COESIONE ITALIA 21-27 PIEMONTE
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# Web Developer

## Programmazione - Javascript e Typescript

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Intervento realizzato da ITS TECNOLOGIE DELL'INFORMAZIONE E DELLA COMUNICAZIONE

le API del browser, ossia funzionalità integrate che permettono ai web developer di accedere a capacità avanzate del browser attraverso JavaScript.

# Browser APIs

interfacing with browsers

Shadi Lahham - Web development

# Browser APIs Overview

Browser APIs, also known as web APIs, are native features within the browser that can be utilized in web applications, allowing for the implementation of features with minimal code, such as network requests

Limitations:

- Not fully standardized yet so support may differ across different browsers
- Developers need to be aware of differences and implement fallbacks
- Standardization and cross-browser support has improved over the years

# Important categories of browser APIs

1. DOM manipulation APIs
2. Fetch API
3. Device APIs
4. Graphics APIs
5. Storage APIs
6. Audio and Video APIs
7. Interface APIs
8. Communication APIs
9. Web Workers API

1. DOM manipulation APIs

# 1.DOM manipulation APIs

La Document Object Model (DOM) API consente l'interazione con elementi della pagina web, permettendo di selezionare, aggiungere, rimuovere e modificare contenuti e stili.

The way web pages are organized and controlled with JavaScript is through the Document Object Model (DOM), while the Browser APIs enable the selection, addition, removal, and modification of web page elements

The DOM API falls into this group of APIs, allowing you to create, delete, and dynamically apply new styles to your page's HTML and CSS

# DOM manipulation APIs

```
// Getting elements
// 1. getElementById(): this method selects an element by its id attribute
let element = document.getElementById('myElement');

// 2. getElementsByClassName(): selects elements by their class name
let elements = document.getElementsByClassName('myClass');

// 3. getElementsByTagName(): selects elements by their tag name
let elements = document.getElementsByTagName('p');

// 4. querySelector(): selects the first matching element that matches the specified CSS selector
let element = document.querySelector('.myClass');

// 5. querySelectorAll(): selects all matching elements that match the specified CSS selector
let elements = document.querySelectorAll('.myClass');
```

# DOM manipulation APIs

```
// Adding elements:
// 1. createElement(): creates a new HTML element
let newElement = document.createElement('p');

// 2. innerHTML or textContent: sets the content of an element
newElement.innerHTML = '<strong>Hello World!</strong>';

// 3. appendChild(): adds an element to the end of the selected element
element.appendChild(newElement);
```

# DOM manipulation APIs

```
// Removing elements:
// 1. removeChild(): removes a child element from the selected element
element.removeChild(childElement);

// 2. remove(): removes the selected element
element.remove();

// 3. innerHTML: sets the content of the selected element to an empty string
element.innerHTML = '';
```

2.

# Fetch API

# 2.Fetch API

La Fetch API è usata per fare RICHIESTE HTTP, ottimizzando l'aggiornamento dinamico dei dati senza ricaricare la pagina.

Supporto e fallback: Funziona su quasi tutti i browser moderni, mentre per i più vecchi è possibile usare un polyfill (es., whatwg-fetch).

The Browser APIs offer a way to send HTTP requests from the front-end of a web app, enabling live updates of dynamic content without the need to refresh the page

This functionality enables communication with a web server and allows for responses in JSON, plain text, or XML format

The Fetch API, a contemporary substitute for XHR, was introduced in modern browsers to simplify asynchronous HTTP requests

# Fetch API

```
const endpoint = 'https://run.mocky.io/v3/fake';

fetch(endpoint)
  .then(response => {
    if (response.ok) {
      return response.json();
    } else {
      throw new Error('Network response was not ok.');
    }
  })
  .then(data => {
    // do something with data
    console.log(data);
  })
  .catch(error => {
    console.error('Error fetching data:', error);
  });
```

# Using xhr

```
// without fetch, using xhr
const xhr = new XMLHttpRequest();
const endpoint = 'https://run.mocky.io/v3/xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx';
xhr.open('GET', endpoint);
xhr.onload = function () {
  if (xhr.status === 200) {
    try {
      const data = JSON.parse(xhr.responseText);
      console.log(data);
    } catch (error) {
      console.error('Error parsing response JSON:', error);
    }
  } else {
    console.error('Request failed.  Returned status of ' + xhr.status);
  }
};
xhr.send();
```

# Fetch API support

The fetch() function is supported by all modern web browsers:

- Chrome 42+
- Firefox 39+
- Safari 10.1+
- Edge 14+
- Opera 29+

# Fetch API support

Older browsers that do not support fetch():

- Internet Explorer (all versions)
- Opera Mini (all versions)
- Android Browser (before version 4.4)
- UC Browser (before version 11.4)

In such cases, a polyfill can be utilized to provide the fetch() function for browsers that lack native support such as the whatwg-fetch polyfill

# Fetch an image

```
const resource = 'https://picsum.photos/400/200';
fetch(resource)
  .then(response => {
    if (!response.ok) {
      throw new Error('Network response was not ok');
    }
    return response.blob();
  })
  .then(blob => {
    const imageUrl = URL.createObjectURL(blob);

    // create a new image element
    const img = new Image();
    img.onload = () => document.body.appendChild(img);
    img.onerror = () => console.error('Failed to create image element.');
    img.src = imageUrl;
  })
  .catch(error => console.error('Error fetching image:', error));
```

# Request an image

```
// without fetch, using xhr
const xhr = new XMLHttpRequest();
xhr.onload = () => {
  if (xhr.status === 200) {
    const blob = xhr.response;
    const imageUrl = URL.createObjectURL(blob); // can use the url now
    // create a new image element
    const img = new Image();
    img.onload = () => document.body.appendChild(img);
    img.onerror = () => console.error('Failed to create image element.');
    img.src = imageUrl;
  }
};
xhr.onerror = () => console.error('Error fetching image.');
const resource = 'https://picsum.photos/400/200';
xhr.open('GET', resource);
xhr.responseType = 'blob';
xhr.send();
```

# Put using Fetch

```
const endpoint = 'https://fake.pipedream.net';

fetch(endpoint, {
  method: 'PUT',
  body: JSON.stringify({ name: 'John', age: 30 }),
  headers: {
    'Content-Type': 'application/json'
  }
})
  .then(response => {
    if (!response.ok) {
      throw new Error('Network response was not ok');
    }
    return response.json();
  })
  .then(data => console.log(data))
  .catch(error => console.error('Error making PUT request:', error));
```

# Async post using fetch

```
async function makePostRequest(endpoint, payload) {
  const headers = new Headers();
  headers.append('Content-Type', 'application/json; charset=UTF-8');
  headers.append('Accept', 'application/json'); // client wants JSON data in response

  try {
    const options = {method: 'POST', headers: headers, body: JSON.stringify(payload)};

    const response = await fetch(endpoint, options);
    if (!response.ok) {
      throw new Error('Network response was not ok.');
    }
    const data = await response.json();
    console.log(data);
  } catch (error) {
    console.error('Error making POST request:', error);
  }
}
```

# Async post using fetch

```
const endpoint = 'https://xxxxxxxxxxxx.x.pipedream.net';

const payload = {
  name: 'Jerry Duncan',
  email: 'jerry.duncan@mail.com'
};

makePostRequest(endpoint, payload);
console.log(`rest of code doesn't wait for the request`);
```

# Device APIs

# 3.Device APIs

Le Device API, come la Geolocation API, permettono di accedere a funzionalità dei dispositivi, inclusa la posizione dell'utente.

APIs for mobile devices enable web applications to access and utilize the features of modern devices

One such example is the Geolocation API, which utilizes the device's capacity to determine the user's geographic location, making it possible to provide location-based services within web applications

This is done using various methods such as GPS, Wi-Fi, and IP address
With this API, developers can query the device's location, watch the device's location in real-time, and handle location-related errors

# Geolocation API

per farlo funzionare richiedono:

- l'interazione da parte dell'utente per PERMETTERE di mostrarla al browser (privacy)
- deve permettere di attivare la geolocalizzazione

```
// note: the following code will be blocked if not triggered by a user event
//       it also need to run in a web server and the user has to allow location in the browser

if (navigator.geolocation) {
  // even if geolocation is supported, it won't work if the user doesn't give permission
  navigator.geolocation.getCurrentPosition(position => {
    console.log(`Latitude: ${position.coords.latitude} Longitude: ${position.coords.longitude}`);
  });
} else {
  console.log('Geolocation is not supported by this browser.');
}
```

# Geolocation API

ESEMPIO:
navigator.geolocation.getCurrentPosition() per ottenere la posizione attuale o watchPosition() per aggiornamenti continui.

Geolocation.getCurrentPosition()
used to fetch the present location of a device

Geolocation.watchPosition()
used to set up a function to handle location updates automatically whenever the device's position changes. The function returns the updated location

Both of these methods can take up to 3 parameters:

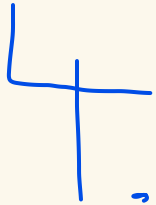
1. successCallback
specifies a function to execute when the current position is successfully retrieved

2 errorCallback
specifies a function to execute if there was an error while retrieving the current position

3 options
An optional parameter that specifies additional options for retrieving the current position

# Geolocation API examples

**Mapping and Navigation:** Google Maps and Waze use geolocation to track the user's location and provide directions
**Local Search:** Yelp and Foursquare identify the user's location and suggest nearby places to eat, drink, and shop
**Weather Reports:** Weather applications use geolocation to provide forecasts for the user's current location
**Social Media:** Snapchat, Instagram, and Facebook use geolocation to add location-based filters and tags to user-generated content



# Graphics APIs

# 4.Graphics APIs

Una delle principali API grafiche, permette di creare immagini dinamiche e animazioni bidimensionali(2d).
un esempio sono i giochini flash che giochiamo sui siti

Within web applications, the canvas API offered by browser APIs enables the creation of interactive and dynamic graphics

Nowadays, modern web browsers support the production of graphics on the internet using the Canvas API

# Canvas API

The Canvas API is a JavaScript and HTML interface for creating dynamic graphics
It allows you to produce a wide range of shapes, objects, and styles on a web page

At present, the Canvas API is limited to two-dimensional graphics
The HTML canvas element provides a designated area on a web page where you can create dynamic graphics using JavaScript

It is a powerful tool for creating animations, games, charts, graphs, and other visual effects, and is compatible with all major web browsers

# Canvas API

**html**

```html
<canvas id="myCanvas"></canvas>
```

**Javascript**

```javascript
// get the canvas element from the HTML document
const canvas = document.getElementById('myCanvas');

// set the canvas dimensions
canvas.width = 500;
canvas.height = 500;

// get the canvas context, which is used for drawing
const ctx = canvas.getContext('2d');

// Set the background color to light blue
ctx.fillStyle = 'lightblue';
ctx.fillRect(0, 0, canvas.width, canvas.height);
```

# Canvas API

```
// Draw other shapes or graphics on top of the background

// draw a rectangle
ctx.fillStyle = '#bada55';
ctx.fillRect(10, 10, 50, 50);

// draw text
ctx.font = '30px Arial';
ctx.fillStyle = '#7555da';
ctx.fillText('Hello World', 20, 80);
```

# Canvas animate example

The following is a more complex example of how to use Canvas API for 2D animations

# Canvas animate example

```
// Get the canvas element from the HTML document
const canvas = document.getElementById('myCanvas');

// Set the canvas dimensions
canvas.width = 500;
canvas.height = 500;

// Get the canvas context, which is used for drawing
const ctx = canvas.getContext('2d');

// Set the initial ball position, size, and velocity
let x = 50;
let y = 50;
let radius = 20;
let dx = 5;
let dy = 5;
```

# Canvas animate example

```
// Set the initial fill color and trail color
let fillColor = 'red';
let trailColor = 'rgba(255, 0, 0, 0.2)';

// Define the animation loop
function animate() {
  // Clear the canvas before drawing the next frame
  ctx.clearRect(0, 0, canvas.width, canvas.height);

  // Draw the trail behind the ball
  ctx.fillStyle = trailColor;
  ctx.beginPath();
  ctx.arc(x, y, radius, 0, 2 * Math.PI);
  ctx.fill();

  // Update the ball position
  x += dx;
  y += dy;
```

# Canvas animate example

```
// Check if the ball has hit the edges of the canvas
if (x + radius > canvas.width || x - radius < 0) {
  dx = -dx;
  fillColor = getRandomColor();
}

if (y + radius > canvas.height || y - radius < 0) {
  dy = -dy;
  fillColor = getRandomColor();
}

// Draw the ball
ctx.fillStyle = fillColor;
ctx.beginPath();
ctx.arc(x, y, radius, 0, 2 * Math.PI);
ctx.fill();
```

# Canvas animate example

```
  // Request the next animation frame
  requestAnimationFrame(animate);
}

// Helper function to generate a random color
function getRandomColor() {
  const r = Math.floor(Math.random() * 256);
  const g = Math.floor(Math.random() * 256);
  const b = Math.floor(Math.random() * 256);
  return `rgb(${r}, ${g}, ${b})`;
}

// Start the animation loop
animate();
```

# 5. Storage APIs

# 5.Storage APIs

Le Storage APIs di JavaScript offrono strumenti per salvare dati direttamente nel browser dell'utente.

Queste API includono principalmente localStorage, sessionStorage, e i cookie, ciascuno con caratteristiche e utilizzi specifici.

Browser APIs offer functionalities for saving data within a web browser, known as Web Storage. This feature is helpful in preserving user preferences, app data, or any other relevant information that needs to be stored locally

Web Storage API enables the client-side storage of data and has two modes:

- sessionStorage
- localStorage

The former stores data temporarily during a session, while the latter keeps it even after the browser is closed

# sessionStorage

```
// Session Storage
// stores data temporarily
// data is lost when closing the browser

// Set data in session storage
sessionStorage.setItem('key', 'value');

// Retrieve data from session storage
let data = sessionStorage.getItem('key');
console.log(data); // Output: 'value'
```

# localStorage

```
// Local Storage
// stores data with no expiration date
// data persists even after closing the browser or shutting down the PC

// Set data in local storage
localStorage.setItem('key', 'value');

// Retrieve data from local storage
let data = localStorage.getItem('key');
console.log(data); // Output: 'value'
```

LOCALSTORAGE PUNTI:

- Memorizza i dati in modo permanente finché non vengono eliminati manualmente (sia dall'utente che dal codice).

- Supporta fino a circa 5-10 MB di dati, molto più dei cookie (4 KB).

- È accessibile SOLO LATO client, quindi i dati non vengono inviati al server con le richieste HTTP.

- Ideale per salvare preferenze utente, impostazioni, dati applicativi o altro che deve essere mantenuto per lungo tempo.

# Storage APIs

```
// Web storage can be used to store objects in the form of JSON strings

// Set object in local storage
let object = { name: 'John', age: 30 };
localStorage.setItem('obj', JSON.stringify(object));

// Retrieve object from local storage
let data = JSON.parse(localStorage.getItem('obj'));
console.log(data.name); // Output: 'John'
```

# Cookies vs Local Storage

- Both are mechanisms for storing data on the client-side
- Both can be used to store
  - user preferences
  - login information
  - other types of data
- Cookies are small text files stored on the user's computer by the browser
- Local Storage is a key-value store that stores large amounts of data
- Limitations of cookies
  - Store up to 4KB of data
  - Sent to the server with every HTTP request
  - Have an expiration date set by the server
- Local Storage never expires. Remains until removed by user or developer

# Setting and Getting a Cookie

```
// set a cookie with a key of "username" and a value of "John Doe" that expires in 7 days
document.cookie =
  'username=John Doe; expires=' + new Date(Date.now() + 7 * 24 * 60 * 60 * 1000).toUTCString();

// get the value of the "username" cookie
const cookieValue = document.cookie.replace(
  /(?:(?:^|.*;\s*)username\s*\=\s*([^;]*).*$)|^.*$/,
  '$1'
);
console.log(cookieValue); // outputs "John Doe"

// note:
// some browsers don't store cookies with the file:/// protocol. Use a webserver
```

6. Audio and Video APIs

# 6.Audio and Video APIs

Web browser APIs offer functionalities for playing and managing audio and video, enabling web applications to deliver immersive multimedia experiences

These APIs are capable of handling, showcasing, and generating various media formats

In terms of JavaScript manipulation, the <video> and <audio> elements are essentially the same. They both have similar APIs for controlling playback, adjusting volume, seeking to specific times, and handling events

# Audio and video elements

```
<audio controls>
  <source src="example.mp3" type="audio/mpeg">
  Your browser does not support the audio element.
</audio>

<video controls>
  <source src="example.mp4" type="video/mp4">
  Your browser does not support the video element.
</video>
```

**Note**

Using the API we can manipulate audio and video without the controls attribute

# Audio API

```
<body>
  <audio>
    <source src="./song.mp3" type="audio/mpeg">
    Your browser does not support the audio element.
  </audio>

  <button>Seek and play</button>

  <!-- end of body  -->
  <script src="./main.js"></script>
</body>
```

# Audio API

```
// get the first audio element first button
const audio = document.querySelector('audio');
const btn = document.querySelector('button');

// Play audio
const playAudio = () => audio.play();

// Pause audio
const pauseAudio = () => audio.pause();

// Seek to a specific time in the audio (in seconds)
const seekAudio = time => (audio.currentTime = time);

// Set the volume of the audio (0.0 to 1.0)
const setVolume = volume => (audio.volume = volume);

// Get the duration of the audio (in seconds)
const getDuration = () => audio.duration;
```

# Audio API

```
// Get the current playback time of the audio (in seconds)
const getCurrentTime = () => audio.currentTime;

// Listen for when the audio has ended
audio.onended = () => console.log('Audio has ended');

// Listen for when the audio playback position has changed
audio.ontimeupdate = () => console.log(`Current time:${audio.currentTime}`);

// Add event listeners to the buttons
btn.addEventListener('click', () => {
  seekAudio(180); // 3 minutes
  setVolume(0.5);
  playAudio();
});
```

# 7. Interface APIs

# 7.Interface APIs

Consente di implementare operazioni di trascinamento e rilascio, usato per creare interfacce avanzate (es. gallerie di immagini).

Drag and drop is an example of Interface APIs

With the drag and drop APIs, users can perform drag and drop operations on a web page, facilitating the creation of advanced user interface designs like file managers, image galleries, and task management tools

This feature allows users to drag files or images from their computer and drop them on a web page or move elements within a web page to alter their position or perform other actions

# Drag and drop API

HTML5 drag and drop API

- Users can move images, text, and files by clicking and dragging
- Web developers can create user-friendly interfaces
- Several events to handle drag and drop events
  - dragstart, dragover, dragenter, dragleave, drop, and dragend sono simili agli eventi del mouse
- Provides a set of methods to handle data in drag and drop interactions

# Simple drag and drop

**HTML**

```html
<div id="drag-item" class="draggable">Drag me</div>
<div id="target" class="droppable">Drop here</div>
```

**CSS**

```css
.draggable {
  width: 100px;
  background-color: orange;
  cursor: move;
}

.droppable {
  width: 200px;
  height: 100px;
  border: 1px solid black;
}
```

# Simple drag and drop

JAVASCRIPT

```javascript
const dragElement = document.getElementById("drag-item");
const dropElement = document.getElementById("target");

dragElement.setAttribute("draggable", true); // assign "draggable" attribute to element

// set the data that will be carried during the drag operation
dragElement.ondragstart = event => event.dataTransfer.setData("text/plain", event.target.id);

dropElement.ondragover = event => event.preventDefault();

dropElement.ondrop = event => {
  event.preventDefault();
  const data = event.dataTransfer.getData("text/plain");
  event.target.appendChild(document.getElementById(data));
};
```

# Drag and drop example

The following is a more complex example but uses the same methods and events as before

This example changes the image that appears below the cursor during the drag operation. This can be set to any image

The drag image works in Chrome, but the code requires changes to work in Firefox and other browsers

# Drag and drop example

```
<!DOCTYPE html>
<html>
<head>
  <title>Drag and Drop</title>
  <link rel="stylesheet" href="./drag.css">
  <link rel="icon"
    href="data:image/svg+xml,<svg xmlns=%22http://www.w3.org/2000/svg%22 viewBox=%220 0 20 19%22><text
y=%2215px%22>🍎</text></svg>">
</head>
<body>
  <!-- note the 'draggable' attribute below -->
  <div id="tree" class="box draggable" draggable="true">🌳🌳🌳🌳🌳🌳🌳</div>
  <div id="truck" class="box drop-target">
    <p>🚚</p>
  </div>
  <script src="./drag.js"></script>
</body>
</html>
```

# Drag and drop example

```css
body { font-size: 36px; }

.box, #truck > p {
  border: 1px dashed #000000;
  padding: 10px;
  border-radius: 6px;
}

.box {
  width: 350px;
  margin-bottom: 10px;
  background-color: #f5f5f5;
}

#tree { background-color: #bada55; }
```

# Drag and drop example

```css
#truck {
  display: flex;
  align-content: flex-start;
  flex-wrap: wrap;
}

#truck > p {
  pointer-events: none; /* important to prevent drag leave on children */
  background-color: #dbc7c0;
  margin: 4px;
}

.draggable { cursor: move; }
.highlighted { background-color: #d9d954; }
.semi-transparent { opacity: 0.5; }
```

# Drag and drop example

```
// get draggable and target elements
const draggable = document.querySelector('.draggable');
const dropTarget = document.querySelector('.drop-target');

// toggleable classnames for styling
const highlightClass = 'highlighted';
const transparentClass = 'semi-transparent';

// drag payload and format - what gets carried
const dragFormat = 'text/plain';
const getDragPayload = () => (Math.random() < 0.5 ? '🍎' : '🍏'); // can be a simple string

// optional drag image; pre-loaded since loading during drag takes too long
// using a code image here, but could also have been dragImg.src = './example.jpg'
const dragImg = new Image();
dragImg.src = `data:image/svg+xml,
<svg xmlns=%22http://www.w3.org/2000/svg%22 viewBox=%220 0 20 19%22>
  <text y=%2215px%22>🍎</text>
</svg>`;
```

# Drag and drop example

```
// implement drag event handlers
const handleDragStart = event => {
  // set the drag image to the preloaded image; this is optional
  event.dataTransfer.setDragImage(dragImg, 0, 0);

  // set the drag content; what actually gets carried during the drag
  event.dataTransfer.setData(dragFormat, getDragPayload());
  event.currentTarget.classList.add(transparentClass);
};

const handleDragEnd = event => event.currentTarget.classList.remove(transparentClass);

// prevent browser default behavior doesn't allow the element to be dropped
const handleDragOver = event => event.preventDefault();

const handleDragEnter = event => event.currentTarget.classList.add(highlightClass);

const handleDragLeave = event => event.currentTarget.classList.remove(highlightClass);
```

# Drag and drop example

```
const handleDrop = event => {
  event.preventDefault(); // prevent browser default action which opens some elements as a link
  const text = event.dataTransfer.getData(dragFormat);
  const elem = document.createElement('p');
  elem.textContent = text;
  event.currentTarget.appendChild(elem);
  event.currentTarget.classList.remove(highlightClass);
};

// setup event handlers
draggable.addEventListener('dragstart', handleDragStart);
draggable.addEventListener('dragend', handleDragEnd);
dropTarget.addEventListener('dragover', handleDragOver);
dropTarget.addEventListener('dragenter', handleDragEnter);
dropTarget.addEventListener('dragleave', handleDragLeave);
dropTarget.addEventListener('drop', handleDrop);
```

# Communication APIs

# 8.Communication APIs

**WebSocket:**

WebSockets is a persistent protocol for real-time communication that allows the server to push data to the client, making it ideal for applications that require real-time updates like gaming, financial trading, and chat apps

**WebRTC: (Real-time communication technology)**

WebRTC facilitates real-time audio and video streaming and data transfer directly between two peers over the internet, without an intermediary, enabling instant communication in web applications

WebRTC: Permette comunicazioni audio, video e trasferimento dati diretto tra utenti senza server intermediario.

# WebSocket

connessione in tempo reale, abilità uno scambio di dati continuo tra client e server.
è utile se c'è bisogno di una comunicazione costante tra i 2

- protocol for real-time communication between client and server
- enables server to push data to client without need for active data requests
- establishes persistent connection between server and client
- both client and server can send messages at any time
- ideal for apps requiring real-time updates
    - gaming
    - financial trading
    - chat apps
    - collaborative work tools

# WebSocket

WebSocket connection establishment and communication

- Client sends handshake request to server to establish WebSocket connection
- Server sends acknowledgment message to client
- Client and server can send messages to each other
  - text, JSON, or other data format
- Client updates UI in real-time upon receiving a message from server
- WebSocket connection remains open until
  - client closes it
  - or server terminates it

# WebSocket - client

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Websocket example</title>
</head>

<body>
  <input type="text">
  <button>send</button>
  <script src="./client.js"></script>
</body>

</html>
```

# WebSocket - client

```
const input = document.querySelector('input');
const btn = document.querySelector('button');

// create a new WebSocket object
const socket = new WebSocket('ws://localhost:8080');

// event handler for when the WebSocket connection is established
socket.onopen = () => {
  console.log('WebSocket connection established');

  const doSend = () => {
    // send a message to the server
    socket.send(input.value);
    input.value = '';
  };
  btn.onclick = doSend;
  input.onkeypress = e => (e.key === 'Enter' ? doSend() : null);
};
```

# WebSocket - client

```
// event handler for incoming messages from the server
socket.onmessage = event => {
  document.body.appendChild(
    document.createElement('p')
  ).textContent = `Received message from server: ${event.data}`;
};

// event handler for when the WebSocket connection is closed
socket.onclose = event => console.log(`WebSocket connection closed with code ${event.code}`);
```

# WebSocket - server

To run the server you need to

- install ws with the command
  - **npm install ws**
- put the server code in a file
  - server.js
- run the program
  - node server.js

# WebSocket - server

```
// create a new websocket server - NodeJS code
const WebSocket = require('ws');
const wss = new WebSocket.Server({ port: 8080 });

// event handler - new websocket connection is established
wss.on('connection', ws => {
  console.log('New WebSocket connection established');

  // event handler - incoming messages from client
  ws.on('message', message => {
    // log and send message back to client
    console.log(`Received message from client: ${message}`);
    ws.send(`You said: ${message}`);
  });

  // event handler for when the websocket connection is closed
  ws.on('close', () => console.log('WebSocket connection closed'));
});
```

9.

# Web Workers API

# Web Workers API

In contesti di frontend (ad es. browser), JavaScript è sempre single-threaded, ma può sfruttare i Web Workers per eseguire codice su thread separati. Ecco come:

- Web Workers: Permettono di eseguire operazioni complesse IN BACKGROUND (ad esempio, calcoli o elaborazione di immagini) su un thread separato, senza bloccare l'interfaccia utente.

Web applications can perform intricate tasks without disrupting the main thread through the utilization of web workers provided by browser APIs

Overall, web workers are a powerful tool for frontend developers to improve the performance and responsiveness of web applications

By offloading complex or time-consuming tasks to a separate background thread, web developers can create faster and more efficient web applications that provide a better user experience

ESEMPIO PRATICO:

EG -> Immagina un'operazione intensiva, come un calcolo matematico complesso.

Senza un Web Worker, JavaScript bloccherebbe l'interfaccia fino al completamento.
Con un Web Worker, invece, si esegue il calcolo in parallelo, lasciando l'interfaccia utente reattiva.

# Web Workers API

Web workers can be used in frontend development for tasks such as:

- Image processing
- Computationally-intensive tasks
- Real-time communication
- Game development
- Data visualization
- Offline functionality
- Background tasks

# Web Worker - HTML

```html
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Worker example</title>
  <link rel="stylesheet" href="./style.css">
</head>

<body>
  <div id="prime-list"></div>
  <script src="./main.js"></script>
</body>

</html>
```

# Web Worker - CSS

```css
body { font-size: 40px; max-width: 1000px; margin: 0 auto; }

.tortoise, .hare {
  padding: 5px;
  border: 1px dashed black;
  margin: 5px;
  border-radius: 5px;
}

.hare { background-color: #ffb74d; }
.tortoise { background-color: #cddc39; }

#prime-list {
  display: flex;
  justify-content: flex-start;
  flex-wrap: wrap;
}
```

# Web Worker - main.js

```
const primeList = document.getElementById('prime-list');

// utility function
const createElem = (content, className) => {
  const elem = document.createElement('div');
  elem.textContent = content;
  elem.classList.add(className);
  return elem;
};
```

# Web Worker - main.js

```
// create and start workers
const worker = new Worker('./worker.js');
worker.postMessage({ start: 0, end: 100 });

const worker2 = new Worker('./worker.js');
worker2.postMessage({ start: 0, end: 100 });

worker.addEventListener('message', ({ data }) => {
  if (data === 'end') worker.terminate();
  primeList.appendChild(createElem(`🐰 ${data}`, 'hare'));
});

worker2.addEventListener('message', ({ data }) => {
  if (data === 'end') worker2.terminate();
  primeList.appendChild(createElem(`🐢 ${data}`, 'tortoise'));
});

// the rest of the code can continue to do other things while the workers work
```

# Web Worker - worker.js

```
const isPrime = n => {
  if (n < 2) return false;
  for (let i = 2; i <= Math.sqrt(n); i++) {
    if (n % i === 0) return false;
  }
  return true;
};
```

# Web Worker - worker.js

```
async function findPrimesInRange(start, end) {
  const delayFactor = 1.05;
  for (let i = start; i <= end; i++) {
    // waste time
    await new Promise(resolve =>
      setTimeout(resolve, Math.floor(Math.random() * delayFactor) * 1000)
    );

    // check if prime
    if (isPrime(i)) self.postMessage(i);
  }
  self.postMessage('end');
}

self.addEventListener('message', ({ data }) => {
  const { start, end } = data;
  findPrimesInRange(start, end);
});
```

# Prime testing

To test if a number is prime, check if it has any divisors other than 1 and itself. When factors of a composite number are examined, if both factors are greater than the square root of the number, their product would exceed the number, which contradicts the definition of a composite number. So at least one of the factors must be less than or equal to the square root of the number

If no divisors are found up to the square root, there won't be any divisors beyond it because any additional divisor would result in a product greater than the original number

Thus it can be concluded that the number is prime

# Your turn

# 1.My album

Create a page with 10 random images that are dynamically loaded using requests when the user opens the page
The images should be of the same height and width. There should be 4 images per row, so a 4x3 grid that fits the 10 images
The user can click buttons to load a new image in real time, or remove an image
The user can also arrange the images in the gallery using drag and drop
The gallery should remember the loaded images and their order so that if the user returns to the page, the same images are loaded and keep the same order

# References


What are browser APIs?

Fetch API

Geolocation API

Canvas API

How to render 3D in 2D canvas

A basic introduction to Canvas API

# References


Web Storage API

Storage - Web APIs

The Embed Audio element

Web Audio API

Video and Audio APIs

The Video Embed element

# References


Drag operations

HTML Drag and Drop API

DataTransfer: setData() method

DataTransfer: getData() method

DataTransfer: setDragImage() method

# References

WebSocket
Web Workers API