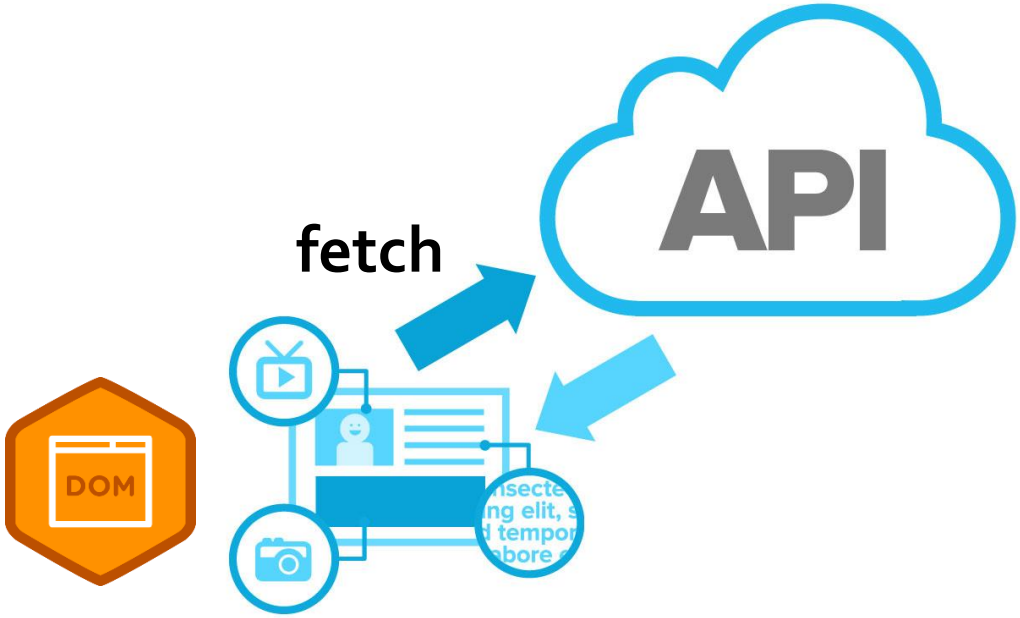
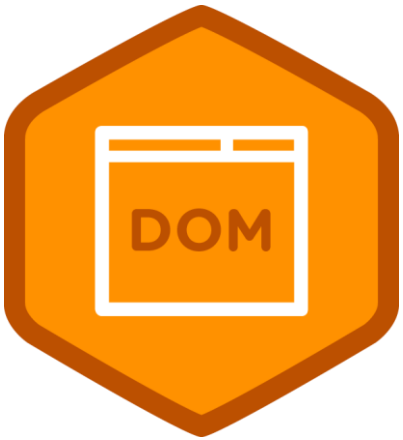
JavaScript on the Client Side



Outline

1. DOM Manipulation using JavaScript
2. Event Handling
3. Consume Web API using Fetch
4. HTML Template to generate the UI
5. Web Storage API
6. IndexedDB

DOM Manipulation using JavaScript



What Can JavaScript Do?

- **Server-Side Web applications**
  - Write server-side application logic and Web API (using Node.js)
- **Client-Side Dynamic Behavior**
  - **React to user input** i.e., handle client-side events such as button clicked event. e.g., valid the form data when the submit button is clicked
  - **Updating the page**
    - Add/update/delete page content: **Manipulate the Document Object Model** (DOM) of the page: read, modify, add, delete HTML elements
    - Change how things look: CSS updates
  - **Validate form input** values before being submitted to the server
  - **Perform computations**, sorting and animation
  - **Perform asynchronous Web API calls** (AJAX) to get or submit JSON data to the server without reloading the page

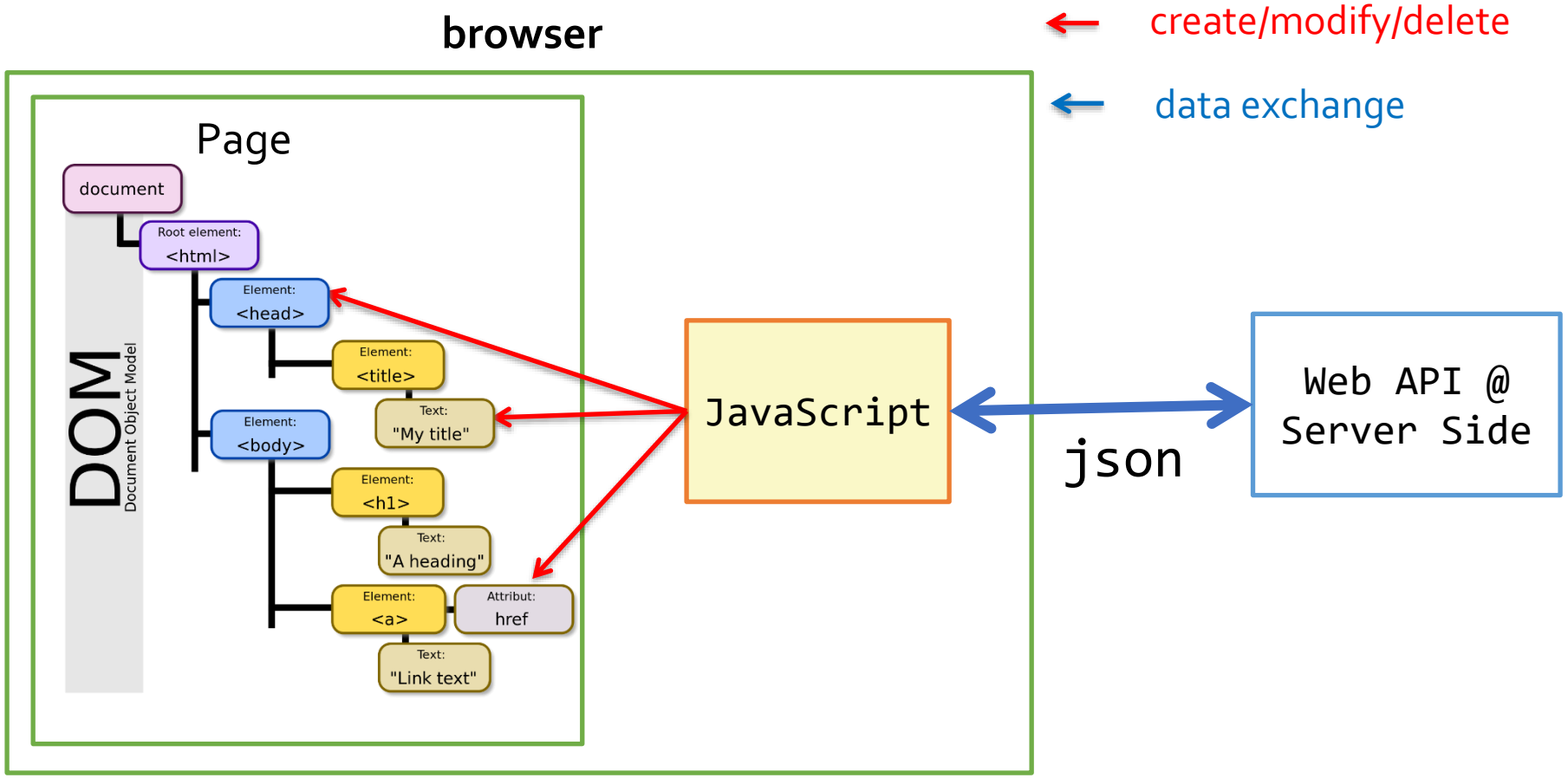
Where to place JavaScript Code?

- The JavaScript code can be placed in:
  - `<script>` tag in the head
  - In an external file and add a reference to it in the HTML file. This is the recommended way
    - Reference via `<script>` tag in the **head** or at the end of the **body**

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

    - JavaScript files usually have **`.js`** extension
    - The `.js` files get cached by the browser

Role of JavaScript on the Client Side

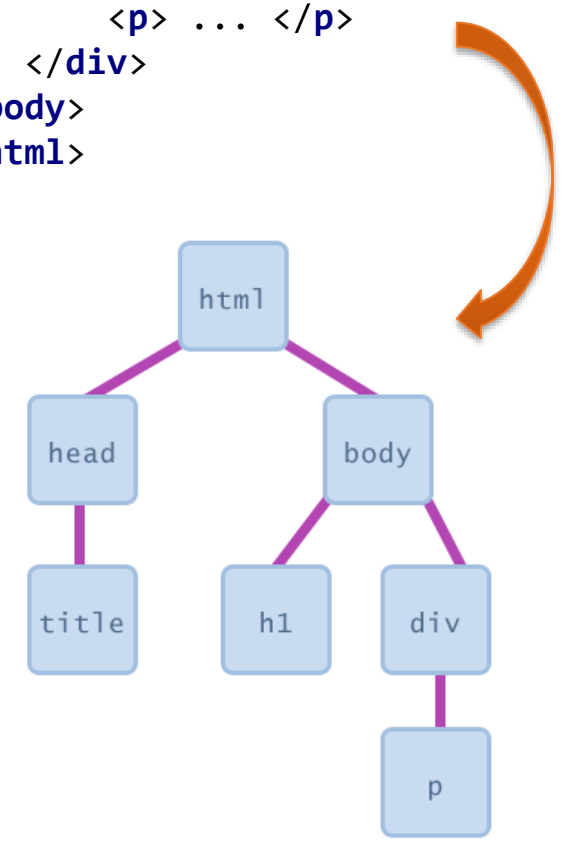


- DOM = A tree structure built out of the page HTML elements
- Use JavaScript to manipulate the DOM

Document Object Model (DOM)

- DOM: Object-oriented Representation of the document
- DOM API consist of objects and methods to interact with the HTML page
  - **Select** page elements
  - **Add**, **update** or **remove** page elements
  - **Apply styles** dynamically
  - **Listen** to and **handle** events

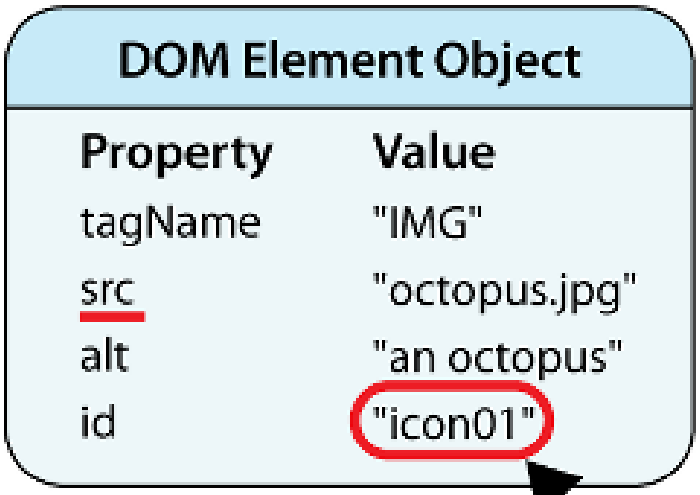
```
<html>
<head>
    <title> ... </title>
</head>
<body>
    <h1> ... </h1>
    <div>
        <p> ... </p>
    </div>
</body>
</html>
```



Example DOM Element

HTML

```
<p>
  Look at this octopus:
  <img src="octopus.jpg" alt="an octopus" id="icon01" />
  Cute, huh?
</p>
```



JavaScript

```
var icon = document.getElementById("icon01");
icon.src = "kitty.gif";
```

document object represents the document displayed

Selecting HTML Elements

- Elements must be **selected first** before changing them or listening to their events
  - **querySelector**() returns the first element that matches a specified *CSS selector* in the document
  - **querySelectorAll**() returns all elements in the document that matches a specified CSS selector

Example CSS selectors:

1. By tag name: `document.querySelector("p")`
2. By id : `document.querySelector("#id")`
3. By class: `document.querySelector(".classname")`
4. By attribute: `document.querySelector("img[src='cat.png']")`
   - Return the first image whose src attribute is set to **cat.png**

- Examples

- https://www.w3schools.com/jsref/met_document_queryselector.asp
- https://www.w3schools.com/jsref/met_document_queryselectorall.asp

Selecting Elements – old way!

- Access elements via their ID attribute

```
const element = document.getElementById("some-id")
```

- Via the **name** attribute

```
const elArray = document.getElementsByName("some-name")
```

- Via tag name

```
const imgTags = document.getElementsByTagName("img")
```

  - Returns array of `<img>` elements

DOM Manipulation

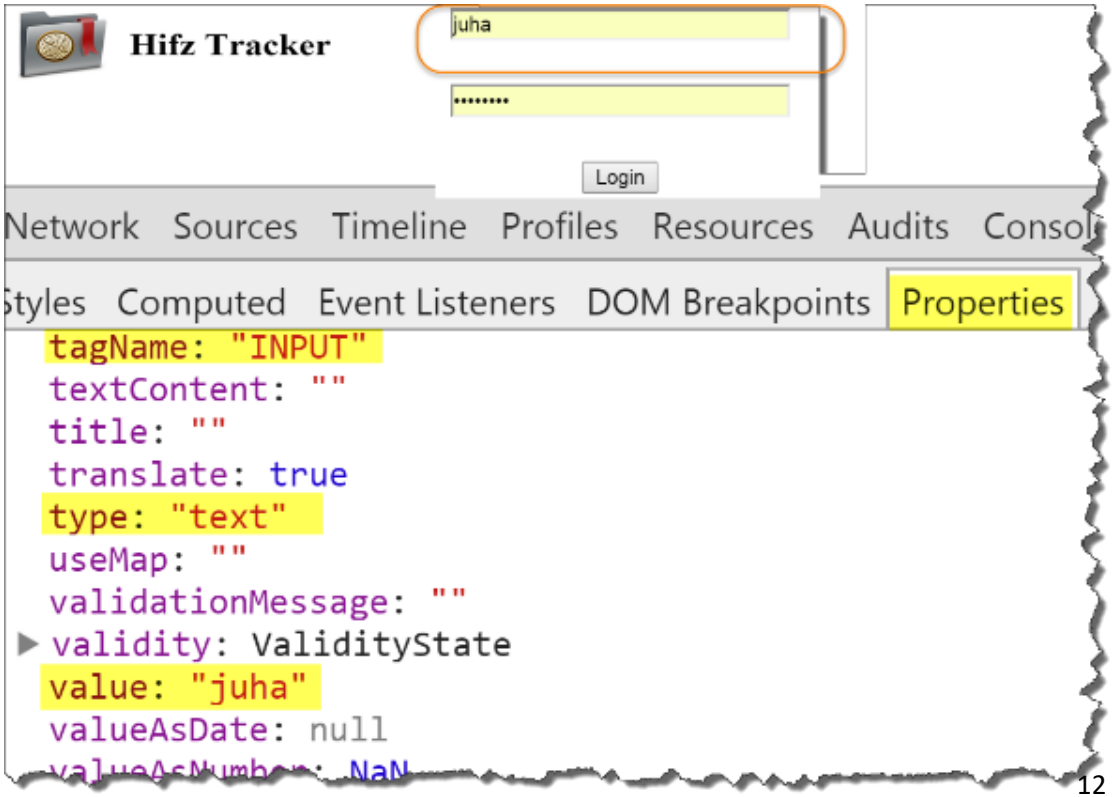
- Once we **select** an element, we can read / change its attributes

```
function change(state) {
  const lampImg = document.querySelector("#lamp")
  lampImg.src = `lamp_${state}.png`
  const statusDiv =
    document.querySelector("#statusDiv")
  statusDiv.innerHTML = `The lamp is ${state}`
}
…
<img src="lamp-on.jpg"  id="lamp"
  onmouseover="change('off')"
  onmouseout="change('on')" />
```

Common Element Properties

- `value` - get/set value of input elements
- `innerHTML` - get/set the HTML content of an element
- `className` - the `class` attribute of an element

User Chrome Dev Tool to see the Properties of Page element



Commonly used DOM methods

- **Add Element**

```
const newDiv = document.createElement('div')
newDiv.innerText = 'Div added by script'
document.body.append(newDiv)
```

- **Remove Element**

```
document.querySelector('#myDiv').remove()
```

- **DOM Traversal**

```
const parent = document.querySelector('#about').parentNode
const children = document.querySelector('#about').children
```

- **Hide & Show**

```
document.querySelector('#myDiv').style.display = 'none'
document.querySelector('#myDiv').style.display = ''
```

- **Add/Remove/Toogle CSS Classes**
  - `document.querySelector('#myDiv').classList.add('alert-success')`
  - `document.querySelector('#myDiv').classList.remove('alert-success')`
  - `document.querySelector('#myDiv').classList.toogle('alert-success')`

data attributes

- **data-*** attributes allow us to store extra information on HTML elements
  - The name of a custom data attribute begins with **data-**
  - The name of a custom data attribute in JavaScript is the same HTML attribute but in camelCase and with no dashes, dots, etc.
- The **dataset** property provides read/write access to all the custom data attributes (data-*) set on the element

Dataset property

- Dataset property is used to read write custom data attributes set on the element

```
<div id="user" data-
id="123456"
data-user-name="johndoe">
    John Doe
</div>
```

```
const el = document.querySelector('#user');
console.log(el.dataset);


// set a data attribute
el.dataset.dob = '1960-10-03';
console.log("dob: ", el.dataset.dob);

delete el.dataset.dob;

console.log("mobile: ", 'mobile' in el.dataset);
if ('mobile' in el.dataset === false) {
    el.dataset.mobile = '55751585';
}
console.log(el.dataset);
```

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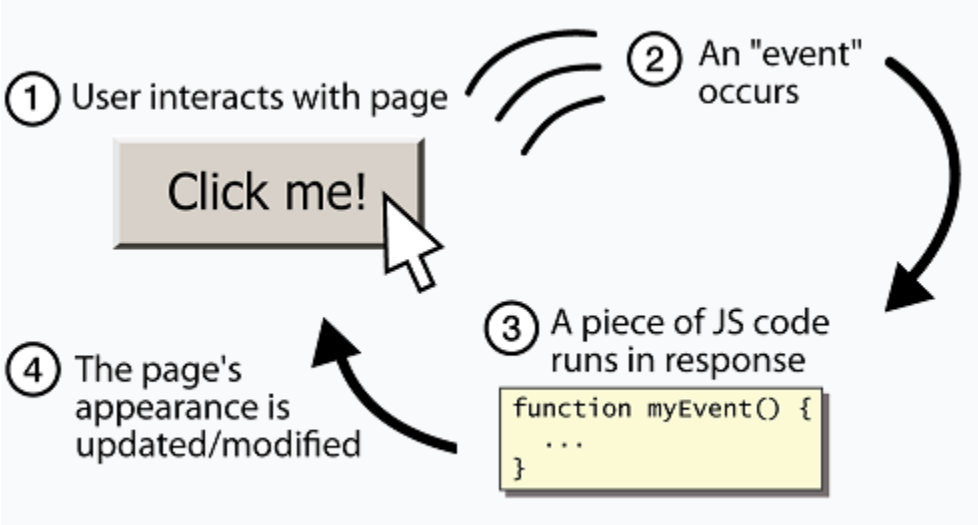
Event Handling



Back

Event Driven Programming

- UI programming model is based on **event driven programming**
  - Code is executed upon activation of events
- An **event** is a signal from the Browser that some something of interest to the app has occurred
  - UI Events (click, change, drag)
  - Input focus (gained, lost)
  - Keyboard (key press, key release)
  - Page events (e.g., DOMContentLoaded)
- When an event is triggered, an event handler can run to respond to the event. e.g.,
  - When the button is clicked -> load the data from a Web API into a list

Events Handling

- UI elements raise Events when the user interacts with them (such as a Clicked event is raised when a button is pressed)
- JavaScript can register event handlers to respond to UI events
  - Events are fired by the Browser and are sent to the specified JavaScript **event handler** function
  - Can be set with HTML attributes:

```
<img src="test.gif" onclick="imageClicked()" />
```

  - Can be set through the DOM:

```
const img = document.querySelector("#myImage")
img.addEventListener('click', imageClicked)
```

Ask to be notified of clicks on element **#myImage**

Event Handler Example

```
<script>
document.querySelector("#btnDate").
    addEventListener("click", displayDate)

function displayDate() {
    document.querySelector("#date").innerHTML = Date()
}
</script>
```

Try it @ http://www.w3schools.com/js/tryit.asp?filename=tryjs_addeventlistener_displaydate

Common DOM Events

- Mouse events:
  - `onclick`, `onmousedown`, `onmouseup`
  - `onmouseover`, `onmouseout`, `onmousemove`
- Key events:
  - `onkeypress`, `onkeydown`, `onkeyup`
  - Only for input fields
- Interface events:
  - `onblur`, `onfocus`, `onscroll`
- Form events
  - `onsubmit` : allows you to cancel a form submission if some input fields are invalid

DOMContentLoaded

- DOMContentLoaded is fired when the DOM tree is built, but external resources like images and stylesheets may be not yet loaded
  - Best event for adding event listeners to page elements

```
//When the document is loaded in the browser then listen to studentsDD on change event
document.addEventListener("DOMContentLoaded", () => {
    console.log("js-DOM fully loaded and parsed");
    document.querySelector('#studentsDD').addEventListener("change", onStudentChange)
})
```

The Event Object

```
function name (event) {
    // an event handler function...
}
```

- Event handlers can accept an optional parameter to represent the event that is occurring
- Event objects have the following properties/methods:

Property	Description
type	what kind of event, such as "click" or "mousedown"
target	the element on which the event occurred
timestamp	when the event occurred

Stopping an Event

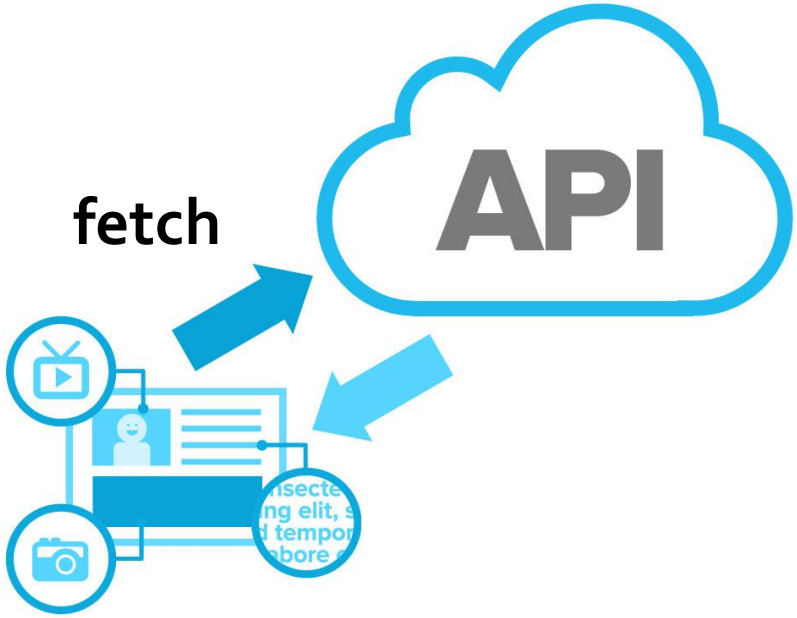
- preventDefault() stops the browser from doing its default action on an event.
  - for example, stops the browser from following a link when <a> tag is clicked
  - Or return false in an event handler to stop an event

```
<a href="#" onclick="onAddHero(event)">Add Hero</a>
```

```
async function onAddHero(event) {
    event.preventDefault();

    const heroesDiv = document.querySelector("#heroes");
    const heroEdtior = await getHeroEditor();
    heroesDiv.innerHTML = heroEdtior;
}
```

Consume Web API using Fetch



- AJAX is acronym of Asynchronous JavaScript and ~~XML~~ JSON
  - AJAX is used for **asynchronously** fetching (in the background) of dynamic Web content and data from Web API
  - Allows dynamically adding elements into the DOM
- Two styles of using AJAX for **partial page update**
  - Load an HTML fragment and inject it in the page
  - Call Web API then use the received JSON object to update the page at the client-side using JavaScript

Web API Get Request using Fetch

- Fetch content from the server

```
async function getStudent(studentId) {
    const url = `/api/students/${studentId}`
    const response = await fetch(url)
    return await response.json()
}
```

- **.json()** method is used to get the response body as a JSON object

Web API Post Request using Fetch

- Fetch could be used to post a request to the server

```
const email = document.querySelector( "#email" ).value,
  password = document.querySelector("#password").value

fetch( "/login", {
    method: "post",
    headers: { "Accept": "application/json",
               "Content-Type": "application/json" },
    body: JSON.stringify({
        email,
        password
    })
})
//headers parameter is optional
```

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`${...}`

HTML Template to generate the UI

HTML template

- **HTML template**: a piece of HTML code that has some parts to fill in (placeholders)
  - the content of those parts can change but the rest remains always the same, so the HTML code has **static parts** and **dynamic parts** (the gaps to fill in). E.g.,

```
Date: ___/___/___
Received from: ____________, the amount of QR__________
For: ____________________________________________
Received by: ___________________
```

  - This template can be printed and used many times filling in the blanks with the data of each payment.
- **Template literals** could be used to define an HTML template to generate the UI.

HTML template example

```
const payment = {
    date: '1/2/2021',
    name: 'Mr Bean',
    amount: 200,
    reason: 'Donation',
    receiver: 'Juha'
}

const receiptTemplate = (payment) =>
    `<div>
      <p>Date: ${payment.date}</p>
      <p>Received from: ${payment.name}, the amount of QR ${payment.amount}</p>
      <p>For: ${payment.reason}</p>
      <p>Received by: ${payment.receiver}</p>
    </div>`

console.log(receiptTemplate(payment));

// Render the template in the DOM
document.body.innerHTML = receiptTemplate(payment);
```

Template literals

Support:

- **Expression interpolation**: a template literal can contain placeholders `${expression}` that get evaluated to produce a string value

```
const a = 5, b = 10;
console.log(`${a} + ${b} = ${a + b}`);
```

- **Conditional expression**

```
const isHappy = true;
const state = `${ isHappy ? '😀' : '😢'}`;
console.log(state);
```

Display an Array using a Template literal

- Display an array elements using a template literal with the .map function

```
const  days = ["Mon", "Tue", "Wed", "Thurs", "Fri", "Sat", "Sun"];
const daysHtml = `<ul>
   ${days.map(day => `<li>${day}</li>`).join('\n')}
</ul>`;
console.log(daysHtml);
```

HTML template – Example 2

- Using HTML template to generate the UI

```
const person = {
    name: 'Mr Bean',
    job: 'Comedian',
    hobbies: ['Make people laugh', 'Do silly things', 'Visit interesting places']
}

function personTemplate({name, hobbies, job}){
    return `<article class="person">
                <h3>${name}</h3>
                <p>Current job: ${job}</p>
                <div>
                    <div>Hobbies:</div>
                    <ul>
                        ${hobbies.map(hobby => `<li>${hobby}</li>`).join(" ")}
                    </ul>
                </div>
    </article>`;
}

// Render the template in the DOM
document.body.innerHTML = personTemplate(person);
```

Web Storage API

Web Storage API

- The Web Storage API provides mechanisms to **store key/value pairs** locally within the user's browser
- The Web storage limit is at least 5MB and information is never transferred to the server
- Web storage is per origin (per domain and protocol). All pages, from one origin, can store and access the same data.
- It provides two objects for storing data on the client:
  - **`localStorage`** - stores data with no expiration date
  - **`sessionStorage`** - stores data for one session (data is lost when the browser tab is closed)

The localStorage Object

- The localStorage object stores the data with no expiration date. The data will not be deleted when the browser tab is closed.

```
// Store
localStorage.setItem("lastname", "Saleh");
// Retrieve
console.log( localStorage.getItem("lastname") );
```

Note:
Name/value pairs are always stored as strings. Remember to convert them to desired format!

- The example above could also be written like this:

```
// Store
localStorage.lastname = "Saleh";
// Retrieve
console.log(  localStorage.lastname );
```

- The syntax for removing the "lastname" localStorage item is as follows:

```
delete localStorage.lastname;
```

localStorage Example

- Store the number of times a user has clicked a button
  - clickCount is converted to a number to be able to increase the counter

```
function clickCounter() {
    if (localStorage.clickCount) {
        localStorage.clickCount = parseInt(localStorage.clickCount) + 1;
    } else {
        localStorage.clickCount = 1;
    }
    document.querySelector("#count").innerHTML = `Button clicked
      ${localStorage.clickCount} times.`;
}
```

sessionStorage Object

- The **sessionStorage** object is the same as the localStorage object, except that it stores the data for only one session. The data is deleted when the user closes the specific browser tab.
- The following example counts the number of times a user has clicked a button, in the current session

```
function clickCounter() {
  if (sessionStorage.clickCount) {
      sessionStorage.clickCount = parseInt(sessionStorage.clickCount) + 1;
  } else {
       sessionStorage.clickCount = 1;
  }
  document.querySelector("#count").innerHTML = `Button clicked
      ${sessionStorage.clickCount} times.`;
}
```


IndexedDB

IndexedDB

- IndexedDB is a database built into the browser and allow storing and querying JSON documents.
- IndexedDB database is a collection of Object Stores
- Object Store: stores a collection of objects, similar to tables in a relation database.
- Object: could be a json object.
- Its API is bit complicated hence IDB library https://github.com/jakearchibald/idb could be used to simply interacting with IndexedDB

Open and Created Database and ObjectStore

```
import { openDB } from 'https://unpkg.com/idb?module';
const dbName = 'heroes-db';   // database name
const dbVersion = 1;   // database version (not IndexedDB version)
const heroesStoreName = 'heroes';  // Name of the objects store
const db = await openDB(dbName, dbVersion, {
        // This callback only runs ONE time per database version.
        // Use it to create object stores.
        upgrade(db) {
           // This is how we create object stores: bit complicated 😢
            if (!db.objectStoreNames.contains(heroesStoreName)) {
              /* keyPath: specify the primary key for each object in the object store.
                 Set autoIncrement to true if you want IndexedDB to handle primary
                 key generation for you */
                db.createObjectStore(heroesStoreName, {
                    keyPath: 'id', autoIncrement: true,
                });
            }
        },
    },
);
```

CRUD Operations

```
// Get all
await db.getAll(heroesStoreName);
// Get object by id
await db.get(heroesStoreName, heroId);
// Add object
await db.add(heroesStoreName, hero);
// Update object
await db.put(heroesStoreName, hero);
// Delete object
await db.delete(heroesStoreName, heroId);
```

Resources

- DOM

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

- Fetch API

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