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2023

JS In The Browser

Handling web document structure

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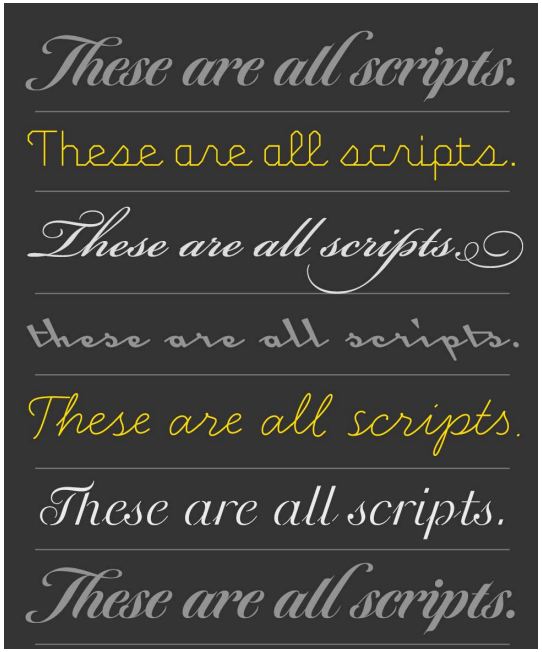
Some slides adapted from Giovanni Malnati



Goal

- Loading JavaScript in the browser
- Browser object model
- Document object model
- DOM Manipulation
- DOM Styling
- Event Handling
- Forms

Mozilla Developer Network: The Script element
https://developer.mozilla.org/en-US/docs/Web/HTML/Element/script

JS in the browser

LOADING JS IN THE BROWSER

Loading JavaScript In The Browser

- JS must be loaded from an HTML document
- `<script>` tag
  - Inline

```
...
<script>
  alert('Hello');
</script>
...
```

  - External

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

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/script

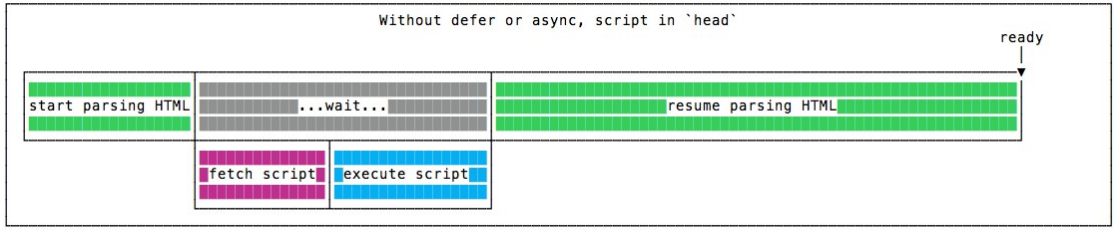
Where To Insert The <script> Tag?

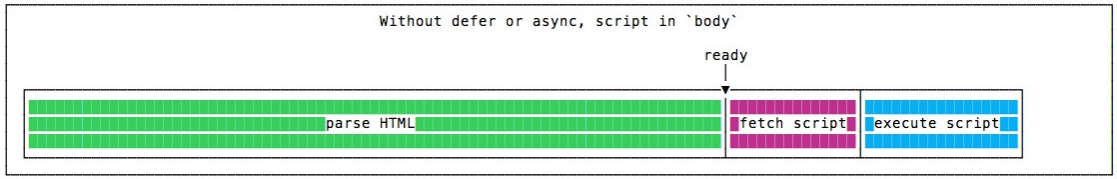
- In the <head> section
  - "clean" / "textbook" solution
  - Very **inefficient**: HTML processing is stopped until the script is loaded and executed
  - Quite **inconvenient**: the script executes when the document's DOM does not exist yet
  - *But*: see after!
- Just before the end of the document
  - More efficient than the "textbook" solution
  - Standard solution in the last years

```
<!DOCTYPE html>
<html>
    <head>
        <title>Loading a script</title>
        <script src="script.js"></script>
    </head>
    <body>
        ...
    </body>
</html>
```

```
<!DOCTYPE html>
<html>
    <head>
        <title>Loading a script</title>
    </head>
    <body>
        ...
        <script src="script.js"></script>
    </body>
</html>
```


Performance Comparison In Loading JS



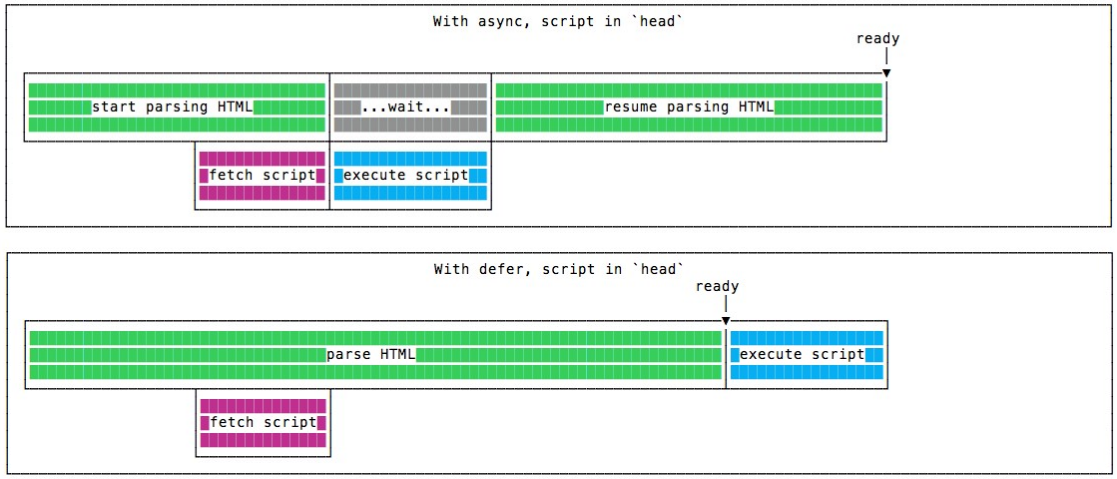


https://flaviocopes.com/javascript-async-defer/

New Loading Attributes

- `<script async src="script.js"></script>`
  - Script will be **fetched in parallel** to parsing and evaluated **as soon as** it is available
  - Not immediately executed, not blocking
- `<script defer src="script.js"></script>` (***preferred***)
  - Indicate to a browser that the script is meant to be
    - Fetched in parallel to parsing
    - Executed **after** the document has been parsed, but before firing `DOMContentLoaded` (that will wait until the script is finished)
  - Guaranteed to execute in the **order** they are loaded
- Both should be placed in the <head> of the document

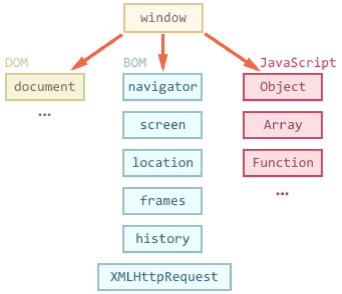
`defer` vs. `async`



https://flaviocopes.com/javascript-async-defer/

Where Does The Code Run?

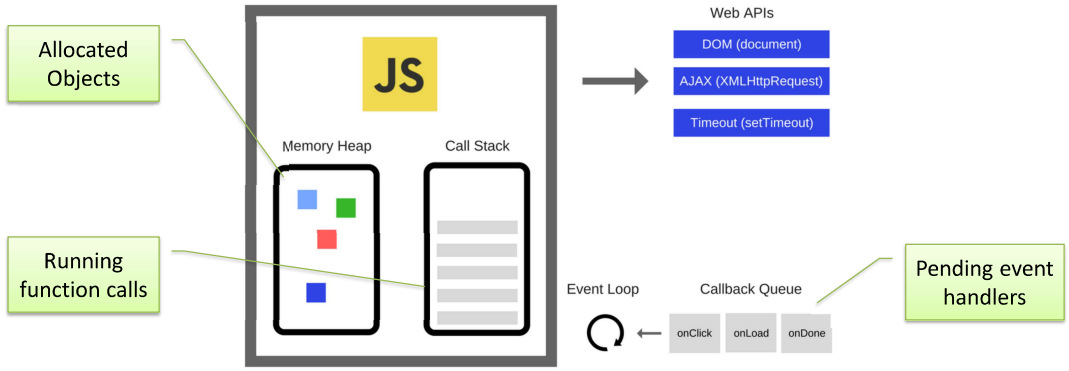
- Loaded and run in the browser *sandbox*
- Attached to a *global context:* the `window` object
- May access only a limited set of APIs
  - JS Standard Library
  - Browser objects (BOM)
  - Document objects (DOM)
- Multiple `<script>`s are independent
  - They all access the same global scope
  - To have structured collaboration, *modules* are needed



Events and Event Loop

- Most phases of processing and interaction with a web document will generate Asynchronous *Events* (100's of different types)
- Generated events may be handled by:
  - Pre-defined behaviors (by the browser)
  - User-defined *event handlers* (in your JS)
  - Or just ignored, if no event handler is defined
- But JavaScript is single-threaded
  - Event handling is *synchronous* and is based on an *event loop*
  - Event handlers are queued on a *Message Queue*
  - The Message Queue is polled when the main thread is idle

Execution Environment



Event Loop

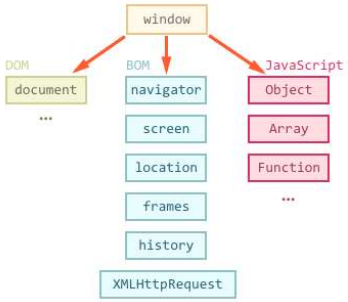
- During code execution you may
  - Call functions → the function call is pushed to the call stack
  - Schedule events → the call to the event handler is put in the Message Queue
    - Events may be scheduled also by external events (user actions, I/O, network, timers, …)
- At any step, the JS interpreter:
  - If the call stack is not empty, pop the top of the call stack and executes it
  - If the call stack is empty, pick the head of the Message Queue and executes it
- A function call / event handler is **never** interrupted
  - Avoid blocking code!

https://developer.mozilla.org/en-US/docs/Web/JavaScript/EventLoop
https://nodejs.org/en/docs/guides/event-loop-timers-and-nexttick/#what-is-the-event-loop

BROWSER OBJECT MODEL

Browser Main Objects

- `window` represents the window that contains the DOM document
  - allows to interact with the browser via the BOM: browser object model (not standardized)
  - global object, contains all JS global variables
    - can be omitted when writing JS code in the page
- `document`
  - represents the DOM tree loaded in a window
  - accessible via a `window` property: `window.document`



https://medium.com/@fknussel/dom-bom-revisited-cf6124e2a816

Browser Object Model

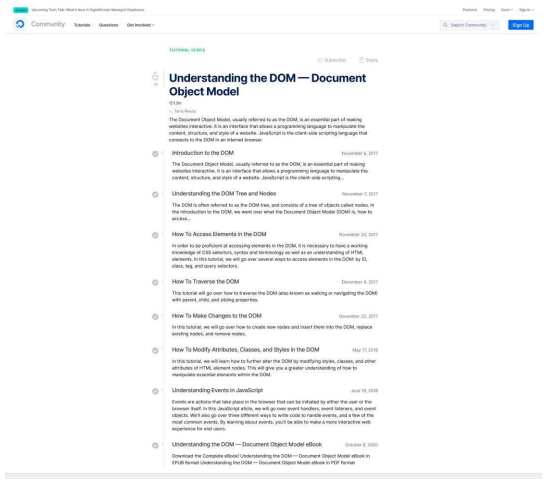
- `window` properties
  - `console`: browser debug console (visible via developer tools)
  - `document`: the document object
  - `history`: allows access to History API (history of URLs)
  - `location`: allows access to Location API (current URL, protocol, etc.). Read/write property, i.e., can be set to load a new page
  - `localStorage` and `sessionStorage`: allows access to the two objects via the Web Storage API, to store (small) info locally in the browser

https://developer.mozilla.org/en-US/docs/Web/API/Window

JS in the browser

DOCUMENT OBJECT MODEL

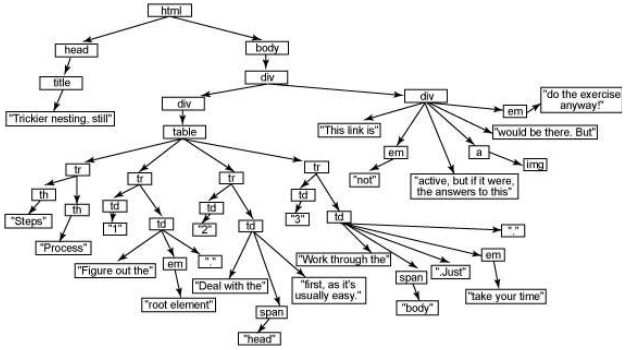
Suggested Reading



- https://www.digitalocean.com/community/tutorial_series/understanding-the-dom-document-object-model
- Complete and detailed tutorial
- Here, we will *focus* on the core concepts and techniques

DOM

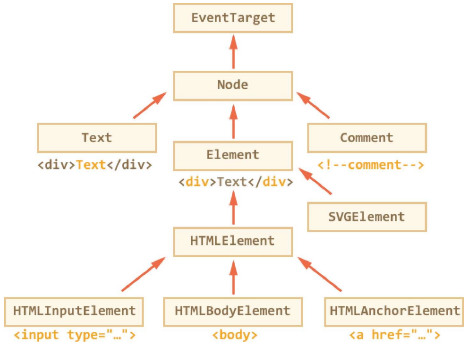
- Browser's internal representation of a web page
  - Obtained through parsing HTML
- Browsers expose an API that you can use to interact with the DOM
  - Access the page metadata and headers
  - Inspect the page structure
  - Edit any node in the page
  - Change any node attribute
  - Create/delete nodes in the page
  - Edit the CSS styling and classes
  - Attach or remove *event listeners*



https://flaviocopes.com/dom/

Types Of Nodes (classes)

- **Document**: the document Node, the root of the tree
- **Element**: an HTML tag
- **Attr**: an attribute of a tag
- **Text**: the text content of an Element or Attr Node
- **Comment**: an HTML comment
- **DocumentType**: the Doctype declaration



Node Lists

- The DOM API may manipulate sets/lists of nodes
- The `NodeList` type is an array-like sequence of Nodes
- May be accessed as a JS Array
  - `.length` property
  - `.item(i)` , equivalent to `list[i]`
  - `.entries()`, `.keys()`, `.values()` iterators
  - `.forEach()` functional iteration
  - `for…of` classical iteration

JS in the browser

DOM MANIPULATION

Finding DOM elements

- `document.getElementById(value)`
  - Returns the Node with the attribute id=value
- `document.getElementsByTagName(value)`
  - Returns the NodeList of all elements with the specified tag name (e.g., 'div')
- `document.getElementsByClassName(value)`
  - Returns the NodeList of all elements with attribute class=value (e.g., 'col-8')
- `document.querySelector(css)`
  - Returns the first Node element that matches the CSS selector syntax
- `document.querySelectorAll(css)`
  - Returns the NodeList of all elements that match the CSS selector syntax

https://flaviocopes.com/dom/

Note

- Node-finding methods also work on any Element node
- In that case, they only search through *descendant* elements
  - May be used to refine the search
- Example:

```
let main = document.getElementById('main');
let articletext = main.getElementsByTagName('p');
```

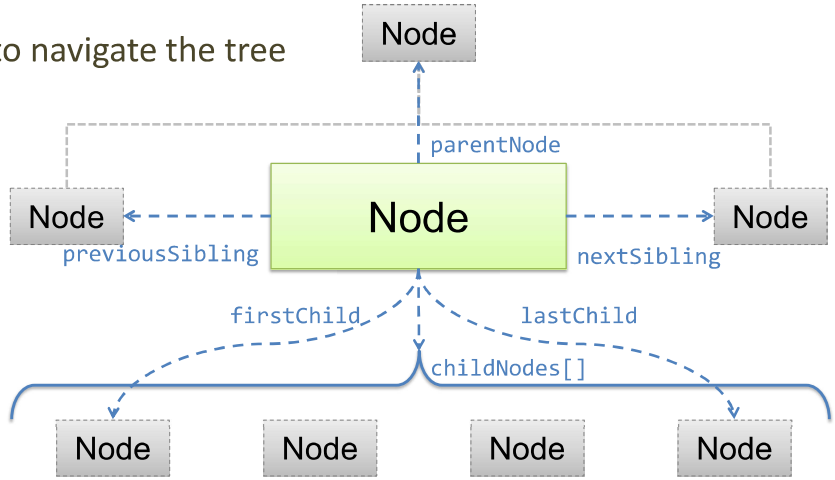

Accessing DOM Elements

```
<!DOCTYPE html>
<html>
<head></head>
<body>
<div id="foo"></div>
<div class="bold"></div>
<div class="bold color"></div>
<script>
 document.getElementById('foo');
 document.querySelector('#foo');
 document.querySelectorAll('.bold');
 document.querySelectorAll('.color');
 document.querySelectorAll('.bold, .color');
</script>
</body>
</html>
```

```
<div id="foo"></div>
<div id="foo"></div>
▶ NodeList(2) [div.bold, div.bold.color]
▶ NodeList [div.bold.color]
▶ NodeList(2) [div.bold, div.bold.color]
>
```

Navigating The Tree

- Properties to navigate the tree



Tag Attributes Exposed As Properties

- *Attributes* of the HTML elements become *object properties* of the DOM objects
- Example
  - `<body id="page">`
  - DOM object: `document.body.id="page"`
  - Also: `document["body"]["id"]`

  - `<input id="input" type="checkbox" checked />`
  - DOM object: `input.checked  // boolean`

Handling Tag Attributes

- `elem.hasAttribute(name)`
  - check the existence of the attribute
- `elem.getAttribute(name)`
  - check the value, like `elem[name]`
- `elem.setAttribute(name, value)`
  - set the value of the attribute
- `elem.removeAttribute(name)`
  - delete the attribute
- `elem.attributes`
  - collection of all attributes
- `elem.matches(css)`
  - Check whether the element matches the CSS selector

Creating Elements

- Use document methods:
  - `document.createElement(tag)` to create an element with a chosen tag
  - `document.createTextNode(text)` to create a text node with the given text
- Example: div with class and content

```
let div = document.createElement('div');
div.className = "alert alert-success";
div.innerText = "Hi there! You've read an important message.";
```

```
<div class="alert alert-success">
Hi there! You've read an important message.
</div>
```

Inserting Elements In The DOM Tree

- If not inserted, they will not appear

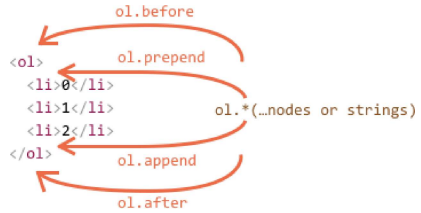
  `document.body.appendChild(div)`

```
...
<body>
 <div class="alert alert-success">
 <strong>Hi there!</strong> You've read an important message.
 </div>
<body>
```


Inserting Children

- **`parentElem.appendChild(node)`**
- `parentElem.insertBefore(node, nextSibling)`
- `parentElem.replaceChild(node, oldChild)`

- `node.append(…nodes or strings)`
- `node.prepend(…nodes or strings)`
- `node.before(…nodes or strings)`
- `node.after(…nodes or strings)`
- `node.replaceWith(…nodes or strings)`



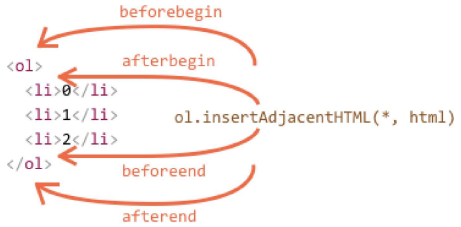
Handling Tag Content

- `.innerHTML` to get/set element content in textual form
- The browser will parse the content and convert it into DOM Nodes and Attrs

```
<div class="alert alert-success">
    <strong>Hi there!</strong> You've read an important message.
</div>
```

```
div.innerHTML  // "<strong>Hi there!</strong> You've read an important message."
```


Inserting New Content



- `elem.innerHTML = "`*html fragment*`"`
- `elem.insertAdjacentHTML(where, HTML)`
  - where = `"beforebegin"` | `"afterbegin"` | `"beforeend"` | `"afterend"`
  - HTML = HTML fragment with the nodes to insert
- `elem.insertAdjacentText(where, text)`
- `elem.insertAdjacentElement(where, elem)`

Cloning Nodes

- `elem.cloneNode(true)`
  - Recursive (deep) copy of the element, including its attributes, sub-elements, …
- `elem.cloneNode(false)`
  - Shallow copy (will not contain the children)
- Useful to “replicate” some part of the document

DOM Styling Elements

- Via values of **class** attribute defined in CSS
- Change class using the property `className`
  - Replaces the whole string of classes
  - *Note*: `className`, not `class` (JS reserved word)
- To add/remove a single class use `classList`
  - `elem.classList.add("col-3")` add a class
  - `elem.classList.remove("col-3")` remove a class
  - `elem.classList.toggle("col-3")` if the class exists, it removes it, otherwise it adds it
  - `elem.classList.contains("col-3")` returns true/false checking if the element contains the class

DOM Styling Elements

- `elem.style` contains all CSS properties
  - Example: hide element

    ```
    elem.style.display="none"
    ```

    (equivalent to CSS declaration `display:none`)

- `getComputedStyle(element[,pseudo])`
  - `element`: selects the element of which we want to read the value
  - `pseudo`: a pseudo element, if necessary
- For properties that use more words the camelCase is used (`backgroundColor`, `zIndex...` instead of `background-color ...`)

Mozilla Developer Network: Event Reference
https://developer.mozilla.org/en-US/docs/Web/Events

JS in the browser

EVENT HANDLING

Event Listeners

- JavaScript in the browser uses an *event-driven* programming model
  - Everything is triggered by the firing of an event
- Events are determined by
  - The Element generating the event (event ~~source~~ target)
  - The type of generated event

https://flaviocopes.com/javascript-events/

addEventListener()

- Can add as many listeners as desired, even to the same node
- Callback receives as first parameter an `Event` object

```
window.addEventListener('load', (event) => {
  //window loaded
})
```

```
const link = document.getElementById('my-link')
link.addEventListener('mousedown', event => {
  // mouse button pressed
  console.log(event.button) //0=left, 2=right
})
```

https://flaviocopes.com/javascript-events/

Event Object

- Main properties:
  - `target`, the DOM element that originated the event
  - `type`, the type of event

https://developer.mozilla.org/en-US/docs/Web/API/Event/type

Event Categories

- User Interface events (load, resize, scroll, etc.)
- Focus/blur events
- Mouse events (click, dblclick, mouseover, drag,
- Keyboard events (keyup, etc.)
- Form events (submit, change, input)
- Mutation events (DOMContentLoaded, etc.)
- HTML5 events (invalid, loadeddata, etc.)
- CSS events (animations etc.)

Category	Type	Attribute	Description	Bubbles	Cancelable
Mouse	click	onclick	Fires when the pointing device button is clicked over an element. A click is defined as a mousedown and mouseup over the same screen location. The sequence of these events is: • mousedown • mouseup • click	Yes	Yes
	dblclick	ondblclick	Fires when the pointing device button is double-clicked over an element	Yes	Yes
	mousedown	onmousedown	Fires when the pointing device button is pressed over an element	Yes	Yes
	mouseup	onmouseup	Fires when the pointing device button is released over an element	Yes	Yes
	mouseover	onmouseover	Fires when the pointing device is moved onto an element	Yes	Yes
	mousemove[1]	onmousemove	Fires when the pointing device is moved while it is over an element	Yes	Yes
	mouseout	onmouseout	Fires when the pointing device is moved away from an element	Yes	Yes
	dragstart	ondragstart	Fired on an element when a drag is started.	Yes	Yes
	drag	ondrag	This event is fired at the source of the drag, that is, the element whose dragstart was fired, during the drag operation.	Yes	Yes
	dragenter	ondragenter	Fired when the mouse is first moved over an element while a drag is occurring.	Yes	Yes
	dragleave	ondragleave	This event is fired when the mouse leaves an element while a drag is occurring.	Yes	No
	dragover	ondragover	This event is fired as the mouse is moved over an element when a drag is occuring.	Yes	Yes
	drop	ondrop	The drop event is fired on the element where the drop occurs at the end of the drag operation.	Yes	Yes
	dragend	ondragend	The source of the drag will receive a dragend event when the drag operation is complete, whether it was successful or not.	Yes	No
Keyboard	keydown	onkeydown	Fires before keypress, when a key on the keyboard is pressed.	Yes	Yes
	keypress	onkeypress	Fires after keydown, when a key on the keyboard is pressed.	Yes	Yes
	keyup	onkeyup	Fires when a key on the keyboard is released.	Yes	Yes
HTML frame/object	load	onload	Fires when the user agent finishes loading all content within a document, including window, frames, objects and images For elements, it fires when the target element and all of its content has finished loading	No	No
	unload	onunload	Fires when the user agent removes all content from a window or frame For elements, it fires when the target element or any of its content has been removed	No	No
	abort	onabort	Fires when an object/image is stopped from loading before completely loaded	Yes	No
	error	onerror	Fires when an object/image/frame cannot be loaded properly	Yes	No
	resize	onresize	Fires when a document view is resized	Yes	No
	scroll	onscroll	Fires when an element or document view is scrolled	No, except that a scroll event on document must bubble to the window[2]	No
HTML form	select	onselect	Fires when a user selects some text in a text field, including input and textarea	Yes	No
	change	onchange	Fires when a control loses the input focus and its value has been modified since gaining focus	Yes	No
	submit	onsubmit	Fires when a form is submitted	Yes	Yes
	reset	onreset	Fires when a form is reset	Yes	No
	focus	onfocus	Fires when an element receives focus either via the pointing device or by tab navigation	No	No
	blur	onblur	Fires when an element loses focus either via the pointing device or by tabbing navigation	No	No
User Interface	focusin	(none)	Similar to HTML focus event, but can be applied to any focusable element	Yes	No
	focusout	(none)	Similar to HTML blur event, but can be applied to any focusable element	Yes	No
	DOMActivate	(none)	Similar to XUL command event. Fires when an element is activated, for instance, through a mouse click or a keypress.	Yes	Yes
Mutation	DOMSubtreeModified	(none)	Fires when the subtree is modified	Yes	No
	DOMNodeInserted	(none)	Fires when a node has been added as a child of another node	Yes	No
	DOMNodeRemoved	(none)	Fires when a node has been removed from a DOM tree	Yes	No
	DOMNodeRemovedFromDocument	(none)	Fires when a node is being removed from a document	No	No
	DOMNodeInsertedIntoDocument	(none)	Fires when a node is being inserted into a document	No	No
	DOMAttrModified	(none)	Fires when an attribute has been modified	Yes	No
	DOMCharacterDataModified	(none)	Fires when the character data has been modified	Yes	No
Progress	loadstart	(none)	Progress has begun.	No	No
	progress	(none)	In progress. After loadstart has been dispatched.	No	No
	error	(none)	Progression failed. After the last progress has been dispatched, or after loadstart has been dispatched if progress has not been dispatched.	No	No
	abort	(none)	Progression is terminated. After the last progress has been dispatched, or after loadstart has been dispatched if progress has not been dispatched.	No	No
	load	(none)	Progression is successful. After the last progress has been dispatched, or after loadstart has been dispatched if progress has not been dispatched.	No	No
	loadend	(none)	Progress has stopped. After one of error, abort, or load has been dispatched.	No	No

https://en.wikipedia.org/wiki/DOM_events

Preventing Default Behavior

- Many events cause a default behavior
  - Click on link: go to URL
  - Click on submit button: form is sent
- Can be prevented by `event.preventDefault()`

HTML Page Lifecycle: Events

- `DOMContentLoaded` (defined on `document`)
  - The browser loaded all HTML, and the DOM tree is ready
  - External resources are not loaded, yet
- `load` (defined on `window`)
  - The browser finished loading all external resources
- `beforeunload`/`unload`
  - The user is about to leave the page / has just left the page
  - Not recommended (not totally reliable)

```
document.addEventListener("DOMContentLoaded", ready);
```

Mozilla Developer Network:
Web forms — Collecting data from users
https://developer.mozilla.org/en-US/docs/Learn/Forms

Handling user input

FORM CONTROLS

Form Declaration

- `<form>` tag
- Specifies URL to be used for submission (attribute `action`)
- Specifies HTTP method (attribute `method`, default GET)

```
...
<form action="/new-task" method="POST" id="userdata">
       ...normal HTML content...
              and
       ...FORM Controls...
</form>
...
```

Form Controls

- A set of HTML elements allowing different types of user input/interaction. Each element should be uniquely identified by the value of the `name` attribute
- Several control categories
  - Input
  - Selection
  - Button
- Support elements
  - Label
  - Datalist

https://developer.mozilla.org/en-US/docs/Web/HTML/Element#Forms

Input Control

- `<input>` tag
- Text input example
- The `value` attribute will hold user-provided text

```
...
<input type="text" name="firstname" placeholder="Your username"></input>
...
```

Locating a Form In The DOM

- `document.forms` is a collection of all forms in the page

```
const myForm = document.forms['form ID’]
```

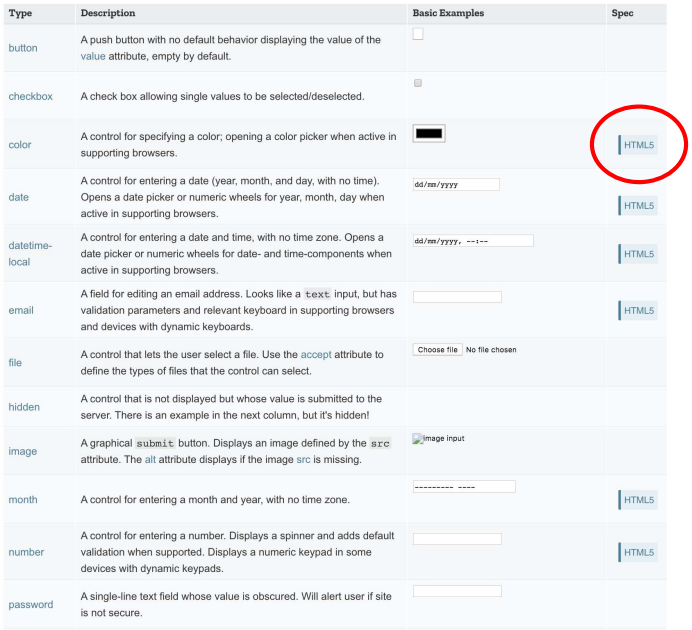
- Each `form` node has an **`elements`** properties, that collects all data-containing inner elements

```
const myElement = myForm.elements['element ID']
```

https://developer.mozilla.org/en-US/docs/Web/API/HTMLFormElement

Input Control (1)

- `type` attribute
  - `button`
  - `checkbox`
  - `color`
  - `date`
  - `email`
  - `file`
  - `hidden`
  - `month`
  - `number`
  - `password`

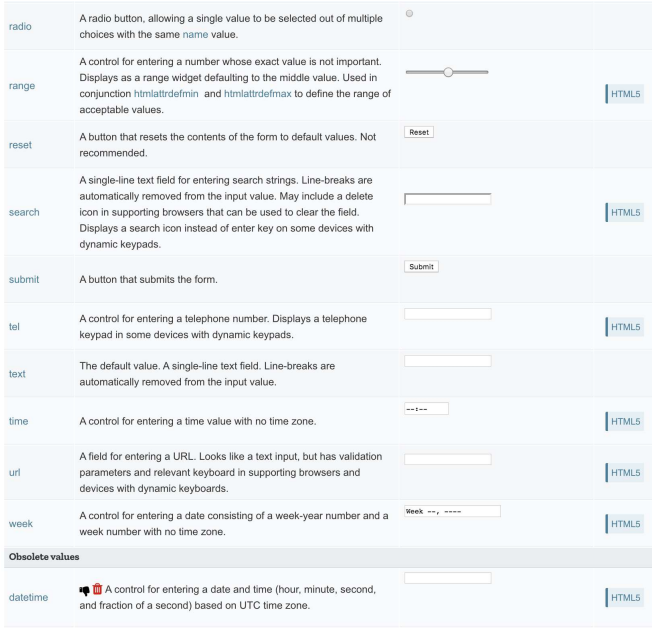


Type	Description	Basic Examples	Spec
button	A push button with no default behavior displaying the value of the value attribute, empty by default.		
checkbox	A check box allowing single values to be selected/deselected.		
color	A control for specifying a color; opening a color picker when active in supporting browsers.		HTML5
date	A control for entering a date (year, month, and day, with no time). Opens a date picker or numeric wheels for year, month, day when active in supporting browsers.	dd/mm/yyyy	HTML5
datetime-local	A control for entering a date and time, with no time zone. Opens a date picker or numeric wheels for date- and time-components when active in supporting browsers.	dd/mm/yyyy, --:--	HTML5
email	A field for editing an email address. Looks like a `text` input, but has validation parameters and relevant keyboard in supporting browsers and devices with dynamic keyboards.		HTML5
file	A control that lets the user select a file. Use the accept attribute to define the types of files that the control can select.	Choose file No file chosen	
hidden	A control that is not displayed but whose value is submitted to the server. There is an example in the next column, but it's hidden!		
image	A graphical `submit` button. Displays an image defined by the `src` attribute. The alt attribute displays if the image src is missing.	image input	
month	A control for entering a month and year, with no time zone.	--------- ----	HTML5
number	A control for entering a number. Displays a spinner and adds default validation when supported. Displays a numeric keypad in some devices with dynamic keypads.		HTML5
password	A single-line text field whose value is obscured. Will alert user if site is not secure.		

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/input

Input Control (2)

- `type` attribute
  - `radio` (button)
  - `range`
  - `submit`/`reset` (button)
  - `search`
  - `tel`
  - `text`
  - `url`
  - `week`



radio	A radio button, allowing a single value to be selected out of multiple choices with the same name value.		
range	A control for entering a number whose exact value is not important. Displays as a range widget defaulting to the middle value. Used in conjunction htmlattrdefmin and htmlattrdefmax to define the range of acceptable values.		HTML5
reset	A button that resets the contents of the form to default values. Not recommended.	Reset	
search	A single-line text field for entering search strings. Line-breaks are automatically removed from the input value. May include a delete icon in supporting browsers that can be used to clear the field. Displays a search icon instead of enter key on some devices with dynamic keypads.		HTML5
submit	A button that submits the form.	Submit	
tel	A control for entering a telephone number. Displays a telephone keypad in some devices with dynamic keypads.		HTML5
text	The default value. A single-line text field. Line-breaks are automatically removed from the input value.		
time	A control for entering a time value with no time zone.	--:--	HTML5
url	A field for entering a URL. Looks like a text input, but has validation parameters and relevant keyboard in supporting browsers and devices with dynamic keyboards.		HTML5
week	A control for entering a date consisting of a week-year number and a week number with no time zone.	Week --, ----	HTML5
Obsolete values			
datetime	A control for entering a date and time (hour, minute, second, and fraction of a second) based on UTC time zone.		HTML5

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/input

Input Control: Commonly Used Attributes

Attribute	Meaning
`checked`	`radio`/`checkbox` is selected
`disabled`	control is disabled
`readonly`	value cannot be edited
`required`	need a valid input to allow form submission
`size`	the size of the control (pixels or characters)
`value`	the value inserted by the user
`autocomplete`	hint for form autofill feature of the browser

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/input#Attributes

Input Control: Other Attributes

- Depends on the control

```
<input type="number" name="age" placeholder="Your age" min="18" max="110" />

<input type="text" name="username" pattern="[a-zA-Z]{8}" />

<input type="file" name="docs" accept=".jpg, .jpeg, .png" />
```

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/input#Attributes

Label Tag

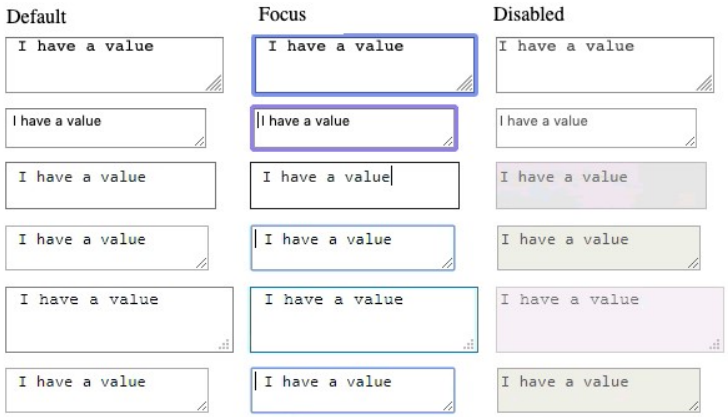
- The HTML `<label>` element represents a caption for an item in a user interface. Associated with `for` attribute and `id` on input
- Important for accessibility purposes (e.g. screenreader etc.), clicking the label activates the control (larger activation area e.g. in touch screens)

```
<div class="preference">
    <label for="cheese">Do you like cheese?</label>
    <input type="checkbox" name="cheese" id="cheese">
</div>
<div class="preference">
    <label for="peas">Do you like peas?</label>
    <input type="checkbox" name="peas" id="peas">
</div>
```

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/label

Other Form Controls

`<textarea>`:
a multi-line text field

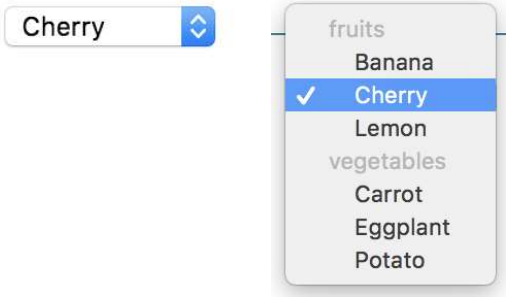


https://developer.mozilla.org/en-US/docs/Learn/Forms/Other_form_controls

Other Form Controls

Drop-down controls

```
<select id="groups" name="groups">
  <optgroup label="fruits">
    <option>Banana</option>
    <option selected>Cherry</option>
    <option>Lemon</option>
  </optgroup>
  <optgroup label="vegetables">
    <option>Carrot</option>
    <option>Eggplant</option>
    <option>Potato</option>
  </optgroup>
</select>
```



https://developer.mozilla.org/en-US/docs/Learn/Forms/Other_form_controls

Button Control

- `<button>` tag
- Three types of buttons
  - `submit`: submits the form to the server
  - `reset`: reset the content of the form to the initial value
  - `button`: just a button, whose behavior needs to be specified by JavaScript

```
...
<button type="submit" value="Send data" />
...
```


Button vs. input type=button

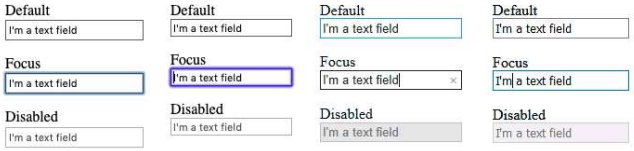
More flexible, can have content (markup, images, etc.)

```
...
<button class="favorite styled"
        type="button">
    Add to favorites
</button>
...
<button name="favorite">
  <svg aria-hidden="true" viewBox="0 0 10 10"><path
d="M7 9L5 8 3 9V6L1 4h3l1-3 1 3h3L7 6z"/></svg>
  Add to favorites
</button>
...
```

https://developer.mozilla.org/en-US/docs/Web/HTML/Element/button

Default Appearance May Vary

- Solve with CSS, but
- Some problems still remain
  - See: "Styling web forms" in MDN
  - Examples of controls difficult to manage:
    - Bad: Checkboxes, …
    - Ugly: Color, Range, File: cannot be styled via CSS



https://developer.mozilla.org/en-US/docs/Learn/Forms/Styling_web_forms

The Road to Nicer Forms

- Useful libraries (frameworks) and polyfills
  - Especially for controls difficult to handle via CSS
  - Rely on JavaScript
- Suggestions
  - Bootstrap
  - Using libraries may improve accessibility

https://developer.mozilla.org/en-US/docs/Learn/Forms/Advanced_form_styling

Mozilla Developer Network:
Web forms — Form Validation
https://developer.mozilla.org/en-US/docs/Learn/Forms/Form_validation

Handling user input

FORM EVENTS

Events On Input Elements

Event	Meaning
`input`	the value of the element is changed (even a single character)
`change`	when something changed in the element (for text elements, it is fired only once when the element loses focus)
`cut copy paste`	when the user does the corresponding action
`focus`	when the element gains focus
`blur`	when the element loses focus
`invalid`	when the form is submitted, fires for each element which is invalid, and for the form itself

https://developer.mozilla.org/en-US/docs/Learn/Forms/Form_validation

Example

```
...
<form action="/add" method="POST">
  <input type="text">
  <input type="submit">
</form>
...
```


```
const inputField = document.querySelector('input[type="text"]')

inputField.addEventListener('input', event => {
  console.log(`The current entered value is: ${inputField.value}`);
})

inputField.addEventListener('change', event => {
  console.log(`The value has changed since last time: ${inputField.value}`);
})
```


Form Submission

- Can be intercepted with the `submit` event
- If required, default action can be prevented in eventListener with the `preventDefault()` method
  - A new page is NOT loaded, everything is handled in the JavaScript: single page application

```
document.querySelector('form').addEventListener('submit', event => {
    event.preventDefault();
    console.log('submit');
})
```

References

- Web forms — Collecting data from users
  - https://developer.mozilla.org/en-US/docs/Learn/Forms
- Basic native form controls
  - https://developer.mozilla.org/en-US/docs/Learn/Forms/Basic_native_form_controls
- The HTML5 input types
  - https://developer.mozilla.org/en-US/docs/Learn/Forms/HTML5_input_types

References

- Web Engineering SS20 - TU Wien, prof. Jürgen Cito, https://web-engineering-tuwien.github.io/
- Async and defer
  - Efficiently load JavaScript with defer and async, Flavio Copes, https://flaviocopes.com/javascript-async-defer/
  - https://hacks.mozilla.org/2017/09/building-the-dom-faster-speculative-parsing-async-defer-and-preload/

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