UNIT 7: JAVASCRIPT

Markup Languages and Information Management Systems

ies SERPIS

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01

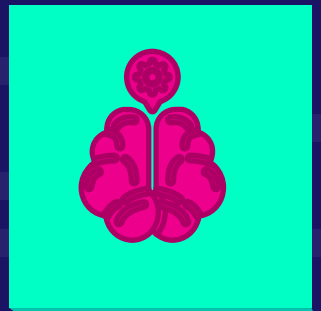
INTRODUCTION

INTRODUCTION

JavaScript is a…

high-level

Instructions understandable by human capacity

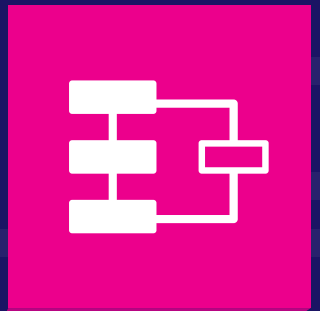


interpreted

Instructions translated to be executed at runtime

weakly-typed

Generic variables for any data type



…programming language

INTRODUCTION

JavaScript code can be declared...

- Internally: as the content of a **<script> element**, either within the HTML <head> or <body> blocks.
    - Discouraged in <body>.
- Inline: as the value of some attributes inside an HTML opening tag.
- Externally: in separate files.

INTRODUCTION

Inline example

```
<!DOCTYPE html>
<html>
  <head>
    <title>Inline Hello World</title>
  </head>
  <body>
    <h1 onclick="alert('Hello world')">
      My first JS web site
    </h1>
  </body>
</html>
```

INTRODUCTION

Good practice

Internal JS

Put the JS code in the `<head>` block, before any link to CSS files.

External JS

- File with `.js` extension
- Stored in `js` folder
- Linked from the `<head>` block by using `<script>` and its `src` attribute

INTRODUCTION

- HTML is sequentially executed.
  - Line by line, from top to bottom.
- To ensure that the JS code is executed when it should:
  - Write instructions within functions.
  - Associate execution with the realization of certain actions

Events

INTRODUCTION

JS function syntax

```
function functionName(args){
  //instruction1;
  //instruction2;
  //…
  return returnedValue;
}
```

The function can be called from the HTML code

`return` *is optional and only required when the function returns a value*

INTRODUCTION

Internal example

```
<!DOCTYPE html>
<html>
  <head>
    <title>Internal Hello World</title>
    <script>
      function helloworld(){
        alert('Hello World');
      }
    </script>
  </head>
  <body>
    <h1 onclick="helloworld()">
      My first JS web site</h1>
  </body>
</html>
```

INTRODUCTION

External example

```html
<!DOCTYPE html>
<html>
  <head>
    <title>External Hello World</title>
    <script src="js/hw.js">
    </script>
  </head>
  <body>
    <h1 onclick="helloworld()">
      My first JS web page</h1>
  </body>
</html>
```

```js
function helloworld(){
        alert('Hello World');
}
```

JavaScript code in the separate `hw.js` *file*

INTRODUCTION

Some basic functions

alert

- Is a method of the `window` object.
  - The `window` word can be omitted.
- Displays a message on screen via pop-up window.
- The message to be displayed is passed as an argument to the function.

```
alert('Message here')
```

INTRODUCTION

Some basic functions

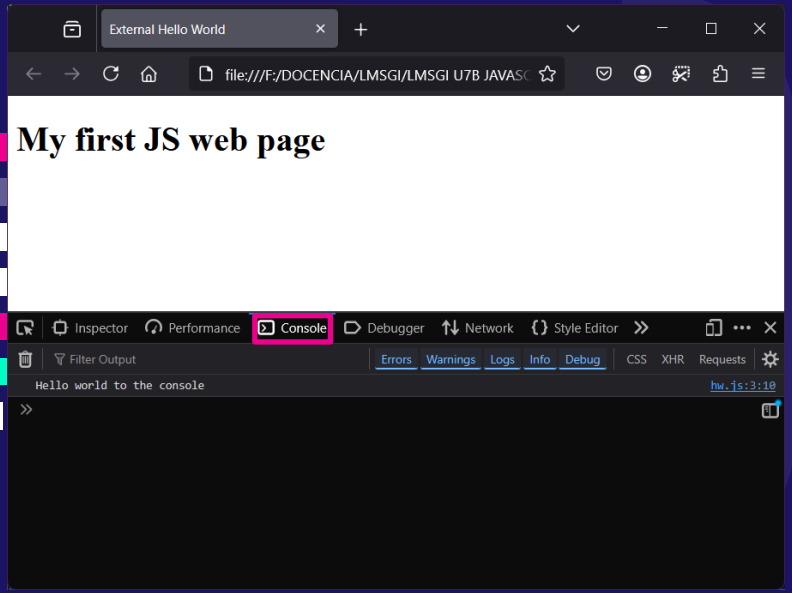
write

- Is a method of the `document` object
- Writes on the page the text passed as an argument.
- If used after the complete load of the page, it overwrites its contents.

```
document.write('Text here')
```

INTRODUCTION

Some basic functions



log

- Is a method of the `console` object
- Outputs a message to the browser console.
  - You need to open the browser's DevTools to read.

```
console.log('Text here')
```

INTRODUCTION

Some basic functions

prompt

- Is a method of the `window` object.
  - The `window` word can be omitted.
- Used to request data entry from the keyboard.

```
let variable =
  prompt(message, initialValue)
```

INTRODUCTION

Function example with prompt + alert

```
function dataRequest(){
  let usrName = prompt(
    'Enter your name', '');
    alert('Hello, ' + usrName);
}
```

INTRODUCTION

- JavaScript is an **object-oriented** programming language.
- Objects have members *(methods and properties)*.
- Invocation of members of the **`window`** object can be made by **omitting the object name**.
  - These are equivalent:
    - `window.alert('Hello')`
    - `alert('Hello')`
- The name of **any other object cannot be omitted**.
  - `write('Hello')` causes an error.

INTRODUCTION

Comments

Multiline

Encase the block inside /* and */

Single line

Start the line with //

INTRODUCTION

<noscript>

- Defines an alternative content to be displayed on the browsers that do not support script execution, or have it disabled.
- Place it in the <body> block.

</>

```
<noscript>
  <p> This page uses JavaScript.
      Please, turn it on to get the full
      experience.
  </p>
</noscript>
```

02

BASIC PROGRAMMING

BASIC PROGRAMMING

BASICS

JavaScript is very similar to Java

Spacing

Spaces and line breaks are ignored.

Case sensitive

Lowercase and uppercase letters are different characters

Semicolon

Not necessary (but advisable) to end instructions with a ;

BASIC PROGRAMMING

Constants

- Cannot modify their value after initialization.
- Must be initialized when declared.
- Reserved keyword `const`.
- Notice: It is possible to
  - change the value of the elements in a constant array.
  - change the value of the properties of a constant object.

```
</>

const pi = 3.14159192;

const daysOfWeek = 7;

const errorMsg =
     "An error occurred";
```

BASIC PROGRAMMING

Variables

- Their values can change.
- Declared only once.
- To use an already declared variable, just write its name (identifier).
- Two types, depending on its scope:
  - global / function: `var`
  - block: `let`

Braces delimit blocks

```
var a = 10;
let b = 3;
{
  let b = 6;
  alert(a + b); //16
}
alert(a + b);   //13
```

BASIC PROGRAMMING

Variables

- Variables (`var` or `let`) defined within a function, or a block, only apply within it.
  - Local variables.
- **`var`** variables outside functions are global.
  - **Problem**: a global **`var`** variable can be redefined from another scope.
- BETTER USE **`let`**.

```
var price = 30;
var quantity = 4;

if (quantity > 3) {
  var price = 45;
}

alert(price) //45
```

BASIC PROGRAMMING

Variables

Valid characters in identifiers

Digits

Except for the first character

Letters

Beyond the American alphabet

$

The dollar symbol

_

Underscore

BASIC PROGRAMMING

Variables

- Weak and dynamic typing:
  - variables are generic (`undefined`) until they take value.
  - they can take value of any type indefinitely.
- Data types:
  - primitive: logical, numeric, textual.
  - collections: array.
  - object.

```
</>

let whatever;

whatever = true;
whatever = 4;
whatever = 'Text string';
whatever = ['Saturday', 'Sunday'];
whatever = {name:Lisa, age:14};
```

BASIC PROGRAMMING

logical

- Also known as *boolean*.
- Two possible values: `true` and `false`.

numeric

- For numbers of all kinds.
- With and without decimals.

Data types

BASIC PROGRAMMING

textual

- For characters and text strings.
- Values in single or double quotes.
- If the string already has quotes of one kind, encase it in quotes of the other one.

```
let str1 = 'I am a text';
let str2 =
  'Begin "laser" ignition sequence';
```

Data types

BASIC PROGRAMMING

collection

- Arrays and such.
- Arrays contain comma-separated values encased in brackets.
- The elements in an array may, or may not, be of the same type (!).
- The first element is at position 0.
- Access to elements: number between brackets.

```
let wkend  = ['saturday', 'sunday'];
alert('wkend[1]');  //sunday
```

Data types

BASIC PROGRAMMING

object

- Collection of **property:value** pairs.
- The pairs are contained in braces and separated by commas.
- Access to members:
  - Property name in brackets.
  - Dot operator.

```
let console =
  {brand:'Nintendo', model:'Switch'};
alert(console['brand'] + console.model);
```

Data types

BASIC PROGRAMMING

Escape sequences

CRLF	\n
tab	\t
single quote	\'
double quote	\"
backslash	\\

To insert special or reserved characters in text strings, the backslash is used.

EXERCISE

Put all the month names into an array and show them all using `alert`.

BASIC PROGRAMMING

Assignment

- Using **=**
- Stores a value in a variable.
- Compound *(cumulative)* assignment can be used.

These assignments are equivalent to:

```
myNumber = myNumber + 4;
myNumber = myNumber - 5;
```

```
let myNumber = 3;
myNumber += 4  //myNumber is 7 now
myNumber -= 5  //myNumber is 2 now
```

Operators

BASIC PROGRAMMING

Logical

Given two booleans, b1 and b2:

- AND: **b1 && b2** is only true if both are.
- OR: **b1 || b2** is true is any of them is.
- NOT: **!b1** is the opposite value of b1

```
let b1 = true, b2 = false;
let res1 = b1 && b2;  //false
let res2 = b1 || !b1;  //true
```

Operators

BASIC PROGRAMMING

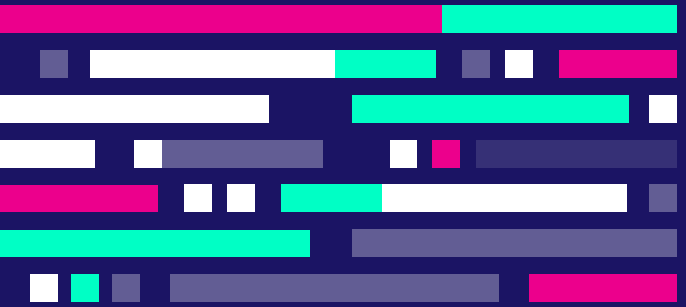
Mathematical

- Addition (+), subtraction (-), multiplication (*), division (/), exponentiation (**), modulo (%).
- Also, increase (++) y decrease (--).

Equivalent to:
`res1 = res1 + 1;`

```
let res1 = 2 ** 3;  //8
res1++;  //9
let res2 = res1 % 4;  //1
```

Operators



Textual

- Concatenation, or text strings connection.
- Using +.
- *Adding* a number and a string results in a string.
- Compound *(cumulative)* assignment can be used.

Equivalent to:
`s1 += s2;`

```
let s1 = 'spanish', s2 = ' omelette';
s1 = s1 + s2;
let order = 1 + ' ' + s1;
```

Operators

Relational

- Greater than (>), less than (<), greater than or equal to (>=), less than or equal to (<=), equals (==), different from (!=).
- Same value and type (===), different value or different type (!==).

```
let n1 = 3, n2 = 6, s3 = '3';
let r1 = (n1 > n2);  //false
let r2 = (n1 == s3);  //true
```

Operators

BASIC PROGRAMMING

Control structures

- When used, the flow of instructions in a program stops being linear and branches out, opening up different alternative paths.
- The decision of following one path or another will depend on the fulfillment of certain conditions.

BASIC PROGRAMMING

Control structures

if

- Encases a code that will only execute if some conditions are met.
- Conditions are logical sentences.
- If the condition is multiple, then logical operations are expected (AND, OR).

</>

```
if (n1 >= 30 && n1 < 40) {
  alert ('The tens digit is 3');
}
```

BASIC PROGRAMMING

Control structures

if-else

- Allows the definition of the paths to follow both when the conditions are met (if block) and when they are not (else block).

```
</>

if (age < 18) {
  alert('I cannot sell you tobacco.');
}
else {
  alert('Your tobacco. Thanks.');
}
```

BASIC PROGRAMMING

Control structures

if-else if

- Allows the addition of a new condition in case the **if** block condition is not met.

```
if (condition1) {
  alert('Condition 1 is met.');
}
else if (condition2) {
  alert('Condition 1 is not met, but
condition 2 is');
}
else {
  alert('None of the conditions are met');
}
```

BASIC PROGRAMMING

Control structures

switch

- Allows the definition of a decision with more than two possible paths.
- Specific instructions for one case are written after a **case** clause and end with **break**
- A **default** block can be used to specify instructions when there was no match in the previous cases.

```
switch (expression){
  case value1:
    //instructions for this case
    break;
  // possibly more cases here
  case valueN:
    //instructions for this case
    break;
  default:
    //instructions in case there was no
    // match in the previous cases
}
```

BASIC PROGRAMMING

Control structures

switch

- The expression is compared with the values of the cases, in order. When they match, the instructions encased in that block are executed.
- If there is no match, the code encased in the **default** block will be executed.
- The **default** block is optional and does not have to be the last one.
- There is no need to use **break** to close the last block.

```
switch (carColor){
  case "red":
    riskFactor = 0.8;
    break;
  case "white":
    riskFactor = 0.15;
    break;
  default:
    riskFactor = 0.25;
}
```

BASIC PROGRAMMING

Control structures

for

- Allows the execution of repetition loops for a given number of iterations.
- *For all the times the condition is met, repeat the code.*
- A control variable is used:
  - It gets an initial value before the first iteration.
  - It is included in the condition that is checked before every iteration.
  - It gets updated after each iteration.

```
</>

for (initialization; condition; update) {

    //instructions that will be repeated

}
```

BASIC PROGRAMMING

Control structures

In this example:

- initialization: the control variable i is created and takes 0 as its initial value.
- condition: every time that i is less than 5, display the message.
- update: the value of i increases by 1.

```
let message = "This is a loop";
for (let i=0; i<5; i++) {
  alert(message);
}
```

BASIC PROGRAMMING

Control structures

for-of

- Allows you to easily traverse arrays and other array-like collections.
- Automatic initialization and updating of the control variable.

```
let days = ['monday', 'tuesday', 'wednesday',
'thursday', 'friday', 'saturday', 'sunday'];
for (let d of days) {
  alert(d);
}
```

BASIC PROGRAMMING

Control structures

while

- Allows the execution of repetition loops for an indeterminate number of iterations.
- *While the condition is met, repeat the code.*
- The condition is checked before the execution of the encased instructions.
- The control variable included in the condition should vary to avoid infinite loops.

</>

```
let result = 0;
let number = 5;
let i = 0;
while (i <= number) {
  result += i;
  i++; //update of the control variable
}
```

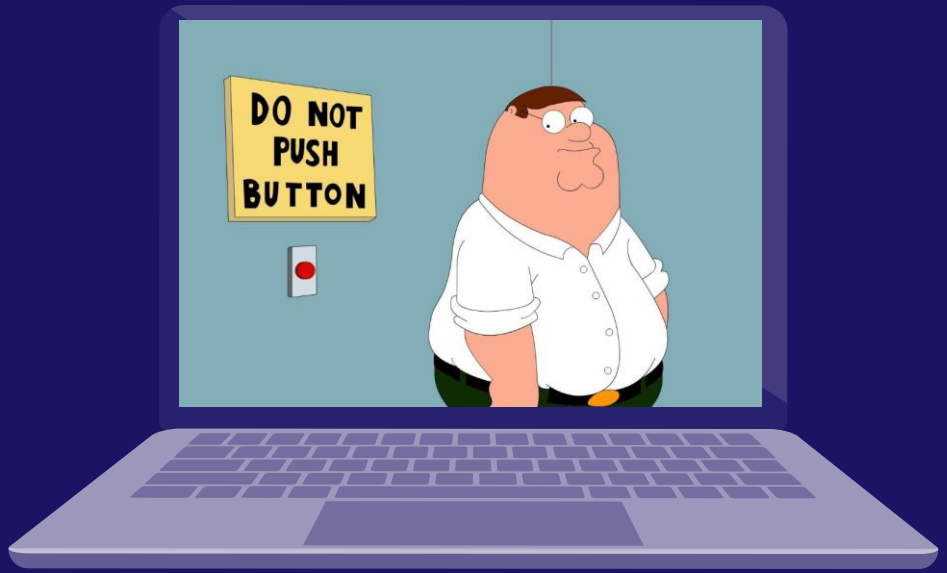
BASIC PROGRAMMING

Control structures

do-while

- Same as `while`, but the condition is checked after the execution of the encased code.
  - Executed at least once.

```
let result = 0;
let number = 5;
do {
  result += number;
  number--;
} while (number > 0);
alert(result);
```



PRACTICAL EXERCISE 7.1

03

BASIC UTILITIES

BASIC UTILITIES

- JavaScript has a bunch of tools and utilities (functions and properties) for managing variables.
- Many of the basic operation with variables can be performed directly with these utilities.

BASIC UTILITIES

text

*You can distinguish between a property and a function because a **function is always followed by parentheses**. The function's **arguments** (input parameters) are indicated inside these parentheses, if any are needed*

length

Its value is the number of characters of the string.

concat(*string*)

Returns the concatenation of both strings, like the + operator.

```
</>

let lm = "Lenguajes de Marcas";
alert(lm.length);  //19


let str1 = "Lenguajes ";
let str2 = str1.concat(" de Marcas");
alert(str2);  //"Lenguajes de Marcas"
```

BASIC UTILITIES

text

toUpperCase()

Returns the string in uppercase.

toLowerCase()

Returns the string in lowercase.

```
</>

let str = "JavaScript";

let str2 = str.toUpperCase();
  //'JAVASCRIPT'

let str3 = str.toLowerCase();
  //'javascript'
```

BASIC UTILITIES

text

charAt(*position*)

Returns the character that occupies the indicated *position*.

indexOf(*character*)

Returns the position of the first occurrence of that *character* (or −1 if not found).

lastIndexOf(*character*)

Returns the position of the last occurrence of that *character* (or −1 if not found).

```
</>

let str = "JavaScript";

let godaime = str.charAt(4);        //'S'

let firstA = str.indexOf('a');      //1

let lastA = str.lastIndexOf('a'); //3
```

BASIC UTILITIES

text

substring(*start*, *end*)

Returns the fragment of the string between the indicated positions.

- *start* included; *end* excluded.
- Inverts positions if *start* > *end*.
- If only one value → *start*.

split(*delim*)

Splits the string, cutting where the *delimiter* is found; returns an array with the fragments.

</>

```
let str = "JavaScript";
let lm = "Lenguajes de Marcas";

let sub1 = str.substring(2,6); //'vaSc'
let sub2 = str.susbtring(6,2); //'vaSc'
let sub3 = str.substring(7);   //'ipt'

let letters = sub2.split("");
//['v','a','S','c']
let words = lm.split(" ");
//["Lenguajes", "de", "marcas"]
```

BASIC UTILITIES

array

length

Number of items of the array.

concat(*array*)

Returns the concatenation of both arrays.

join(*delim*)

Returns a string formed by joining all the items in the array and using the indicated *delimiter* (commas default).

```
</>

let abcde = ['a', 'b','c','d','e'];
alert(abcde.length); //5

let arr1 = [1,2,3];
let arr2 = arr1.concat([4,5]);
//[1,2,3,4,5]

let lm =["Lenguajes", "de", "Marcas"];
let strlm = lm.join(" ");
//"Lenguajes de Marcas"
```

BASIC UTILITIES

array

pop()

Deletes the last item in an array.

Returns the deleted item.

push(*items*)

Attaches those *items* to the end of the array.

Returns the new length.

```
let lm =["Lenguajes", "de", "Marcas"];

let deleted = lm.pop();
// deleted is "Marcas"
//lm contains ['Lenguajes', 'de']

let amount =
  lm.push('y', 'Sistemas');
//amount is 4
//lm contains ['Lenguajes', 'de', 'y',
//'Sistemas']
```

BASIC UTILITIES

array

shift()

Deletes the first item in an array.

Returns the deleted item.

unshift(*items*)

Attaches those *items* to the beginning of the array.

Returns the new length.

```
let lm =["Lenguajes", "de", "Marcas"];

let deleted2 = lm.shift();
//deleted2 is "Lenguajes"
//lm contains ['de','Marcas']

let amount2 = lm.unshift(373);
//amount2 is 3
//lm contains [373, 'de', 'Marcas']
```

BASIC UTILITIES

array

splice(*pos, remAmount, items*)

- If two arguments, removes *remAmount* items from the array, starting at *pos;* returns an array with the removed items.
- If *remAmount* is 0, the remaining arguments (*items*) are attached to the array, starting at *pos;* returns an empty array.

reverse()

Reverses the order of the items.

```
let lm =["Lenguajes", "de", "Marcas"];

lm.reverse();
//lm contains ['Marcas', 'de',
//'Lenguajes']

let p1 = lm.splice(1,2);
//lm contains ['Marcas']
//p1 contains ['de', 'Lenguajes']

lm.splice(1,0,"la","diferencia");
//lm contains ['Marcas', 'la',
'diferencia']
```

BASIC UTILITIES

number

NaN

Not a Number; the result of an operation impossible to calculate.

isNaN(*param*)

Returns `true` when *param* is NaN.

```
</>

let num = 0 / 0;  //NaN

if (isNaN(num1/num2)) {
  alert("The division cannot be done.");
}
```

BASIC UTILITIES

number

Infinity and -Infinity

Positive and negative infinity.

isFinite(*param*)

Returns `true` when *param* is a finite number.

Returns `false` when *param* is (positive or negative) infinity, or `NaN`.

```
</>

let num1 = 10 / 0;    //Infinity

if (!isFinite(num3)){
  alert('Non-finite number.');
}
```

BASIC UTILITIES

number

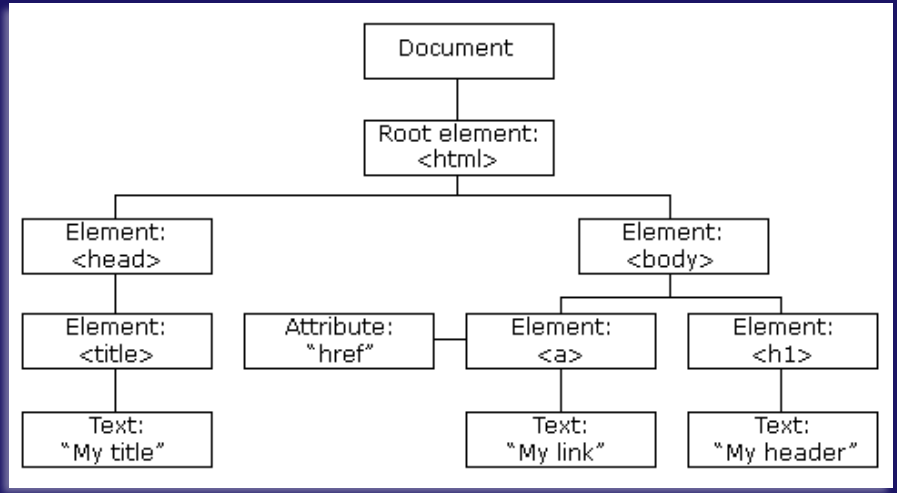
toFixed(*numDigits*)

Returns, as a string, the number rounded to *numDigits* decimal places.

```
</>

let num2 = 3.141591;
let str = num2.toFixed(2);
//"3.14"
```

04

DOCUMENT OBJECT MODEL



HTML DOM

- The **DOM** is an **API** for manipulating **tree-like** representations of the **HTML** and **XML** documents.
- The **HTML DOM** is created by the browser when the page loads.
- An **object** is created for each element, attribute, text content and comment in the page.

Provides an API

- Properties that can be read and written.
- Methods that can be used for various actions.

- Modifications in content, structure and style

Allows programs to read from and write to the page

HTML DOM

The document object

- Is the object that represents the page.
- Has properties to easily access its main elements:
  - `document.head`
  - `document.body`
- Has methods that allow you to access any of its elements:
  - `document.getElementById(`*`id`*`)`
  - `document.getElementsByTagName(`*`tagName`*`)`
  - `document.getElementsByClassName(`*`className`*`)`
  - `document.getElementsByName(`*`name`*`)`
  - `document.querySelector(`*`selector`*`)`
  - `document.querySelectorAll(`*`selector`*`)`

HTML DOM

The document object

getElementById(*id*)

Returns the element with the matching id attribute.

getElementsByTagName(*tag*)

Returns, in an ~~array~~ HTMLCollection, the elements with the matching tag name.

*HTMLCollections and NodeLists are **array-like collections** in that they **can be iterated over and their items accessed using position numbers**; but do not have array methods like push(), pop(), join()…*
*The **length** property is also available*

</>

```
let element =
  document.getElementById("example");

let array1 =
  document.getElementsByTagName("input");
```

HTML DOM

The document object

getElementsByName(*name*)

Returns, in ~~an array~~ a NodeList, the elements with the matching name attribute.

getElementsByClassName(*class*)

Returns, in an ~~array~~ HTMLCollection, the elements with the matching class attribute.

```
</>

let array2 =
 document.getElementsByName("tbx1");

let array3 =
  document.getElementsByClassName(
  "main");
```

HTML DOM

The document object

querySelector(*selector*)

Returns the first element that matches the given CSS *selector*.

querySelectorAll(*selector*)

Returns, in ~~an array~~ a NodeList, all the matching elements with the given CSS *selector*, in order of appearance.

```
</>

let element =
  document.querySelector("#example");

let array1 =
  document.querySelectorAll("input");
```

HTML DOM

Access to element data

This methods return an array-like object, even if it only contains one item

innerHTML

Property of an HTML element that holds the content encased by its opening and ending tags.
Can be both read and written.

tagName

(Read-only) property of an HTML element that holds its tag name, UPPER-CASE.

```
</>

alert(document.getElementsByClassName(
  "sth")[0].tagName.toLowerCase());

let mainTitle =
  document.getElementsByTagName("h1")[0];
alert(mainTitle.innerHTML);
mainTitle.innerHTML = "My new header";
```

HTML DOM

Access to element data

children

(Read-only) array-like (HTMLCollection) property of an element that contains its children.

```
let string1 = "";
for (let e of document.body.children) {
  string1 += e.tagName.toLowerCase() + '\n';
}
  alert(string1);
```

HTML DOM

Access to element data

setAttribute(*attName*, *value*)

Adds an attribute to the element, or modifies its value, if exists.

getAttribute(*attName*)

Reads the value of an attribute of the element.

Alternatively, you can use the property with that same attribute name for both reading and writing attribute values.

</>

```
let a =
  document.getElementsByTagName("a")[0];
let newURL = "https://www.iesserpis.org";

alert(a.getAttribute("href"));
a.setAttribute("href", newURL);

alert(a.href);
a.id = "1stlink";
```

HTML DOM

Example: change content using innerHTML

```
<body>
  <p>TEXT1</p>
  <p>TEXT2</p>
  <p>TEXT3</p>
  <button type="button"
    onclick="changeContent()">CHANGE
  </button>
</body>
```

```
function changeContent(){
  let p1 =document.querySelector(
    "body p:first-child");
  p1.innerHTML =  "TEXT CHANGED";
}
```

HTML DOM

Element creation and insertion

document.createElement(*tagName*)

Creates an element of the given *tag name*.

document.createTextNode(*text*)

Creates a text node with the given *text*.

appendChild(*newElement*)

Method of an element to add *newElement* as the last of its children.

insertBefore(*newElement, existingChild*)

Method of an element to add *newElement* before its *existingChild*.

HTML DOM

Example: inserting <li> elements before and after

Note: function with a return value

It can be assigned to variables

```
<html>
<head>
  <script>
    let newLi;
    function createLi(text) {
      let e = document.createElement("li");
      let content = document.createTextNode(text);
      e.appendChild(content);
      return e;
    }
    function liAfter() {
      newLi = createLi("Inserted after the sample");
      document.getElementById("u1").appendChild(newLi);
    }
    function liBefore() {
      newLi = createLi("Inserted before the sample");
      let sample = document.getElementById("li1");
      document.getElementById("u1").insertBefore(newLi, sample);
    }
  </script>
</head>
<body>
  <ul id=u1>
    <li id=li1>Sample item</li>
  </ul>
  <button type=button onclick=liAfter()>After</button>
  <button type=button onclick=liBefore()>Before</button>
<body>
</html>
```

- Sample item

After Before

- Inserted before the sample
- Sample item

After Before

- Sample item
- Inserted after the sample

After Before

HTML DOM

Element replacement and removal

replaceChild(*newElement, oldElement*)

Replaces one of the element's children with a new one.

remove()

Method of an element that removes it from the DOM.

```
//replace <body>'s existing <h1> with a new <h2>
let h1 = document.getElementsByTagName("h1")[0];
let h2 = document.createElement("h2");
h2.innerHTML="Replaced";
document.body.replaceChild(h2, h1);

//remove 2nd item from a <ul>
let b = document.getElementsByTagName("ul")[0]
  .children[1];
b.remove();
```

HTML DOM

CSS inline style modification

style

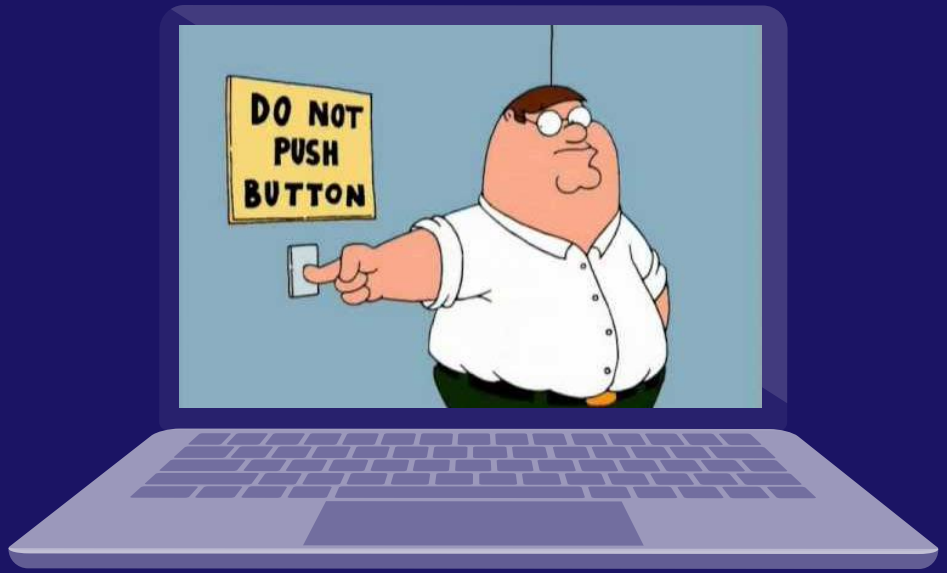
Property of an element that gives access to its **style** attribute (inline CSS).

Access to CSS properties is done using the dot operator.

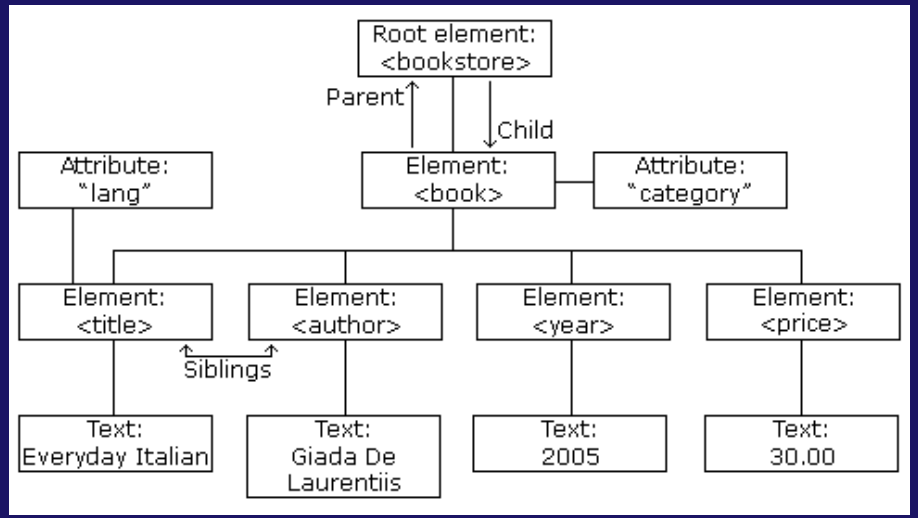
CSS property names containing dashes are converted to lowerCamelCase notation.

Example: `font-family` → `fontFamily`

```
</>

document.body.style
  .backgroundColor = "lightgrey";
document.getElementsByTagName("h1")[0]
  .style.fontFamily = "verdana";
```



PRACTICAL EXERCISE 7.2




```xml
<?xml version="1.0" encoding="UTF-8"?>
<bookstore>
    <book category="cookbook">
        <title lang="en">Everyday Italian</title>
        <author>Giada de Laurentiis</author>
        <year>2005</year>
        <price>30.00</price>
    </book>
</bookstore>
```

XML DOM

- The XML DOM is created by the browser's XML parser.
- An object is created for each node.
- In XML, everything is a node:
  - The document
  - Each element
  - An element's text content
  - Each attribute
  - Each comment
- Provides an API that allows reading from an writing to the XML document.

XML DOM

Basic XML node properties

nodeName

(Read-only) name of the node.

nodeValue

Text content of the node. Can be read and written.

attributes

Object that contains the attributes of the node, and their values.

parentNode

Contains a reference to the parent of the node.

childNodes

(Read-only) NodeList with the child nodes of the node.

XML DOM

Basic XML node methods

getElementsByTagName(*name*)

(XML document method that) Returns a NodeList with all the elements with the matching *name*.

~~**appendChild(*newNode*)**~~

~~Method of a node to add *newNode* as the last of its children.~~

~~**removeChild(*childNode*)**~~

~~Method of a node to remove an existing *child node*.~~

getAttribute(attributeName)

Method of a node that returns the value of its matching attribute.

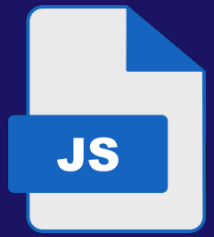
~~**setAttribute(*attributeName, value*)**~~

~~Method of a node to assign *value* to its matching attribute.~~

XML DOM

Thus, appendChild(), removeChild() and setAttribute() will not be used here

- Our goal in this section is to **present** data taken from an XML file in an HTML page.
- Our HTML project needs, at least:
  - ✓ An **XML file** with the data to present.
  - ✓ A page where the data will be presented (**HTML file**).
  - ✓ The JavaScript code, which has to **access the XML DOM**, **read its content** and **write it to the HTML page**. (a external **JS file** in the example).



XML DOM

```
<?xml version="1.0" encoding="UTF-8"?>
<bookstore>
  <book category="cookbook">
    <title lang="en">Everyday Italian</title>
    <author>Giada de Laurentiis</author>
    <year>2005</year>
    <price>30.00</price>
  </book>
</bookstore>
```

XML DOM

```html
<!DOCTYPE html>
<html>
<head>
  <meta charset="utf-8"/>
  <script src="js/example.js"></script>
</head>
<body>
  <h1>Data taken from the XML file</h1>
  <div>
    <b>category</b> <i>(attribute)</i>: <span
id="cat"></span></br>
    <b>title:</b> <span id="title"></span><br>
    <b>author:</b> <span id="author"></span><br>
    <b>year:</b> <span id="year"></span><br>
    <b>price:</b> <span id="price"></span> €
  </div
</body>
</html>
```

XML DOM

"The readFromXml function will run on page load"
Events and their handlers are studied later

JS

1

3

4

2

```
window.addEventListener("load", readFromXml);

function readFromXml() {
  let xmlhttp = new XMLHttpRequest();
  xmlhttp.open("GET","xml/bookstore.xml", false);
  xmlhttp.send();
  let xmlDoc = xmlhttp.responseXML;

  document.getElementById("cat").innerHTML =
xmlDoc.getElementsByTagName("book")[0].getAttribute("category");
  document.getElementById("title").innerHTML =
xmlDoc.getElementsByTagName("title")[0].childNodes[0].nodeValue;
  document.getElementById("author").innerHTML =
xmlDoc.getElementsByTagName("author")[0].childNodes[0].nodeValue;
  document.getElementById("year").innerHTML =
xmlDoc.getElementsByTagName("year")[0].childNodes[0].nodeValue;
  document.getElementById("price").innerHTML =
xmlDoc.getElementsByTagName("price")[0].childNodes[0].nodeValue;
}
```

XMLHttpRequest object

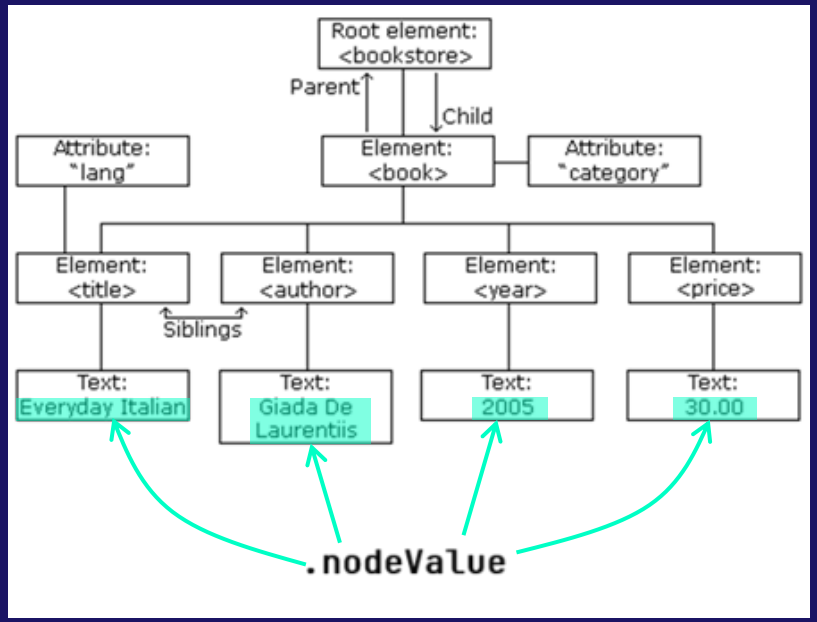
```
window.addEventListener("load", readFromXml);

function readFromXml() {
  let xmlhttp = new XMLHttpRequest();
  xmlhttp.open("GET","xml/bookstore.xml", false);
  xmlhttp.send();
  let xmlDoc = xmlhttp.responseXML;

  document.getElementById("cat").innerHTML =
xmlDoc.getElementsByTagName("book")[0].getAttribute("category");
  document.getElementById("title").innerHTML =
xmlDoc.getElementsByTagName("title")[0].childNodes[0].nodeValue;
  document.getElementById("author").innerHTML =
xmlDoc.getElementsByTagName("author")[0].childNodes[0].nodeValue;
  document.getElementById("year").innerHTML =
xmlDoc.getElementsByTagName("year")[0].childNodes[0].nodeValue;
  document.getElementById("price").innerHTML =
xmlDoc.getElementsByTagName("price")[0].childNodes[0].nodeValue;
}
```

- Is used to read XML from JS code.
- How-to:
  1. Create a new one (instantiation).
  2. Configure file access (HTTP method, path and response type; `false` means *synchronous*).
  3. *Send* it.
  4. The response is a **`Document`** object:
     - Like **`document`** in the HTML DOM, but the entire XML document now.
     - Assign it to a variable.

The sender of the request stops its activity while waiting for the recipient's response

XML DOM

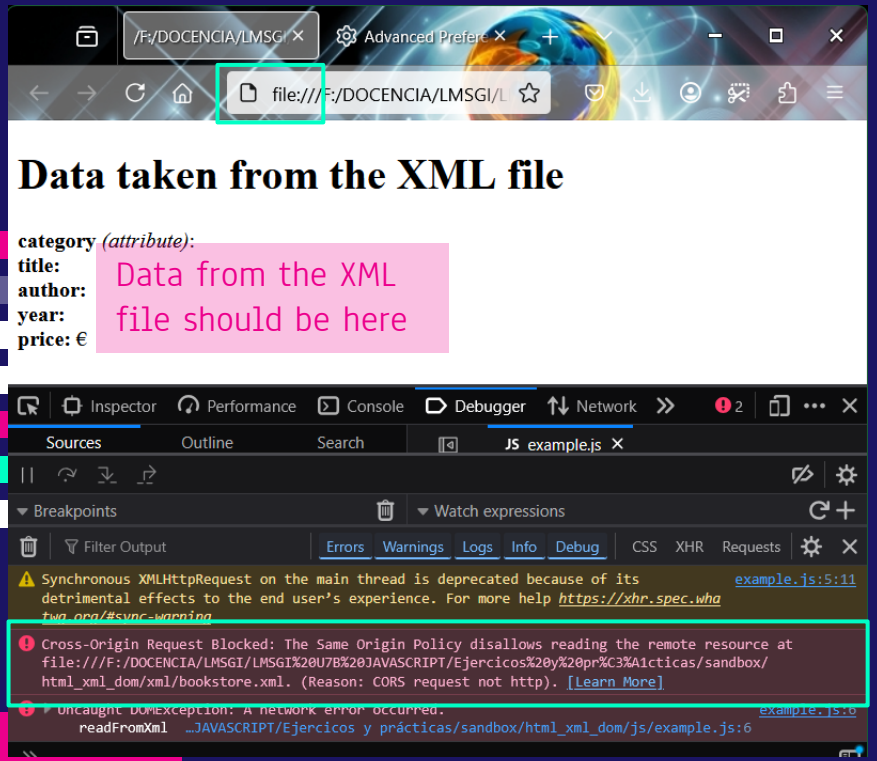
"In XML, everything is a node"



- **`childNodes`** is an array-like property that contains all the direct children of a node.
- If the node is a *leaf* (has no element children), then **`childNodes[0]`** or **`firstChild`** is the node that represents its (text) content.
- To get the actual text, the **`nodeValue`** property must be read:

```
xmlDoc.getElementsByTagName("author")[0]
.childNodes[0].nodeValue;
```

XML DOM



CORS blocking

- `XMLHttpRequest`s with local files using `file:///` instead of `http://` or `https://` pose a security risk *(Cross-Origin Resource Sharing)*.
- Modern browsers block them by default.

XML DOM

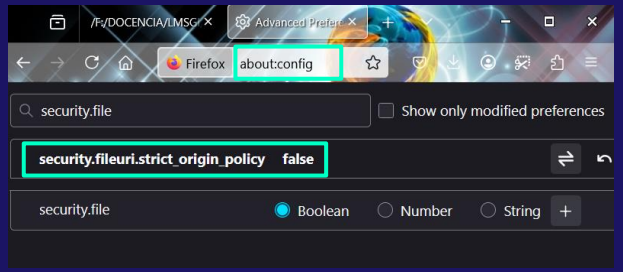
Avoid CORS blocking

You have several choices:

- Upload the HTML project to a remote web server.
- Set up a local web server for the HTML project and use `http://localhost` to load pages in the browser.
  - Easy with VS Code or IIS (Windows only).
- Override the CORS blocking in your browser:

Easy

Very easy → Go to `about:config`, accept risk warning, disable `security.fileuri.strict_origin_policy`

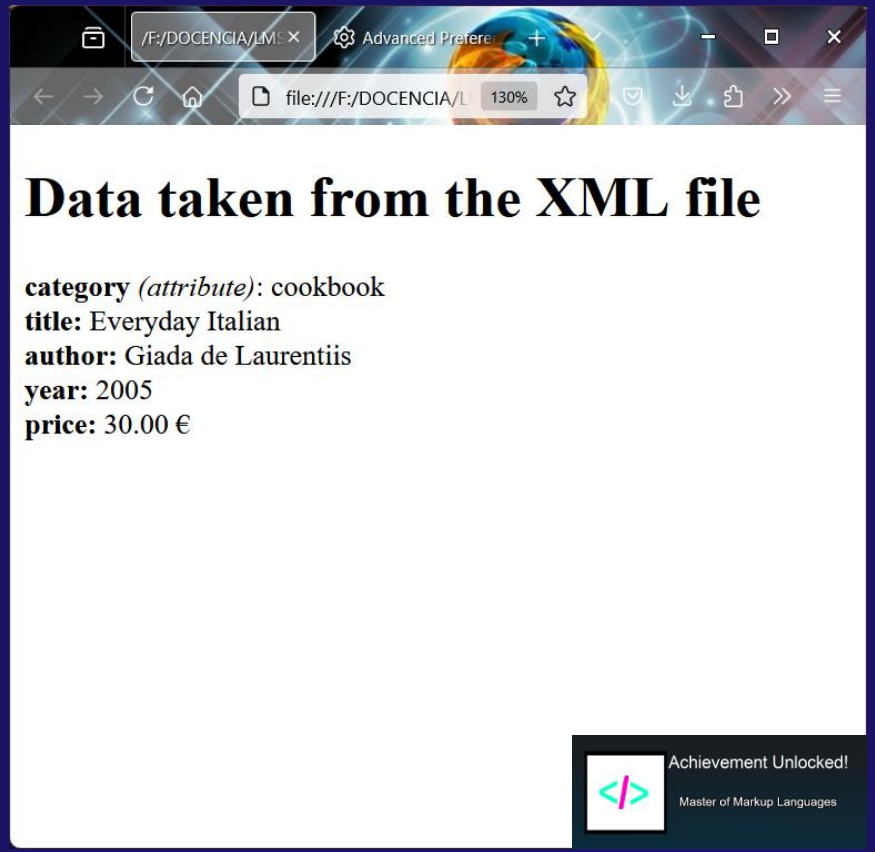


Easy, but slow → Run using command:

```
msedge --disable-web-security --user-data-dir="path_to_root_dir"
```

Other browsers?

XML DOM


/F:/DOCENCIA/LMS
Advanced Prefere
file:///F:/DOCENCIA/L
130%
Data taken from the XML file
category (attribute): cookbook
title: Everyday Italian
author: Giada de Laurentiis
year: 2005
price: 30.00 €
Achievement Unlocked!
Master of Markup Languages


GREAT SUCCESS

About the child nodes…

- Spaces and CRLF between tags are also in nodes!
- In this example, **<book>** has 9 child nodes:
  - 4 nodes containing elements
  - 5 nodes containing CRLF and tabs

```
xmlDoc.getElementsByTagName("book")[0].childNodes
NodeList(9) [ #text , title , #text , author , #text , year , #text , price , #text ]
  0: #text "\n\t\t"
  1: <title lang="en">
  2: #text "\n\t\t"
  3: <author>
  4: #text "\n\t\t"
  5: <year>
  6: #text "\n\t\t"
  7: <price>
  8: #text "\n\t"
  length: 9
```

- Use **getElementsByTagName()** to access to XML nodes whenever possible!

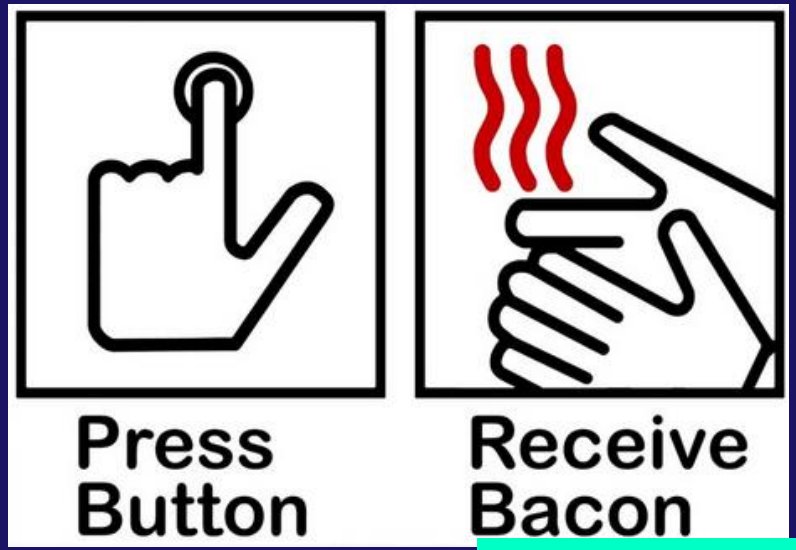
```
<?xml version="1.0" encoding="UTF-8"?>
<bookstore>
  <book category="cookbook">
    <title lang="en">Everyday Italian</title>
    <author>Giada de Laurentiis</author>
    <year>2005</year>
    <price>30.00</price>
  </book>
</bookstore>
```

05

EVENTS

EVENTS

- Actions that can be detected by a program.
  - Example: the `click` event is detected when the user clicks on any element on the page.
- When included in HTML pages, JavaScript can react to them.
- The browser can be instructed to do something when certain event is detected.



EVENTS

Functioning

- Events in HTML files are set as attributes for elements.
- You can set one or more detectable events in the opening tag of an element.
- The corresponding event attribute has the same name as the event, prefixed with **on-**.
- The value these attributes accept is either JS code or a call to the function where the JS code is.
- Example:

```
<body onclick="alert('Some message');">
```

EVENTS

of the user interface

- `resize`: the size of the browser window has changed.
  - <body>
- `load`: the resource has finished loading on the page.
  - window; <body>, <img>, <input type="image">, <link>, <script>, <style>
- `error`: the resource load failed and could not be completed.
  - <img>, <input type="image">, <audio>, <video>, <link>, <script>

EVENTS

of the user interface

- `scroll`: detected when the user *scrolls* over the element.
  - *Scrollable* elements, blocks typically.
- `select`: the user has selected some text in a text box or area.
  - <input> *(all the text box types)*, <textarea>

EVENTS

relative to the focus of an element

- `blur`: the element has lost focus.
- `focus`: the element has gained focus.
- `focusout`: the element has lost focus (*bubbling*).
- `focusin`: the element has gained focus (*bubbling*).
  - Can be applied to any element able to gain focus.

➢ *Event bubbling*: the event is detected either by the element or by any of its children.

EVENTS

generated with the mouse

- `click`: the element was clicked (pressed + released).
- `dblclick`: the element was double clicked.
- `mousedown`: the element was pressed, but not released.
- `mouseup`: the element was pressed and has just been released.
  - Happens before `click`.
- `contextmenu`: like `click`, but using the secondary button.

➢ Can be applied to any clickable element.

EVENTS

generated with the mouse

- `wheel`: the mouse wheel was rotated over an element.
- `mouseenter`: the mouse pointer entered an element.
- `mousemove`: the pointer moved while over an element.
- `mouseleave`: the pointer moved out of an element.
- `mouseover`: the pointer entered an element (*bubbling*).
  `mouseout`: the pointer moved out of an element (*bubbling*).

  - Can be applied to any element with size > 0.

EVENTS

of media elements

- `loadstart`: the element started loading.
- `loadeddata`: the data for the first *frame* was loaded.
- `canplay`: enough of the element was downloaded to play.
- `canplaythrough`: like before, but allowing non-stop playback.
- `error`: the load of the element failed.

EVENTS

of media elements

- `play`: the element started playing.
- `playing`: the element resumed playing after a pause (or after being halted due to lack of data).
- `pause`: the element was paused.
- `ended`: the element ended playback.
- `volumechange`: the volume level of the element changed.

06

EVENT HANDLERS

EVENT HANDLERS

- JavaScript code usually runs after the user performs some actions.
- These user actions and other events will trigger JavaScript functions, which will handle the event.
- But first, event-function assignments must be done.

EVENT HANDLERS

ASSIGNMENT

Three ways to register an event for an HTML element

Inline

Add the event attribute to its HTML tag

HTML DOM

Assign as a value to the corresponding property of the HTML object

addEventListener()

As arguments of this method of the element

EVENT HANDLERS

Inline

- Declaration of event and handler assignment are directly done in the element's tag.
- Using *attribute="value"* pairs.
- Deprecated technique, although very practical due to its simplicity.

```
<button onclick="doSomething()">PRESS</button>
```

EVENT HANDLERS

HTML DOM

- Assignment is done using JS code.
- Use the corresponding element's event attribute property to set the value:
  - Actual JS code, or
  - Name of the triggered function, without parentheses (if they are used, the function will immediately run and not be registered).
- If the function has input parameters, a *lambda expression* should be used in this form (not studied here).

</>

```
<button id="myButton">
  PRESS</button>

<script>
  document.getElementById("myButton")
    .onclick = doSomething;

  function doSomething() {
        //instructions here
  }
</script>
```

EVENT HANDLERS

addEventListener()

- Method of an HTML element.
- Is the most powerful way of assigning functions to events.
- Has three arguments:
  1. The name of the event *(without on-)*, in quotes.
  2. The name of the triggered function, without parentheses.
  3. *(Optional)* A boolean value indicating, in case of nested elements, whose event will trigger first.
     - `false`: *(default)* the child's event first (*event bubbling*)
     - `true`: the parent's event first (*event capturing*).
- If the function has input parameters, a *lambda expression* should be used in this form (not studied here).

EVENT HANDLERS

addEventListener()

</>

```
//1) When the page is loaded, register events
window.addEventListener('load', registerEvents);

//2) When the first <p> is clicked, show message
function registerEvents() {
  let elem = document.querySelector(
    "body p:first-child");
  elem.addEventListener('click', showAlert);
}

//3) This function shows a message
function showAlert() {
  alert('YOU CLICKED!');
}
```

Register events inside a function

Call that function on page load

Declare event handlers

EVENT HANDLERS

addEventListener()

- addEventListener() makes it possible to assign multiple functions to handle the same event of an element:

```
someElement.addEventListener("click", function1);
someElement.addEventListener("click", function2);
someElement.addEventListener("mouseover", function3);
```

EVENT HANDLERS

removeEventListener()

- This method of an element can be used to remove a previously registered event handler.

```
someElement.removeEventListener("click", function2);
```

EVENT HANDLERS

In an event handler…

this

Refers to the element that triggered the event

event

Refers to the triggered event

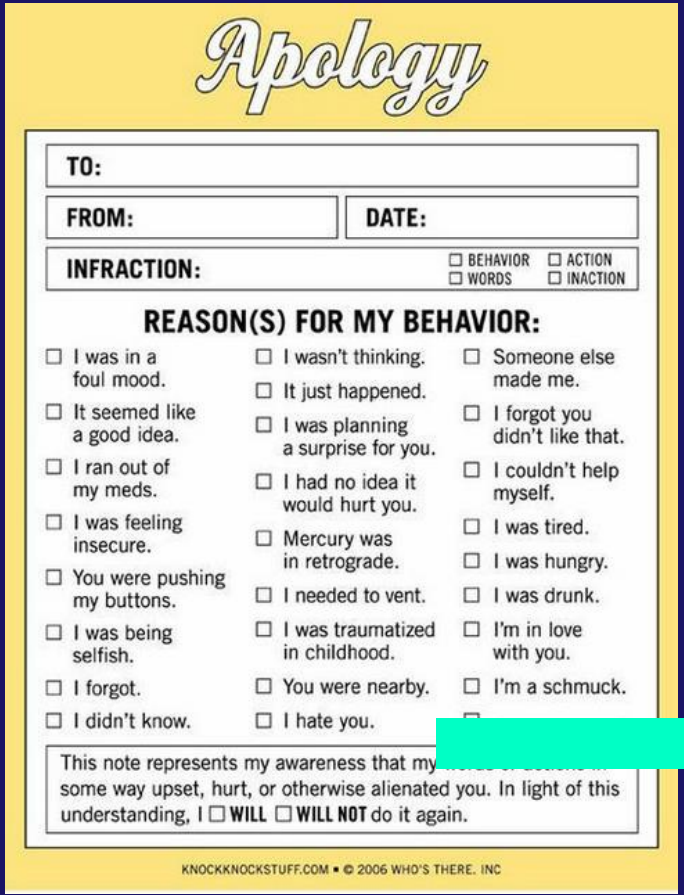
PRACTICAL EXERCISE 7.3

07

FORMS

FORMS

- JavaScript has properties and functions that facilitate the programming of applications that handle the appearance of forms, client-side.



FORMS

- There are many ways to access to forms on web pages through the HTML DOM.
- As with any other element, you can make use of the **`document` object's getter methods**; **but also**:

1. The **`document.forms`** property:
   HTMLCollection (array-like) whose items are references to each form on the page.
   - For example, the first form would be:

     `document.forms[0]`

FORMS

2. If the `<form>` has the **name** attribute, you can use its value, instead of the position number, to select it from **`document.forms`**.

3. If the `<form>` has the **name** attribute, a property for **`document`** is created with its value to point at that `<form>`.

This also happens for `<img>` and `<a>` elements

Assuming it's the first form on the page

```
<form name="form1">
        ...
</form>
```

```
//the following are equivalent
let form1_1 = document.forms[0];
let form1_2 = document.forms["form1"];
let form1_3 = document.form1;
```

FORMS

Access to input data from controls

<textarea> and all **<input>** controls:
(except **type=radio**, **type=checkbox** and **type=file**)

- the element's **value** property.

```
</>

<input type="text" id="tbx1">
<input type="range" id="rng1">
<textarea id="ta1"></textarea>

let value1 = document
  .getElementById("tbx1").value;
let value2 = document
  .getElementById("rng1").value;
let value3 = document
  .getElementById("ta1").value;
```

FORMS

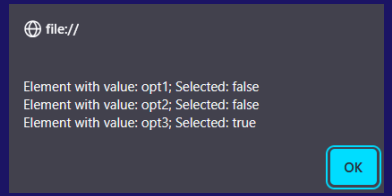
***Important**: radios must have a* `value`*, because they share a* `name` *and their default value is* `on`

Access to input data from controls

Radio buttons:

- The key point is knowing which one is **checked**, and its **value**.
- Done by reading the **checked** boolean property of the radios.

OPTION 1
OPTION 2
OPTION 3




```
<input type="radio" value="opt1"
  name="question" id="ropt1">OPTION 1<br>
<input type="radio" value="opt2"
  name="question" id="ropt2">OPTION 2<br>
<input type="radio" value="opt3"
  name="question" id="ropt3">OPTION 3<br>
```

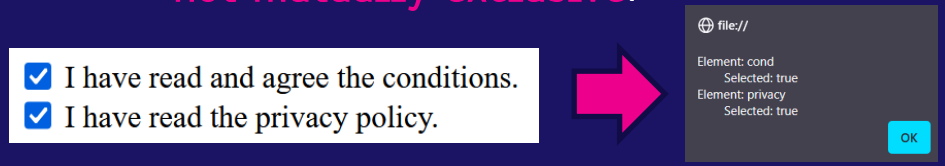
```
let result="";
let elem =
  document.getElementsByName("question");
for (let item of elem) {
  result +=
    "\nElement with value: " + item.value +
    "; Selected: " + item.checked;
}
alert(result);
```

FORMS

Access to input data from controls

Checkboxes:

- Similar to radios, but **name** could be read instead of **value**. (+**checked**).
- It should be noted that they are not mutually exclusive.




```
<input type="checkbox" value="cond"
  name="cond" id="cond"/>
I have read and agree the conditions.<br>
<input type="checkbox" value="privacy"
  name="privacy" id="privacy"/>
I have read the privacy policy.
```

```
let result = "";
let elem = document.getElementById("cond");
result += "Element: " + elem.value +
  "\n\tSelected: " + elem.checked;
elem = document.getElementById("privacy");
result += "\nElement: " + elem.value +
  "\n\tSelected: " + elem.checked;
alert(result);
```

FORMS

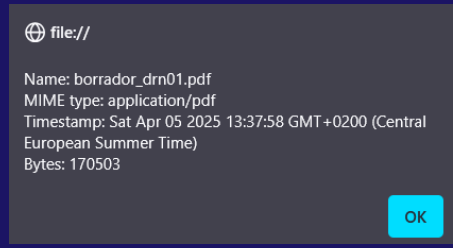
Is null for any other `<input>` *types*

Access to input data from controls

File attachment control:

- Its **files** property is an array-like collection of files.
- Items in this collection have file-related properties:
  - **name**
  - **size**
  - **type**
  - **lastModified**

Requires format conversion



</>

```
<input type="file" name="file1">
```

```
let result="Empty";
let elem = document.
  getElementsByName("file1")[0];
if (elem.files.length>0) {
  let f1 = elem.files[0];
  result = "Name: " + f1.name;
  result += "\nMIME type: " + f1.type;
  result += "\nTimestamp: " +
    Date(f1.lastModified);
  result += "\nBytes: " + f1.size;
}
alert(result);
```

FORMS

Access to input data from controls

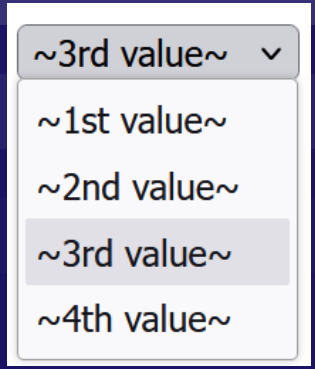
Selection controls:

- Key properties of the **<select>** element DOM object:
  - **selectedIndex**: position of the first selected option.
  - **value**: value of the first selected option.
  - **options**: array-like collection of options.
- Key properties of the **<option>** element DOM object:
  - **value**
  - **innerHTML**
  - **selected**

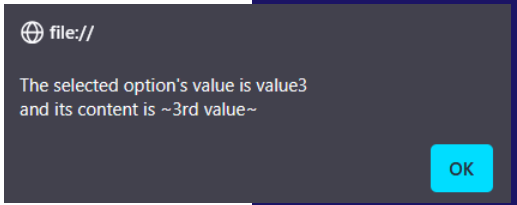
If `<select` **`multiple`**`>`, *then you should read/write its* `selectedOptions` *array-like property; and from its items, their* `index` *and* `value` *properties*

FORMS

```
<select name=selector>
  <option value=value1>~1st value~</option>
  <option value=value2>~2nd value~</option>
  <option value=value3>~3rd value~</option>
  <option value=value4>~4th value~</option>
</select>
```




```
let elem = document
  .getElementsByName("selector")[0];
let pos = elem.selectedIndex;
let result = "The selected option's value is "
  + elem.value + "\nand its content is "
  + elem.options[pos].innerHTML;
alert(result);
```

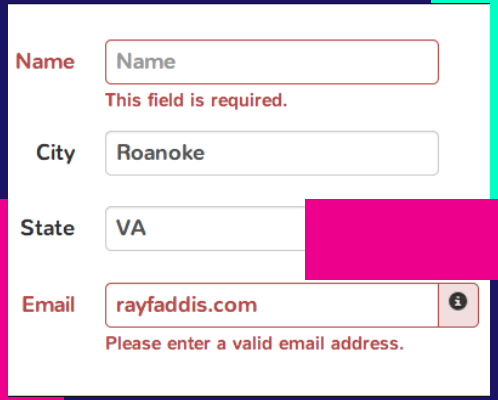


FORM VALIDATION

- HTML5 offers different ways to validate the data entered in a form control:
  - Default validation (`url`, `email` and `tel` <input> controls).
  - The `required` attribute.
  - The `pattern` attribute (RegEx).
- Sometimes it will be necessary to apply more complex validation mechanisms.
  - Combination of controls.
  - Checking the results of a calculation.

FORM VALIDATION

If users make any mistakes while filling the form, they can be immediately notified, even before the submit button is clicked.



The main use of JavaScript in form handling is the validation of data entered by the user

FORM VALIDATION

Some useful events:

submit

Triggered when the submit button of the form is clicked

invalid

Triggered when the data in a form control is not valid when the submit button is clicked

input

Triggered when the content of a text box or area is changed

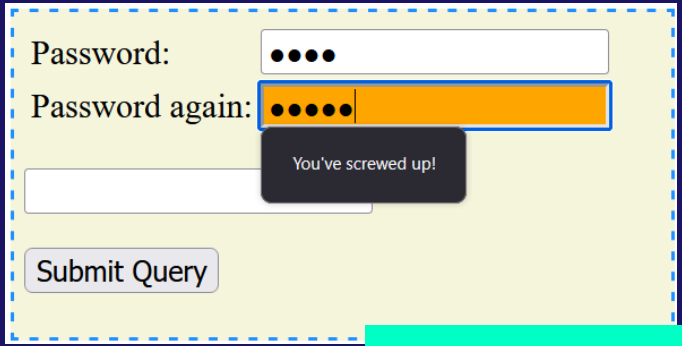
keyup

Triggered when any key press is released

FORM VALIDATION

Customizing the error message

- Browsers display an error message when the user tries to submit a form and any of its controls has invalid data.
- This message can be customized by using the control's `setCustomValidity()` method.



FORM VALIDATION

Customizing the error message

- Use the control's `setCustomValidity()` method to set a custom validation error message.
- This way, the control is marked as invalid.
  - `validity.customError = true`
- When the submit button is clicked, any controls with a custom validation message *(i.e., invalid)* will block the submission of the form.
- To remove the custom validation message: `setCustomValidity("")`

FORM VALIDATION

setCustomValidity()

Checking that two password inputs are the same

```
<form>
  <input type="password" name="pw1">
  <input type="password" name="pw2">
  <input type="submit" id="sub1">
</form>
```

```
document.getElementById("sub1")
  .addEventListener('click', validatePw);

function validatePw() {
  let pass1 = document.getElementsByName("pw1")[0];
  let pass2 = document.getElementsByName("pw2")[0];
  if (pass1.value !== pass2.value) {
    pass2.setCustomValidity(
      "<Custom error message>");
  } else {
    pass2.setCustomValidity("");
  }
}
```

```
▼ pass2.validity: ValidityState
    badInput: false
    customError: true
    patternMismatch: false
    rangeOverflow: false
    rangeUnderflow: false
    stepMismatch: false
    tooLong: false
    tooShort: false
    typeMismatch: false
    valid: false
    valueMissing: false
```

```
▼ pass2.validity: ValidityState
    badInput: false
    customError: false
    patternMismatch: false
    rangeOverflow: false
    rangeUnderflow: false
    stepMismatch: false
    tooLong: false
    tooShort: false
    typeMismatch: false
    valid: true
    valueMissing: false
```

FORM VALIDATION

invalid event

- Is triggered for a control that has invalid data at the time the submit button is pressed.
- By handling this event, the response can be fully customized.

FORM VALIDATION

invalid event

If any of the textboxes have invalid data, change its background color to orange

```
<form id="form2">
  <input type="email" name="mail"
    oninvalid="actionsInvalid(this)">
  <input type="number" min="20" name="numbox"
    oninvalid="actionsInvalid(this)">
  <input type="submit" id="sub2">
</form>
```

```
function actionsInvalid(element){
  element.style.background = 'orange';
}
```

FORM VALIDATION

Validation control

- **checkValidity()**: method of a control that returns **true** if has valid data.
- **submit()**: method of a form that submits the collected data.
- **reset()**: method of a form that sets all its controls to their default values.

- Used together, the validity of the controls can be checked before submitting the form.

FORM VALIDATION

Validation control

(Using the same <form> as in the last example)

Display an alert if any fields are invalid

```
document.getElementById("sub2")
  .addEventListener('click', mySubmit);

function mySubmit() {
  let tbMail =
    document.getElementsByName("mail")[0];
  let tbNum =
    document.getElementsByName("numbox")[0];
  if (tbMail.checkValidity() &&
    tbNum.checkValidity()) {
      document.getElementById("form2").submit();
  }
  else {
    alert('Please double check');
  }
```

FORM VALIDATION

Real-time validation

- You have learned validation related to the submission of the form so far.
- To check the validity of the data as the user enters it into a control, its **`validity`** property must be read.
  - This property is a `ValidityState` object, with 11 properties.
  - You already learned about **`customError`**

FORM VALIDATION

All boolean and read-only

PROPERTIES OF ValidityState

All definitions start as: "This property is **`true`** when..."

badInput

...the entered value does not conform the expected *internal* type. Example: text in a numeric textbox.

patternMismatch

...the entered value does not match the specified pattern.

rangeOverflow

...the entered value is greater than the value of the **`max`** attribute.

rangeUnderflow

...the entered value is less than the value of the **`min`** attribute.

stepMismatch

...the entered value does not fit the rule set by the **`step`** attribute.

FORM VALIDATION

tooLong

...the entered value is longer than the value of the **maxlength** attribute.

tooShort

...the entered value is shorter than the value of the **minlength** attribute.

typeMismatch

...the entered value does not conform the value of the **type** attribute. Example: URL in an email textbox.

valid

...every other property of **ValidityState** is **false**.

valueMissing

...the control is **required** but has no value.

PROPERTIES OF ValidityState

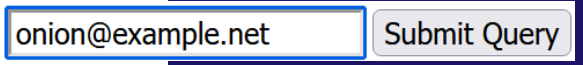
FORM VALIDATION

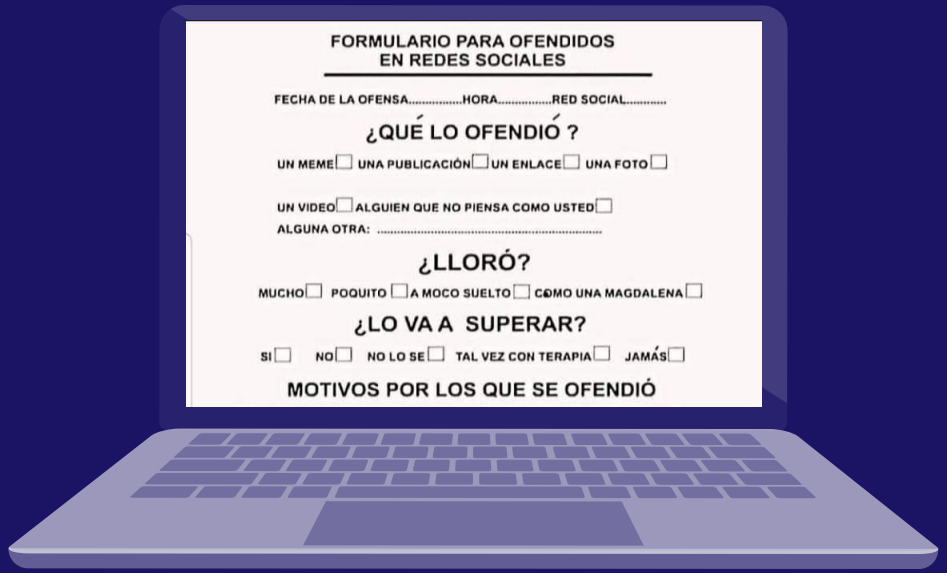
Real-time validation

If the textbox is empty or its value is not an email address, change its background color to tomato.

```
<form oninput="validateOnInput(event)">
  <input type="email" required>
  <input type="submit">
</form>
```

```
function validateOnInput(ev){
  let control = ev.target;
  if (control.validity.typeMismatch ||
    control.validity.valueMissing)
   control.style.background = "tomato";
else
  control.style.background = "transparent";
}
```





PRACTICAL EXERCISE 7.4

08

CANVAS

CANVAS

- `<canvas>` is an inline HTML element that basically serves as a container for graphics.
    - You have to draw with JS.
- Its optional **`width`** and **`height`** attributes default to 300 and 150, respectively.

CANVAS

`<canvas>`

- Can receive CSS styles like any other box.
  - But they only affect the canvas, not what is drawn on it.
  - If no style ⟶ transparent canvas.
- Initially empty.
  - The script first needs to access the drawing context, which supplies the drawing functions.
    - `getContext()` method.
    - Argument is the context type: `"2d"`, `"webgl"`…

CANVAS

empty canvas

```
<canvas id="canvas1" width="150"
  style="border: 1px solid black;
  background-color: lightgrey;">
</canvas>
```

```
function draw() {
  let canvas1 =
    document.getElementById("canvas1");
  let ctx1 = canvas1.getContext("2d");
}

window.addEventListener("load", draw);
```

You need to somehow style the canvas to make it visible (add border, bg color…)

We will only draw using 2d drawing functions.

CANVAS

rectangles

- filled rectangle
  `fillRect(x, y, width, height)`
- empty rectangle
  `strokeRect(x, y, width, height)`
- erases rectangular area and lets the canvas show
  `clearRect(x, y, width, height)`

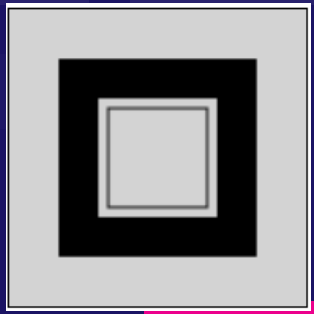
x, y: coordinates of the starting point (top left corner of the rectangle);
width is positive to the right;
height is positive down

CANVAS

rectangles

Using the previous empty canvas example

```
function draw() {
  let canvas1 =
    document.getElementById("canvas1");
  if (canvas1.getContext){
    let ctx1 = canvas1.getContext('2d');

    ctx1.fillRect(25,25,100,100);
    ctx1.clearRect(45,45,60,60);
    ctx1.strokeRect(50,50,50,50);
  }
}
```

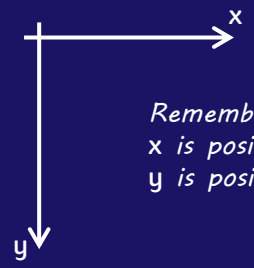


CANVAS

paths

Drawing any other shape requires:

1. creating a path (`beginPath()`)
2. using instructions to draw the path
3. closing the path (`closePath()`)
4. (optionally) setting the width of the path (`lineWidth`; default: 1)
5. applying a contour (`stroke()`) and/or fill (`fill()`)



Remember:
x *is positive to the right;*
y *is positive downwards*

CANVAS

paths

beginPath()

- internally, paths are stored as a list of sub-paths (segments, arcs...).
- every time this method is invoked, that list is emptied to begin drawing a new path.

moveTo(*x*, *y*)

- positions the *pen* on the canvas.
- must be the first instruction of a line (not an arc).

CANVAS

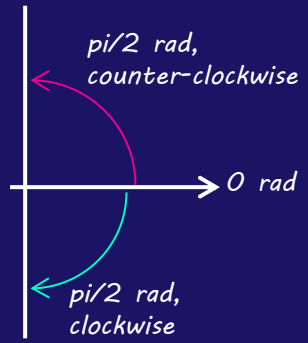
paths

`lineTo(x, y)`

- draws a line from the current position of the pen to the position passed as an argument (coordinates).

`arc(x, y, radius, startAngle, endAngle, counterCW)`

- draws an arc centered at **`x,y`**
  - angles, in radians (`0 rad` is equal to *East*)
  - the last argument, optional, is boolean.
    - `false` by default (meaning clockwise rotation)



CANVAS

paths

`closePath()`

- optional use.
- tries to close the path with a straight line to the start point.
  - if already closed or impossible to close, does nothing.
- calling `fill()` automatically closes an open shape.

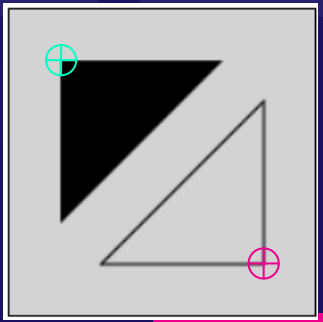
CANVAS

triangles

You can test this code by adding it to the `draw()` function.

Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas2`.

```
if (canvas2.getContext) {
  let ctx2 = canvas2.getContext("2d");

  ctx2.beginPath();
  ctx2.moveTo(25,25);
  ctx2.lineTo(105,25);
  ctx2.lineTo(25,105);
  //ctx2.closePath();
  ctx2.fill();

  ctx2.beginPath();
  ctx2.moveTo(125,125);
  ctx2.lineTo(125,45);
  ctx2.lineTo(45,125);
  ctx2.closePath();
  ctx2.stroke();
}
```

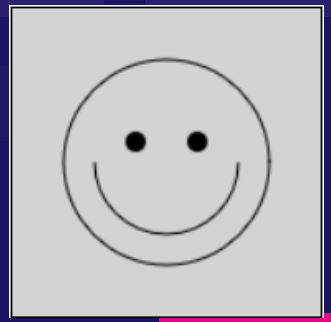


CANVAS

180º = π rad
90º = π/2 rad
360º = 2π rad
xº = x * π / 180 rad

arcs

```
if (canvas3.getContext){
  let ctx3 = canvas3.getContext("2d");

  //round face
  ctx3.beginPath();
  ctx3.arc(75,75,50,0,Math.PI*2,true);
  ctx3.stroke();
  //mouth, clockwise
  ctx3.beginPath();
  ctx3.arc(75,75,35,0,Math.PI,false);
  ctx3.stroke();
  //left eye
  ctx3.beginPath();
  ctx3.arc(60,65,5,0,2*Math.PI,true);
  ctx3.fill();
  //right eye
  ctx3.beginPath();
  ctx3.arc(90,65,5,0,2*Math.PI,true);
  ctx3.fill();
}
```



You can test this code by adding it to the `draw()` function.

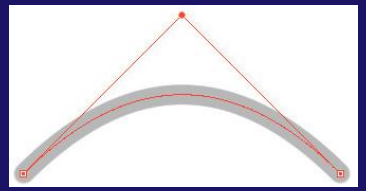
Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas3`.

CANVAS

Bézier curves

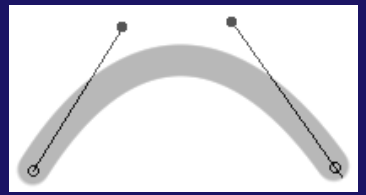
`quadraticCurveTo(cp1x, cp1y, x, y)`

- Draws a quadratic Bézier curve from the current pen position to `(x, y)` using the given control point `(cp1x, cp1y)`.



`bezierCurveTo(cp1x, cp1y, cp2x, cp2y, x, y)`

- Draws a cubic Bézier curve from the current pen position to `(x, y)` using the given control points `(cp1x, cp1y)` and `(cp2x, cp2y)`.



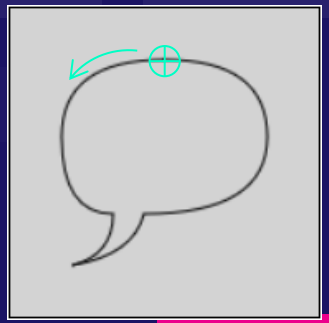
CANVAS

quadratic curves

You can test this code by adding it to the `draw()` function.

Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas4`.

```
if (canvas4.getContext){
  let ctx4 = canvas4.getContext("2d");

  ctx4.beginPath();
  ctx4.moveTo(75,25);
  ctx4.quadraticCurveTo(25,25,25,62.5);
  ctx4.quadraticCurveTo(25,100,50,100);
  ctx4.quadraticCurveTo(50,120,30,125);
  ctx4.quadraticCurveTo(60,120,65,100);
  ctx4.quadraticCurveTo(125,100,125,62.5);
  ctx4.quadraticCurveTo(125,25,75,25);
  ctx4.stroke();
}
```



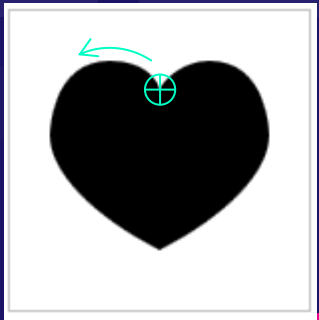
CANVAS

cubic curves

You can test this code by adding it to the `draw()` function.

Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas5`.

```
if (canvas5.getContext) {
  let ctx5 = canvas5.getContext('2d');

  ctx5.beginPath();
  ctx5.moveTo(75,40);
  ctx5.bezierCurveTo(75,37,70,25,50,25);
  ctx5.bezierCurveTo(20,25,20,62.5,20,62.5);
  ctx5.bezierCurveTo(20,80,40,102,75,120);
  ctx5.bezierCurveTo(110,102,130,80,130,62.5);
  ctx5.bezierCurveTo(130,62.5,130,25,100,25);
  ctx5.bezierCurveTo(85,25,75,37,75,40);
  ctx5.fill();
}
```



PEN MODIFICATIONS

- So far, our drawings are black and have default one pixel wide lines.
- The line width of the *pen* can be modified using the context `lineWidth` property.
- You can color paths and fills using the following context properties:
  - `strokeStyle`
  - `fillStyle`
- Their values should be set before actually drawing.

CANVAS

line width

- `lineWidth` property of the 2D context.
- Positive integer values are accepted (*default is 1*)

```
ctx4.lineWidth = 10;
ctx4.stroke();
```

colors

- As mentioned above, you can color paths and fills using these properties:
  - **strokeStyle**
  - **fillStyle**
- Their accepted values are:
  - a color
  - ~~a gradient~~ *(not studied here)*
  - an image pattern

CANVAS

colors

- In quotes.
- Any valid HTML format.
- Default value is "#000000" ("black").

```
ctx2.fillStyle = "#F1E574";
ctx2.fill();

ctx2.strokeStyle = "hsl(273, 68%, 47%)";
ctx2.stroke();
```

CANVAS

image pattern

`createPattern(`*`image`*`, `*`repetition`*`)`

- Arguments:
  1. reference to an image.
  2. `"repeat"`, `"repeat-x"`, `"repeat-y"` or `"no-repeat"`.
- The canvas can only draw fully loaded images.
  - After assigning an image file to a variable, you must wait for it to finish loading.
    - Handling the image **`load`** event with an internal function.

CANVAS

image pattern

You can test this code by adding it to the `draw()` function.

Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas6`.

```
if (canvas6.getContext) {
  let ctx6 = canvas6.getContext('2d');
  let img1 = new Image();
  img1.src = "img/help.png";
  img1.addEventListener("load", myFill);

  function myFill() {
    let patt =
      ctx6.createPattern(img1, "repeat");
    ctx6.fillStyle = patt;
    ctx6.fillRect(25, 35, 100, 85);
  }
}
```

The first image sticks to the upper left corner of the canvas

CANVAS

text

- Three context properties allow setting the insertion of text into the canvas:
  - font: *shorthand* for the font-family, font-size, font-style, font-weight and line-height CSS properties, in quotes.
  - textAlign: defines the horizontal alignment.
    - NOTE → aligned with respect to the x coordinate of the text position.
    - valores: start, end, left, right, center.
  - ~~textBaseline: defines the vertical alignment.~~
    - ~~accepted values: top, hanging, middle, alphabetic, ideographic, bottom.~~

CANVAS

text

- Then, to insert text, the following context functions are available:
  - `fillText("text", x, y, maxWidth)`
  - `strokeText("text", x, y, maxWidth)`
    - `(x, y)`: coordinates of the insertion point.
    - `maxWidth`: the text shrinks if exceeded (*optional*).

CANVAS

text

You can test this code by adding it to the `draw()` function.

Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas7`.

```
if (canvas7.getContext){
  let ctx7 = canvas7.getContext("2d");

  ctx7.font = "italic 40px Calibri";
  ctx7.strokeStyle = "mediumvioletred";
  ctx7.strokeText("Markup", 10, 40);

  let img1 = new Image();
  img1.src = "img/colors.png";
  img1.onload = myFill;

  function myFill() {
    let patt = ctx7.createPattern(img1, "no-repeat");
    ctx7.fillStyle = patt;
    ctx7.font = "bold 40px Consolas";
    ctx7.textAlign ="right";
    ctx7.fillText("Languages!", 250, 110);
  }
}
```

250 px

CANVAS

image

- Use **drawImage()** to insert an image into the canvas:

  drawImage(*image*, *x*, *y* ,*width*, *height*)

  - **image**: the already loaded image.
  - **(x, y)**: coordinates of the insertion point (top left corner).
  - **width**, **height**: (*optional*) modified lengths of its sides.
- You need to consider the loading of the image from the file and handle its **load** event.

CANVAS

image

You can test this code by adding it to the `draw()` function.

Add a new `<canvas>` to the page for this example and assign it to a new variable, `canvas8`.

```
if (canvas8.getContext) {
  let ctx8 = canvas8.getContext("2d");
  let agmt = new Image();
  agmt.src = "img/agamotto.webp";
  agmt.onload = imgLoadHandler;

  function imgLoadHandler() {
    ctx8.drawImage(agmt, 0, 0, 150, 150);
  }
}
```

PRACTICAL EXERCISE 7.5

THANKS !

Do you have any questions?

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