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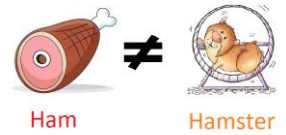
Context



- **Java ≠ JavaScript**
- **JavaScript** created in 1995 by Brendan Eich for the Netscape Navigator 2
- Its first name was LiveScript but because of Java's popularity at the time, the name was changed
- In 1997 it became a *European Computer Manufacturers Association* (ECMA) standard
    - **ECMAScript:** https://www.ecma-international.org/publications/standards/Ecma-262.htm
        - Last version: ECMA-262, 10th edition, June 2019
- **JavaScript** é is a *scripting* language that follows the **ECMAScript** standard
- It became popular as a programming language used for browsers, but it is now also used for other purposes (e.g: Node.js)

- To see JavaScript console in any browser: **Ctrl + Shift + I**

Syntax

```
// comment
```

```
/* another
comment */
```

```
let username = "Maria" // the value in variable username is "Maria"

{
let x = 1 // x is initialised with 1
x = 2 // x now has the value 2
let x = 3 // error: x identifier was already used
}
```

Variables declared with `let` have local scope (in the block)

Variable names

- May contain characters, numbers, symbols ($, _).
- The 1st character can not be a number
- Are *case-sensitive*
- Can not be reserved words (JavaScript keywords)

```
let x = 1 // x is initialised with 1
{
let x = 2 // no error. x now has the value 2
}
// x has the value 1 again
```

The variable x only has the value 2 inside the block

```
const yearOfBirth = 2000
yearOfBirth = 2001 // error: constant values can not be changed
```

Primitive data types

JavaScript is a dynamically typed language: a variable may contain data in any type. Example:

```
let message = "hello"
message = 123 // changing the data type is valid
```

Primitive data types: `typeof x` `typeof(x)`

- **number**: integer and decimal numbers
  - Operations: +, -, *, /
  - Special values: `Infinity (1/0)`, `-Infinity (-1/0)`, `NaN ("hello"*3)`

```
"2" * 3 // 6
```

```
isNaN("hello"*3) // true
```

- **string**: sets of characters (words, text)
  - Backticks

```
const name = "Maria"
`Hello ${name}!` //Result: Hello Maria!
```

  - Concatenating (+)

```
"1" + 2 // 12
```

- **boolean**: true / false
- **null** (unknown)
- **undefined** (not yet defined)

Non primitive data types

- **object**: more complex data structures

```
let person = {
      firstName: "Maria",
      lastName: "Sousa",
      age: 37,
      favouriteColor: "purple"
}
```

- **symbol**: exclusive identifiers
  - May be used to identify objects' properties

Type conversion

- To String

```
let age = String(12)      // "12"
```

- To number

```
let age = Number(12)      // 12
Number("   123   ")       // 123
Number("casa")            // NaN
Number("")                // 0
Number("true")            // 1
Number("false")           // 0
```

- To Boolean

```
let eyes
Boolean(eyes)             // false
eyes = 2
Boolean(eyes)             // true
```

Operators

In JavaScript there are several different operator types:

- Arithmetic: used for arithmetic operations
- Assignment: used to assing values to the variables
- Comparison: used to determine equalities between variables or values
- Logical: used to determine logical properties between variables or values

Arithmetic operators

Operator	Description	Example
`+, -, *, /`	Sum, subtraction, multiplication, division	`3+2 // 5`
`%`	Module	`12%10 // 2`
`**`	Power	`3**2 // 9`
`++, --`	Increment, decrement	`let y=3; y++; y // 4`

Assignment operators

Operator	Description	Example
`=`	Simple assignment	`let x = 3 // 3`
`+=, -=, *=, /=, %=`	Assignment with operations	`let x = 3; x+=2; x // 5`

Comparison operators

Operator	Description	Example

==	Equals (value)	2==2 // true
		2==3 // false

===	Equals (value and type)	2===2 // true
		2===“2” // false

!=	Different (value)	2!=2 // false 2!=3 // true
!==	Different (value or type)	2!==2 // false 2!==“2” // true 2!==3 // true
>, >= <, <=	Greater than, grater or equal, less than, less or equal	2>2 // false 2>=2 // true 2>1 // true “Porta” > “Porto” // false
?	Ternary operator	Math.PI > 4 ? ”S" : ”N"; // ”N”

Logical operator

Operator	Description	Example

`&&`	Logical AND	`false && false  // false`
		`false && true  // false`
		`true  && false  // false`
		`true  && true  // true`

`||`	Logical OR	`false || false  // false`
		`false || true  // true`
		`true  || false  // true`
		`true  || true  // true`

`!`	Logical NOT	`!true  // false` `!false  // true`

Conditional structures

if

```
if(condition){
  instructions
}
```

```
if(hour <= 12){
  greeting = "Bom dia"
}
```

if / else

```
if(condition){
  instructions-if
} else {
  instructions-else
}
```

```
if(hour <= 12){
  greeting = "Bom dia"
} else {
  greeting = "Boa tarde"
}
```

if / else if / else

```
if(condition){
  instructions-if
} else if (condição2) {
  instruções-if2
} else {
  instructions-else
}
```

```
if(hour <= 12){
  greeting = "Bom dia"
} else if(hour<=20){
  greeting = "Boa tarde"
} else {
  greeting = "Boa noite"
}
```

switch

```
switch(value){
  case …: instructions; break;
  ...
}
```

```
switch(new Date().getDay(){
  case 0: day = "Domingo"; break;
  case 1: day = "Segunda"; break;
  case 2: day = "Terça"; break;
  case 3: day = "Quarta"; break;
  case 4: day = "Quinta"; break;
  case 5: day = "Sexta"; break;
  case 6: day = "Sábado"; break;
}
```

Cycle structures

for

```
for(initialization; condition; update) {
  instructions
}
```

```
for(let i=0; i<3; i++){
  alert(i)
}
```

do-while

```
do {
  instructions
} while(condition)
```

```
let i=0
do {
  alert(i)
  i++
} while(i<3)
```

while

```
while(condition) {
  instructions
}
```

```
let i=0
while(i<3){
  alert(i)
  i++
}
```

Functions

- **JavaScript function**: block of code designed to perform a specific task and can be reused
  - The code becomes smaller, more readable and easier to maintain

- Syntax:

```
function name (param1, param2,  …) {
     code to execute
}
```

- Example: declaring a function:

```
function showMessage () {
     let mensage = "Olá!"
     console.log(mensage)
}
```

- Example: calling a function:

```
showMessage() // Result: Olá!
```

Return

```
function sum(a,b) {
    return a + b
}
```

```
let result1 = sum(4,3)
result1 // 7
let result2 = sum(4)
result2 // NaN
```

```
function sum2(a,b = 0) {
    return a + b
}
```

```
let result3 = sum2(4)
result3 // 4
```

Variable scope

Global

```
let nome = "Ana"
function mostraMensagem() {
  nome = "Maria"
  let mensagem = `Olá ${nome}`
  console.log(mensagem)
}

console.log(nome) // Ana
mostraMensagem()  // Olá Maria
console.log(nome) // Maria
```

Local

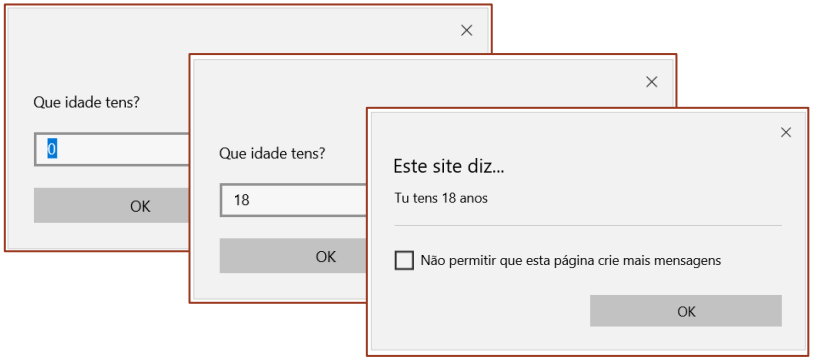
```
let nome = "Ana"
function mostraMensagem() {
  let nome = "Maria"
  let mensagem = `Olá ${nome}`
  console.log(mensagem)
}

console.log(nome) // Ana
mostraMensagem()  // Olá Maria
console.log(nome) // Ana
```

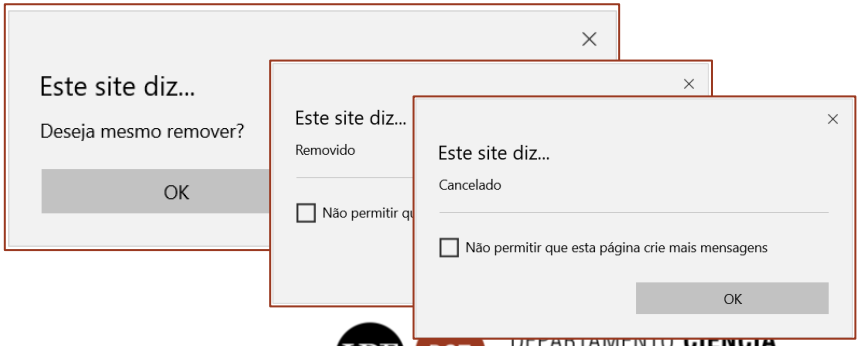
User interface functions

```
alert("Hello")
```


```
let idade = prompt("How old are you?",0)
if(idade!=null) {
  alert(`You are ${idade} years old`)
}
```



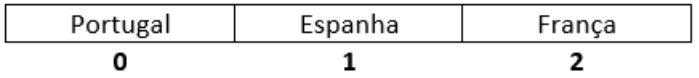

```
let removerRegisto = confirm("Remove?")
if(removerRegisto) {
  alert("Removed")
} else {
  alert("Cancelled")
}
```



Arrays

- Declaration

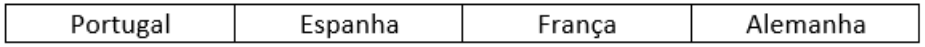
```
let countries = new Array()
let countries = []
let countries = [“Portugal”,”Espanha”,”França”]
```



- Operations

```
console.log(countries.length) // 3
console.log(countries[1])     // Espanha
console.log(countries())      // [object Array]: ["Portugal", "Espanha", "França"]

let outro = countries              // copy the arrays by reference
console.log(outro === countries) // true
outro[3] = “Alemanha”              // modifies the array
console.log(countries)             // [object Array]:["Portugal","Espanha","França“,”Alemanha”]
```



Array manipulation: adding elements

Portugal	Espanha	França
0	1	2

Example: add elements

`countries[3] = "Alemanha"`

Portugal	Espanha	França	Alemanha
0	1	2	3

`countries[5] = "Itália"`

Portugal	Espanha	França	Alemanha	*undefined*	Itália
0	1	2	3	4	5

Useful operations

Portugal	Espanha	França
0	1	2

- **Push**: adds elements to the end of the array. Returns its new size.

`countries.push("Alemanha") //4`

Portugal	Espanha	França	Alemanha
0	1	2	3

- **Unshift**: adds elements to the end of the array. The other elements are shifted forward. Returns its new size.

`countries.unshift("Itália") // 5`

Itália	Portugal	Espanha	França	Alemanha
0	1	2	3	4

- **Splice**: adds/removes elements without leaving empty spaces
  - syntax: `arrayName.splice(index, 0, elementToAdd1, elementToAdd2, …)`

`countries.splice(1,0,"Polónia","Marrocos") // []`

Itália	Polónia	Marrocos	Portugal	Espanha	França	Alemanha
0	1	2	3	4	5	6

Note: operations at the end of the array are better, because they are faster

Array manipulation: removing elements

Portugal	Espanha	França
0	1	2

Example: remove elements

```
delete countries[1]
```

Portugal	*undefined*	França
0	1	2

Useful operations

Itália	Polónia	Marrocos	Espanha	França	Alemanha
0	1	2	3	4	5

- **Pop**: removes the array's last element. Returns the element.

```
countries.pop() // Alemanha
```

Itália	Polónia	Marrocos	Espanha	França
0	1	2	3	4

- **Shift**: removes the array0s first element. Other elements shift back. Returns the element.

```
countries.shift() // Itália
```

Polónia	Marrocos	Espanha	França
0	1	2	3

- **Splice**: adds/removes elements without leaving empty spaces
  - syntax: `arrayName.splice(index, nrOfElementsToRemove)`

```
countries.splice(1,1) // Marrocos
```

Polónia	Espanha	França
0	1	2

```
countries.splice(0,2) // Polónia, Espanha
```

França
0

Note: operations at the end of the array are better, because they are faster

Other methods to add/remove array elements

```
let paises = [“Portugal”,“Espanha”,“França”,“Itália”,“Alemanha”]
```

Method	Description	Example

`slice(start, end)`	Creates a new array with the elements between the **start** and **end** indexes	`let menosPaises = paises.slice(1,3)`
		`console.log(menosPaises)`
		`// "Espanha", "França"`

`concat(…items…)`	Joins items to the array	`menosPaises.concat("Marrocos")` `// "Espanha", "França", "Marrocos"`

Iterating

```
let paises = [“Portugal”,“Espanha”,“França”]
```

```
let size = paises.length
for(let i=0; i<size; i++) {
  console.log(paises[i])
}
```

```
for(let index in paises) {
  console.log(paises[index])
}
```

```
for(const pais of paises) {
  console.log(pais)
}
```

```
paises.forEach((item, index, array) => {
  alert(`${item} is at index ${index} in ${array}`)
});
```

Ordering

```
let countries = ["Portugal","Espanha","França"]
countries.sort()  // "Espanha", "França", "Portugal‟ (alphabetical order)
countries.reverse() // "Portugal", "França", "Espanha"


let numbers = [12,7,10,18,5]
numbers.sort() // 10, 12, 18, 5, 7 (alphabetical order)


function ascOrder(a, b) {
  return a - b
}
numbers = [12,7,10,18,5]
numbers.sort(ascOrder) // 5, 7, 10, 12, 18 (ascending order)

numbers.sort(function(a,b){return a - b}) // 5, 7, 10, 12, 18 (same, but smaller)
```

Gives a different order

Search methods

```
let paises = ["Portugal","Espanha","França","Itália","Alemanha"]
let numeros = [1,2,3,4,5,4,3,2,1,2,3,4,5]
let idades = [12,20,40,15,17,31]
```

```
function isAdult(idade){
  return idade>=18
}
```

Method	Description	Example

`indexOf(element,pos)`	Searches for the **element** on the array starting on index **pos** and returns the index or -1	`paises.indexOf("Espanha") // 1`
		`paises.indexOf("Inglaterra") // -1`
		`numeros.indexOf(2) // 1`
		`numeros.indexOf(2,3) // 7`

`lastIndexOf(element)`	Searches for the **element** on the array and returns the index of the last occurrence or -1	`numeros.lastIndexOf(2) // 9` `numeros.lastIndexOf(7) // -1`
`includes(element)`	Determines if **element** belongs to the array	`numeros.includes(3) // true` `numeros.includes(7) // false`
`find(function)`	Searches elements through **function** and returns the 1st found	`idades.find(isAdult) // 20`
`filter(function)`	Searches elements through **function** and returns all found	`idades.filter(isAdult) // [20, 40, 31]`

Array transformation methods

```
let numeros = [1,2,3,4,5]
```

```
function mult2(nr){
  return nr*2
}

function soma (acumulado,atual){
  return acumulado + atual
}
```

Method	Description	Example
`map(function)`	Applies **function** to all the elements in the array and returns the result	`numeros.map(mult2)  // [2,4,6,8,10]`
`fill(value, start, end)`	Fills the arrays positions from **start** to **end** with **value**	`numeros.fill(9,1,3)  // [1,9,9,4,5]` `numeros.fill(9)  // [9,9,9,9,9]`
`join(separator)`	Joins the array's elements separated by **separator**, into a string	`numeros.join("*")  // 1*2*3*4*5`
`reduce(func, initValue)`	Applies **func**[(1)] from an **initValue** to reduce the array to a single value	`numeros.reduce(soma)  // 15`

[(1)]Function func must be like:

```
function(acumulator, current, index, array){…}
```

Objects: creation and properties

Object creation

```
let user1 = {}

let user2 = new Object()
```

Empty objects

```
let user3 = {
  name: "Maria",
  age: 39
}
```

Properties

pairs `key: value`

```
let name = "Ana"
let age = 41
let user4 = {name, age}
```

Property creation

```
let newProp = "gender"
let user5 = {
  [newProp]: "male"
}
```

Property deletion

```
delete user3.age
console.log(user3)
          // {name: "Maria"}
```

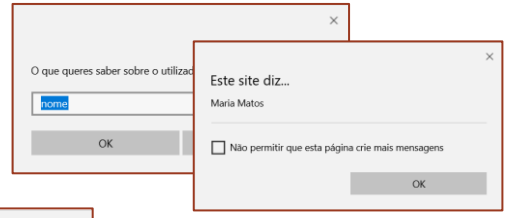
Objects: access and modify properties

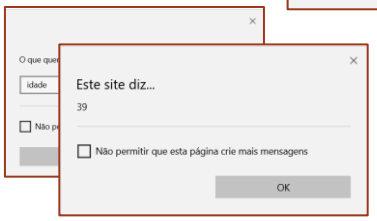
Access / modify object's properties

```
console.log(user3.name) // "Maria"

user3.name = "Maria Matos"
console.log(user3) // {age: 39, name: "Maria Matos"}

let key = prompt("What do you want to know about the user?", "name")
alert(user3[key])
```



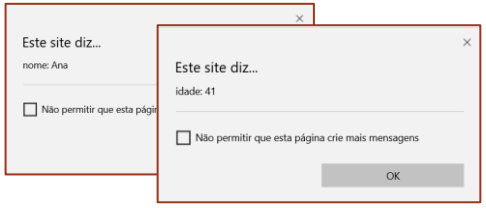


Determine if a property exists

```
console.log("age" in user4)      // true
console.log("eyeColor" in user4) // false
```

Iterate through all object's keys

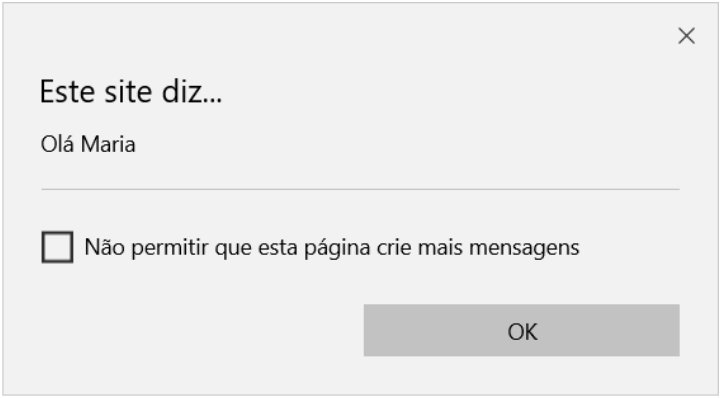
```
for(let key in user4){
  alert(key + ": " + user4[key])
}
```



Objects: methods

```
let user = {
  name: "Maria",
  age: 39,
  sayHello() {
    alert(`Hello ${this.name}`)
  }
}

user.sayHello()
```



Object copy

```
let person = {name = "Ana"}
```

- The copy is made by reference

```
let newPerson = person
newPerson.name = "Maria"
console.log(newPerson.name) // "Maria"
console.log(person.name) // "Maria" (the value is modified in both objects)
```

- How to not copy by reference

```
let newPerson ={}
// copy all properties
for(let key in person) {
  newPerson[key]  = person[key]
}
newPerson.name = "Maria"
console.log(newPerson.name) // "Maria"
console.log(person.name) // "Ana" (unchanged)
```

- Another way

```
let newPerson = Object.assign({},person)
newPerson.name = "Maria"
console.log(newPerson.name) // "Maria"
console.log(person.name) // "Ana" (unchanged)
```

Classes

- Used when several objects are needed

- Syntax

```
class MyClass {
  constructor(…){…}
  method1(…){…}
  method2(…){…}
  get property(…){…}
  set property(…){…}
  static staticMethod(…){…}
  …
}
```

1st character is CAPS

- Create a class object

```
let myObject = new MyClass(…)
```

Classes

- Example

```
class Person{
  constructor(name, age) {
    this.name = name
    this.age = age
  }
  get name(){
    return this._name
  }
  set name(value){
    this._name = valur
  }
  sayHello() {
    alert(`Olá ${this._name}`)
  }
  static compare(personA,personB) {
    return personA.age - personB.age
  }
}
```

_ : internal variable

```
let person1 = new Person("Maria",39)
person1.sayHello()
```

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