–BLOCK

- `display: inline-block` is the same as `inline`, but allows also to set a `width` and a `height`

```
em {
  display: inline-block;
  background: yellow;
  border: 1px solid;
  width: 50px; height: 50px;
}
```

```
<h3>Heading</h3>
<p>
  Learning <em>HTML</em> and <em>CSS</em>
</p>
```

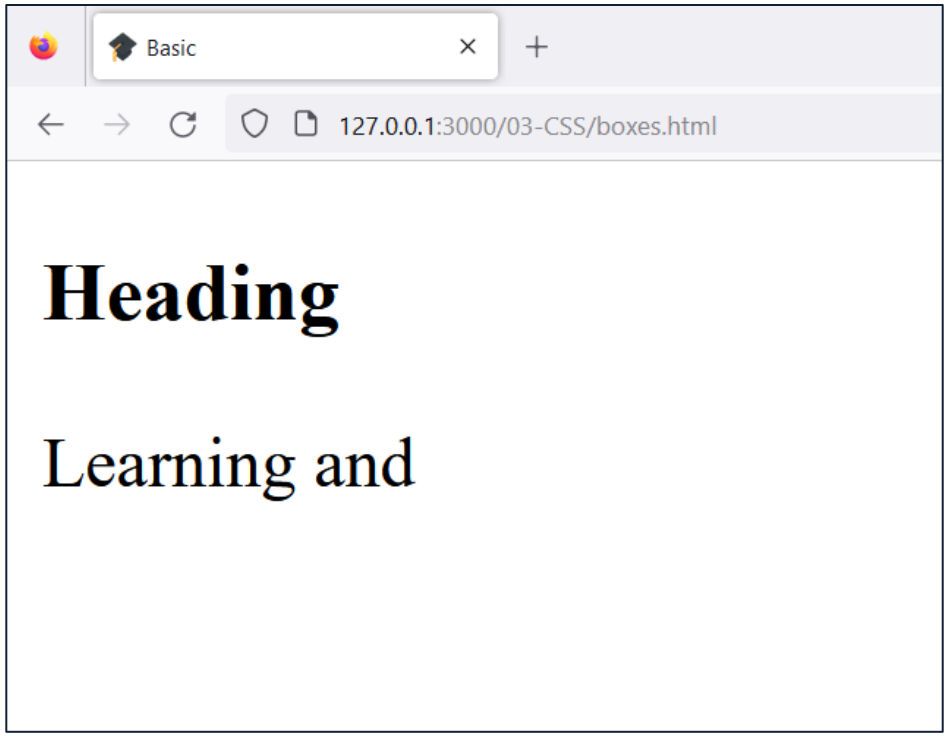


THE DISPLAY PROPERTY: NONE

- `display: none` can be used to completely **remove** the element from the visualization

```
em {
  display: none;
  background: yellow;
  border: 1px solid;
  width: 50px; height: 50px;
}
```

```
<h3>Heading</h3>
<p>
  Learning <em>HTML</em> and <em>CSS</em>
</p>
```

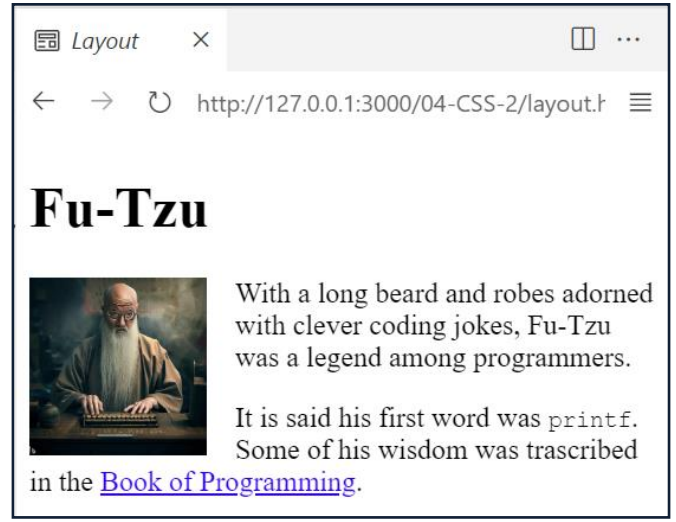


FLOATS

The **float** property can be used to make elements «float» in the given direction, and have subsequent sibling elements **wrap** around it

```
<h1>Fu-Tzu</h1>
<img src="pic.jpg">
<p>With a long beard and robes adorned with clever
coding jokes, Fu-Tzu was a legend among programmers.</p>
<p>It is said his first word was <code>printf</code>.
Some of his wisdom was trascribed in the
<a href="index.html">Book of Programming</a>.</p>
```

```
img {
  width: 20vw; min-width: 100px;
  float: left; margin-right: 1rem;
}
```

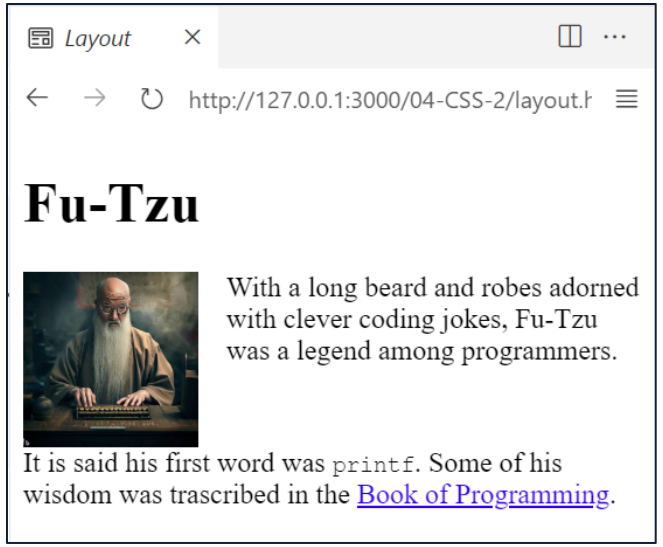


FLOATS

The **clear** property can be used to prevent a subsequent sibling to **wrap** around a floating element

```
<h1>Fu-Tzu</h1>
<img src="pic.jpg">
<p>With a long beard and robes adorned with clever
coding jokes, Fu-Tzu was a legend among programmers.</p>
<p>It is said his first word was <code>printf</code>.
Some of his wisdom was trascribed in the
<a href="index.html">Book of Programming</a>.</p>
```

```
img {
  width: 20vw; min-width: 100px;
  float: left; margin-right: 1rem;
}
p+p { clear: both; }
```



POSITIONING

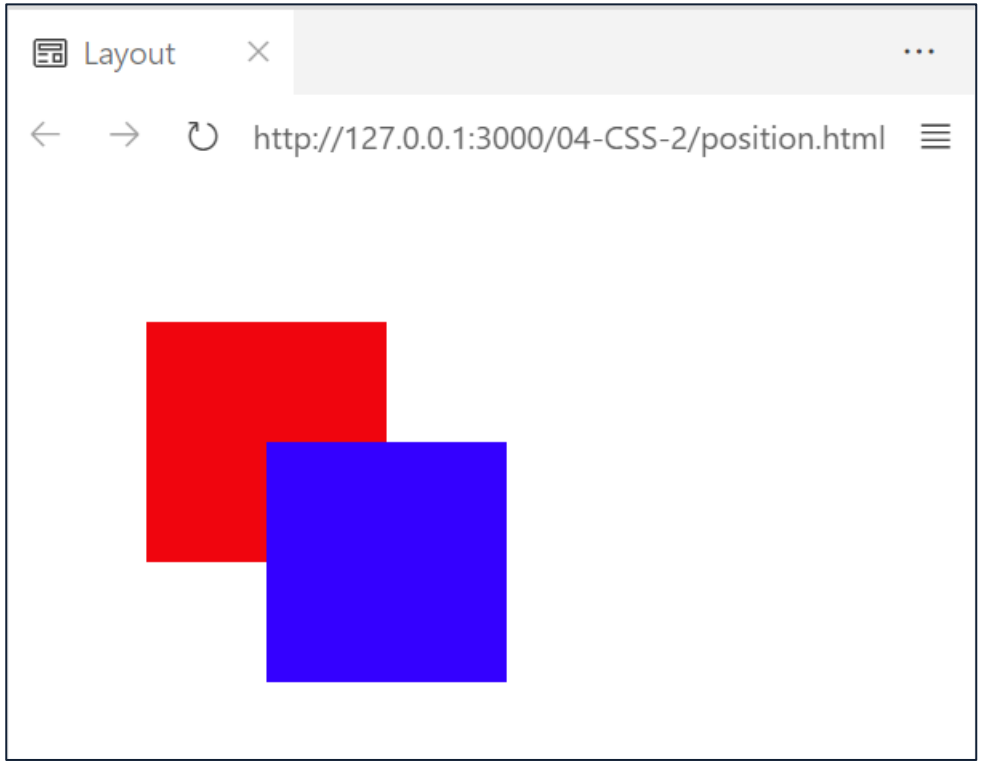
- The **position** property changes the way an element behaves in the normal flow of the document.
- The default value for the property is **static**
- Other possible values are:
  - **relative**
  - **absolute**
  - **fixed**
  - **sticky**

POSITION: RELATIVE

- Elements with **position: relative** are positioned relative to their normal position

```
div {
  position: relative;
  top: 50px; left: 50px;
  background: red;
  width: 100px; height: 100px;
}
div div {
  background: blue;
}
```

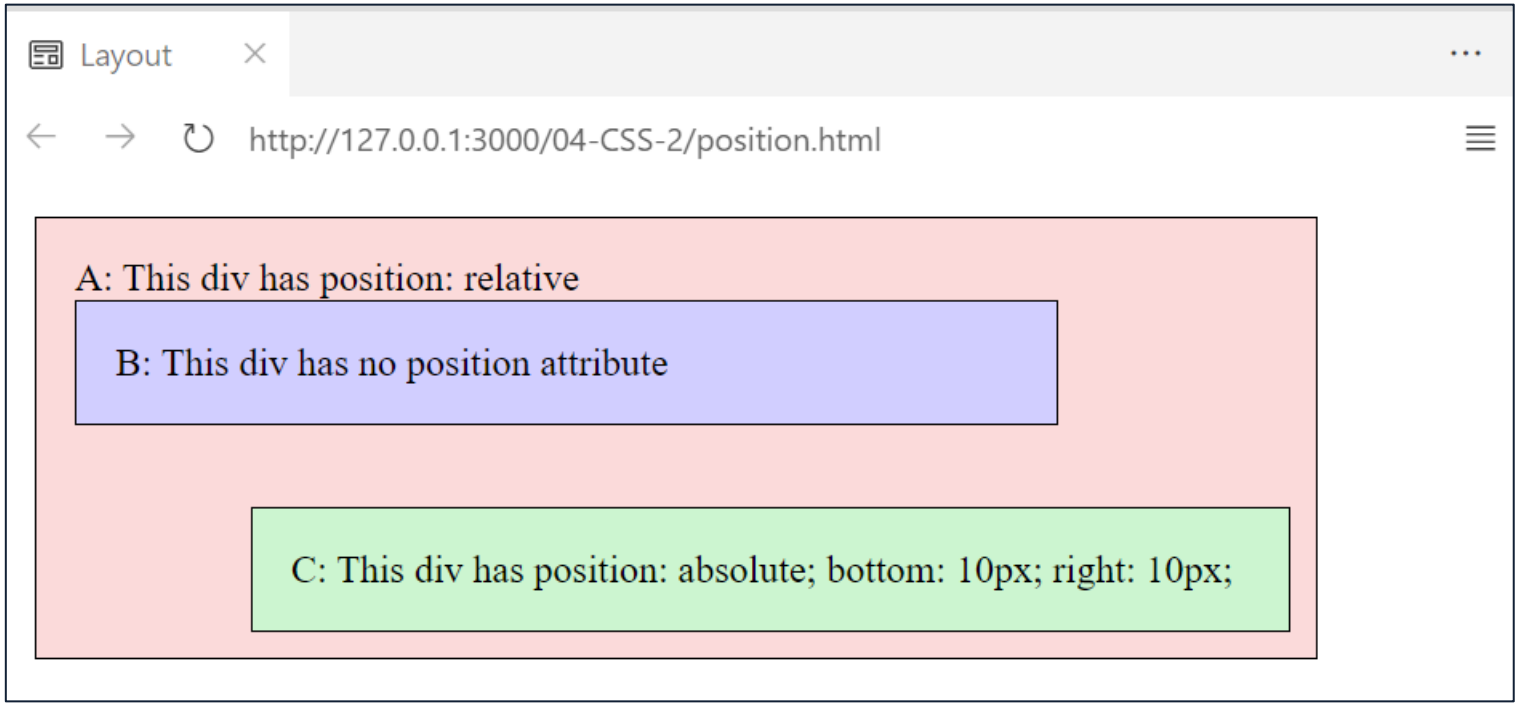
```
<div><div></div></div>
```



POSITION: ABSOLUTE

- Elements with **position: absolute** are positioned relative to their **nearest relative-positioned ancestor**

```
<div class="a">
  <!-- text -->
  <div class="b">
    <!-- text -->
    <div class="c">
      <!-- text -->
    </div>
  </div>
</div>
```

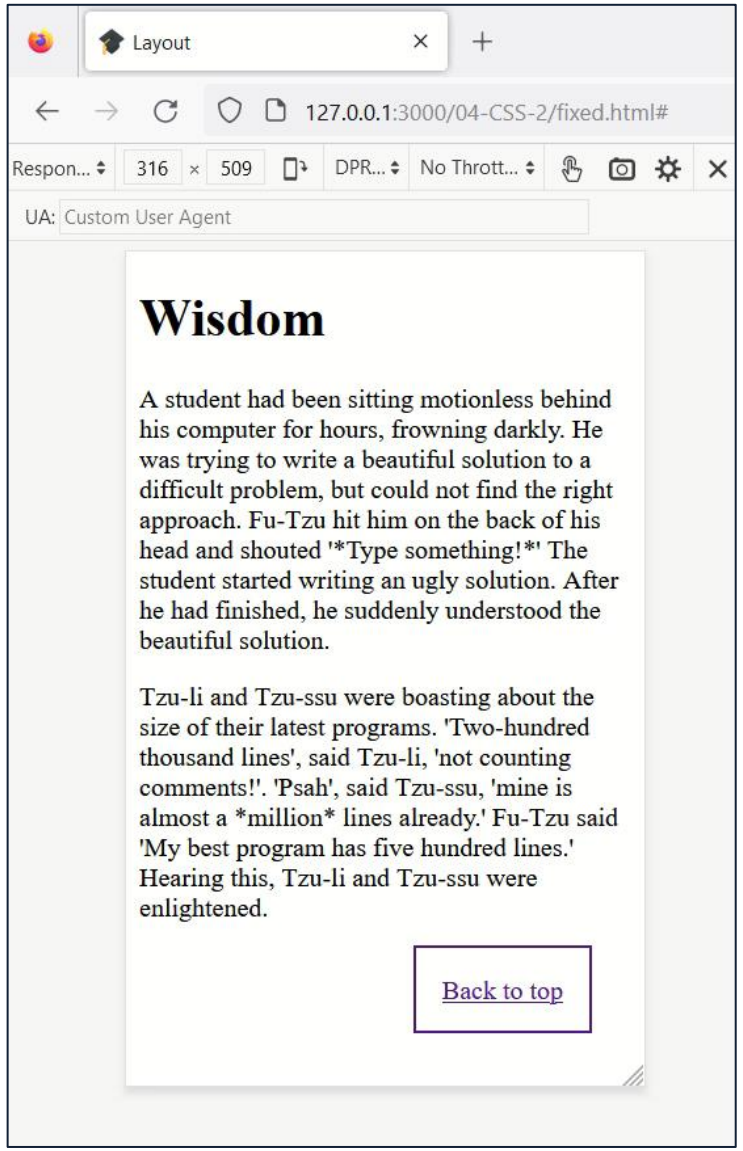


POSITION: FIXED

- Elements with **position: fixed** are positioned relative to the viewport

```
<h1>Wisdom</h1>
<p><!-- text --></p>
<p><!-- text --></p>
<a href="#">Back to top</a>
```

```
a {
  position: fixed;
  bottom: 2rem; right: 2rem;
  background-color: white;
  border:2px solid;
  padding: 1em;
}
```

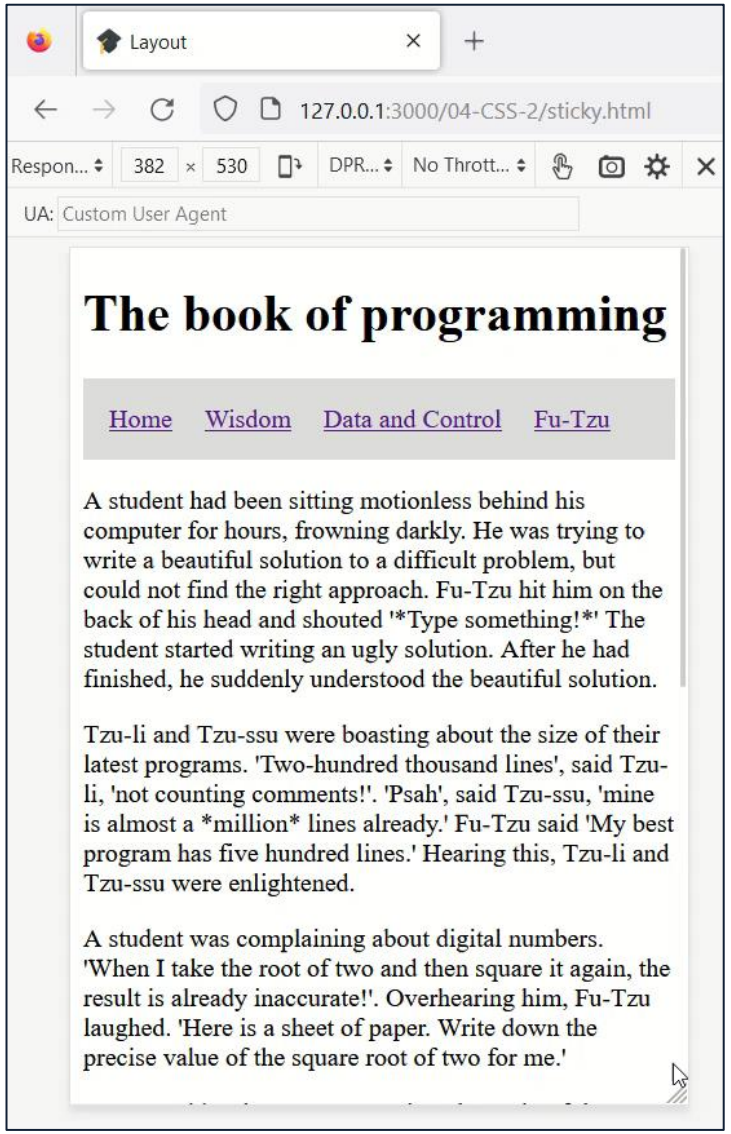


POSITION: STICKY

- Elements with **position: sticky** are positioned based on the user's scroll position
- Sort of a relative/fixed hybrid
  - Relative until it crosses a threshold
  - Fixed until it reaches the boundary of its parent

```
<h1>The book of programming</h1>
<nav><!-- links --></nav>
<p><!-- text --></p><p><!-- text --></p>
```

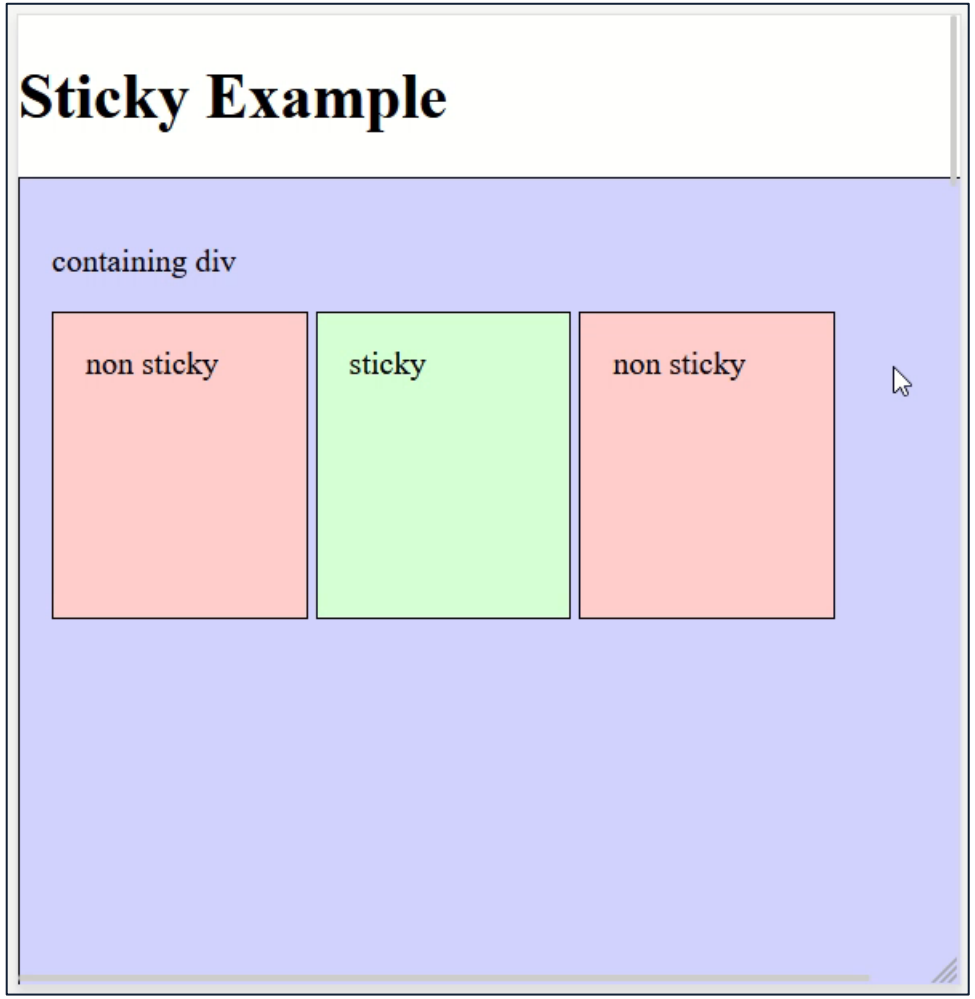
```
nav {
  padding: 1em; background: gainsboro;
  position: sticky; top: 0px;
}
nav a { padding-right: 1em; }
```



POSITION: STICKY

```
<div class="container">
  <p>containing div</p>
  <div class="item"></div>
  <div class="item sticky"></div>
  <div class="item"></div>
</div>
```

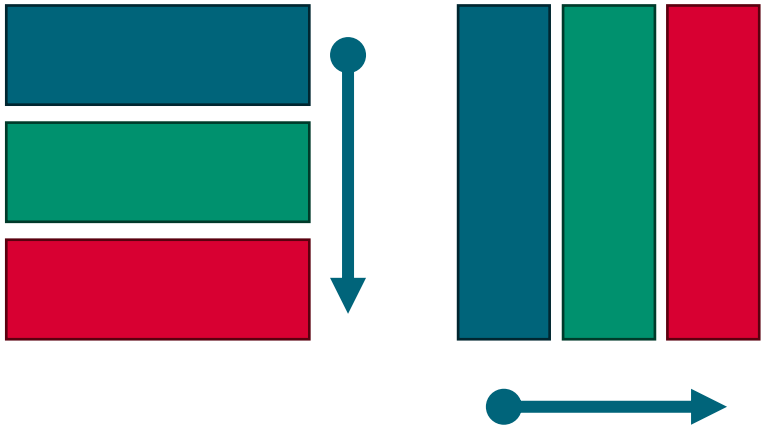
```
.sticky {
  position: sticky;
  top: 10px;
  background: rgb(212, 255, 212);
}
```



MODERN CSS LAYOUTS: FLEX AND GRID

Modern CSS features two additional layout mechanisms in addition to the normal flow: **Flexbox** and **Grid**

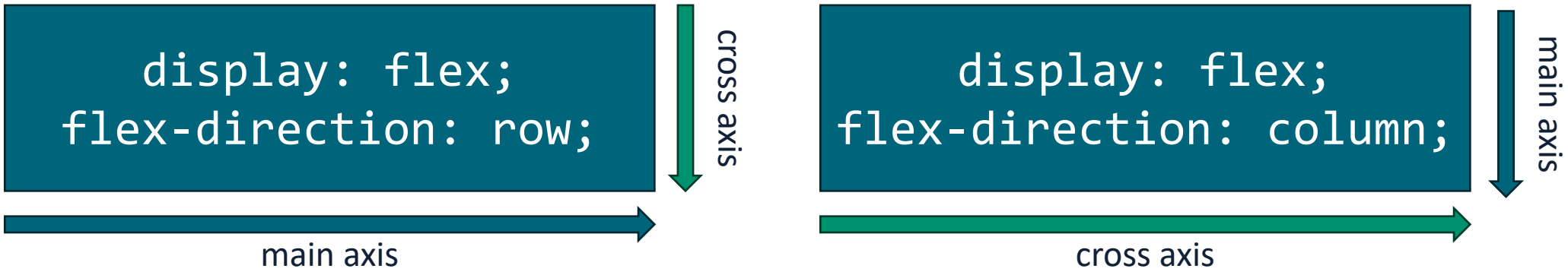
- **Flexbox** is designed for **one-dimensional layouts** (either horizontal or vertical)
- **Grid** is designed for **two-dimensional layouts**



FLEXBOX: FLEX CONTAINERS

Flex containers are declared using the **display: flex** property

- They are **block-level** elements, with **flex item** children
- Each flex container has a **main** and a **cross axis**
- The main axis is set using the **flex-direction** property (default is row)
- The cross axis is orthogonal to the main one

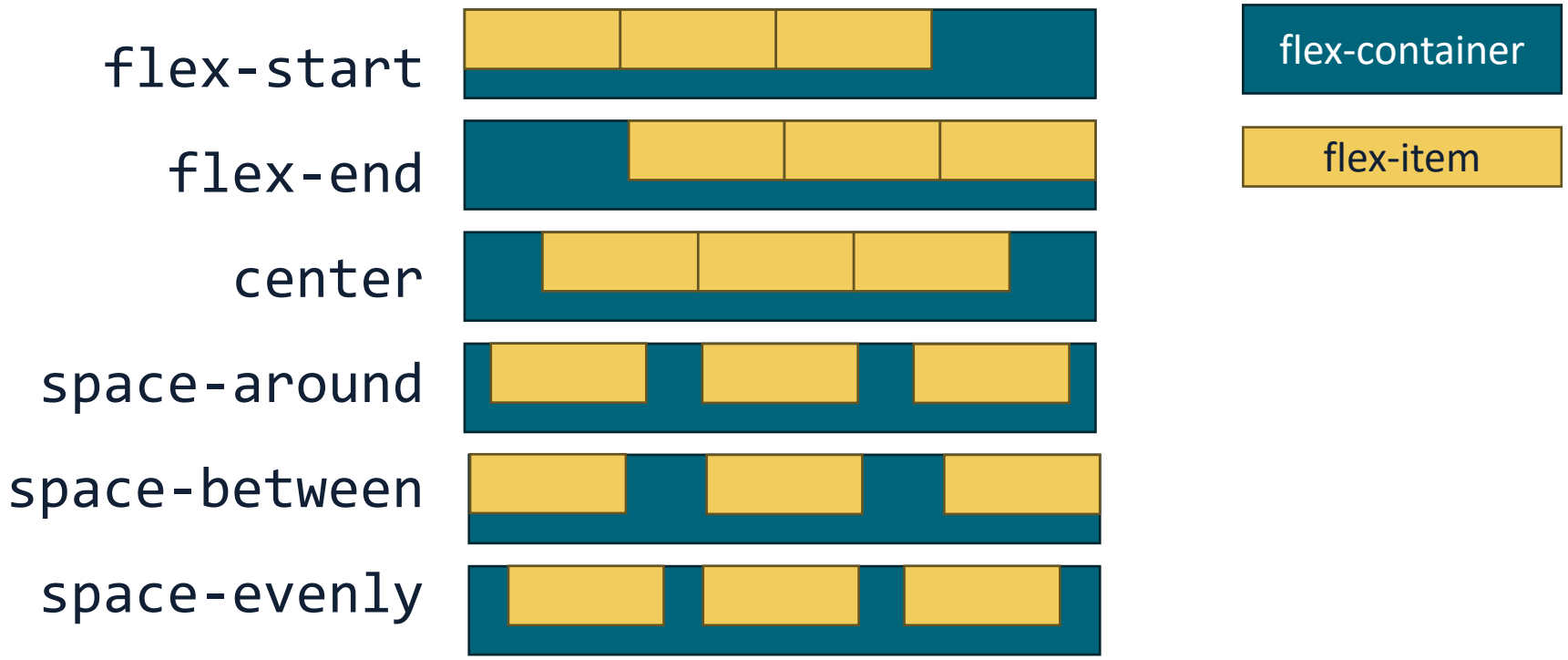


FLEXBOX: FLEX ITEMS

- The children of the flex container are converted to **flex items**
  - Support **flex** properties, to specify how they behave in the flex container
- They are placed along the main axis
- Setting **flex-grow** on a flex item makes it expand to all the available space in the main axis.
- Setting **flex-shrink** can be used to control whether the flex item can reduce its base size along the main axis to fit in the flex container.
- Overflows are possible, and can be controlled using the **flex-wrap** property on the flex container.

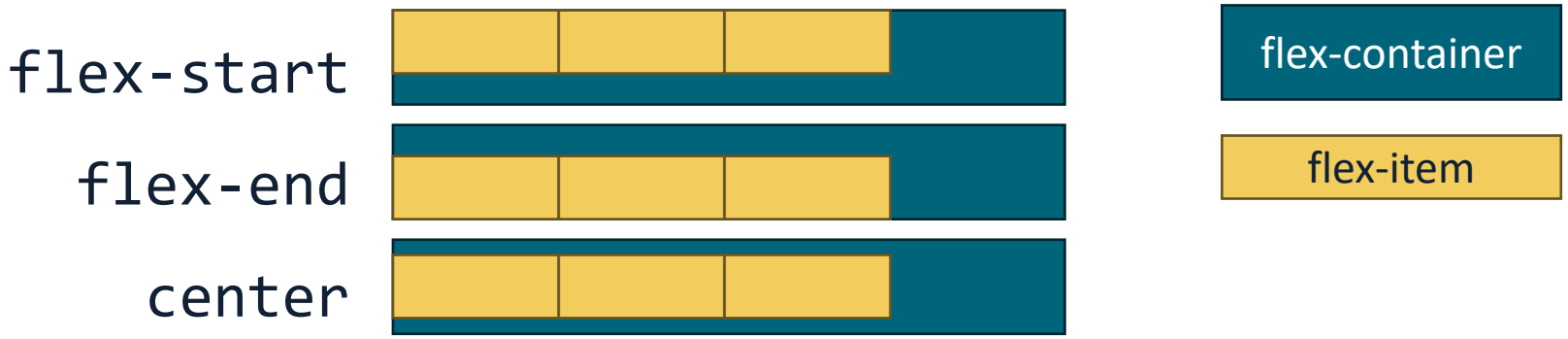
FLEXBOX: JUSTIFY–CONTENT

The **justify-content** flex container property specifies how the **free space** along the main axis is to be managed. Possible values include:



FLEXBOX: ALIGN–CONTENT

The **align-content** flex container property specifies how the **free space** along the cross axis is to be managed. Possible values include:



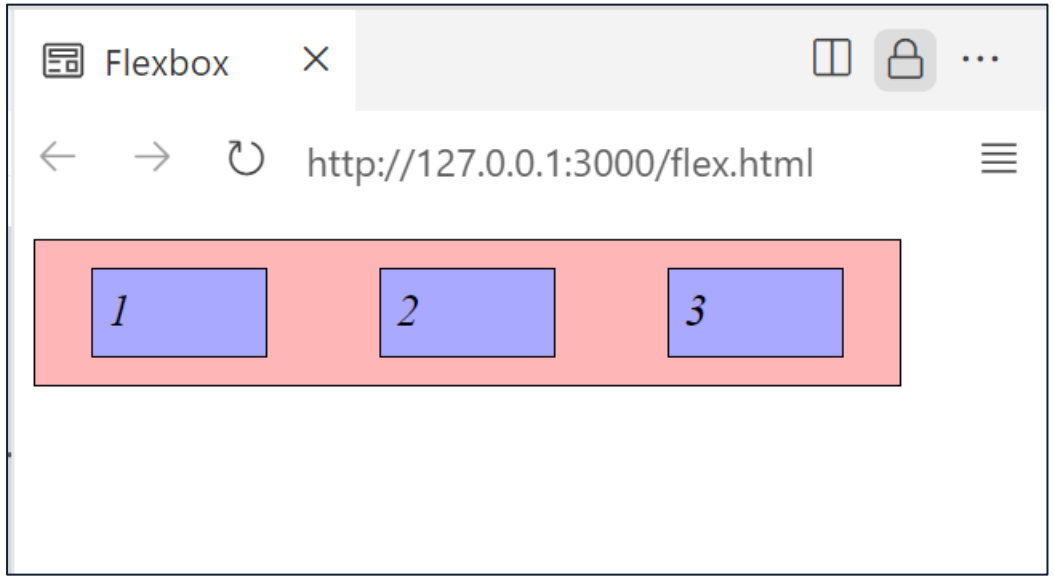
https://flexbox.help/ is useful to visualize and practice with these properties

FLEXBOX: EXAMPLE

```css
.container {
  width: 300px;
  height: 50px;
  background: rgb(255, 182, 182);
  display: flex;
  justify-content: space-around;
  align-items: center;
}

.item {
  height: 20px; width: 50px;
  padding: 5px;
  background: rgb(169, 169, 255);
}
```

```html
<div class="container">
  <div class="item special"><em>1</em></div>
  <div class="item "><em>2</em></div>
  <div class="item"><em>3</em></div>
</div>
```



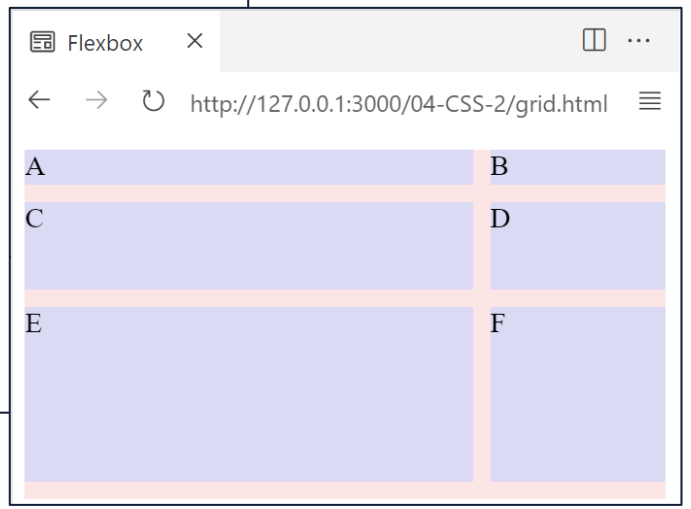
GRID

Grid is a **two-dimensional** layout, based on **rows** and **columns**

- Grid containers are declared using the **display: grid** property
  - The direct **children** of grid containers are **grid items**.
  - Containers define **number** and **size** of their rows and columns

```
.container {
  display: grid;
  /* two columns */
  grid-template-columns: 1fr 100px;
  /* three rows */
  grid-template-rows: 20px 50px 100px;
  gap: 10px;
}
```

```
<div class="container">
  <div>A</div>
  <div>B</div>
  <div>C</div>
  <div>D</div>
  <div>E</div>
  <div>F</div>
</div>
```



GRID: THE FR UNIT

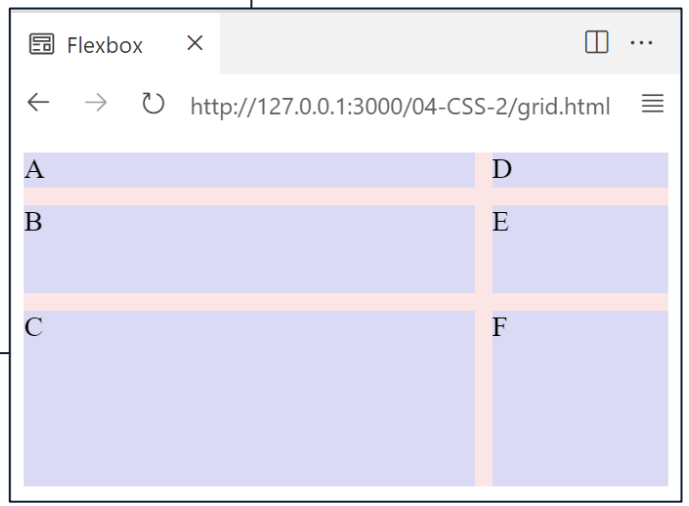
- The **fr** unit is a specialized relative unit that works only in grid layouts
- It represents a flexible length corresponding to a share of the available space
- It works similarly to the flex property
- For example, **grid-template-columns: 1fr 1fr 1fr;** defines three columns which all get the same share of the available space.

GRID: PLACEMENT OF GRID–ITEMS

- By default, grid items are placed along the rows
- It is possible to place items along columns using the **grid-auto-flow: column** property

```
.container {
  display: grid;
  /* two columns */
  grid-template-columns: 1fr 100px;
  /* three rows */
  grid-template-rows: 20px 50px 100px;
  grid-auto-flow: column;
  gap: 10px;
}
```

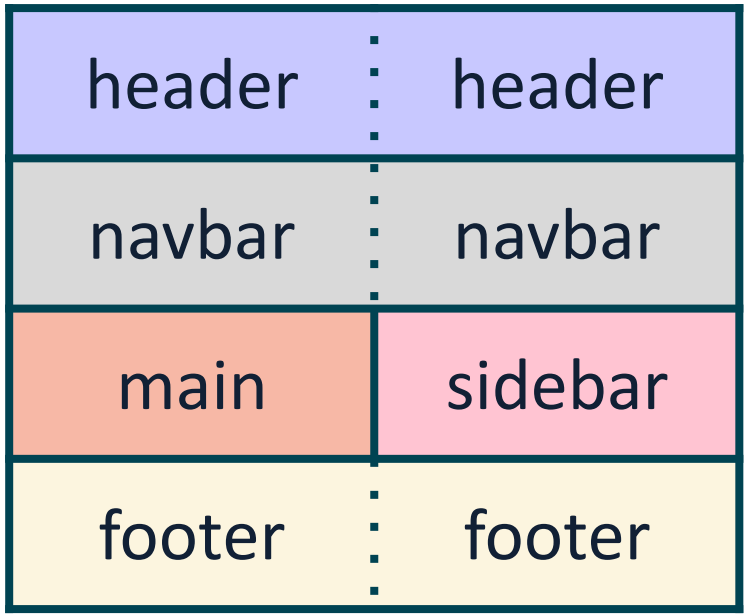
```
<div class="container">
  <div>A</div>
  <div>B</div>
  <div>C</div>
  <div>D</div>
  <div>E</div>
  <div>F</div>
</div>
```



GRID: TEMPLATE AREAS

- It is also possible to assign a name to **areas** (set of cells) of the grid
- And to place grid items in a given area using the **grid-area** property

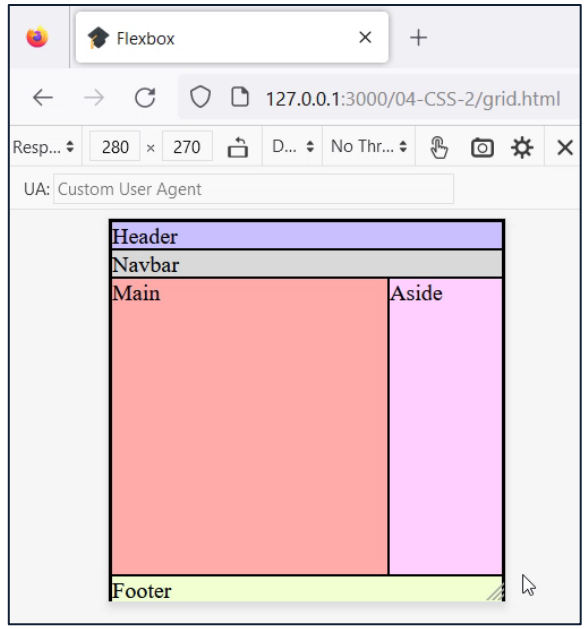
```
display: grid;
grid-template-columns: 70vw 1fr;
grid-template-rows: auto auto 1fr auto;
grid-template-areas:
  "header header"
  "navbar navbar"
  "main   sidebar"
  "footer footer";
height: 100vh;
margin: 0;
```



GRID: USING TEMPLATE AREAS

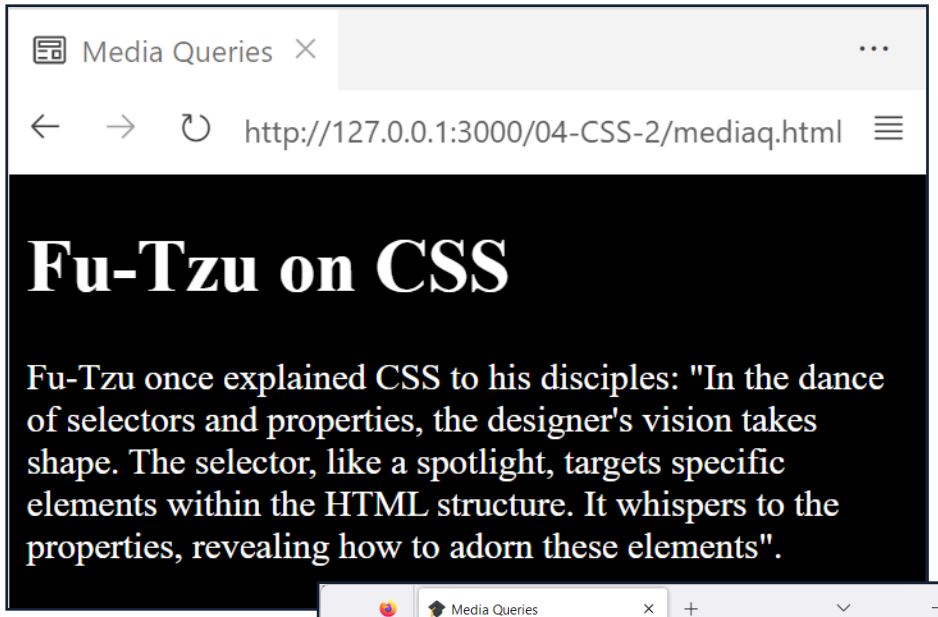
```css
* {border: 1px solid black;}
body {
  display: grid;
  grid-template-columns: 70vw 1fr;
  grid-template-rows: auto auto 1fr auto;
  grid-template-areas:
    "header header"
    "navbar navbar"
    "main   sidebar"
    "footer footer";
  height: 100vh; margin: 0;
} /* background colors omitted */
header { grid-area: header;}
nav { grid-area: navbar;}
main { grid-area: main;}
aside { grid-area: sidebar;}
footer { grid-area: footer;}
```

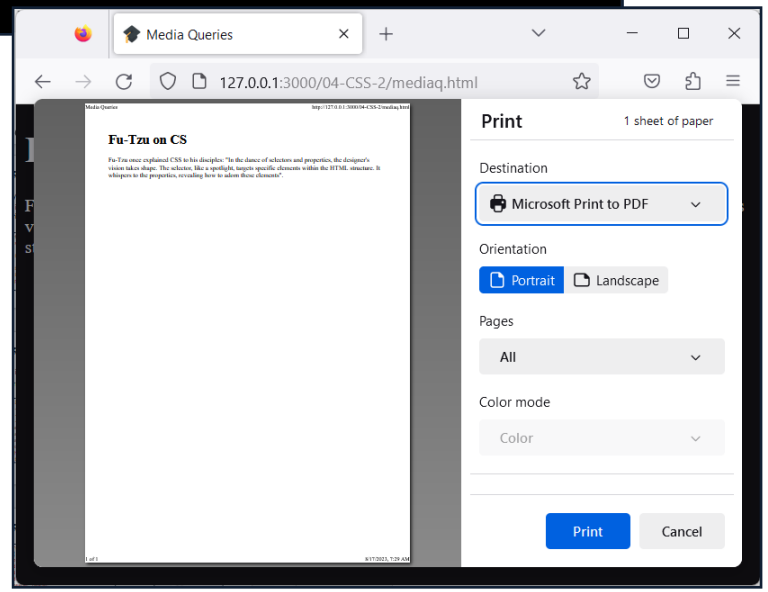
```html
<body>
  <header>Header</header>
  <nav>Navbar</nav>
  <main>Main</main><aside>Aside</aside>
  <footer>Footer</footer>
</body>
```



MEDIA QUERIES

- Media queries can apply certain CSS styles only when the **device** which is viewing the content has **specific characteristics**
- Media queries are initiated with the **@media** keyword






```
body {color: white; background: black;}
@media print {
  body {
    color: black; background: transparent;
  }
}
```

MEDIA QUERIES: TYPES OF OUTPUT

Modern CSS supports three output (media) types in media queries:

- **print** intended for paged materials and documents viewed on a screen in print preview mode
- **screen** intended for devices that visualize the document on a screen
- **all** applies to all output devices

MEDIA QUERIES: MEDIA FEATURES

- Media queries can also test for specific characteristics of the user-agent, output device, or environment.
  - These are called «Media Features» (reference here)
- The full syntax of a media query is as follows

```
@media media_type and (media_feature: value) and ...
```

- If **`media_type`** is omitted, **`all`** is used by default
- Media features need to be enclosed in parentheses, and are optional

MEDIA QUERIES: EXAMPLES

```
@media screen and (orientation: landscape) {
  h1::after {
    content: "Landscape";
  }
}

@media screen and (orientation: portrait) {
  h1::after {
    content: "Portrait";
  }
}
```

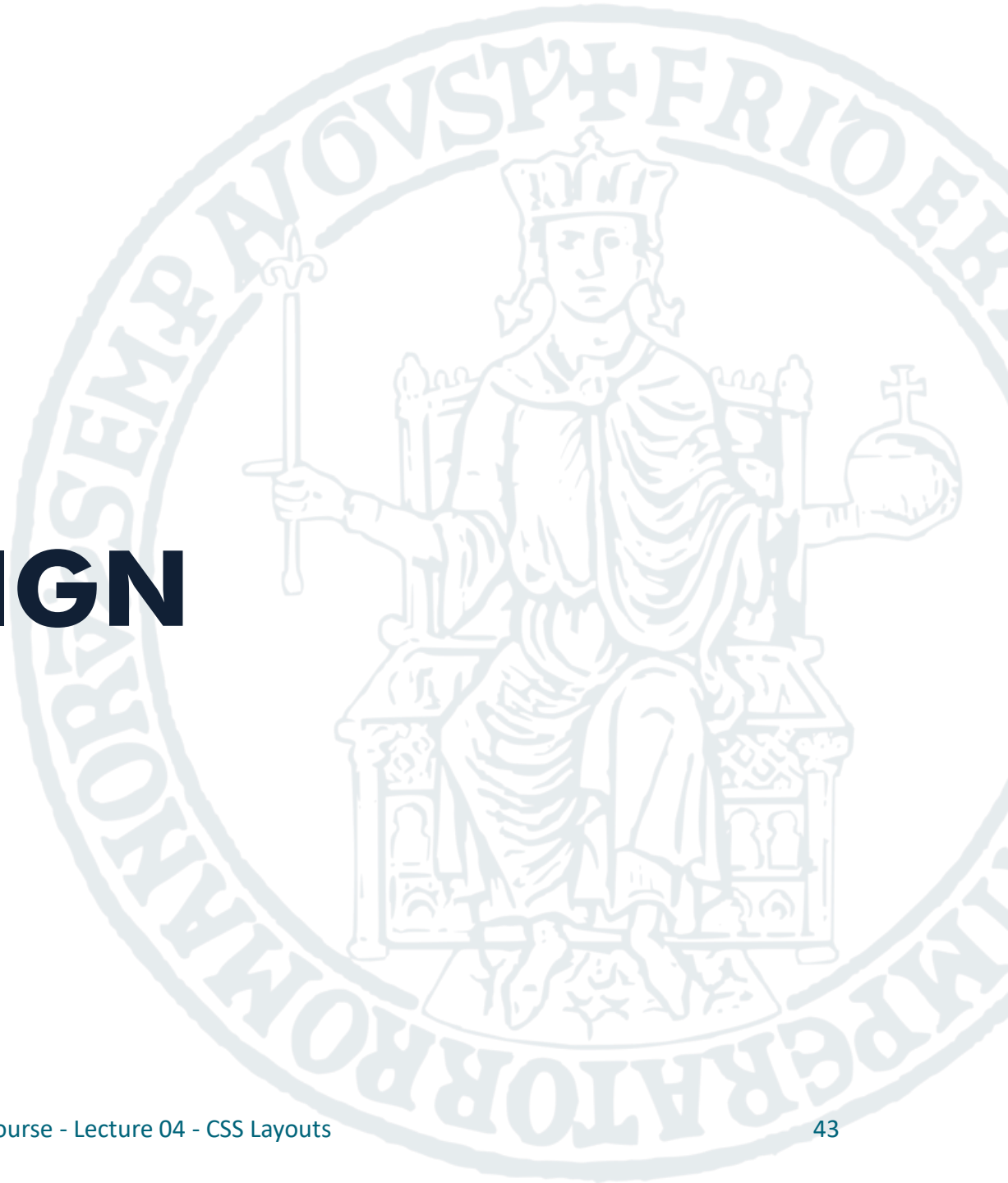
```
<body><h1></h1></body>
```

MEDIA QUERIES: EXAMPLES

```
@media (max-width: 600px) {
  h1::after {content: "XSmall";}
}
@media (min-width: 600px) {
  h1::after {content: "Small";}
}
@media (min-width: 768px) {
  h1::after {content: "Medium";}
}
@media (min-width: 992px) {
  h1::after {content: "Large";}
}
@media (min-width: 1200px) {
  h1::after {content: "XLarge";}
}
```

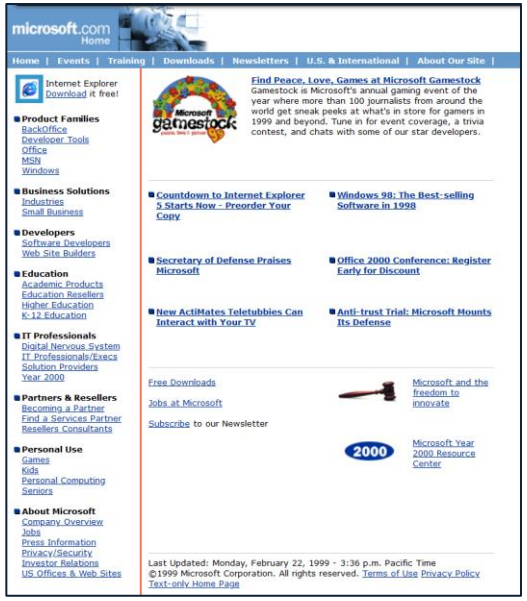
```
<body><h1></h1></body>
```

RESPONSIVE DESIGN



FIXED–WIDTH LAYOUTS

- In the late 1990s, most monitors were 640px wide and 480px tall
- In the early days of web design, it was a safe bet to design pages with a 640px width.

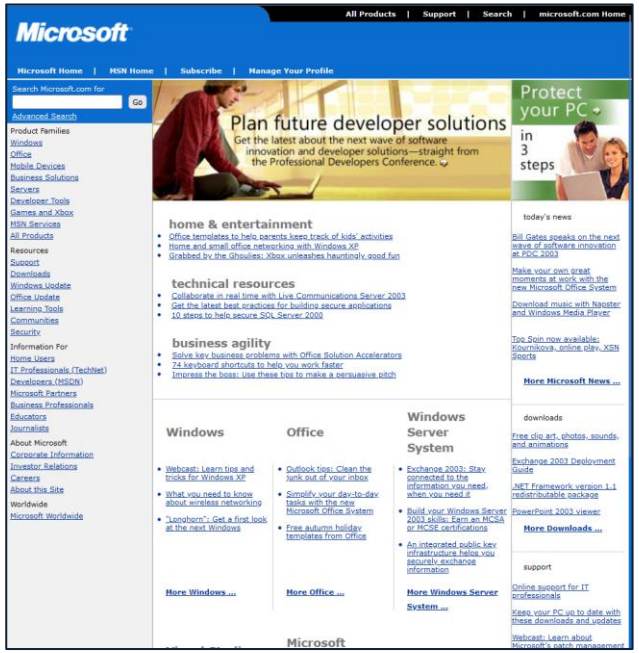


The Microsoft website, from 1999 (640px wide)

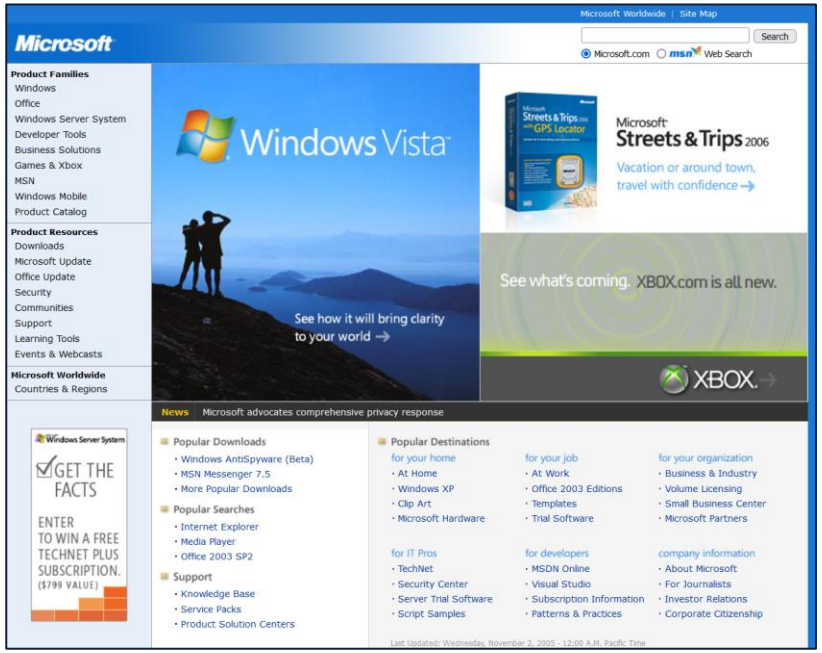
Illustration: Freepik.com

FIXED–WIDTH LAYOUTS

- Then the monitors started getting bigger…
- Most monitors became 800x600, then 1024x768, …
- Web designers updated their fixed-width design accordingly



The Microsoft website, from 2003 (800px)



The Microsoft website, from 2005 (1024px)

FIXED–WIDTH LAYOUTS

- Whether it is 640, 800, or 1024 pixels, working with a single specific width is called **fixed-width** design
- Fixed-width design will look good only at the considered width.
  - Smaller screens won't be able to see the entire page without horizontal scrolling

The Microsoft website, from 1999 (640px wide) on a 400px screen

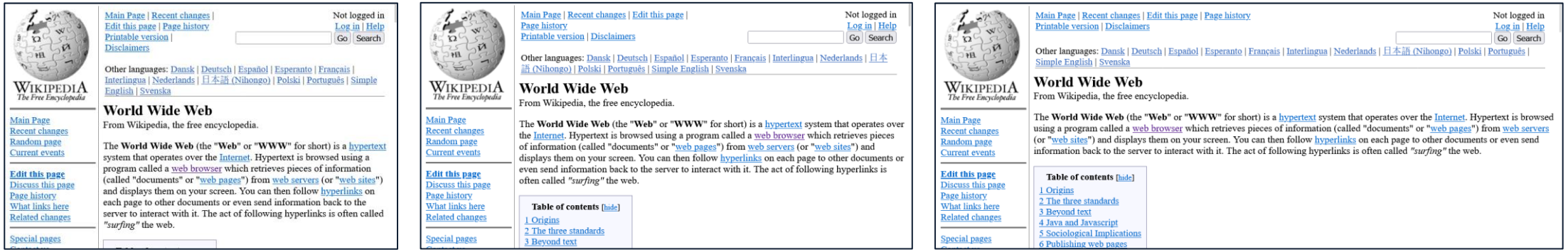
FIXED–WIDTH LAYOUTS

- Whether it is 640, 800, or 1024 pixels, working with a single specific width is called **fixed-width** design
- Fixed-width design will look good only at the considered width.
  - Smaller screens won't be able to see the entire page without horizontal scrolling
  - Larger screens will have a lot of (wasted) space

The Microsoft website, from 1999 (640px wide) on a QHD 2560px screen

LIQUID (FLUID) LAYOUTS

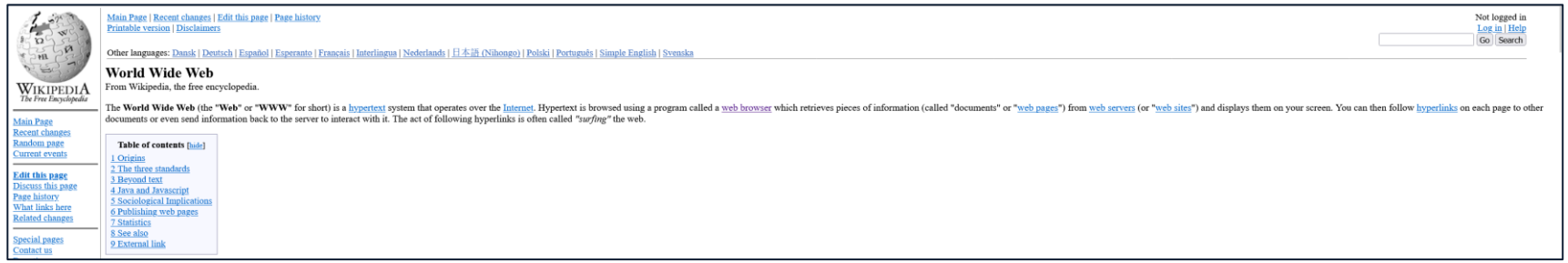
- While most web designers used fixed-width layouts, some made their layouts **more flexible**
- There was no flexbox, grid or media queries. They did that by using percentages as column widths. The layouts are called **liquid layouts**.
- The Wikipedia website did this

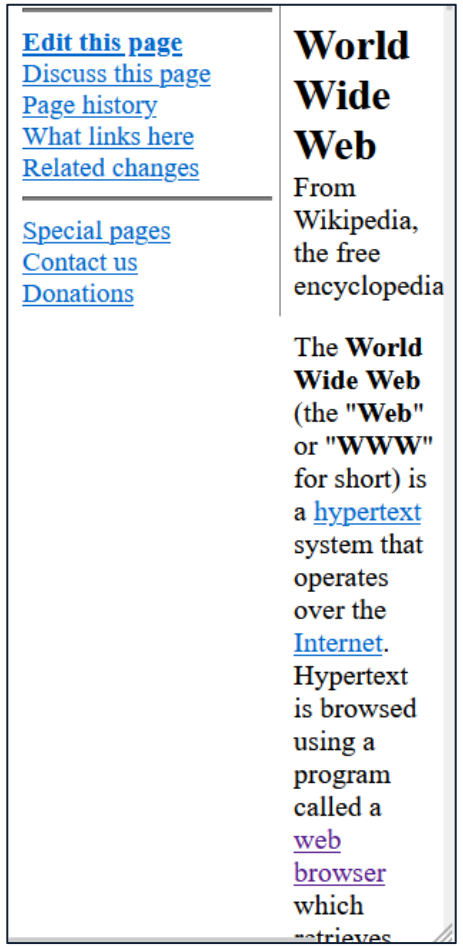


The Wikipedia website from 2004, viewed in a 640px, 800px, and 1024px screens

LIQUID (FLUID) LAYOUTS

- Liquid layouts looks good across a wide range of widths…
- … but begin to **worsen** at the **extremes**:
  - On a very wide screen, the layout will look **stretched**
  - On a very narrow one, the layout will look **squashed**



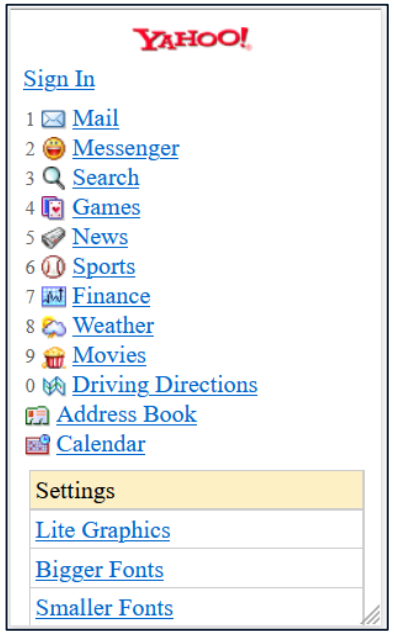


The Wikipedia website from 2004, viewed in a 2560px (left) and in a 250px (right) screens

SEPARATE WEBSITES

- Then, mobile devices arrived, with screens as small as 240px
  - Fixed-width and liquid layouts do not work well on those
- One option is to have a **separate website** for mobile devices

yahoo.com, 2006, on a 800px screen



wap.oa.yahoo.com, 2006, on a 240px screen

SEPARATE WEBSITES

- Typically leveraged user agent sniffing to redirect mobile users to the mobile version of the website, which was hosted in a subdomain.
- **Cons:**
  - UA sniffing is unreliable (might fail to redirect mobile users, and might wrongly redirect desktop users)
  - Each separate website needs to be maintained
  - Today, the distinction between mobile and non-mobile is blurred

- It would be nice to have a single website that renders differently depending on the characteristics of the viewing device…

ADAPTIVE LAYOUTS

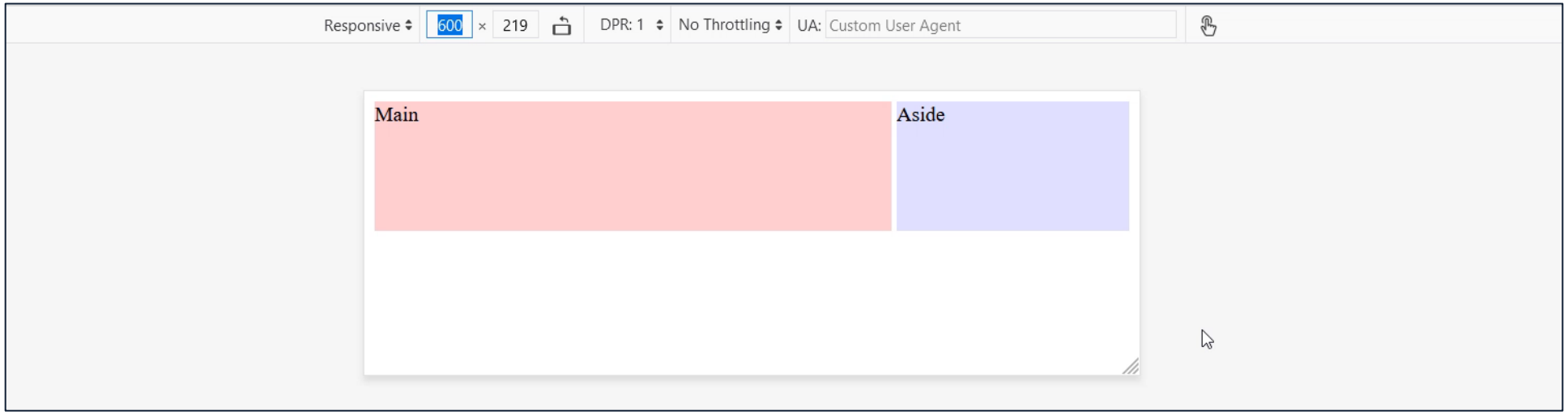
- With the introduction of CSS media queries (~2009), more flexible layouts were possible
- Initially, web designers were still most comfortable with fixed-widths layouts
- They designed websites that switched between a handful of fixed-widths designs using media queries.
- This approach is called **adaptive design**

ADAPTIVE LAYOUT: EXAMPLE

```
@media (max-width: 800px) {
  main  {width: 400px;}
  aside {width: 180px;}
}
@media (min-width: 800px) {
  main  {width: 500px;}
  aside {width: 280px;}
}
```

```
main {
  display: inline-block;
  height: 200px;
}
aside {
  display: inline-block;
  height: 200px;
}
```

```
<body>
<main>Main</main>
<aside>Aside</aside>
</body>
```



ADAPTIVE LAYOUTS

- Allow to style a single website that looks good at few different sizes
- Still, the design does not look quite right for any size in between the considered ones
- Users are shown the layout that is closest to the size of their browser.
- Due to the variety of device sizes, chances are most users will experience a layout that looks less than optimal.

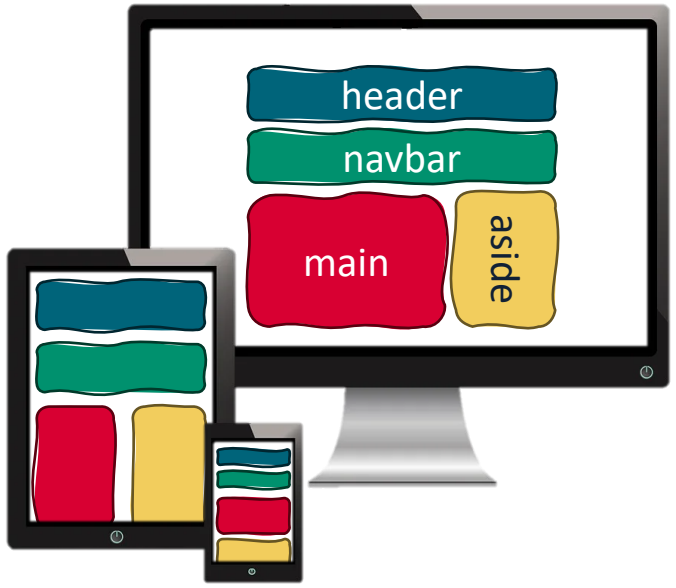
RESPONSIVE LAYOUTS

- Adaptive layouts are a mashup of media queries + fixed-width layouts
- **Responsive layouts are a mashup of media queries + liquid layouts**
- The term was coined by Ethan Marcotte in an article in 2010

Responsive design is characterized by:

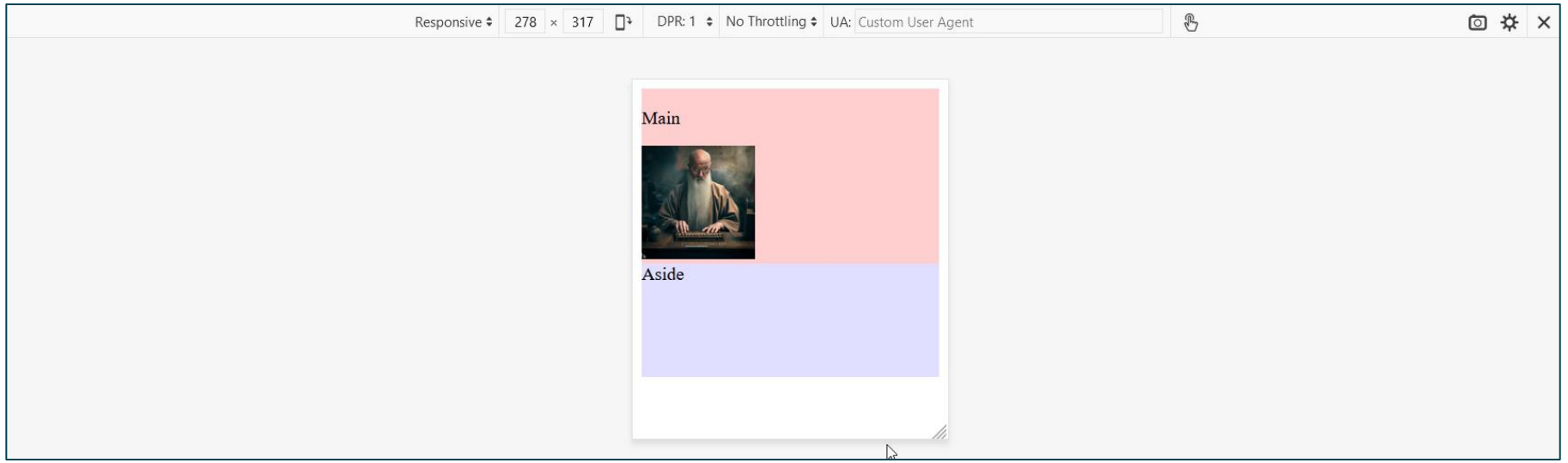
- Fluid containers
- Fluid media
- Media Queries

Layout and images of a responsive site should look good on **any** device



RESPONSIVE LAYOUT: EXAMPLE

```
body {  display: flex; justify-content: center; flex-wrap: wrap; }
@media (max-width: 600px){ main {width: 100%;} aside {width: 100%;}}
@media (min-width: 600px){ main {width: 60%;}  aside {width: 40%;}}
@media (min-width: 768px){ main {width: 70%;}  aside {width: 20%;}}
main  {display: inline-block;}
aside {display: inline-block; min-height: 100px;}
img   {width: 20%; min-width: 100px;}
```



RESPONSIVE LAYOUT: VIEWPORT META TAG

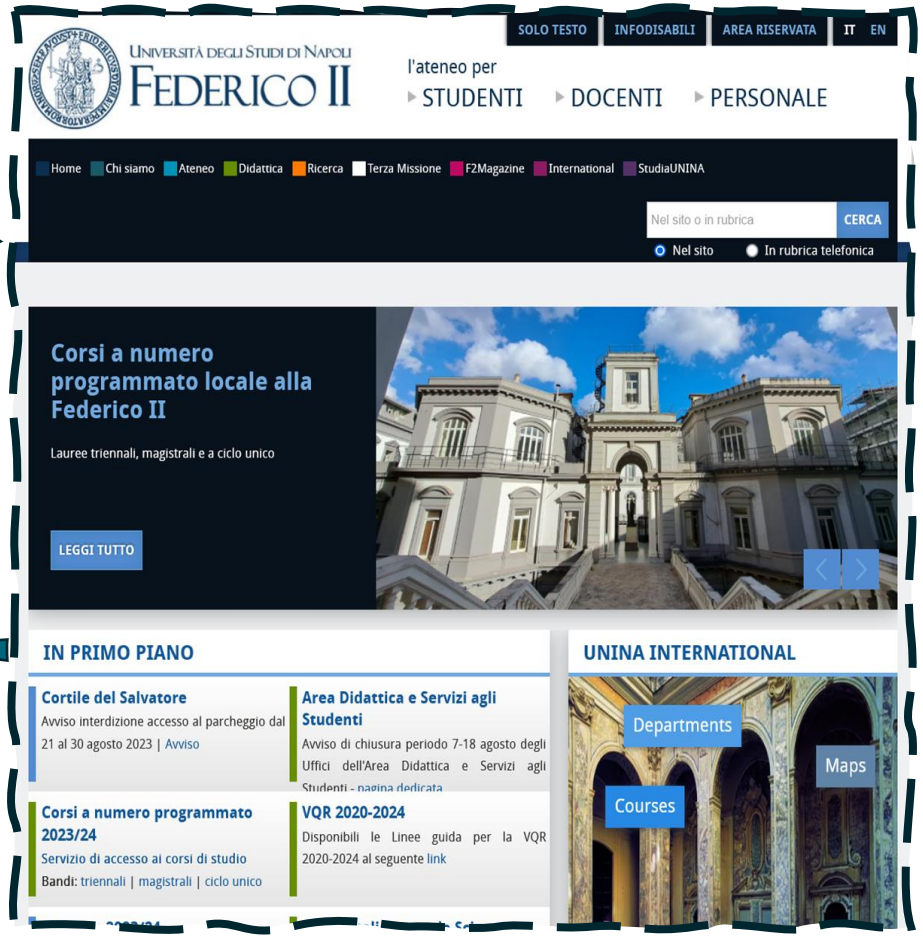
The first mobile browsers had to deal with websites that were designed for screens much wider than their own

- They assumed that websited were designed for a **980px** wide screen
- They rendered the web pages in a 980px **virtual viewport**
- Then, they **scaled** the rendered page down to fit the actual screen width

RESPONSIVE LAYOUT: VIEWPORT META TAG

1: Render in virtual viewport

2: Scale down to device



BlackBerry Torch 9800 (2010)
480x360 display

980px-wide Virtual Viewport

RESPONSIVE LAYOUT: VIEWPORT META TAG

- The virtual viewport mechanism allowed non-mobile-optimized websites to look better on narrow screens
- However, the mechanism doesn't work for websited that **are** optimized for mobile devices
  - The media queries that kick in at 640px will never be used at 980px!
- The **viewport** HTML **meta tag** allows to control the virtual viewport mechanism
- Mobile-optimized web pages should include in their **<head>**:

```
<meta name="viewport"
      content="width=device-width, initial-scale=1">
```

RESPONSIVE LAYOUT: VIEWPORT META TAG

```
<meta name="viewport"
      content="width=device-width, initial-scale=1">
```

The above viewport HTML meta tag specifies two rules:

- `width=device-width` tells the browser to assume that the width the website was designed for is the width of the device
- `initial-scale=1` tells the browser to do no scaling at all.

RECAP: A BRIEF HISTORY OF WEB LAYOUTS

FIXED–WIDTH LAYOUTS

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- In the early days of web design, it was a safe bet to design pages with a 640px width.

The Microsoft website, from 1999 (640px wide)

Illustration: Freepik.com

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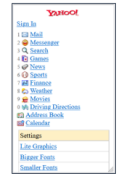

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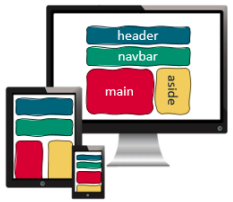
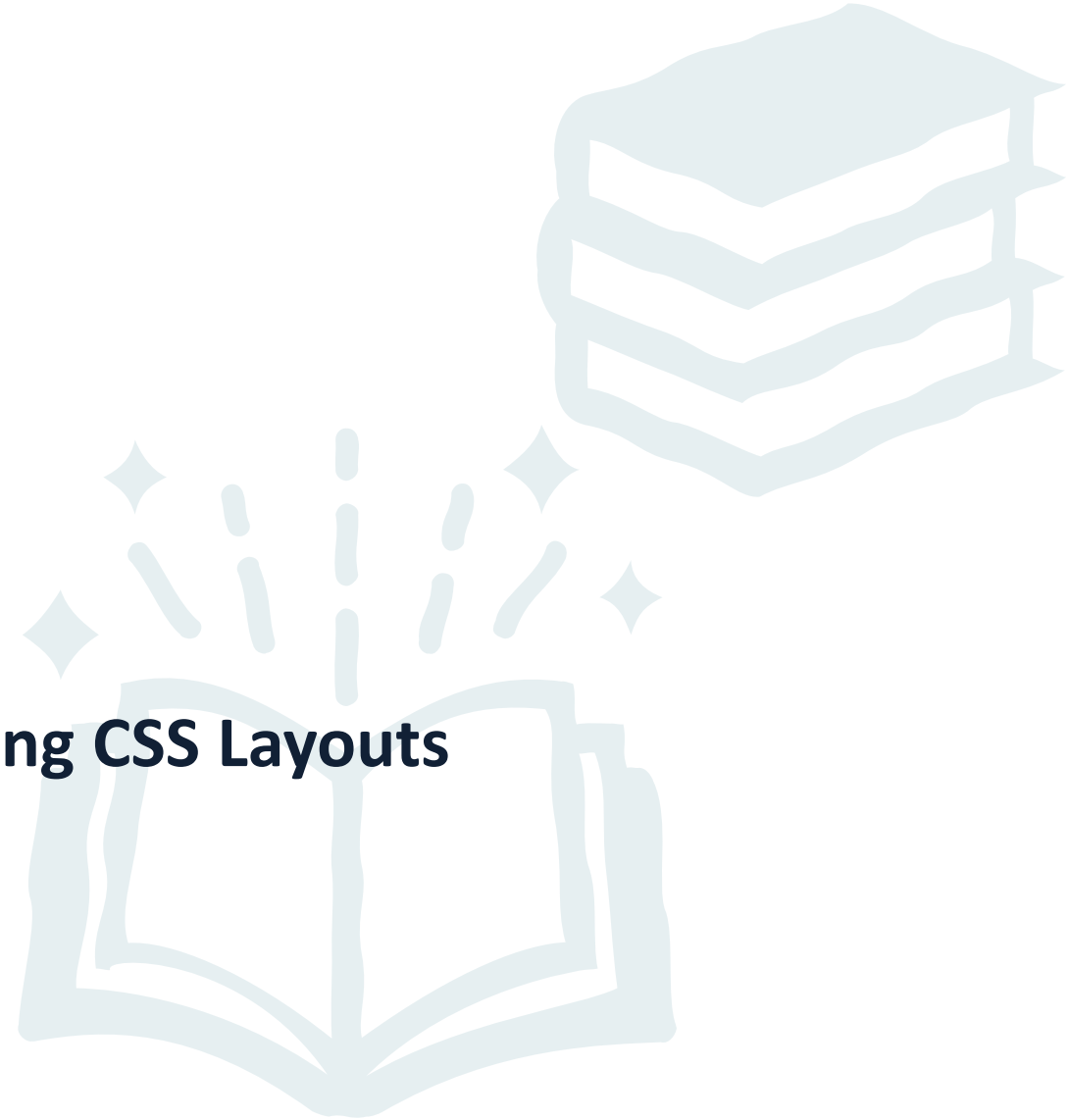


REFERENCES



- **Learn CSS**
  web.dev
  https://web.dev/learn/css/
  Sections: 2, 8 to 11
- **Learn Responsive Design**
  web.dev
  https://web.dev/learn/design/
  Sections: 1 to 3, 15
- **Game-based approaches to learning CSS Layouts**
  https://flexboxfroggy.com/ (Flexbox)
  https://cssgridgarden.com/ (Grid layouts)