# JavaScript

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## Why JavaScript? What is JavaScript?

- JavaScript is a programming language that allows you to implement complex things on web pages.
  - displaying timely content updates, or interactive maps, or animated 2D/3D graphics, or scrolling video jukeboxes, etc.
- JavaScript is a scripting language that enables you to create dynamically updating content, control multimedia, animate images, and pretty much everything else.

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## More on JavaScript Use

- The JavaScript is executed by the browser's JavaScript engine, after the HTML and CSS have been assembled and put together into a web page.
- A very common use of JavaScript is to dynamically modify HTML and CSS to update a user interface, via the Document Object Model API.

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## Document Object Model API

- The DOM (Document Object Model) API allows you to manipulate HTML and CSS, creating, removing and changing HTML, dynamically applying new styles to your page, etc.

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## Interpreted vs Compiled Code

- JavaScript is an interpreted language — the code is run from top to bottom and the result of running the code is immediately returned. You don't have to transform the code into a different form before the browser runs it.
- Compiled languages on the other hand are transformed (compiled) into another form before they are run by the computer. For example C/C++ are compiled into assembly language that is then run by the computer.

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## Server-Side vs Client Side Code

- Client-side code is code that is run on the user's computer — when a web page is viewed, the page's client-side code is downloaded, then run and displayed by the browser. In this JavaScript module we are explicitly talking about client-side JavaScript.
- Server-side code on the other hand is run on the server, then its results are downloaded and displayed in the browser. Examples of popular server-side web languages include PHP, Python, Ruby, and ASP.NET.
- And JavaScript! JavaScript can also be used as a server-side language, for example in the popular Node.js environment.

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## How do you add JavaScript to your HTML Page?

1. Internal JavaScript
2. External JavaScript
3. Inline JavaScript Handlers

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## 1. Internal JavaScript

- Write Html file.
- Next, go to your text editor and add the following just before your closing </body> tag:
- <script>
- // JavaScript goes here
- </script>

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## 2. External JavaScript

- First, create a new file in the same directory as your sample HTML file.
- Make sure it has that .js filename extension, as that's how it is recognized as JavaScript.
- Next, copy all of the script out of your current <script> element and paste it into the .js file. Save that file.
- Now replace your current <script> element with the <script src="scriptwhatever.js"></script>

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## 3. Inline JavaScript Handlers

- Something like:

button onclick="createParagraph()">Click me!</button>

Is inline JavaScript Handler.

It is not a good practice to pollute your HTML with JavaScript handlers.

You'd have to include the onclick="createParagraph()" attribute on every button you wanted the JavaScript to apply to.

```
var buttons = document.querySelectorAll('button');
for (var i = 0; i < buttons.length ; i++)
{
      buttons[i].addEventListener('click', createParagraph);
}
```

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## JavaScript Fundamentals

- Hello, world!
- Code structure
- The modern mode, "use strict"
- Variables
- Data types
- Type Conversions
- Operators
- Comparisons
- Interaction: alert, prompt, confirm
- Conditional operators: if, '?'
- Logical operators
- Loops: while and for
- The "switch" statement
- Functions
- Function expressions and arrows
- JavaScript specials

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## Hello World!

- <!DOCTYPE HTML>
- <html>
- <body>
- Before the script...
- <script>
- alert( 'Hello, world!' );
- </script>
- ...After the script.
- </body>
- </html>

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## Code Structure

- Statements
- Semicolons
- Comments

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## Use Strict

- The "use strict" directive switches the engine to the "modern" mode, changing the behavior of some built-in features. We'll see the details as we study.
- The strict mode is enabled by "use strict" at the top. Also there are several language features like "classes" and "modules" that enable strict mode automatically.
- The strict mode is supported by all modern browsers.
- It's always recommended to start scripts with "use strict".

```
alert("some code");
// "use strict" below is ignored, must be on the top

"use strict";

// strict mode is not activated
```

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## Variables

- Named storage.
- Keyword used is "let".

let yourName;

- *Assign value with declaration:* let yourName = "abc";
- Now string is stored in the memory; with following statement:
  - alert(yourName); //output will be abc
- Declare multiple variables in one line; for example:
  - let yourName=abc, age=10, comment="hello"; //not recommended

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## Var in place of let

- Var is in older scripts.
- There are subtle differences but they do not matter now.

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## Variable Naming

- The name must contain only letters, digits, symbols $ and _.
- The first character must not be a digit.
- Case matters
- There is a list of reserved words, which cannot be used as variable names, because they are used by the language itself.
- An assignment without strict and declaration gives error.

Incorrect Naming:

- let 5a; // cannot start with a digit
- let first-name; // a hyphen '-' is not allowed in the name
- let mes;
- let Mes;
- let class;
- "use strict";
- num = 5; // error: num is not defined

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## Constants

- To declare a constant (unchanging) variable, one can use const instead of let.
- We generally use upper case for constants that are "hard-coded". Or, when the value is known prior to execution and directly written into the code.

```
const myBirthday = '19.04.1982';
myBirthday = '01.01.2000'; // error, can't reassign the constant!
```

```
const BIRTHDAY = '18.04.1982'; // make uppercase?

const AGE = someCode(BIRTHDAY); // make uppercase?
```

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## Naming your variables

- Use human-readable names like userName or shoppingCart.
- Stay away from abbreviations or short names like a, b, c, unless you really know what you're doing.
- Make the name maximally descriptive and concise. Examples of bad names are data and value. Such a name says nothing. It is only ok to use them if it's exceptionally obvious from the context which data or value is meant.
- Agree on terms within your team and in your own mind. If a site visitor is called a "user" then we should name related variables like currentUser or newUser, but not currentVisitor or a newManInTown.

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## Data Types

- A variable in JavaScript can contain any data. A variable can at one moment be a string and later receive a numeric value:
  - // no error
  - let message = "hello";
  - message = 123456
- Therefore JavaScript is known as "dynamically typed"

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## Seven basic Datatypes in JavaScript

- number for numbers of any kind: integer or floating-point.
- string for strings. A string may have one or more characters, there's no separate single-character type.
- boolean for true/false.
- null for unknown values – a standalone type that has a single value null.
- undefined for unassigned values – a standalone type that has a single value undefined.
- object for more complex data structures.
- symbol for unique identifiers.
- The typeof operator allows us to see which type is stored in the variable.

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## A number

- The number type serves both for integer and floating point numbers.
- There are many operations for numbers, e.g. multiplication *, division /, addition +, subtraction - and so on.
- Special numeric values" which also belong to that type: Infinity, -Infinity and NaN.
- Infinity represents the mathematical Infinity ∞. It is a special value that's greater than any number. alert( 1 / 0 );
- We can get it as a result of division by zero: alert( Infinity );

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## A number -- continued

- NaN represents a computational error. It is a result of an incorrect or an undefined mathematical operation, for instance:
  - alert( "not a number" / 6 ); // NaN, such division is erroneous

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## A string

- A string in JavaScript must be quoted.
  - let str = "Hello";
  - let str2 = 'Single quotes are ok too';
  - let phrase = `can embed ${str}`;
  - alert( str+ 'Tong');

```
let name = "John";

// embed a variable
alert(`hello ${name}!`); // Hello, John!

// embed an expression
alert(`the result is ${1 + 2}`); // the result is 3
```

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## A boolean

- The boolean type has only two values:
  - true and false

```
let nameFieldChecked = true; // yes, name field is checked
let ageFieldChecked = false; // no, age field is not checked.
```

```
let isGreater = 4 > 1;

alert( isGreater ); // true (the comparison result is "yes")
```

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## A null value

- The special null value does not belong to any type of those described above.
- It forms a separate type of its own, which contains only the null value:
  - let age = null;
- In JavaScript null is not a "reference to a non-existing object" or a "null pointer" like in some other languages.
- It's just a special value which has the sense of "nothing", "empty" or "value unknown".
- The code above states that the age is unknown or empty for some reason.

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## An "undefined" value

- The special value undefined stands apart. It makes a type of its own, just like null.
- The meaning of undefined is "value is not assigned".
- If a variable is declared, but not assigned, then its value is exactly undefined:
  - let x;
  - alert(x); // shows "undefined"
- Normally, we use null to write an "empty" or an "unknown" value into the variable, and undefined is only used for checks, to see if the variable is assigned or similar.

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## Objects and Symbols

- The object type is special.
- All other types are called "primitive", because their values can contain only a single thing (be it a string or a number or whatever).
- In contrast, objects are used to store collections of data and more complex entities.
- The symbol type is used to create unique identifiers for objects.

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## The typeof operator

- The typeof operator returns the type of the argument.
- It's useful when we want to process values of different types differently, or just want to make a quick check.
- It supports two forms of syntax:
  - As an operator: typeof x.
  - Function style: typeof(x).

```
typeof undefined // "undefined"

typeof 0 // "number"

typeof true // "boolean"

typeof "foo" // "string"

typeof Symbol("id") // "symbol"

typeof Math // "object"  (1)

typeof null // "object"  (2)

typeof alert // "function"  (3)
```

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## Quick Question

- What is the output?
  - let name = "Adam";
  - alert( `hello ${1}` ); // ?
  - alert( `hello ${"name"}` ); // ?
  - alert( `hello ${name}` ); // ?
  - alert( 'hello '+ name +'!')

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## Operators

- Operand and operator
- Unary operator: operator with one operand
- Binary operator: operator with two operands
  - if the binary + is applied to strings, it merges (concatenates) them:
  - if any of operands is a string, then the other one is converted to a string too.
  - String concatenation and conversion is a special feature of the binary plus "+". Other arithmetic operators work only with numbers. They always convert their operands to numbers.
  - the plus operator + applied to a single value, doesn't do anything with numbers, but if the operand is not a number, then it is converted into it.

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## Binary +

- let string1 = "3";
- let string2 = "4";
- alert( string1 + string2 ); // "34",

```
let string1 = "3";
let string2 = "4";
// both values converted to numbers before the binary plus
alert( +string1 + +string2 ); // 7

// the longer variant
// alert( Number(string1) + Number(string2) ); // 7
```

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## Remainder operator %

- The remainder operator % does not have a relation to percents.
- The result of x % y is the remainder of the integer division of x by y.
- For instance:

```
alert( 5 % 2 ); // 1 is a remainder of 5 divided by 2
alert( 8 % 3 ); // 2 is a remainder of 8 divided by 3
alert( 6 % 3 ); // 0 is a remainder of 6 divided by 3
```

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## Exponentiation **

- The exponentiation operator ** is a recent addition to the language.
- For a natural number x the result of x ** y is a multiplied by itself y times.
- For instance:

```
alert( 3 ** 2 ); // 9  (3 * 3)
alert( 3 ** 3 ); // 27  (3 * 3 * 3)
alert( 3 ** 4 ); // 81 (3 * 3 * 3 * 3)
```

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## Increment and decrement

- Increment ++ increases a variable by 1:

```
let counter = 3;
counter++;     // works same as counter = counter + 1, but shorter
alert( counter ); // 4
```

- Decrement -- decreases a variable by 1:

```
let counter = 4;
counter--;     // works same as counter = counter - 1, but shorter
alert( counter ); // 3
```

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## Prefix and postfix form

- Operators ++ and -- can be placed both after and before the variable.
- When the operator goes after the variable, it is called a “postfix form”: counter++.
- The “prefix form” is when the operator stands before the variable: ++counter.

```
let counter = 0;
alert( ++counter ); // 1
```

```
let counter = 0;
alert( counter++ ); // 0
```

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## Quick Check

- What should be the output?
  - let a = 2;
  - let x = 1 + (a *= 2);

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## Comparisons

- Many comparison operators we know from maths:
  - Greater/less than: a > b, a < b.
  - Greater/less than or equals: a >= b, a <= b.
  - Equality check is written as a == b (please note the double equation sign '='. A single symbol a = b would mean an assignment).
  - Not equals. In maths the notation is ≠, in JavaScript it's written as an assignment with an exclamation sign before it: a != b.
- Result is always Boolean

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## String Comparisons

- strings are compared letter-by-letter.
- Strings "Glow" and "Glee" are compared character-by-character:
  - G is the same as G.
  - l is the same as l.
  - o is greater than e. Stop here. The first string is greater.

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## Strict Equality

- A regular equality check "==" has a problem. It cannot differ 0 from false:
  - alert( 0 == false ); // true
  - alert( '' == false ); // true
- A strict equality operator === checks the equality without type conversion.
  - alert( 0 === false ); // false, because the types are different
- There also exists a "strict non-equality" operator !==, as an analogy for !=.

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## null and undefined

- Values null and undefined equal == each other and do not equal any other value.
- Be careful when using comparisons like > or < with variables that can occasionally be null/undefined.

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## Interaction

- alert
- prompt
- confirm

Syntax: alert(message);
e.g alert("hello");

result = prompt(title[, default]);

```
let age = prompt('How old are you?', 100);

alert(`You are ${age} years old!`); // You are 100 years old!
```

Function confirm shows a modal window with a question and two buttons: OK and CANCEL.

```
let isStudent = confirm("Are you the student?");

alert( isStudent); // true if OK is pressed
```

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## Interaction Methods: Modal

- All these methods are modal: they pause the script execution and don't allow the visitor to interact with the rest of the page until the message has been dismissed.
- There are two limitations shared by all the methods above:
- The exact location of the modal window is determined by the browser. Usually it's in the center.
- The exact look of the window also depends on the browser. We can't modify it.

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## Conditional Operators if, ?

- let year = prompt('In which year was ECMAScript-2015 specification published?', '');
- if (year == 2015) alert( 'You are right!' );

```
let year = prompt('In which year was ECMAScript-2015 specification published?', '');

if (year == 2015) {
  alert( 'You guessed it right!' );
}
else {
  alert( 'How can you be so wrong?' ); // any value except 2015
}
```

```
let year = prompt('In which year was ECMAScript-2015 specification published?', '');

if (year < 2015) {
  alert( 'Too early...' );
} else if (year > 2015) {
  alert( 'Too late' );
} else {
  alert( 'Exactly!' );
}
```

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## Ternary operator ?

- let result = condition ? value1 : value2
- let accessAllowed = (age > 18) ? true : false;

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## Loops

- while (condition) {
- // code
- // so-called "loop body"
- }

```
let i = 0;
while (i < 3) { // shows 0,
then 1, then 2
 alert( i );
 i++;
}
```

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## Do while loop

- do {
- // loop body
- } while (condition);

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

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## The for loop

- for (begin; condition; step) {
- // ... loop body ...
- }

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

| | | |
|---|---|---|
| begin | i = 0 | Executes once upon entering the loop. |
| condition | i < 3 | Checked before every loop iteration, if fails the loop stops. |
| step | i++ | Executes after the body on each iteration, but before the condition check. |
| body | alert(i) | Runs again and again while the condition is truthy |

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## Breaking the loop

```
let sum = 0;
while (true) {
  let value = +prompt("Enter a number", '');
  if (!value) break; // (*)
  sum += value;
}
alert( 'Sum: ' + sum );
```

The break directive is activated in the line (*) if the user enters an empty line or cancels the input. It stops the loop immediately, passing the control to the first line after the loop. Namely, alert.

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## Continue to the next iteration

```
for (let i = 0; i < 10; i++) {
  // if true, skip the remaining part of the body
  if (i % 2 == 0) continue;
  alert(i); // 1, then 3, 5, 7, 9
}
```

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## Labels for break/continue

- A label is an identifier with a colon before a loop:

```
outer: for (let i = 0; i < 3; i++) {
  for (let j = 0; j < 3; j++) {
    let input = prompt(`Value at coords (${i},${j})`, '');
// if an empty string or canceled, then break out of both loops
    if (!input) break outer; // (*)
    // do something with the value...
  }
}
alert('Done!');
```

A label is the only way for break/continue to escape the nesting and go to the outer loop.

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## Switch Statement

```
switch(expression) {
  case x:
    // code block
    break;
  case y:
    // code block
    break;
  default:
    // code block
}
```

This is how it works:

- The switch expression is evaluated once.
- The value of the expression is compared with the values of each case.
- If there is a match, the associated block of code is executed.
- If there is no match, the default code block is executed.

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## Switch Statement Example

```
let i=5;
switch(i) {
  case 1:
    alert('Too small');
    break;
  case 5:
    alert('Exactly!');
    break;
  case 10:
    alert('Too big');
    break;
  default:
    alert("I don't know");
}
```

Here the switch starts to compare a from the first case variant that is 1. The match fails.

Then 5. That's a match, so the execution starts from case 5, output "Exactly!".

If the i = 0; the output will be "I don't know" because there is no match, the default code block is executed.

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## JavaScript Function Syntax

Syntax

```
function name(parameter1, parameter2)
{
  // code to be executed
}
```

- Function parameters are listed inside the parentheses () in the function definition.
- Function arguments are the values received by the function when it is invoked.
- A Function is much the same as a Method, Procedure or a Subroutine, in other programming languages.

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## JavaScript Function Return

```
let x = myFunction(2, 3);
function myFunction(a, b)
{
    return a * b;
}
```

- Function myFunction is called with parameters 2 and 3
- arguments a = 2 and b =3
- Function returns the product of a and b
- Return value will end up in x
- The result in x will be 6

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## Function expressions and arrows

Function

```
hello = function() {
  return "Hello World!";
}
```

Arrow Function

```
hello = () => "Hello World!";
```

Arrow functions allow us to write shorter function syntax

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## JavaScript Specials

Variables Declaration

- let
- const (constant)
- var (old-style)

Variable name

- Letters and digits, but the first character may not be a digit.
- Characters $ and _ are normal, on par with letters.

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## JavaScript Specials

Interaction

prompt(question, [default])

- Ask a question, and return either what the visitor entered or null if they clicked “cancel”.

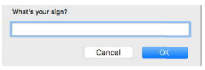
confirm(question)

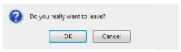
- Ask a question and suggest to choose between Ok and Cancel. The choice is returned as true/false.

alert(message)

- Output a message.

Examples





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