Introduction to JavaScript

JS Syntax, JS IDE, Mix HTML and JS,
JS Data Types, Variables and Scope

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#JSCORE

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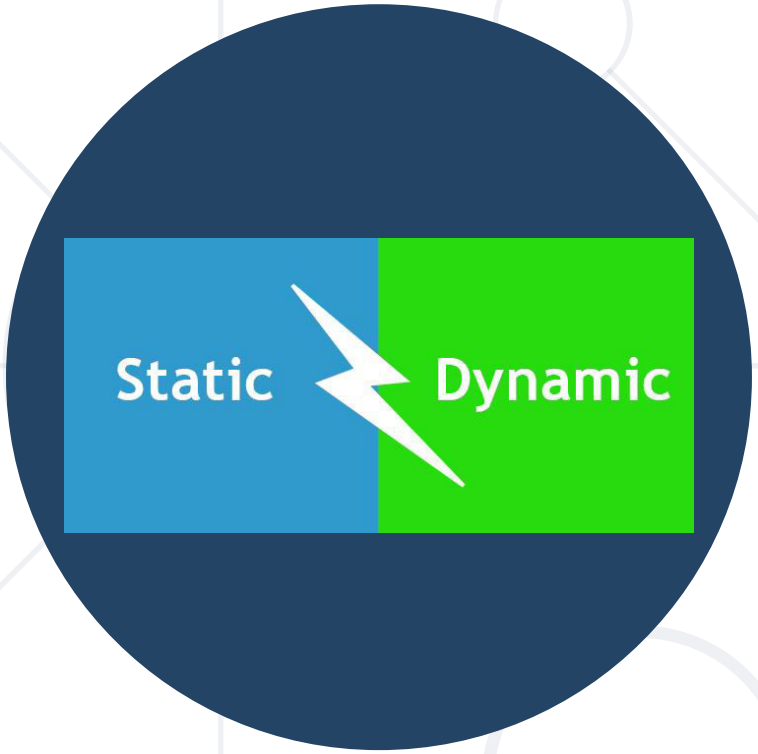

Static vs. Dynamic Languages

C++ / C# / Java vs. JS / PHP / Python

Static vs. Dynamic Languages

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Static Languages

- Explicit type declaration

```
string name = "Pesho";
int age = 25;
```

- Strongly typed
- Type checking occurs at compile-time
- Statically-typed languages: **C, C++, C#, Java**

Dynamic (Scripting) Languages

- Implicit type declaration

```
let name = "Pesho"
let age = 25;
```

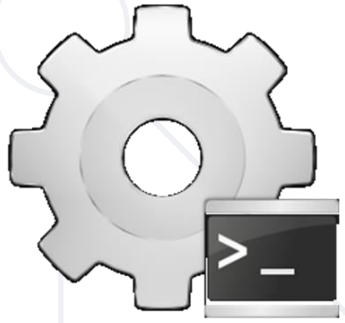
- Weakly typed
- Type checking occurs at run-time
- Dynamic languages: **JavaScript, PHP, Python, Ruby**

Compilers

- A **compiler** converts a high level language code (like C#, Java) into **machine code**
  - Machine code is executed by the **CPU** or **VM**
  - Most errors are found at **compile time**, before execution
  - **C** and **C++** use compilers to produce **native code** for the CPU
  - **C#** and **Java** use compilers to produce **intermediate code** for VM

Interpreters

- An **interpreter** executes a script code line by line
  - Code is analyzed at **run-time** (no compilation)
  - Errors are found at **run-time**, during the code execution
  - **JavaScript**, **Python**, **Ruby** and **PHP** use interpreters
- **JIT** (just-in time compilers) compile to **native code** at runtime
  - JIT occurs during the execution, on demand
  - Available for Java, JavaScript and other languages



Virtual Machines (VM)

- **Virtual machine (VM)** is
  - A virtual computer (computer inside the computer)
  - Runs an intermediate code for a virtual CPU
- VM-based languages:
  - **JVM** (Java Virtual Machine) for Java
  - **CLR** (Common language Runtime) for C# / .NET
  - **HHVM** for PHP

Compiler vs. Interpreter vs. Virtual Machine

- Compiled languages are **faster** than interpreted languages
  - C, C++, Go and Swift are very **fast**
    - Compiled to native code for CPU
  - C# and Java are **slower**
    - Compiled to intermediate code for VM
  - JS, Python, Ruby, PHP are **even slower**
    - Interpreted / JIT-compiled

JavaScript IDEs

Development Environments for JS

Chrome Web Browser

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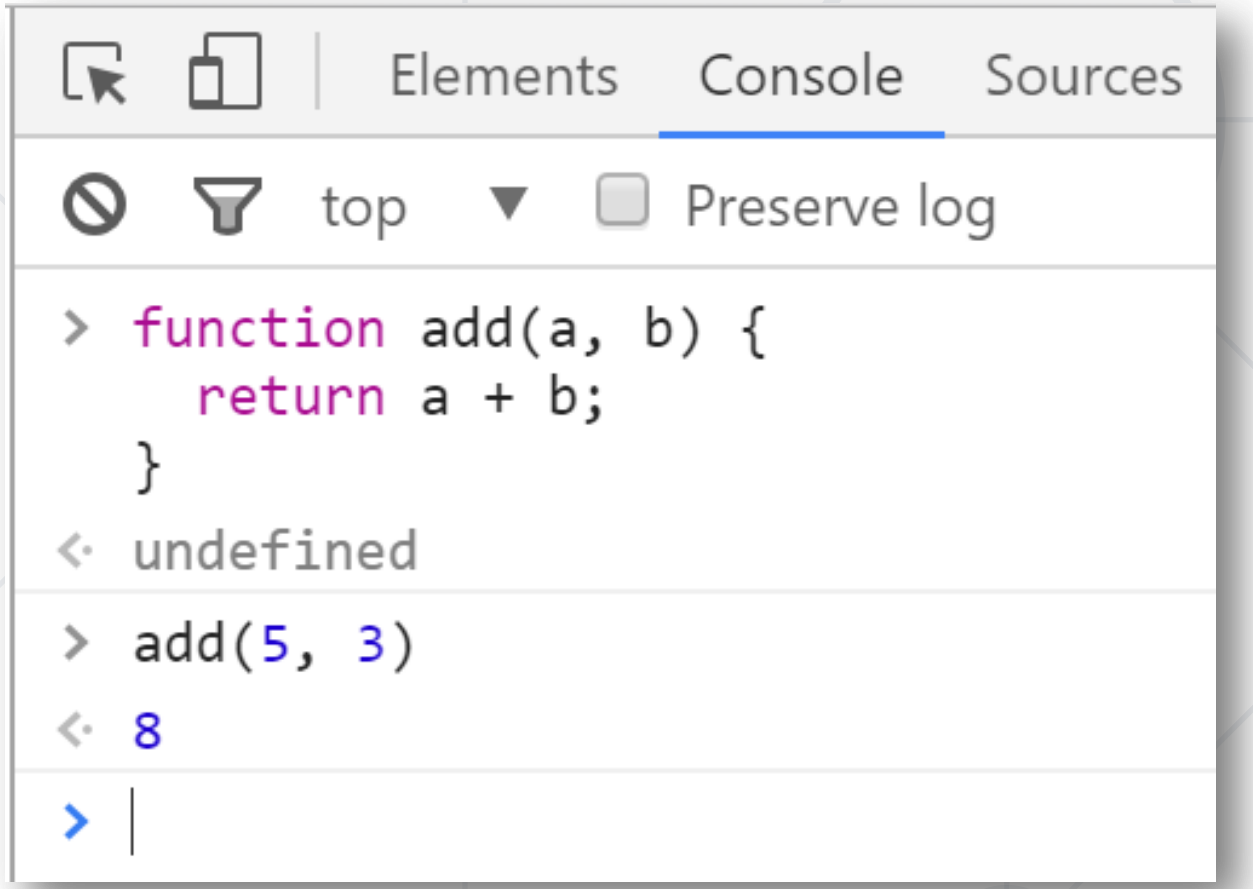
Developer Console: [F12]



Firefox Web Browser

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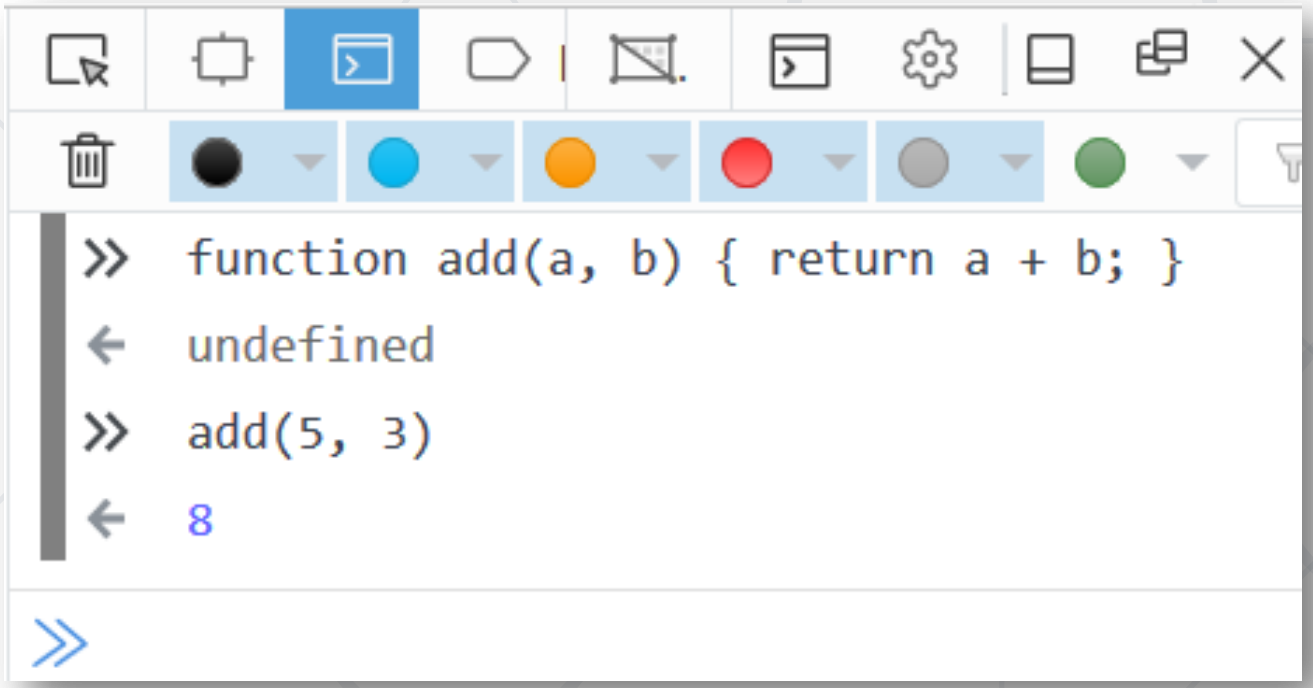
Developer Console: **[Ctrl] + [Shift] + [i]**



Install the Latest Node.js

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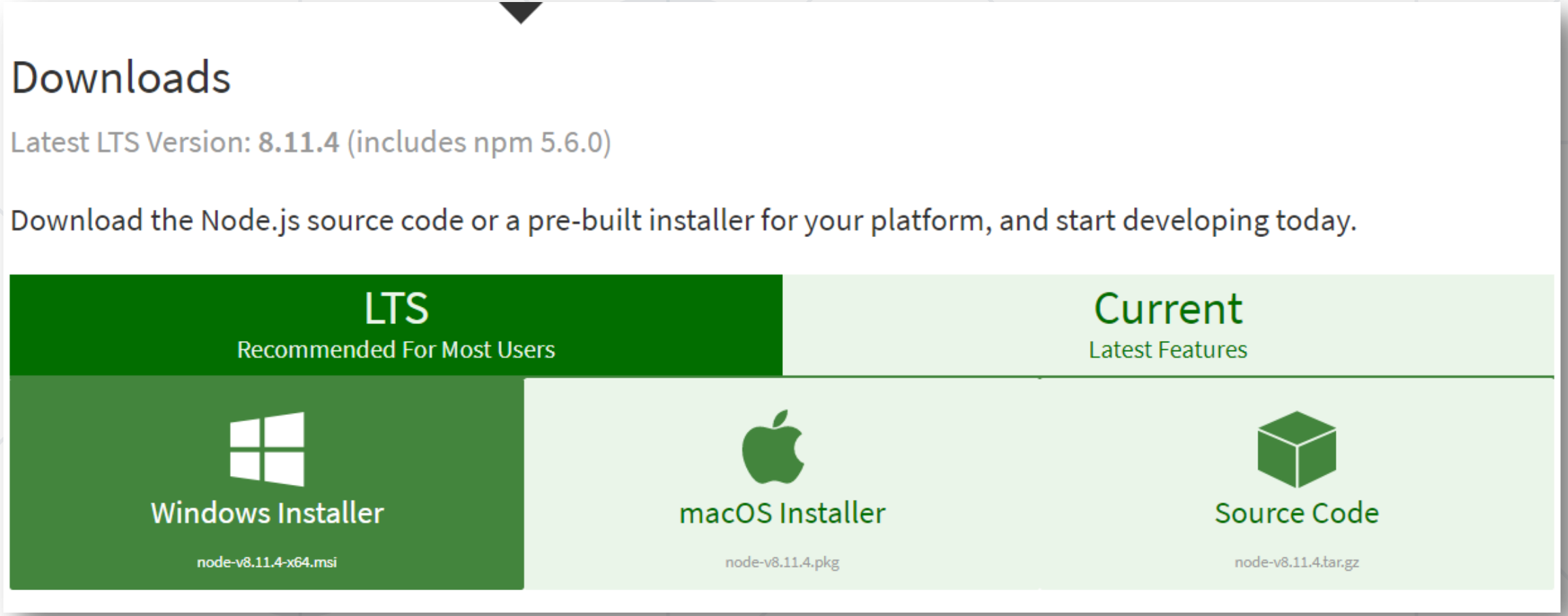

Node.js

- What is **Node.js**?
  - Server-side JavaScript runtime
  - Chrome **V8** JavaScript engine

```
Command Prompt - node
>node
> let a = 5;
undefined
> console.log(a);
5
undefined
>
```

```
Command Prompt
>npm install express
C:\Trash\node-test
`-- express@4.14.0
  +-- accepts@1.3.3
  | +-- mime-types@2.1.11
  | | `-- mime-db@1.23.0
  | `-- negotiator@0.6.1
  +-- array-flatten@1.1.1
  +-- content-disposition@0.5.1
```

- **npm** package manager
  - Install node packages

Install WebStorm

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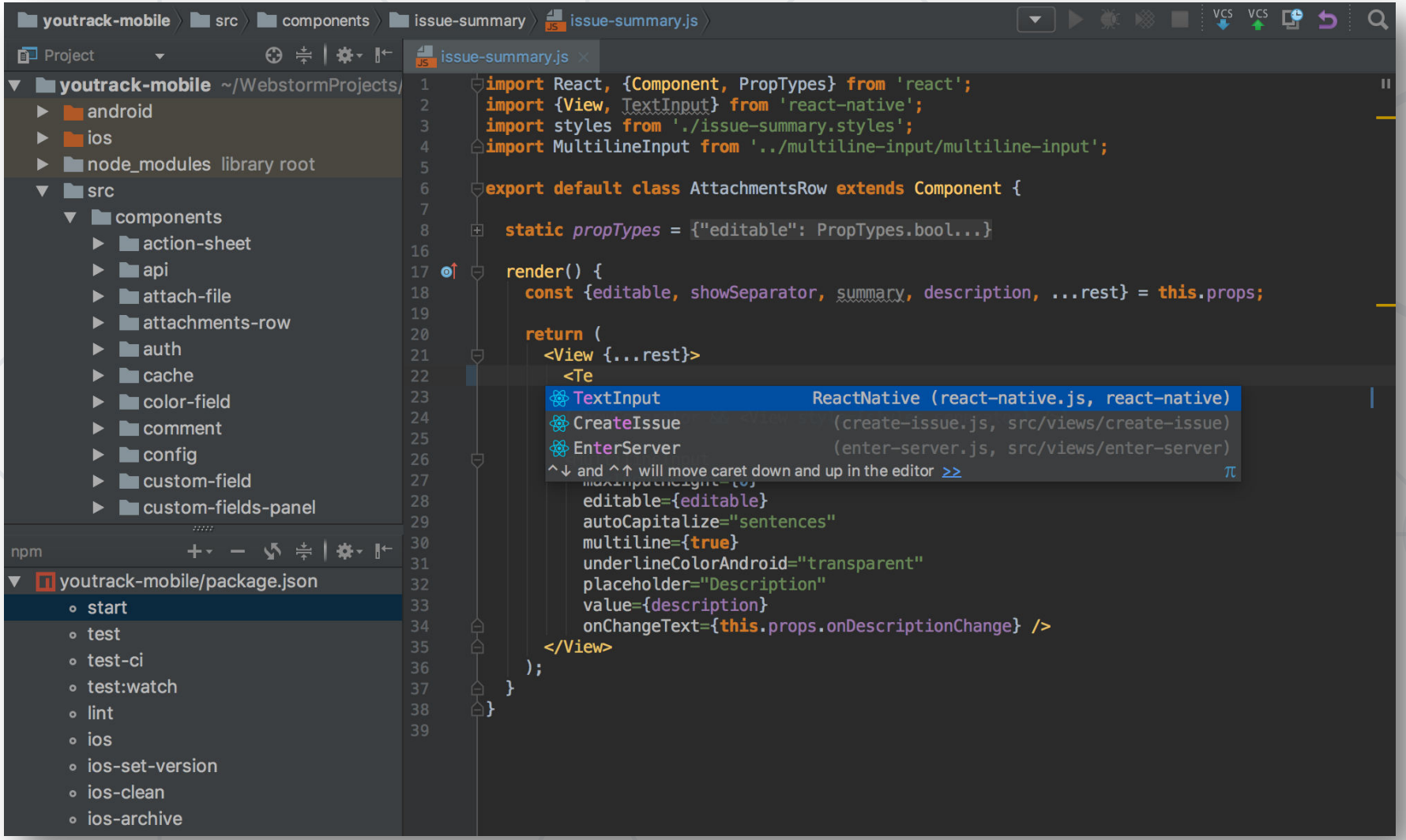
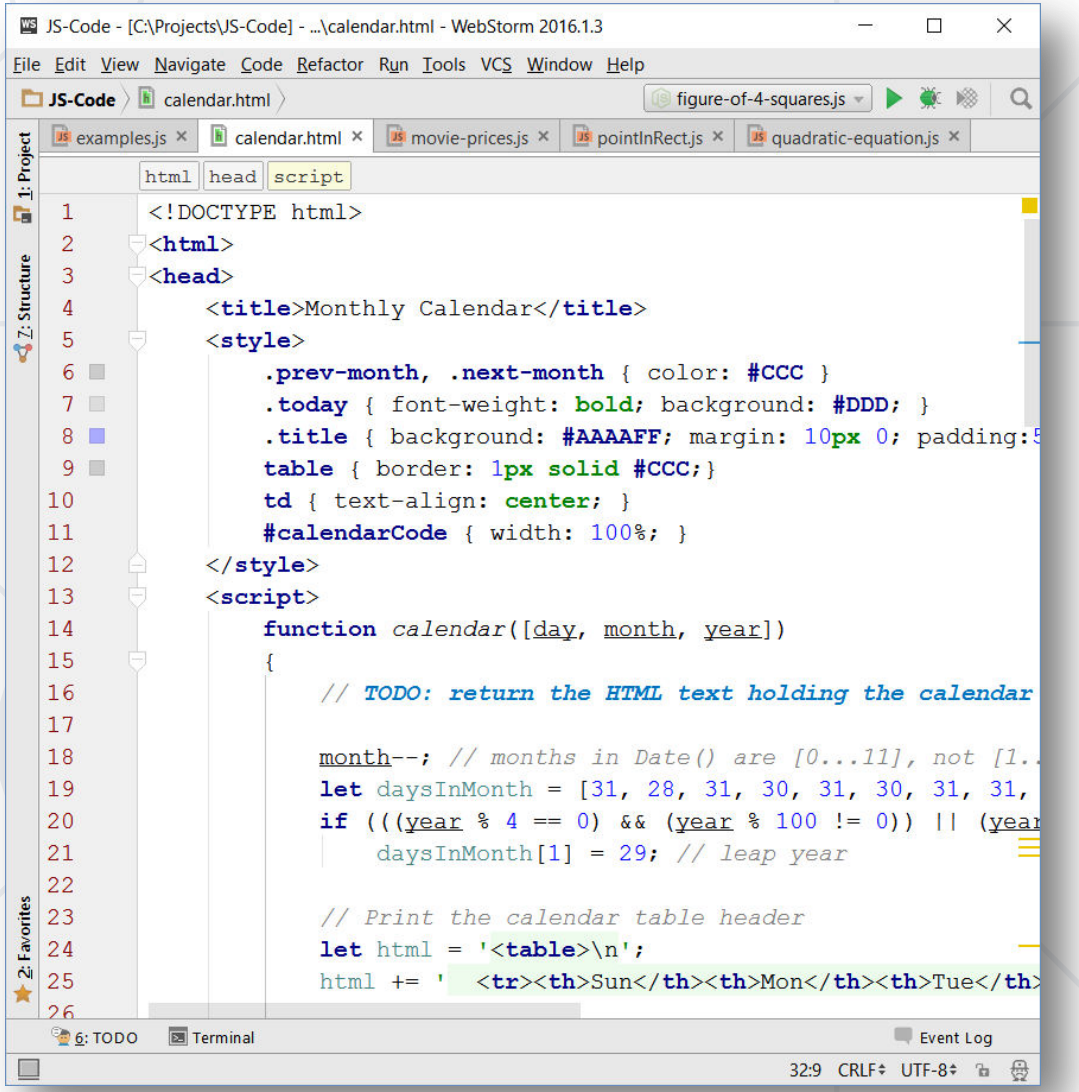


WebStorm

- Powerful IDE for HTML5
  - JavaScript, HTML, CSS
  - Babel, TypeScript, Sass / LESS, …
- Code, run, debug JS code
- Paid product
  - Free license for SoftUni students



WebStorm Debugger

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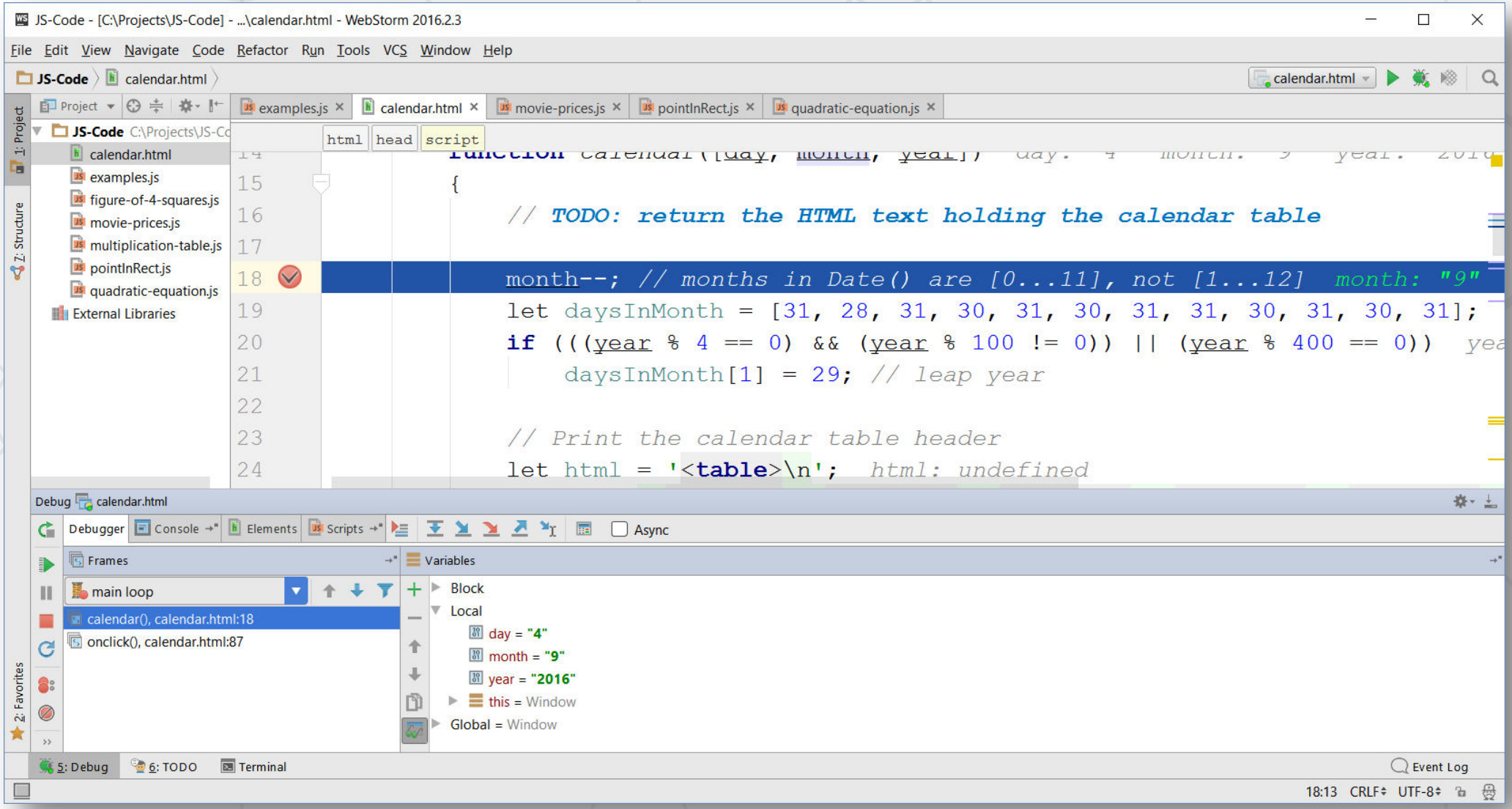

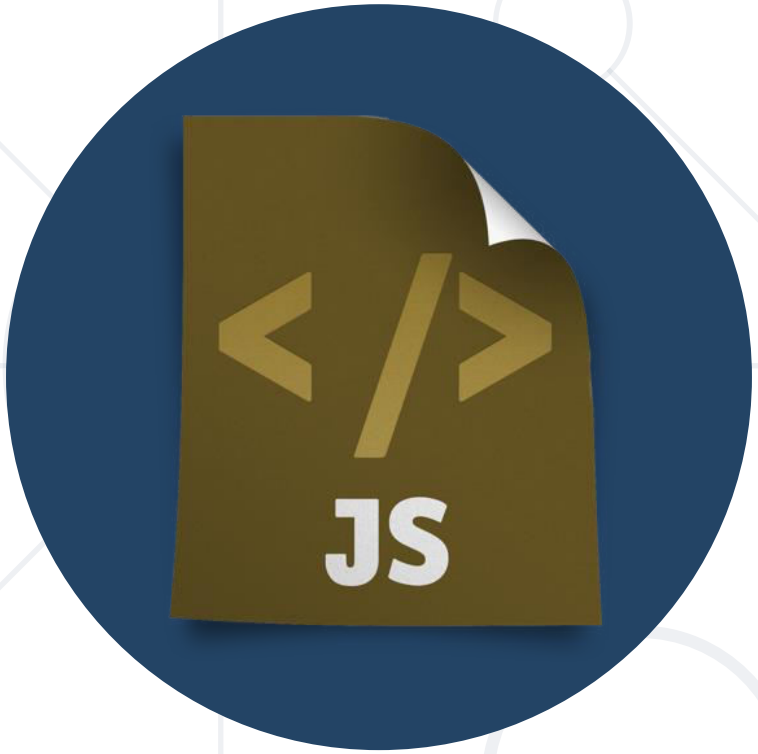

JavaScript Syntax

JavaScript Syntax

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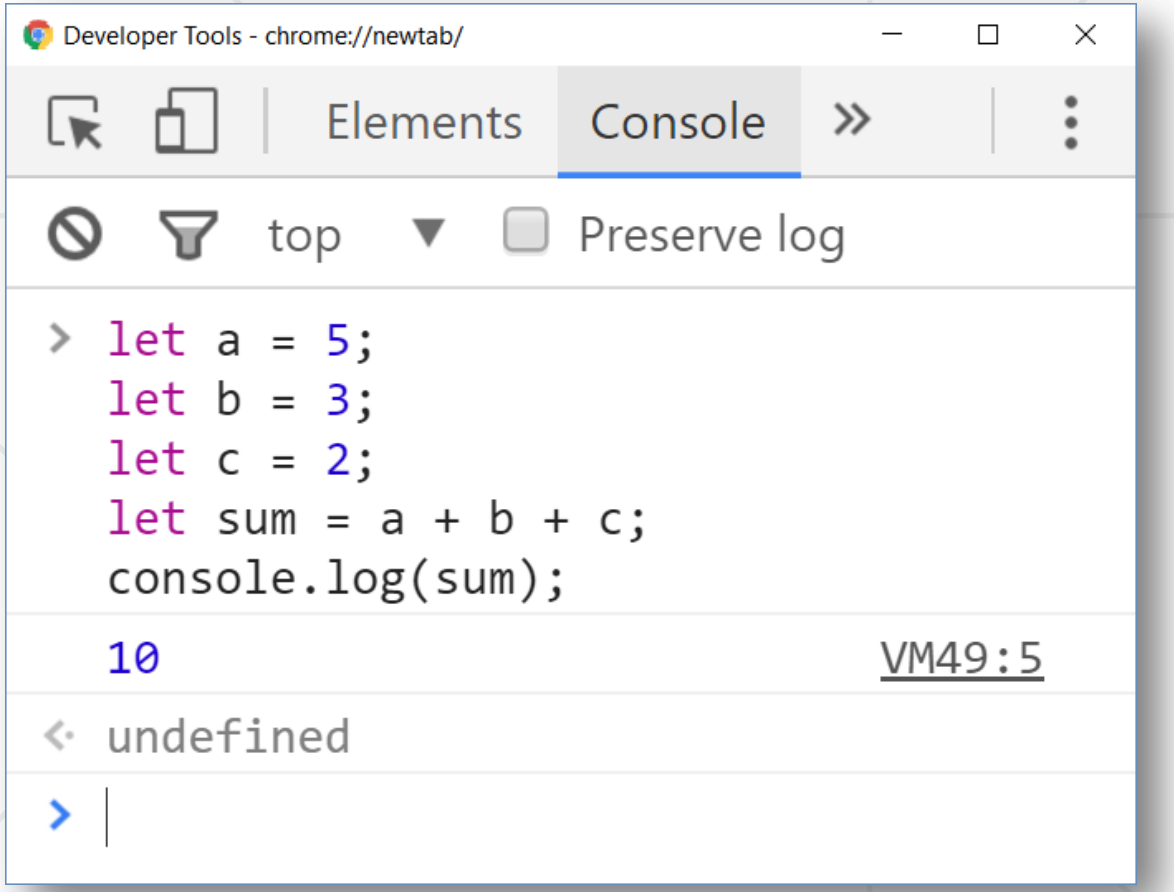
- The JavaScript syntax is similar to C#, Java and PHP
  - Operators (**+, *, =, !=, &&, ++, …**)
  - Variables (typeless)
  - Conditional statements (**if, else**)
  - Loops (**for**, **while**)
  - Functions (with parameters and return value)
  - Arrays (**arr[5]**) and associative arrays (**arr['maria']**)
  - Objects and classes

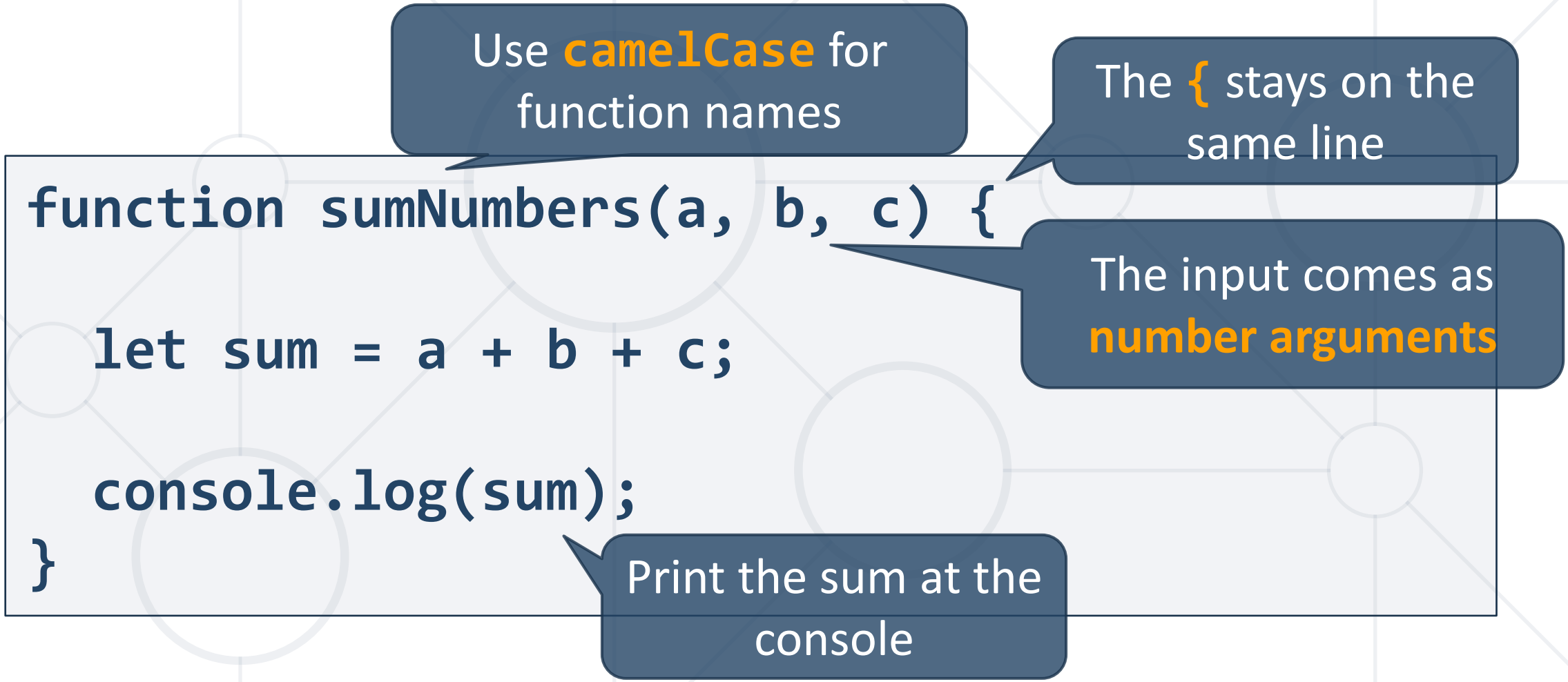
JavaScript Code: Example

- JS variables, operators, expressions, statements

```
let a = 5;
let b = 3;
let c = 2;
let sum = a + b + c;
console.log(sum);
```



Problem: Function to Sum 3 Numbers



Check your solution here: https://judge.softuni.bg/Contests/287

Test the Function in Your Browser

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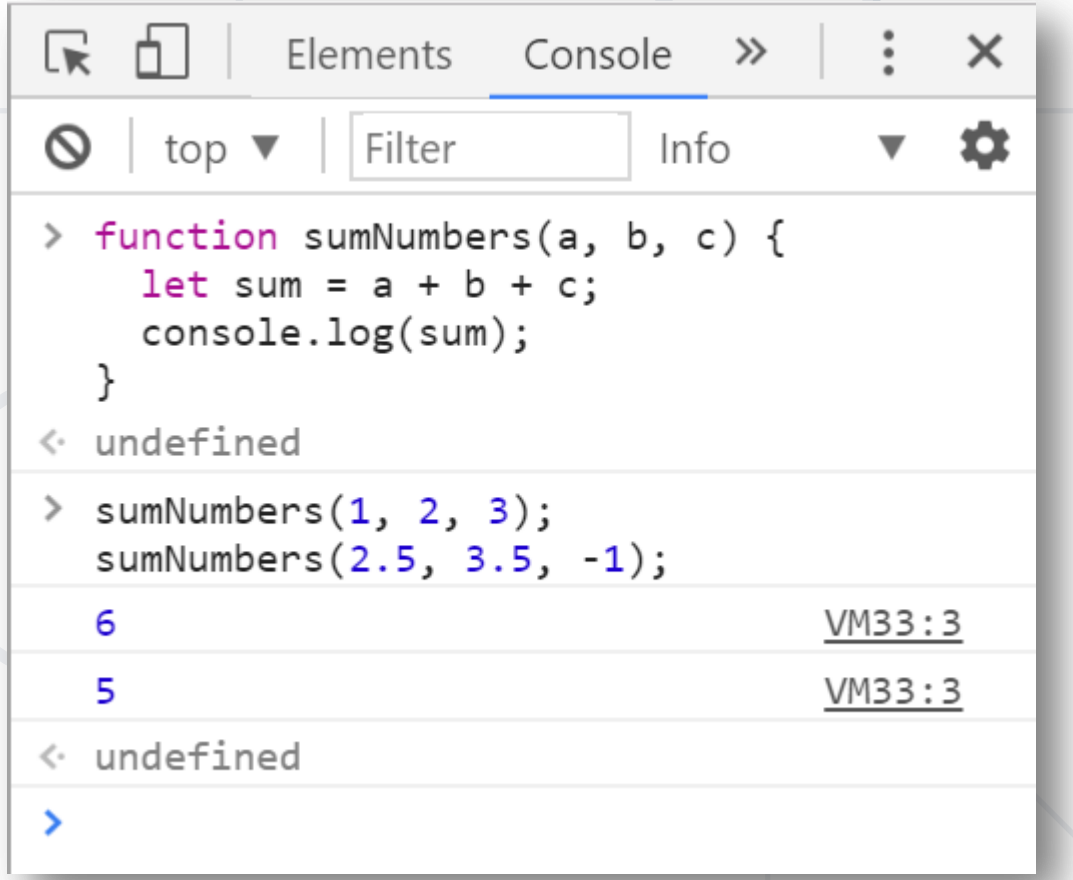
- Call the function with three arguments holding numbers:

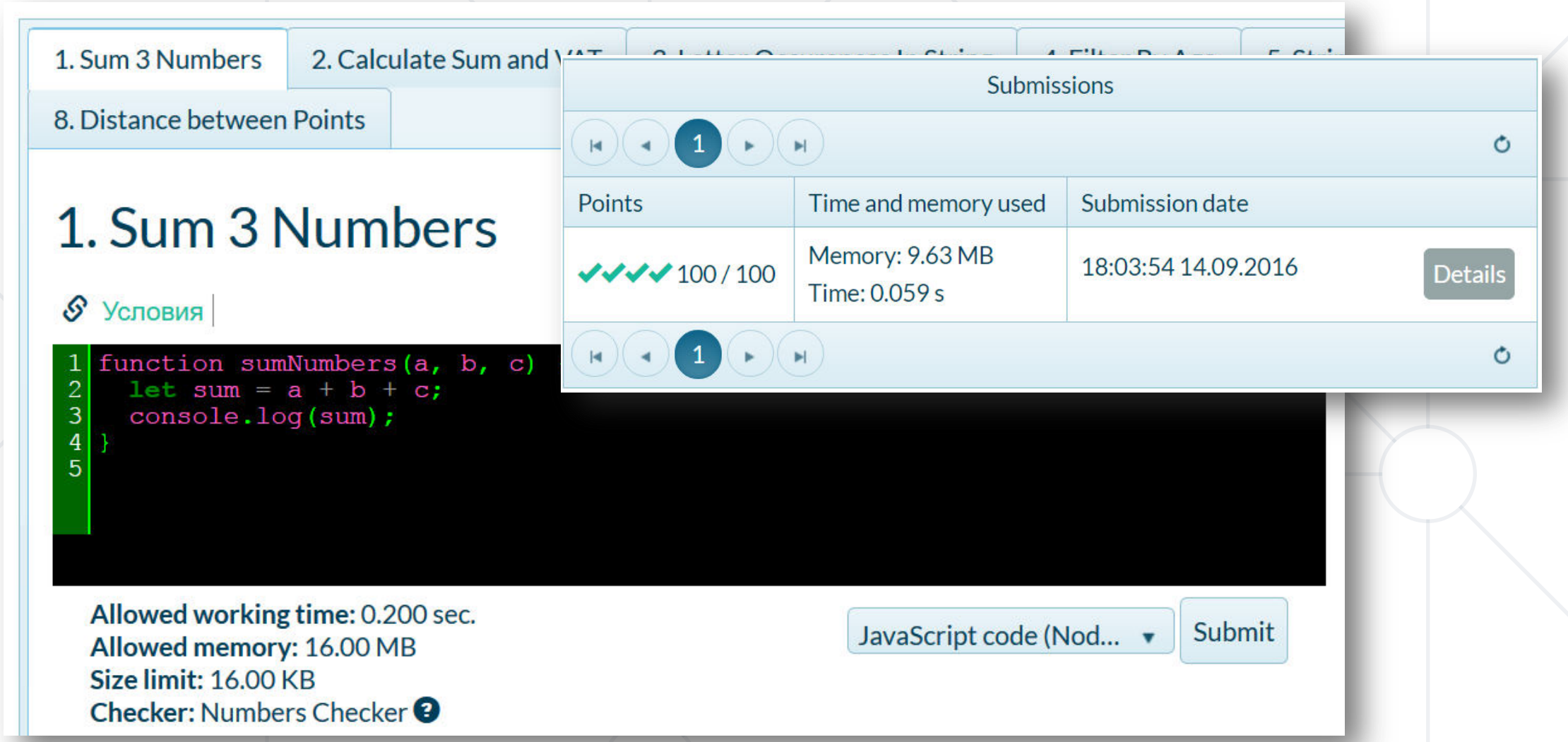
```
sumNumbers(1, 2, 3);
// 6
```

```
sumNumbers(2.5, 3.5, -1);
// 5
```

```
sumNumbers(-1, -2, -3);
// -6
```



Test the Function in the Judge System



Mix HTML and JavaScript

Using JS Code from HTML Page

Mixing HTML + JavaScript

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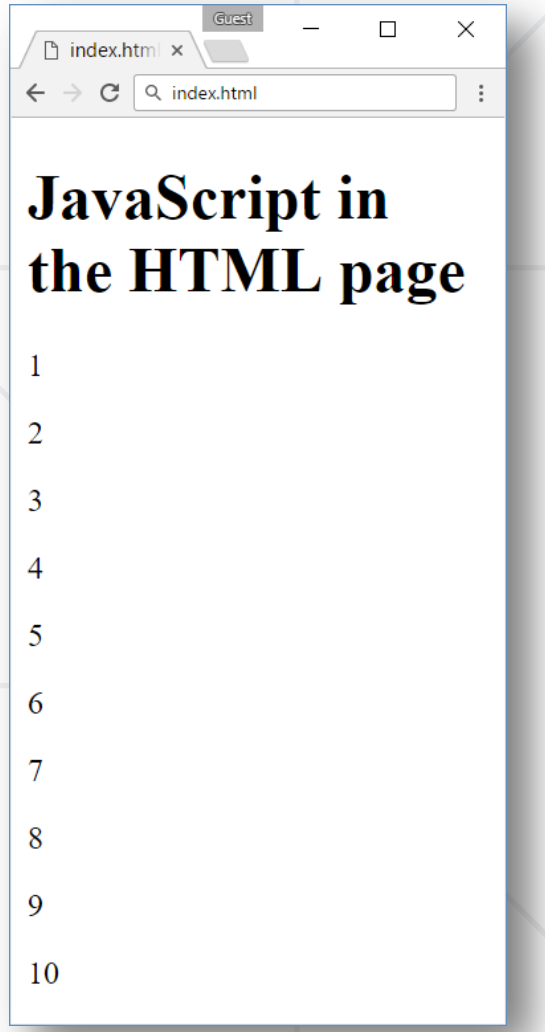
```
<!DOCTYPE html>
<html>
<body>
  <h1>JavaScript in the HTML page</h1>
  <script>
    for (let i=1; i<=10; i++) {
      document.write(`<p>${i}</p>`);
    }
  </script>
</body>
</html>
```



Sum Numbers with HTML Form

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```
<form>
  num1: <input type="text" name="num1" /> <br>
  num2: <input type="text" name="num2" /> <br>
  sum: <input type="text" name="sum" /> <br>
  <input type="button" value="Sum" onclick="calcSum()" />
</form>
```

```
function calcSum() {
  let num1 = document.getElementsByName('num1')[0].value;
  let num2 = document.getElementsByName('num2')[0].value;
  let sum = Number(num1) + Number(num2);
  document.getElementsByName('sum')[0].value = sum;
}
```

Load JavaScript File from HTML Document

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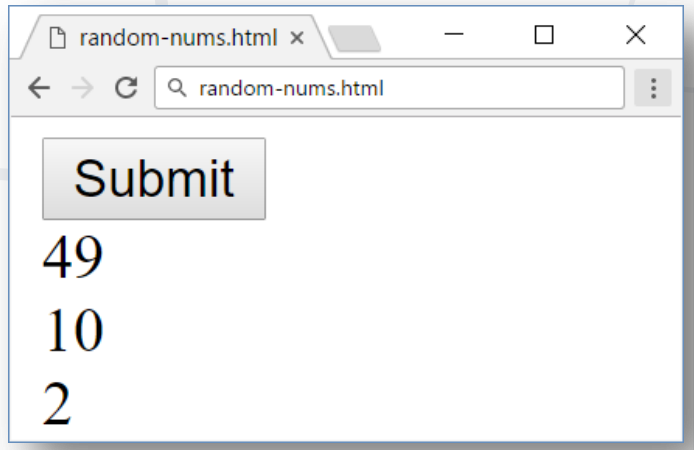
random-nums.html

```
<!DOCTYPE html>
<html>
<head>
  <script src="numbers.js">
  </script>
</head>
<body>
  <input type="submit"
onclick="printRandNum()" />
</body>
</html>
```

numbers.js

```
function printRandNum() {
  let num = Math.round(
    Math.random() * 100);
  document.body.innerHTML +=
    `<div>${num}</div>`;
}
```



Data Types in JS

Numbers, Strings, Booleans, Objects

Numbers in JavaScript

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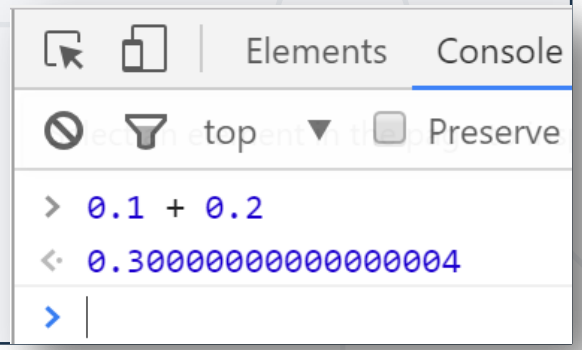
- All numbers in JS are floating-point (64-bit double-precision)

```
let n = 5;
console.log(typeof(n) + ' ' + n); // number 5

let bin = 0b10000001;
console.log(typeof(bin) + ' ' + bin); // number 129

let x = Number.parseInt("2.99");
console.log(typeof(x) + ' ' + x); // number 2

let y = Number("2.99");
console.log(typeof(y) + ' ' + y); // number 2.99
```

Numbers in JavaScript are floating-point

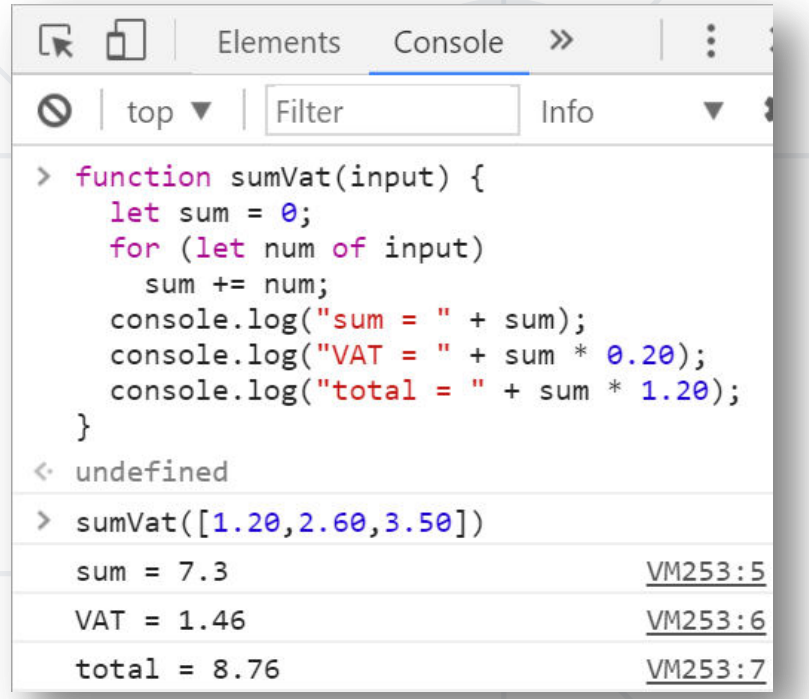
```
let a = 3, b = 4 / a;
console.log(`a=${a} b=${b}`); // a=3
b=1.3333333333333333
console.log(a / 0); // Infinity
console.log(a * Infinity); // Infinity
console.log(0 / 0); // NaN
let bigNum = 10000000000000000;
console.log(bigNum + 1); // 10000000000000000
let num = 0.01, sum = 0;
for (let i=0; i<100; i++)
  sum += num;
console.log(sum); // 1.0000000000000007
```



Problem: Calculate Sum + VAT

- You are given an array of numbers
  - Print their **sum, 20% VAT** and **total sum**

```
function sumVat(input) {
  let sum = 0;
  for (let num of input)
    sum += num;
  console.log("sum = " + sum);
  console.log("VAT = " + sum * 0.20);
  console.log("total = " + sum * 1.20);
}
sumVat([1.20,2.60,3.50])
```



Check your solution here: https://judge.softuni.bg/Contests/287

Strings in JavaScript

- **Strings** in JS are **immutable** sequences of **Unicode** characters

```
let ch = 'x';
console.log(typeof(ch) + ' ' + ch); // string x

let str = "hello";
console.log(typeof(str) + ' ' + str); // string hello
console.log(str.length); // 5

console.log(str[0]); // h
str[0] = 's'; // Beware: no error, but str stays
unchanged!
console.log(str); // hello
console.log(str[10]); // undefined
```

In **strict mode** this gives error

Problem: Letter Occurrences in String

- We are given a string (text) and a letter
  - Count how many times given letter occurs in given string

```
function countLetter(str, letter) {
  let count = 0;
  for (let i=0; i<str.length; i++)
    if (str[i] == letter)
      count++;
  return count;
}
```

```
countLetter('hello', 'l')
```

The input comes as two strings: `str` and `letter`

Check your solution here: https://judge.softuni.bg/Contests/287

Objects in JavaScript

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- JS **objects** hold key-value pairs

```
let point = {x: 5, y: -2};
console.log(point); // Object {x: 5, y: -2}
console.log(typeof(point)); // object

let rect = {name:"my room", width: 4.5, height: 3.5};
rect.name = "old room";
rect.color = "red";
console.log(rect); // Object {name: "old room", width:
4.5, height: 3.5, color: "red"}
rect = undefined; // "rect" now has no value
console.log(rect); // undefined
```

Problem: Filter By Age

- We are given a **minimum age** and two pairs of **names** and **ages**
  - Store each name and age into an object
  - Print each object whose age ≥ minimum age

```
function filterByAge(minAge, nameA, ageA, nameB, ageB)
{
  let personA = {name:nameA, age:ageA};
  let personB = {name:nameB, age:ageB};
  if (personA.age >= minAge) console.log(personA);
  if (personB.age >= minAge) console.log(personB);
}
```

```
filterByAge(12, 'Ivan', 15, 'Asen', 9)
```

Check your solution here: https://judge.softuni.bg/Contests/287

Automatic Type Conversion

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- JS converts between types automatically

```
let ch = 'x'; // string
console.log(typeof(ch));
ch++; // ch is now number
console.log(typeof(ch));
console.log(ch); // NaN
```

```
let num = 0xFF; // 255
console.log(typeof(num));
num = num + "x"; // string
console.log(typeof(num));
console.log(num); // 255x
```

```
let n = "1" * 1; // number
let b = Boolean(n);
console.log(typeof(b));
console.log(b); // true
```

```
let n = [1]; // array
console.log(typeof(n));
n++; // n is now 2 (number)
console.log(typeof(n));
```

Problem: String of Numbers 1…N

- Write a JS function that concatenates numbers as text
  - Input: a string parameter, holding a number **n**
  - Output: the numbers **1…n**, concatenated as single string
  - Example: **'11' → "1234567891011"**

```
function numbers(n) {
  let str = '';
  for (let i=1; i<=n; i++) str += i;
  return str;
}
```

```
numbers('11')
```

Check your solution here: https://judge.softuni.bg/Contests/287

Variables and Scope

`let` vs. `var`

Assigning Variables

- Variables in JS have no type, values have type

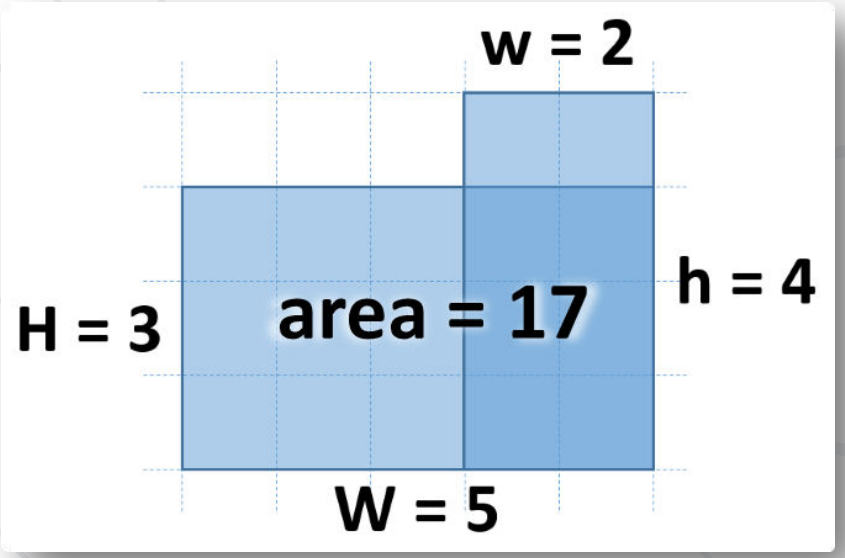
```
let x = 5; console.log(typeof(x)); // x is number
x = 'str'; console.log(typeof(x)); // x is now string
x = {x:5, y:7}; console.log(typeof(x)); // x is now
object
```

```
let n = 5, str = "hello"; // Assigning variables
```

```
// Group declaration + assignment (destructuring)
let [name, x, y] = ["point", 5, 7];
console.log(`${name}(${x}, ${y})`); // point(5, 7)
```

Problem: Figure Area

- Calculate the figure area by given **w**, **h**, **W** and **H**



  - Sample solution:

```
function figureArea(w, h, W, H) {
  let [s1, s2, s3] = [w * h, W * H,
    Math.min(w, W) * Math.min(h, H)];
  return s1 + s2 - s3;
}
```

```
figureArea(2, 4, 5, 3)
```

Check your solution here: https://judge.softuni.bg/Contests/287

Undefined Variables

- JS cannot access undefined variables

```
console.log(x);
// Uncaught ReferenceError: x is not defined(…)
```

- Once defined, variables cannot be deleted!

```
let x = 5;
x = undefined;
console.log(x); // undefined
// The variable x exists, but has no value defined
```

Variable Scope: let vs. var

- let has "block scope"

```
for (let x=1; x<=5; x++)
  console.log(x); // 1 … 5
console.log(x); // Ref. error
```

```
function test() {
  console.log(x); // Ref. error
  let x = 5;
}
test();
```

- var has "function scope"

```
for (var x=1; x<=5; x++)
  console.log(x); // 1 … 5
console.log(x); // 6
```

```
function test() {
  console.log(x); // undefined
  var x = 5;
}
test();
```

Variable Scope: let vs. var (2)

- let has "block scope"

```
let x = 100; // block scope
console.log(x); // 100
for (let x=1; x<=5; x++) {
  console.log(x); // 1 … 5
} // end of block scope
console.log(x); // 100
```

```
  console.log(x); // Ref. error
  let x;
```

- var has "function scope"

```
var x = 100; // function scope
console.log(x); // 100
for (var x=1; x<=5; x++) {
  console.log(x); // 1 … 5
} // same x inside the loop
console.log(x); // 6
```

```
  console.log(x); // undefined
  var x;
```

Global Variables

- In the Web browser

```
x = 5;
console.log(x); // 5
console.log(window.x); // 5
```

- Server side (in Node.js)

```
x = 5;
console.log(x); // 5
console.log(global.x); // 5
```

- Strict mode forbids using global variables

```
'use strict';
x = 10; // Reference error
window.x = 5;
console.log(x);
```

```
'use strict';
window.x = 5;
x = 10; // This will work
console.log(x); // 10
```

Constant Declarations

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- JS supports **constants** – declared by the **const** keyword
  - Once assigned, constants cannot be modified

```
const path = '/images';

console.log(`${path}/logo.png`);
// Logo path: /images/logo.png

path = '/img/new';
// TypeError: Assignment to constant variable
```

Using the JS Console

The "console" Object

The "console" Object in JS

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```
console.log("The date is: " + new Date());
```

```
> console.log("The date is: " + new Date());
  The date is: Fri Sep 16 2016 13:25:59 GMT+0300 (FLE Daylight Time)
```

Always appends a trailing new line: \n

```
console.error("Cannot load comments");
```

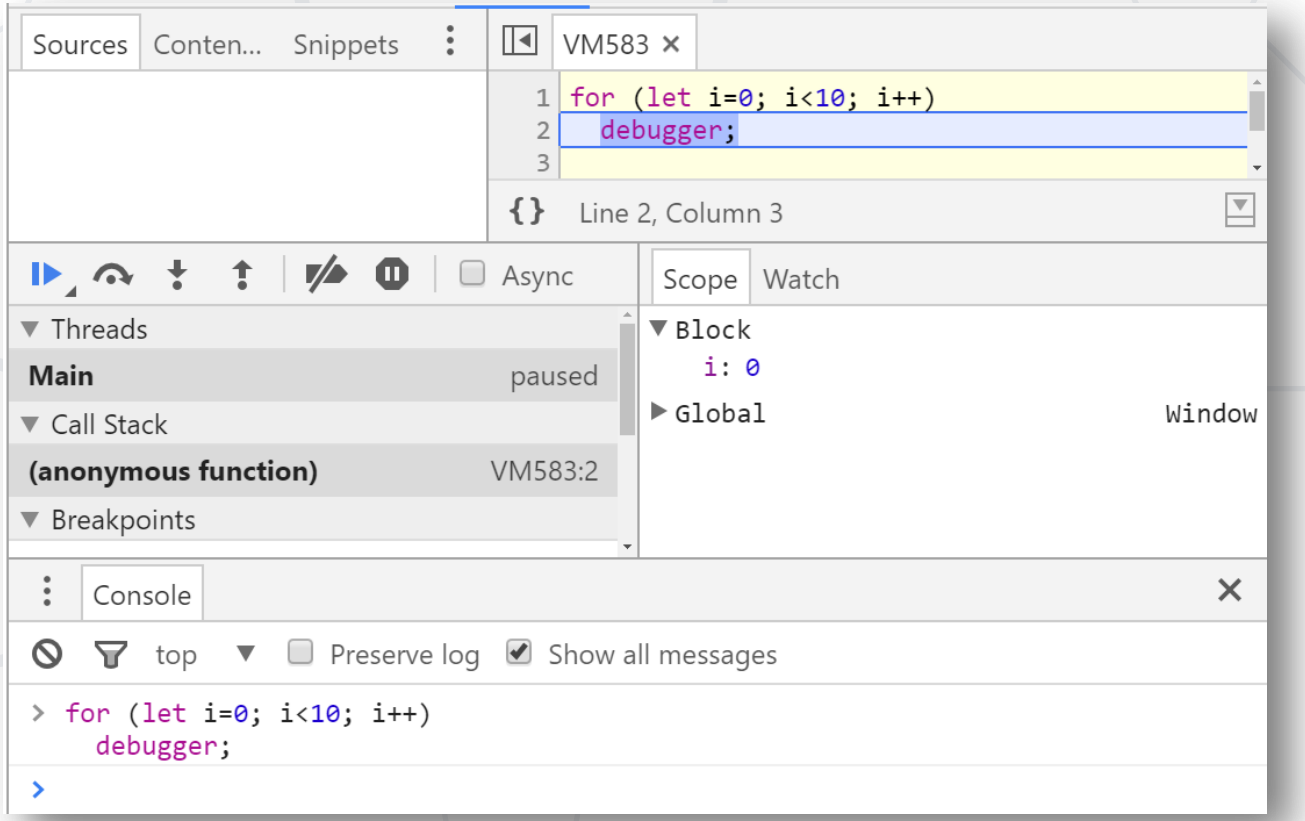
```
> console.error("Cannot load comments");
✕ ▶ Cannot load comments
```

```
console.warn("Article has no cover image");
```

```
> console.warn("Article has no cover image");
⚠ Article has no cover image
```

Invoking the JS Debugger

```
for (let i=0; i<10; i++) {
  debugger;
}
```



Problem: Next Day

- Print the next day by given **year, month, day**
  - Example: 2016, 9, 30 → 2016-10-1

```
function calcNextDay(year, month, day)  {
  let date = new Date(year, month-1, day);
  let oneDay = 24 * 60 * 60 * 1000; // milliseconds in 1 day
  let nextDate = new Date(date.getTime() + oneDay);
  return nextDate.getFullYear() + "-" +
    (nextDate.getMonth() + 1) + '-' +
    nextDate.getDate();
}
```

```
calcNextDay(2016, 9, 30)
```

Check your solution here: https://judge.softuni.bg/Contests/287

Problem: Distance Between Points

- Return the distance between two points
  - Sample solution:

```
function distanceBetweenPoints(x1, y1, x2, y2)  {
  let pointA = {x:x1, y:y1};
  let pointB = {x:x2, y:y2};

  let distanceX = Math.pow(pointA.x - pointB.x, 2);
  let distanceY = Math.pow(pointA.y - pointB.y, 2);
  return Math.sqrt(distanceX + distanceY);
}
```

Use the Pythagorean theorem

```
distanceBetweenPoints(2, 4, 5, 0)
```

Check your solution here: https://judge.softuni.bg/Contests/287

Live Exercises

Summary

- We learned what compilers, interpreters and VM's are
- We made our first program in WebStorm
- We learned basic JS syntax
- We learned how to mix HTML with JS
- We learned about data types in JS

Questions?

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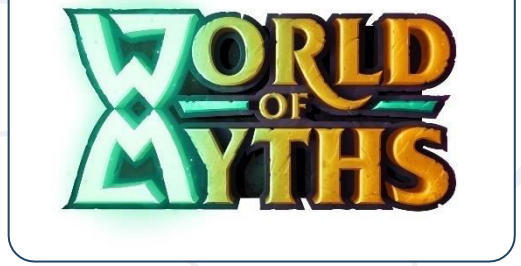

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