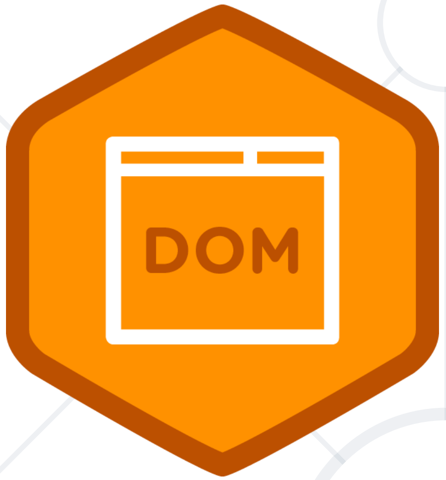
DOM and Events



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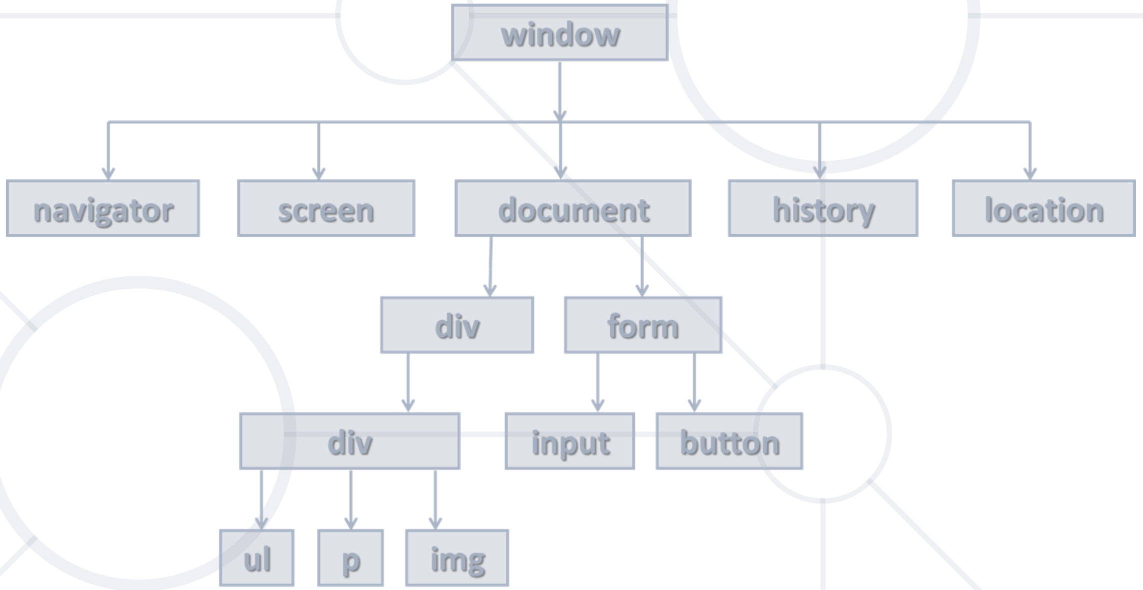
#QA-Auto-FrontEnd

Browser API

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);
```



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

Document Object Model (DOM)

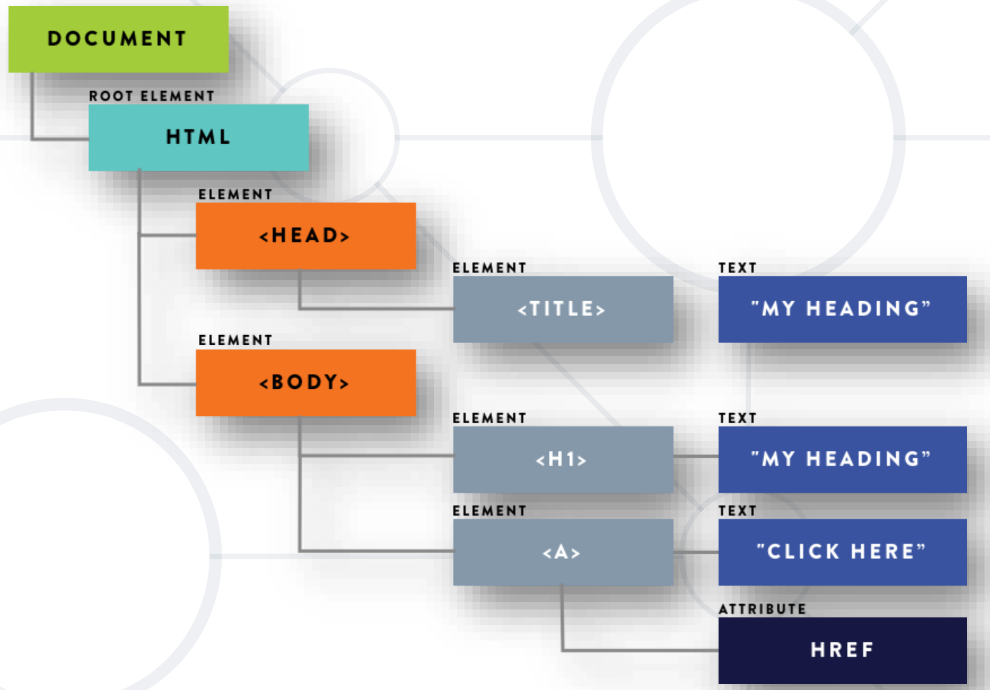
Document Object Model

- 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
  - HTML DOM method is an action you can do, e.g., add or delete an HTML element
- **DOM Properties**
  - Values of HTML elements that you can **set** or **change**
  - HTML DOM property is a value that you can **get** or **set**, e.g., changing the content of an HTML element

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

JavaScript in the Browser

- Code can be **executed in the page** in different ways
  - Directly in the **developer console**, during **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

Elements and Properties

- 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!

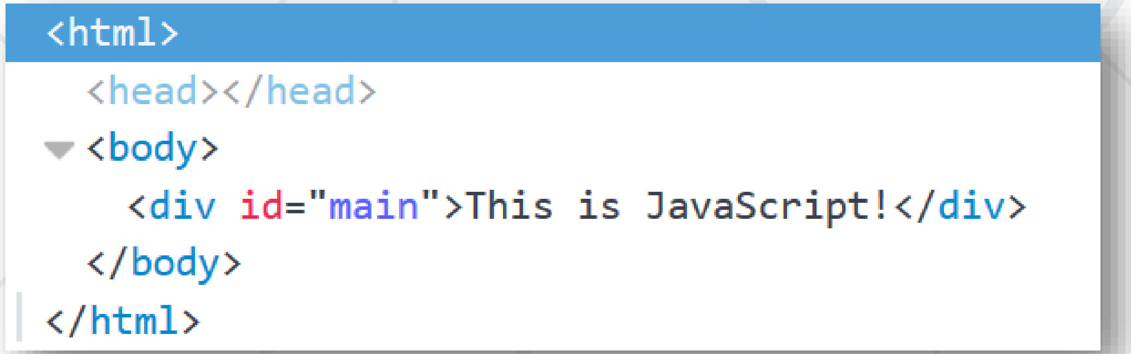
DOM Manipulations

- The **HTML DOM** allows JavaScript to change the content of **HTML elements**
  - **`innerHTML`**
  - **`textContent`**
  - **`value`**
  - **`style`**
  - and more

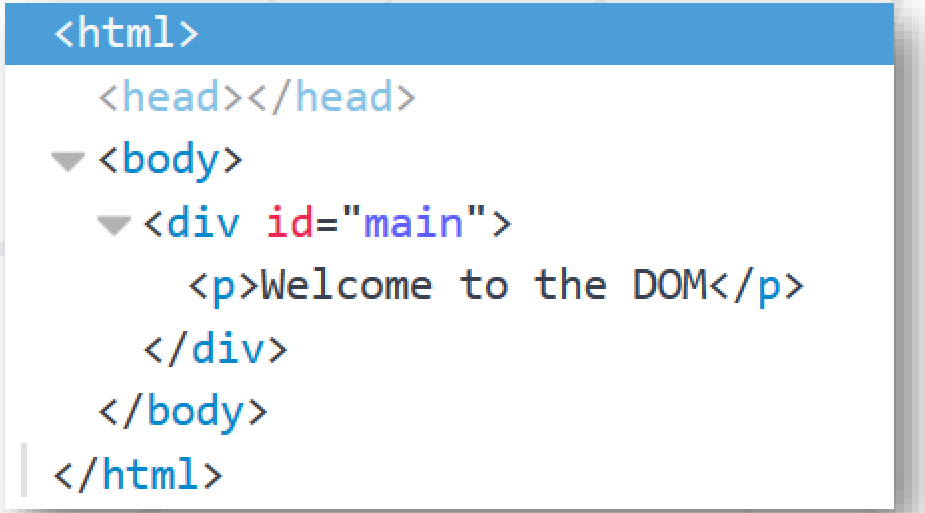
Accessing Element HTML

- 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>
```



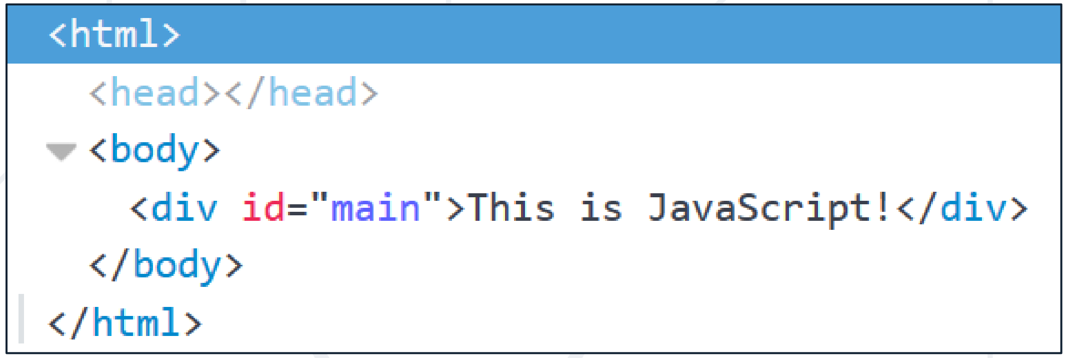
```
<html>
  <head></head>
  <body>
    <div id="main">
      <p>Welcome to the DOM</p>
    </div>
  </body>
</html>
```

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

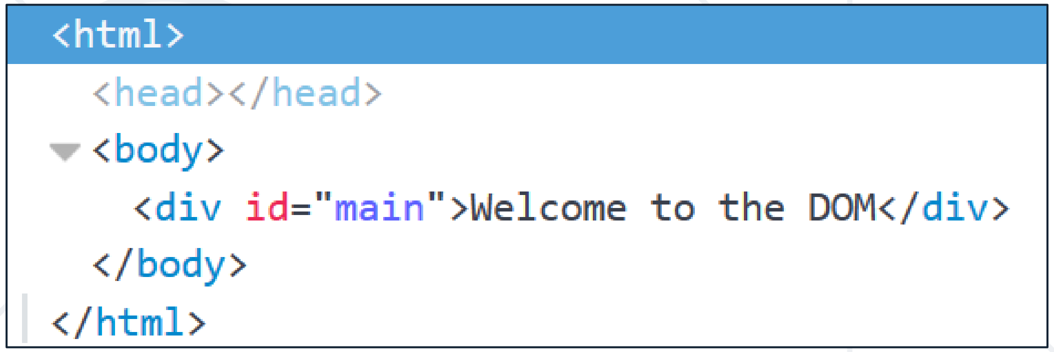
Accessing Element Text

- 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>
```

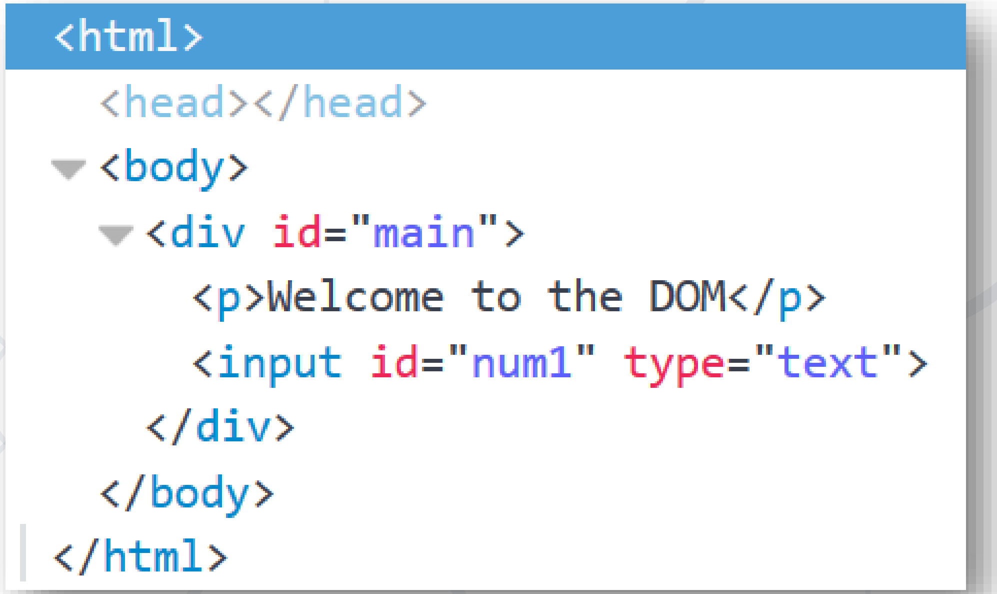


```
<html>
  <head></head>
  <body>
    <div id="main">Welcome to the DOM</div>
  </body>
</html>
```

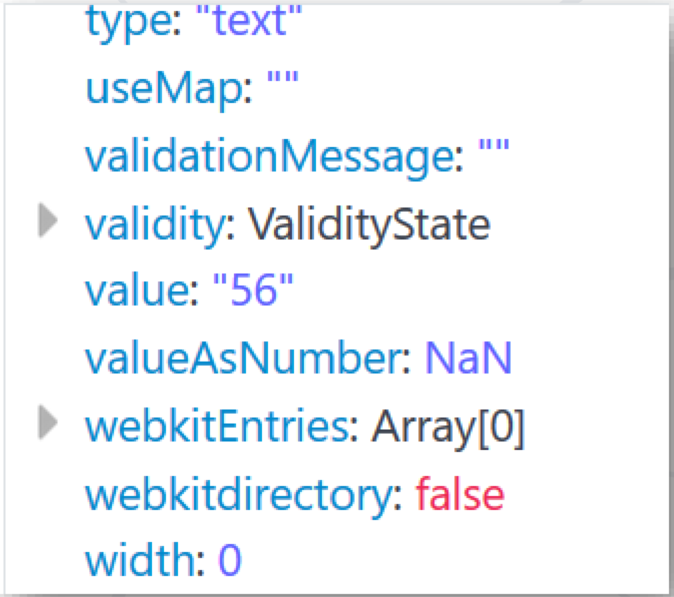
  - If the element has children, returns all text **concatenated**

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;
```

Targeting Elements

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 Tag and Class Names

- 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
  - `"#main"`
    - Returns the element with ID "main"
  - `"#content div"`
    - Selects all `<div>`s inside `#content`
  - `".note, .alert"`
    - All elements with class "note" or "alert"
  - `"input[name='login']"`
    - `<input>` with name "login"

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

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

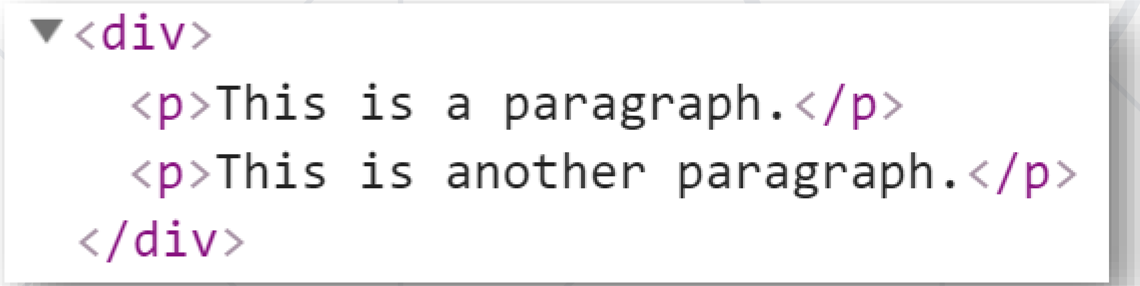
```
const elements = document.querySelectorAll('p');
const first = elements[0];
// Select the first paragraph on the page

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
```

Parents and Child Elements

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

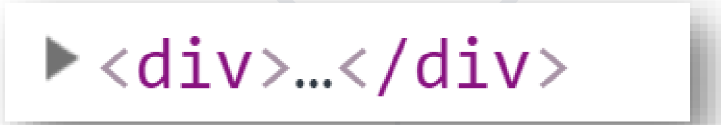


```
<div>
  <p>This is a paragraph.</p>
  <p>This is another paragraph.</p>
</div>
```

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

Accessing the first child

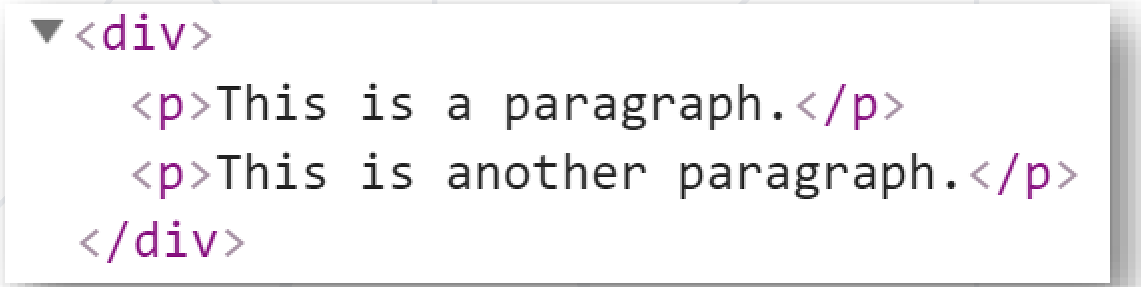
Accessing the child's parent



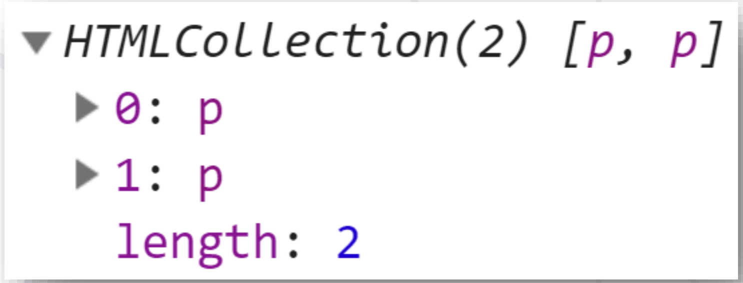
```
<div>…</div>
```

Parents and Child Elements

- When some element contains other elements, that means it is **parent** of those elements
  - Those elements 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**!

Control Content via Visibility

- 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.
```

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
```

DOM Manipulation

DOM Manipulations

- We can **create**, **append** and **remove** HTML elements dynamically
  - `appendChild()`
  - `removeChild()`
  - `replaceChild()`

Creating New DOM Elements

- HTML elements are created with **`document.createElement`**
  - This is called a **Factory Pattern**
- Variables holding HTML elements are **live**
  - If you **modify** the contents of the variable, the DOM is **updated**
  - If you **insert** it somewhere in the DOM, the original is **moved**
- Text added to **`textContent`** will be **escaped**
- Text added to **`innerHTML`** will be **parsed** and turned into actual HTML elements → beware of **XSS attacks**!

Creating DOM Elements

- Creating a new DOM element

```
let p = document.createElement("p");
let li = document.createElement("li");
```

Tag name

- Create a copy / cloning DOM element

```
let li = document.getElementById("my-list");
let newLi = li.cloneNode(true);
```

- Elements are created **in memory** – they don't exist on the page
- To become visible, they must be **appended** to the DOM tree

Manipulating Node Hierarchy

- **appendChild**
  - Adds a new child, as the **last child**

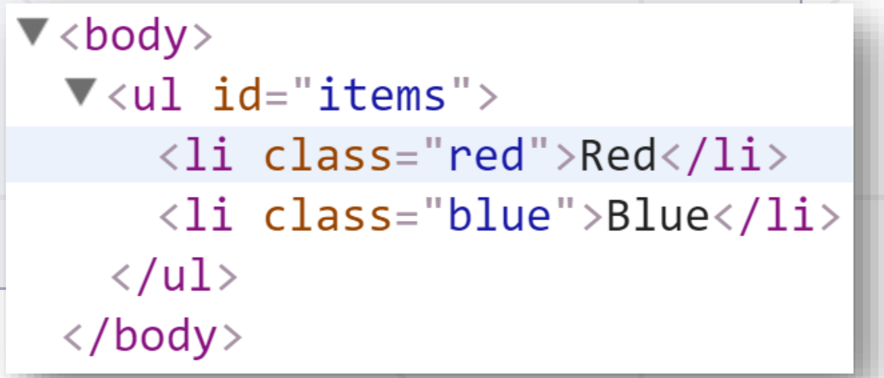
```
let p = document.createElement("p");
let li = document.createElement("li");
li.appendChild(p);
```

- **prepend**
  - Adds a new child, as the **first child**

```
let ul = document.getElementById("my-list");
let li = document.createElement("li");
ul.prepend(li);
```

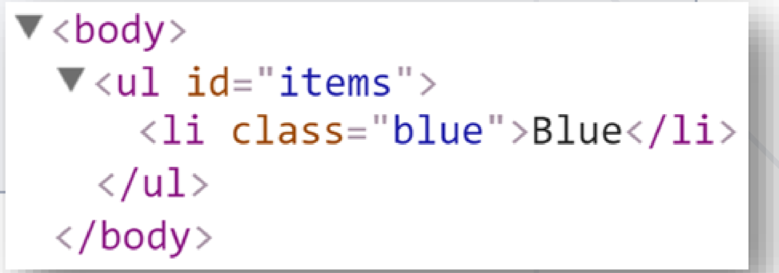
Deleting DOM Elements

```
<ul id="items">
  <li class="red">Red</li>
  <li class="blue">Blue</li>
</ul>
```



```
▼<body>
  ▼<ul id="items">
      <li class="red">Red</li>
      <li class="blue">Blue</li>
    </ul>
  </body>
```

```
let redElements =
  document.querySelectorAll("#items li.red");
redElements.forEach(li => {
  li.parentNode.removeChild(li);
});
```



```
▼<body>
  ▼<ul id="items">
      <li class="blue">Blue</li>
    </ul>
  </body>
```

The DOM Event

Event Object and Types

Event Object

- Calls its **associated function**
- Passes a **single argument** to the function - a **reference** to the event object
- Contains **properties** that describe the event
  - Which **element** triggered the event
  - Screen **coordinates** where it occurred
  - What is the **type** of the event
  - And more

Event Types in DOM API

- **Mouse** events

```
click
mouseover
mouseout
mousedown
mouseup
```

- **Touch** events

```
touchstart
touchend
touchmove
touchcancel
```

- **DOM / UI** events

```
load
unload
resize
dragstart / drop
```

- **Keyboard** events

```
keydown
Keypress
keyup
```

- **Focus** events

```
focus (got focus)
blur (lost focus)
```

- **Form** events

```
input
change
submit
reset
```

Event Handling

Event Handler

- Event registration is done by providing a **callback function**
- Three ways to register for an event:
  - With **HTML Attributes**
  - Using **DOM element properties**
  - Using **DOM event handler** – preferred method

```
function handler(event){
    // this --> object, html reference
    // event --> object, event configuration
}
```

Event Listener

- addEventListener();

```
htmlRef.addEventListener( 'click' , handler);
```

- removeEventListener();

```
htmlRef.removeEventListener( 'click' , handler);
```

Events Handler Execution Context

- In event handlers, **`this`** refers to the event **source element**
  - **`target`** is the element that triggered the event
  - **`currentTarget`** is the element that the event listener is attached to

```
element.addEventListener("click", function(e) {
  console.log(this === e.currentTarget); // true
});
```

Events Handler Execution Context

- Pay attention when using **object methods** as event listeners!

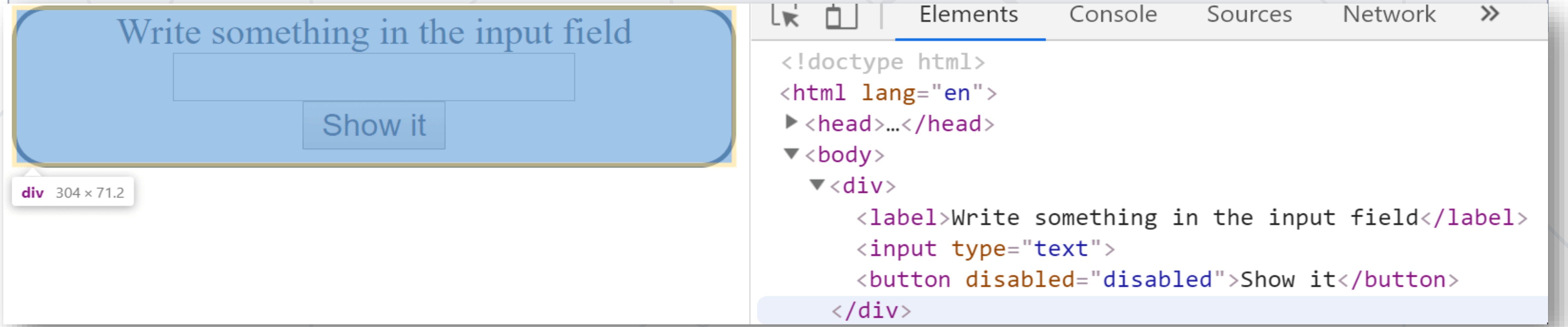
```
const myObject = {
   value: 42,
   handleClick: function () { console.log(this) },
};

myObject.handleClick(); // { value: 42, handleClick: f}
const myButton = document.getElementsByTagName("button")[0];
myButton.addEventListener("click", myObject.handleClick);
// User clicks the button - this == myButton
```

Attaching Hover Handler

```
const button = document.getElementsByTagName("button")[0];

button.addEventListener("mouseover", function (e) {
   const buttonElementStyles = e.currentTarget.style;
   buttonElementStyles.backgroundColor = "red";
});

button.addEventListener("mouseout", function (e) {
   const buttonElementStyles = e.currentTarget.style;
   buttonElementStyles.backgroundColor = "blue";
});
```

Attaching Input Handler

```
const inputField = document.getElementsByTagName('input')[0];
const button = document.getElementsByTagName('button')[0];

inputField.addEventListener('input', function () {
    button.setAttribute('disabled', 'false')
});
```



```
<!doctype html>
<html lang="en">
▶<head>…</head>
▼<body>
  ▼<div>
     <label>Write something in the input field</label>
     <input type="text">
     <button disabled="disabled">Show it</button>
   </div>
```

Remove Listeners

```
const button = document.getElementById('myButton’);
function handleClick() {
   alert('Button clicked!’);
}

button.addEventListener('click', handleClick);

// Add a timeout to remove the event listener after 5
  seconds
setTimeout(function() {
   button.removeEventListener('click', handleClick);
   alert('Event listener removed!’);
}, 5000);
```

Multiple Listeners

- The **addEventListener()** method also allows you to add many listeners to the same element, without overwriting existing ones

```
element.addEventListener("click", myFirstFunction);
element.addEventListener("click", mySecondFunction);
element.addEventListener("mouseover", myThirdFunction);
element.addEventListener("mouseout", myFourthFunction);
```

*Note that you don't use the "**on**" prefix for the event use "**click**" instead of "**onclick**"*

Multiple Listeners

```
const input = document.getElementsByTagName('input')[0];

// First event listener
input.addEventListener('focus', function () {
   console.log('Input focused (First listener)');
});

// Second event listener
input.addEventListener('focus', function () {
   console.log('Input focused (Second listener)');
});

// Input focused (First listener)
// Input focused (Second listener)
```

Summary

- **BOM** == Browser API
- **DOM** == programming API for HTML documents
  - Selecting DOM Elements by **id**, **class** or **query selectors**
  - DOM **Properties** & HTML **Attributes**
  - **Manipulating** the DOM tree
  - User **interaction triggers events**

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