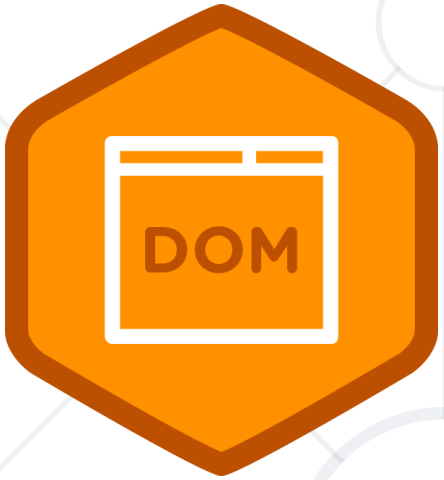
DOM Introduction

Document Object Model



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Have a Question?

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#js-advanced

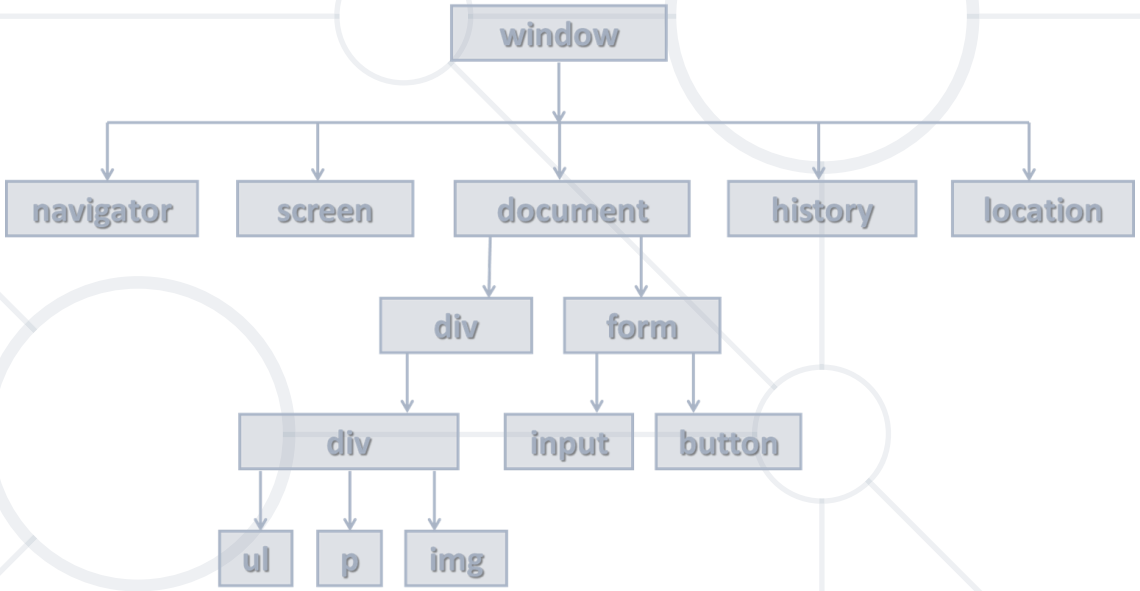
Browser API

Browser Object Model (BOM)

Browser Object Model (BOM)

- Browsers expose some objects like `window`, `screen`, `navigator`, `history`, `location`, `document`, …

```
console.dir(window);
console.dir(navigator);
console.dir(screen);
console.dir(location);
console.dir(history);
console.dir(document);
```



- Most of this **API** will be examined in the **next course**

Global Context in the Browser

- The **global object** in the browser is **window**

```
let b = 8;
console.log(this.b); // undefined
```

```
var a = 5;
console.log(this.a); // 5
```

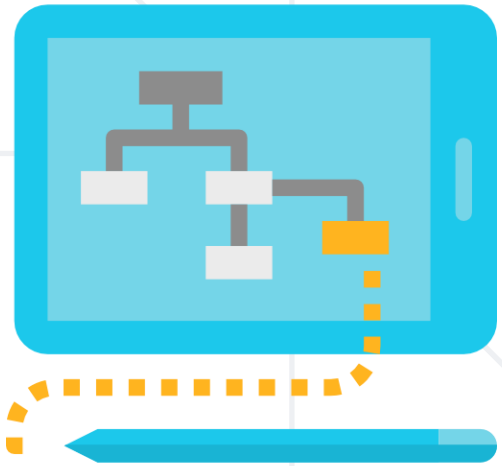
```
function foo() {
  console.log("Simple function call");
  console.log(this === window);  // true
}
foo();
```

Document Object Model (DOM)

Document with a Logical Tree

Document Object Model

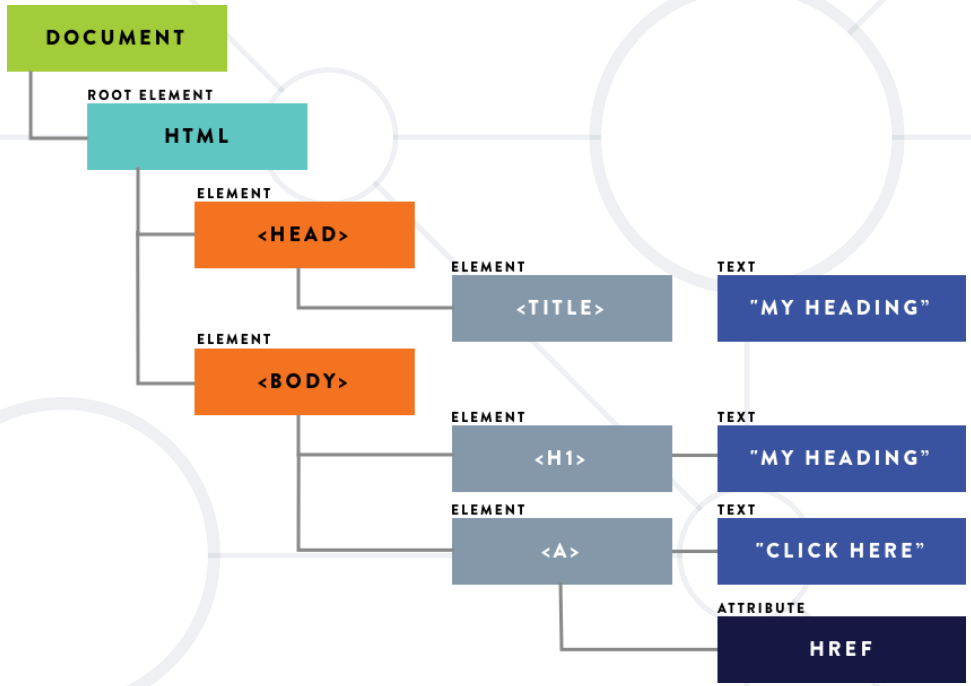
- The **DOM** represents the document as **nodes** and **objects**
  - That way, the programming languages **can connect** to the page
- The **HTML DOM** is an **Object Model** for **HTML**. It defines:
  - HTML elements as **objects**
  - **Properties**
  - **Methods**
  - **Events**



From HTML to DOM Tree

- The browser **parses** HTML and creates a **DOM Tree**

```
<html>
  <head>
    <title>My Heading</title>
  </head>
  <body>
    <h1>My Heading</h1>
    <a href="/about">Click Here</a>
  </body>
</html>
```



- The elements are **nested** in each other and create a **hierarchy**
  - Like the hierarchy of a **street address** – Country, City, Street, etc.

DOM Methods

- **DOM Methods** - **actions** you can perform on HTML elements
- **DOM Properties** - values of HTML elements that you can **set** or **change**

Example: DOM Methods

- HTML DOM **method** is an action you can do (like **add** or **delete** an HTML element)

```
<!doctype html>
<html> == $0
  <head>
    <title>Intro to DOM</title>
  </head>
  <body>
    <h1>Introduction to DOM</h1>
    <ul>
      <li>DOM Methods example</li>
      <li>DOM Properties example</li>
    </ul>
  </body>
</html>
```

```
> let h1Element = document.getElementsByTagName('h1')[0];

console.log(h1Element);

<h1>Introduction to DOM</h1>
```

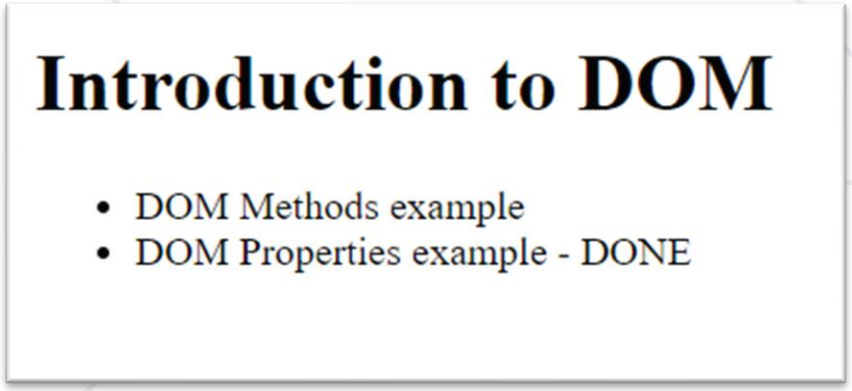
Example: DOM Methods

- HTML DOM **property** is a value that you can **get** or **set** (changing the content of an HTML element)

```
<!doctype html>
…<html> == $0
  ▼<head>
     <title>Intro to DOM</title>
   </head>
  ▼<body>
     <h1>Introduction to DOM</h1>
    ▼<ul>
       <li>DOM Methods example</li>
       <li>DOM Properties example</li>
     </ul>
   </body>
 </html>
```

```
let secondLi = document.getElementsByTagName('li')[1];
```

```
secondLi.innerHTML += " - DONE"
```



Using the DOM API

- JavaScript can **interact** with web pages via the **DOM API**:
  - Check the **contents** and **structure** of elements on the page
  - Modify element **style** and **properties**
  - Read **user input** and react to **events**
  - **Create** and **remove** elements
- Most actions are performed when an **event** occurs
  - Events are **"fired"** when something of interest happens
- All of this **and more** will be examined in upcoming lessons

JavaScript in the Browser

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- Code can be **executed in the page** in different ways:
  - Directly in the **developer console** – when **debugging**
  - As a page **event handler** – e.g., user **clicks** on a button

```
<button onclick="console.log('Hello, DOM!')">Click Me</button>
```
event

  - Via **inline** script, using **<script>** tags

```
<script>
    function sum(a, b) {
        let result = a + b;
        return result;
    }
</script>
```

  - By **importing** from external file – most **flexible method**

HTML Elements

DOM Properties and HTML Attributes

Elements and Properties

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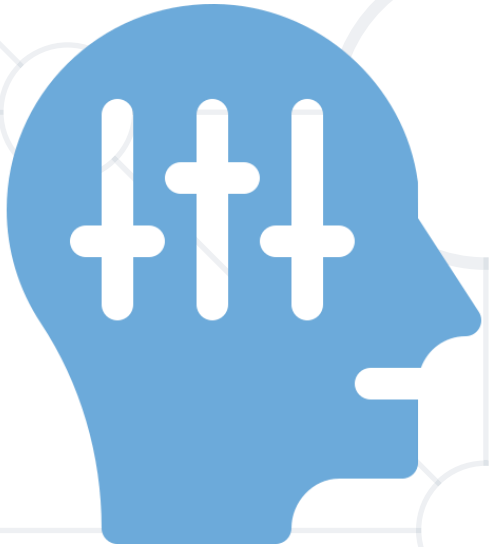
- The DOM Tree is comprised of **HTML elements**
- Elements are **JS objects** with **properties** and **methods**
  - They can be **accessed** and **modified** like regular objects
- To change the contents of the page:
  - **Select** an element to obtain a **reference**
  - **Modify** its **properties**

Attributes and Properties

- Attributes are defined by **HTML**
  - Attributes **initialize** DOM properties
  - **Property** values can **change** via the DOM API
- The HTML **attribute** and the DOM **property** are technically **not the same thing**
- Since the **outcome is the same**, in practice you will **almost never** encounter a difference!

DOM Manipulations

- The **HTML DOM** allows JavaScript to change the content of **HTML elements**
  - `innerHTML`
  - `textContent`
  - `value`
  - `style`
  - And many others to be discussed in upcoming lessons



Accessing Element HTML

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- To access raw HTML:

```
element.innerHTML = "<p>Welcome to the DOM</p>";
```

```
<html>
  <head></head>
  <body>
    <div id="main">This is JavaScript!</div>
  </body>
</html>
```

```
<html>
  <head></head>
  <body>
    <div id="main">
      <p>Welcome to the DOM</p>
    </div>
  </body>
</html>
```

- This will be **parsed** – beware of **XSS attacks**!
- Changing **textContent** or **innerHTML** removes all child nodes

Accessing Element Text

- The contents of HTML elements are stored in text nodes
  - To access the contents of an element:

```
let text = element.textContent; //This is JavaScript!
element.textContent = "Welcome to the DOM";
```

```
<html>
  <head></head>
  <body>
    <div id="main">This is JavaScript!</div>
  </body>
</html>
```

```
<html>
  <head></head>
  <body>
    <div id="main">Welcome to the DOM</div>
  </body>
</html>
```

  - If the element has children, returns all text **concatenated**

Accessing Element Values

- The **values** of input elements are **string properties** on them:

```
<html>
  <head></head>
  <body>
    <div id="main">
      <p>Welcome to the DOM</p>
      <input id="num1" type="text">
    </div>
  </body>
</html>
```

```
type: "text"
useMap: ""
validationMessage: ""
validity: ValidityState
value: "56"
valueAsNumber: NaN
webkitEntries: Array[0]
webkitdirectory: false
width: 0
```

```
let num = Number(element.value);
element.value = 56;
```

Problem: Edit Element

- Create function **edit()** that takes **three** parameters:
  - A **reference** to an HTML element
  - Two strings – **match** and **replacer**
- Replace all occurrences of **match** inside the **text content** of the given element with **replacer**

```
<body>
  <h1>Hello, %insert name here%!</h1>
</body>
```

```
'%insert name here%',
'Document Object Model'
```

```
<body>
  <h1>Hello, Document Object Model!</h1>
</body>
```

Solution: Edit Element

```
function edit(ref, match, replacer) {
  const content = ref.textContent;
  const matcher = new RegExp(match, 'g');
  const edited = content.replace(matcher, replacer);
  ref.textContent = edited;
}
```

Check your solution here: https://judge.softuni.bg/Contests/2760#0

Targeting DOM Elements

Obtaining Element References

Targeting Elements

- There are a few ways to **find** a certain **HTML element** in the **DOM**:
  - By ID - `getElementById()`
  - By class name - `getElementsByClassName()`
  - By tag name - `getElementsByTagName()`
  - By CSS selector - `querySelector()`, `querySelectorAll()`
- These methods return a **reference** to the element, which can be **manipulated** with JavaScript

Targeting by ID - Example

- The **ID attribute** must be **unique** on the page

```
const element = document.getElementById('main');
console.log(element);
```

```
<html>
  <head> ··· </head>
  <body>
    <div id="main">
      <article class="list">
        <p>First</p>
        <p>Second</p>
        <p>Third</p>
      </article>
    </div>
  </body>
</html>
```

```
div#main
    accessKey: ""
    accessKeyLabel: ""
    align: ""
    assignedSlot: null
  ▶ attributes: NamedNodeMap [ id="main" ]
```

Targeting by Tag and Class Names – Example

- The **tag name** specifies the **type** of element – **`div`**, **`p`**, **`ul`**, etc.

```
const elements = document.getElementsByTagName('p');
// Select all paragraphs on the page
```

- **Class names** are used for **styling** and easier **selection**

```
const elements = document.getElementsByClassName('list');
// Select all elements having a class named 'list'
```

- Both methods return a live **HTMLCollection**
  - **Even if** only **one** element is selected! This is a **common mistake**

CSS Selectors

- **CSS selectors** are strings that follow CSS syntax for matching
- They allow very fast and powerful element matching, e.g.:
  - **"#main"** - returns the element with ID "main"
  - **"#content div"** - selects all ** **s inside **#content**
  - **".note, .alert"** - all elements with class "note" or "alert"
  - **"input[name='login']"** - **<input>** with name "login"

CSS Selectors - Example

- Select the **first matching** element

```
const mainDiv = document.querySelector('#main');
// Select the element with ID 'main'

const element = document.querySelector('p');
// Select the first paragraph on the page
```

- Select **all** matching elements
  - Returns a **static NodeList**

```
const elements = document.querySelectorAll('article.list');
// Select all <article> elements having a class named 'list'
```

NodeList vs. HTMLCollection

- Both interfaces are **collections** of **DOM nodes**
- **NodeList** can contain **any** node type, including **text** and **whitespace**
- **HTMLCollection** contains only **Element nodes**
- Both have **iteration** methods, **HTMLCollection** has an extra **`namedItem`** method
- **HTMLCollection** is **live**, while **NodeList** can be either **live** or **static**

Iterating Element Collections

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- **NodeList** and **HTMLCollection** are **NOT** arrays but can be **indexed** and **iterated**

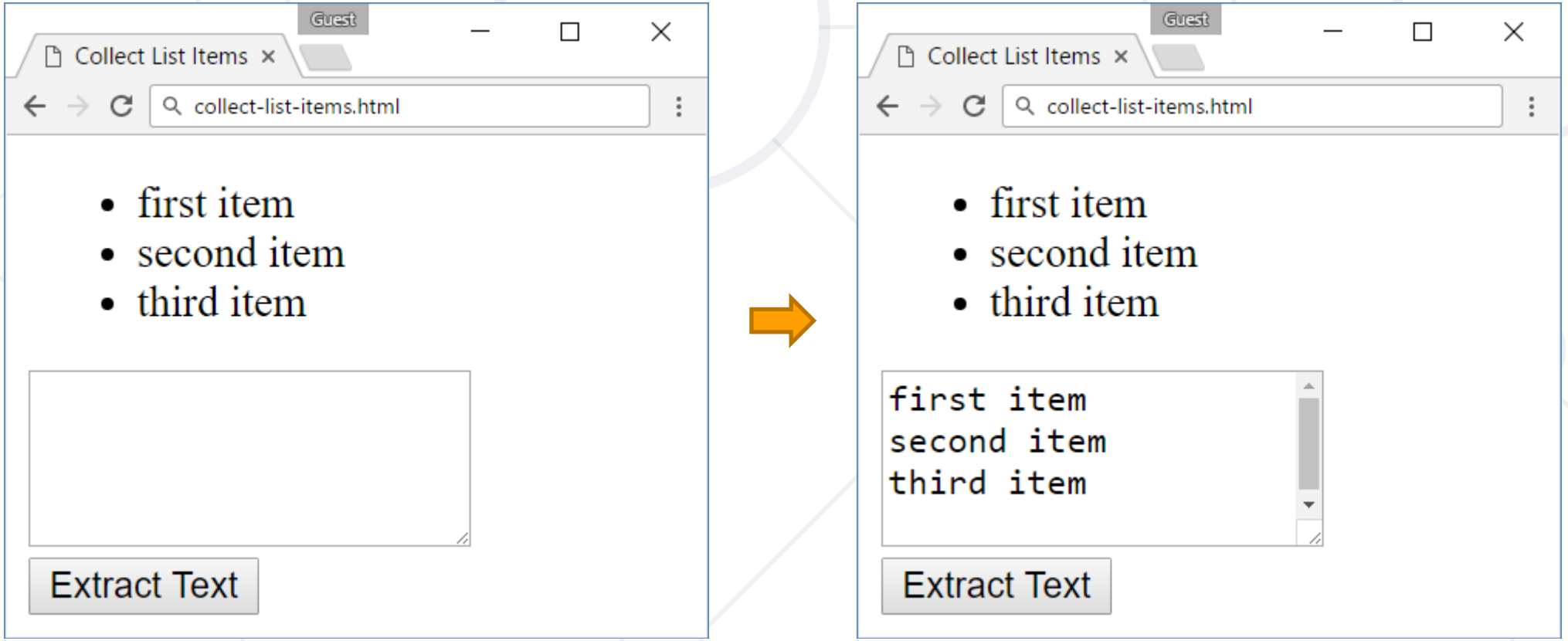
```
const elements = document.querySelectorAll('p');
const first = elements[0];
// Select the first paragraph on the page

for (let p of elements) { /* … */ }
// Iterate over all entries
```

- Both can be **explicitly converted** to an array

```
const elementArray = Array.from(elements);
const elementArr2 = [...elements]; // Spread syntax
```

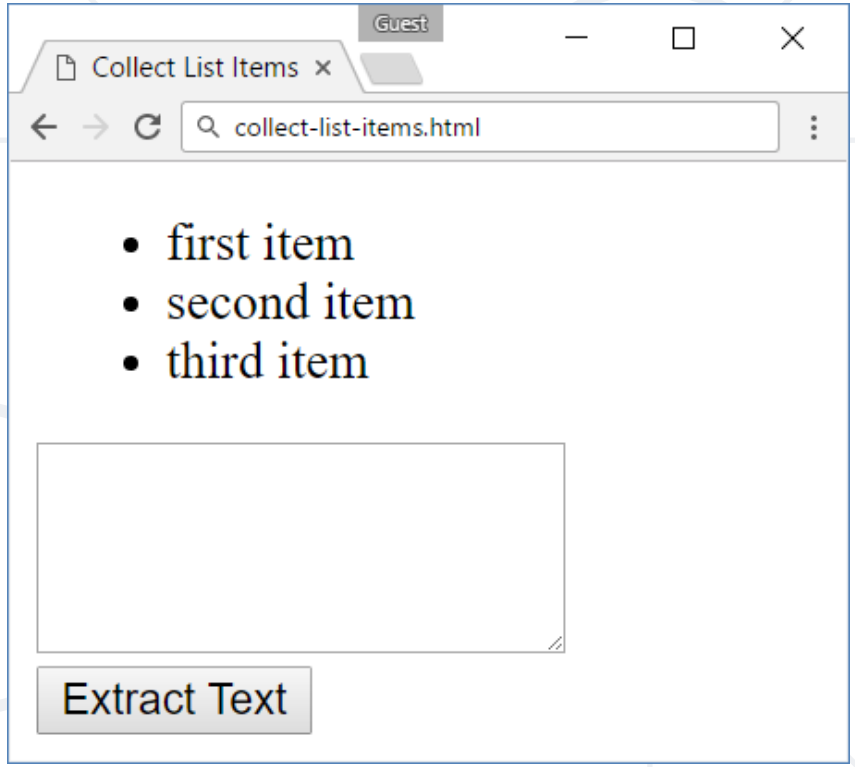
Problem: Collect List Items

- Collect the **list items** from given HTML list and append their **text** to given **text area**



Problem: Collect List Items – HTML

```
<ul id="items">
  <li>first item</li>
  <li>second item</li>
  <li>third item</li>
</ul>

<textarea id="result">
</textarea>

<br>

<button onclick="extractText()">
Extract Text</button>
```



Solution: Collect List Items

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```
function extractText() {
  let itemNodes =
    document.querySelectorAll("ul#items li");
  let textarea =
    document.querySelector("#result");
  for (let node of itemNodes) {
    textarea.value += node.textContent + "\n";
  }
}
```

Check your solution here: https://judge.softuni.bg/Contests/2760#1

Parents and Child Elements

- Every DOM Element has a **parent**
  - Parents can be accessed by property `parentElement` or `parentNode`

```
▼<div>
    <p>This is a paragraph.</p>
    <p>This is another paragraph.</p>
  </div>
```

Accessing the first child

```
let firstP = document.getElementsByTagName('p')[0];
console.log(firstP.parentElement);
```

Accessing the child's parent

```
▶<div>…</div>
```

Parents and Child Elements

- When some element contains other elements, that means he is **parent** of those elements
- They are **children** to the **parent**. They can be accessed by property **children**

```
▼<div>
    <p>This is a paragraph.</p>
    <p>This is another paragraph.</p>
  </div>
```

```
▼HTMLCollection(2) [p, p]
  ▶0: p
  ▶1: p
    length: 2
```

```
let pElements = document.getElementsByTagName('div')[0].children;
```

Returns live HTMLCollection

Using the DOM API

Common Techniques and Scenarios

External Page Scripts

- Page scripts can be **loaded** from an external file
  - Use the `src` attribute of the **script element**

```
<script src="app.js"></script>
```

- **Functions** from script files are in the **global scope**
  - Can be referenced and **executed** from **events** and **inline** scripts
  - **Multiple** script files in a page can see **each other**
- Pay attention to **load order**!

Problem: Sum Numbers

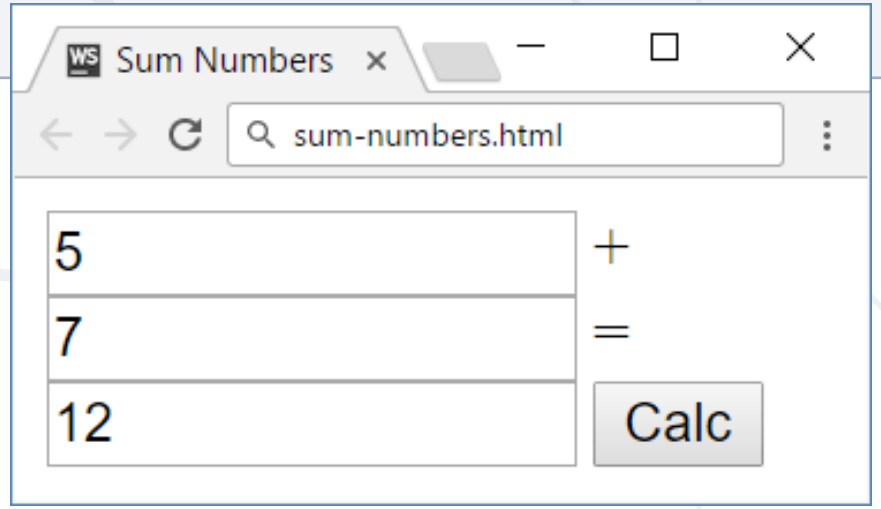
- Write a JS function to sum two numbers (fill the missing code)

```
<input type="text" id="num1" /> +
<input type="text" id="num2" /> =
<input type="text" id="sum" readonly="readonly" />
<input type="button" value="Calc" onclick="calc()" />

<script src="calc.js"></script>
```

calc.js

```
function calc() {
  // TODO
}
```



Solution: Sum Numbers

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```
function calc() {
  let num1 = document.getElementById('num1').value;
  let num2 = document.getElementById('num2').value;

  let sum = Number(num1) + Number(num2);

  document.getElementById('sum').value = sum;
}
```

Check your solution here: https://judge.softuni.bg/Contests/2760#2

Control Content via Visibility

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- Content can be **hidden** or **revealed** by changing its **display** style
  - This is a **common technique** to display content dynamically
- To **hide** an element:

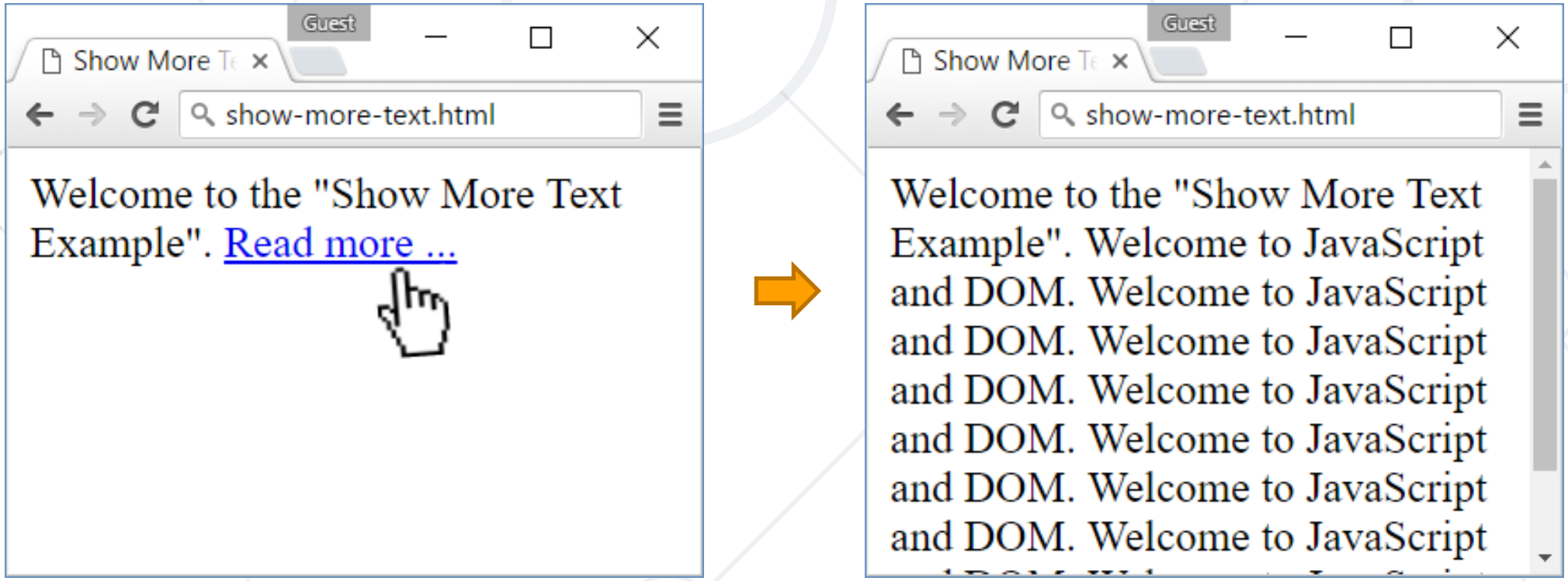
```
const element = document.getElementById('main');
element.style.display = 'none';
```

- To **reveal** an element, set **display** to anything that isn't **'none'** (including **empty string**)

```
element.style.display = ''; // Can be 'inline', 'block', etc.
```

Problem: Show More Text

- A HTML page holds a short text + link "*Read more …*"
  - Clicking on the link shows more text and hides the link



Problem: Show More Text – HTML

```
Welcome to the "Show More Text
Example".

<a href="#" id="more" onclick=
"showText()">Read more …</a>

<span id="text" style=
"display:none">Welcome to …</span>

<script>
  function showText() {
    // TODO
  }
</script>
```

- See the DOM tree here: http://software.hixie.ch/utilities/js/live-dom-viewer/?saved=4275

Solution: Show More Text

```
Welcome to the "Show More Text Example". <a href="#"
id="more" onclick="showText()">Read more …</a>
<span id="text" style="display:none">Welcome to …</span>
<script>
  function showText() {
    document.getElementById('text')
      .style.display = 'inline';
    document.getElementById('more')
      .style.display = 'none';
  }
</script>
```

Check your solution here: https://judge.softuni.bg/Contests/2760#3

Match n-th Child

- Sometimes we need to target an element based on its **relation** to other **similar elements**
  - E.g., **row** or **column** in a table, **list item**, etc.
- Can be done either by **index** or with a **CSS selector**

```
const list = document.getElementsByTagName('ul')[0];
// First <ul> on the page

const thirdLi = list.getElementsByTagName('li')[2];
// Third <li> inside the selected <ul>
```

```
const thirdLi = document.querySelector('ul li:nth-child(3)');
// Third <li> inside the first <ul> on the page
```

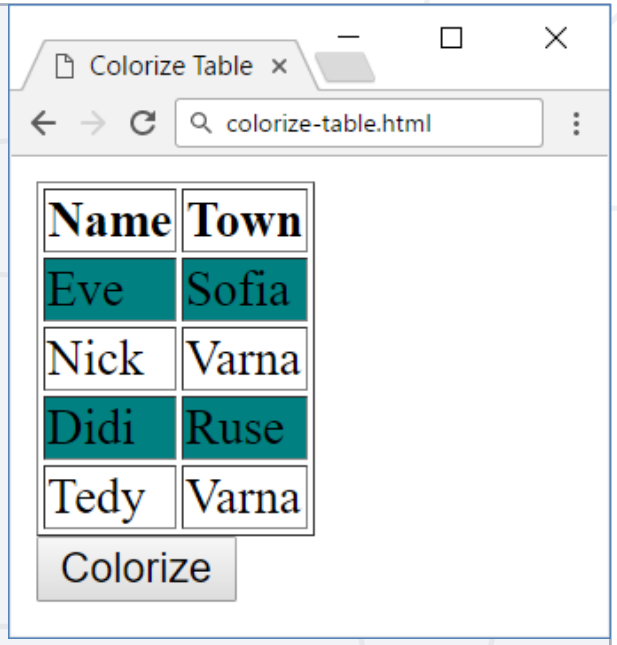
Problem: Colorize Table Rows

- A HTML page holds a **table** with **rows**
  - On button click, colorize in color "**teal**" all even rows

```
<table border="1">
  <tr><th>Name</th><th>Town</th></tr>
  <tr><td>Eve</td><td>Sofia</td></tr>
  <tr><td>Nick</td><td>Varna</td></tr>
  <tr><td>Didi</td><td>Ruse</td></tr>
  <tr><td>Tedy</td><td>Varna</td></tr>
</table>
<button onclick="colorizeRows()">Colorize</button>
```

Solution: Colorize Table Rows

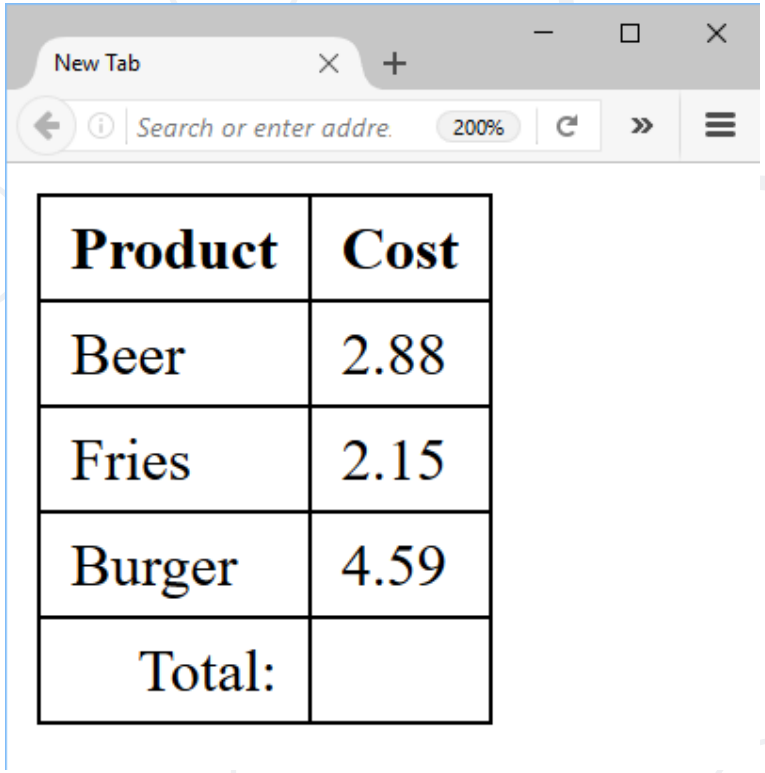
```
function colorizeRows() {
  let rows = document.
    querySelectorAll("table tr");
  let index = 0;
  for (let row of rows) {
    index++;
    if (index % 2 == 0)
      row.style.background = "teal";
  }
}
```



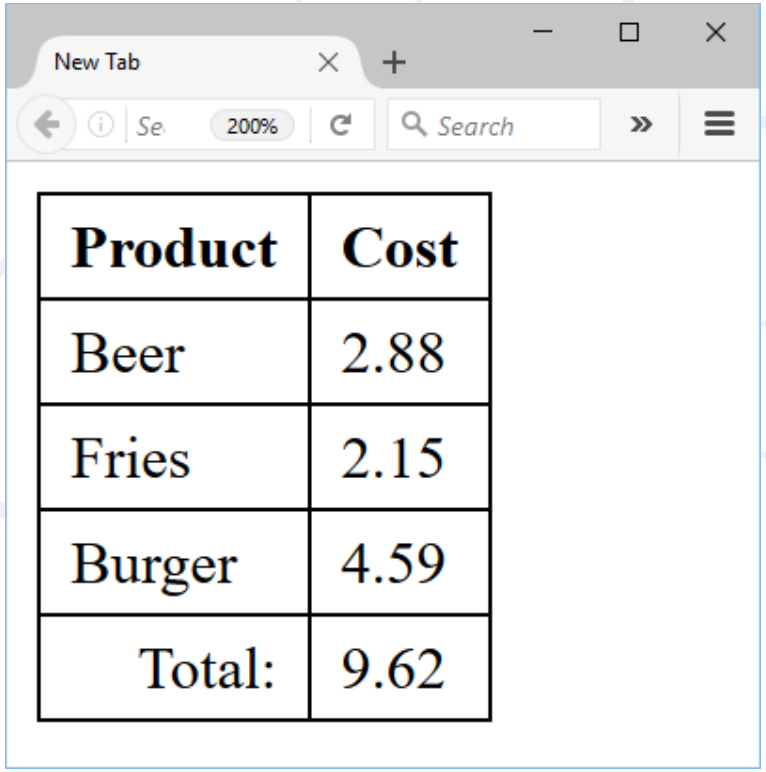
Check your solution here: https://judge.softuni.bg/Contests/2760#4

Problem: Sum Table

- Find the **first table** and sum all values in the **last column**
- Display the result inside element with **ID "sum"**



Product	Cost
Beer	2.88
Fries	2.15
Burger	4.59
Total:	



Product	Cost
Beer	2.88
Fries	2.15
Burger	4.59
Total:	9.62

Problem: Sum Table (2)

- Sample HTML

```
<table>
  <tbody>
    <tr><th>Product</th><th>Cost</th></tr>
    <tr><td>Beer</td>   <td>2.88</td></tr>
    <tr><td>Fries</td>  <td>2.15</td></tr>
    <tr><td>Burger</td> <td>4.59</td></tr>
    <tr><td>Total:</td> <td id="sum"></td></tr>
  </tbody>
</table>
<button onclick="sum()">Sum</button>
```

Solution: Sum Table

```
function sum() {
  let table = document.querySelectorAll("table tr");
  let total = 0;
  for (let i = 1; i < table.length; i++) {
    let cols = table[i].children;
    let cost = cols[cols.length - 1].textContent;
    total += Number(cost);
  }
  document.getElementById("sum").textContent = total;
}
```

Check your solution here: https://judge.softuni.bg/Contests/2760#5

Live Demonstration

Lab Problems

Problem: Extract Parenthesis

- Extract all **parenthesized text** from a **target** paragraph
  - Your function will receive an element ID to parse
  - Return the result as string, joined by `"; "`;

```
<!DOCTYPE html> == $0
<html lang="en">
▶<head>…</head>
▼<body>
  ▼<p id="content">
      "
          The Rose Valley (Bulgaria) is located just south of the Balkan Mountains
      (Kazanlak).The most common oil-bearing rose found in the valley is the pink-
      petaled Damask rose (Rosa damascena Mill).
      "
    </p>
  </body>
</html>
```

```
>> let text = extract("content")
```

```
Bulgaria;
Kazanlak;
Rosa demascena Mill;
```

Problem: Extract Parenthesis (2)

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- Sample HTML

```
<p id="content">
  The Rose Valley (Bulgaria) is located just south of the
Balkan Montains(Kazanlak).The most common oil-bearing rose
found in the valley is the pink-petaled Damask rose (Rosa
damascena Mill).
</p>
<p id="holder">
  Lorem ipsum dolor sit amet, (consectetur adipiscing elit),
  sed do eiusmod (tempor) incididunt ut labore (et dolore
  magna) aliqua.
</p>
```

Solution: Extract Parenthesis

```
function extract(elementId) {
  let para = document.getElementById(elementId).textContent;
  let pattern = /\(([^)]+)\)/g;
  let result = [];

  let match = pattern.exec(para);
  while(match) {
    result.push(match[1]);
    match = pattern.exec(para);
  }

  return result.join('; ');
}
```

Check your solution here: https://judge.softuni.bg/Contests/2760#6

Summary

- BOM – Browser API
- DOM
  - DOM is a programming API for HTML and XML documents
  - Selecting DOM elements
    - By Id
    - By Class Name
    - Query Selectors
  - DOM Properties & HTML Attributes

Questions?

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