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# WRITING A PROGRAM: BASIC SOURCE CODE

|  |  |  |
| --- | --- | --- |
| File Name | Only lowercase (when possible). Files containing a class should have the name of the class, with initial capital letter. | [Python](Python.docx#BasicSourceCode) C++ C# Java |
| Run in Command Prompt | Command Prompt > type node, press enter, type operation |
| Optimal Line Length in Source Code | no longer than 80 characters (break it after an operator or a comma) |
| Break a String into Multiple Lines | using `` instead of '' or "" |
| Comments (Not Executable Code) | // a single-line comment  /\* a multiline comment \*/ |

# IDENTIFIERS (VARIABLE/FUNCTION/PROPERTY NAMES)

|  |  |  |
| --- | --- | --- |
| Lower Camel Case | let firstName = 'John'; | [Python](Python.docx#Identifiers) C++ C# Java |
| Starting with a Number | no |
| Case-Sensivite | yes |
| Hyphens in Identifiers | no |

# DATA TYPES

## BASIC DATA TYPES

|  |  |  |
| --- | --- | --- |
| Data Types That Can Contain Values | *string*: a sequence of characters *number*: whole numbers or decimals *boolean*: true or false *object*: contains several properties, each of them has a value *function*: does something | [Python](Python.docx#BasicDataTypes) C++ C# Java |
| Data Types That Cannot Contain Values | *null* *undefined* |
| Primitive Data Types (Stored in the Heap and Accessed by Value, Changing a Copy Does NOT Change the Initial Variable) | *string*, *number*, *boolean*, *null*, *undefined, bigInt, symbol*  let name = 'John';  let firstName = name; firstName = 'Mark';  firstName // returns 'Mark'  name // returns 'John' |
| Reference Data Types (Stored in the Stack and Accessed by Reference, Changing a Copy DOES Change the Initial Variable) | *object*, *function*  let numbers = [1, 2, 3];  let numbers2 = numbers; numbers2 += 1;  numbers2 // returns '1,2,31'  numbers // returns [1, 2, 3] |

## FIND THE DATA TYPE OF A VARIABLE

|  |  |  |
| --- | --- | --- |
| Find the Data Type of a Variable | typeof 'John' // returns string  typeof 35 // returns number  isNaN(35) // returns false Number.isInteger(35) // returns true typeof NaN // returns number typeof Infinity // returns number typeof true // returns boolean  typeof { name: 'John',  age: 35 } // returns object typeof ['John', '35'] // returns object  Array.isArray(['John', '35']) // returns true  ['John', '35'] instanceof Array // returns true  ['John', '35'].constructor.toString().includes('Array') // returns true typeof new Date() // returns object  typeof (() => { console.log('Hi!') }) // returns function  typeof undefined // returns undefined | [Python](Python.docx#FindTheDataTypeOfAVariable) C++ C# Java |
| Find the Constructor Function for a Variable | 'John'.constructor // returns f String() (3.14).constructor // returns f Number() false.constructor // returns f Boolean() [1, 2, 3].constructor // returns f Array() { name: 'John', age: 35 }.constructor // returns f Object() new Date().constructor // returns f Date() function () { }.constructor // returns f Function() |
| Find Out if an Object is an Array | Array.isArray([1, 2]) // returns true [1, 2].constructor == Array // returns true |
| Find Out if an Object is a Date | function isDate(myDate) {  return myDate.constructor.toString().indexOf('Date') > -1;  } // returns true or false  function isDate(myDate) {  return myDate.constructor == Date;  } // returns true or false |

## CONVERT DATA TYPES. TYPE COERCION

|  |  |  |
| --- | --- | --- |
| Convert Other Types to Strings | String(3) // returns '3' (3).toString() // returns '3' | [Python](Python.docx#ConvertDataTypes) C++ C# Java |
| Convert Other Types to Numbers | Number('3') // returns 3 parseInt('3') // returns 3 parseFloat('3.14') // returns 3.14 Number('John') // returns NaN Number('') // returns 0 Number([20]) // returns 20 Number([10, 20]) // returns NaN Number([]) // returns 0 Number({}) // returns NaN Number(false) // returns 0 Number(true) // returns 1 Number(new Date('Mar 25 2015')) // returns 1427234400000 (milliseconds counted from Jan 01 1970 00:00:00 UTC) |
| Convert Other Types to Booleans (Truthy and Falsy Values) | Boolean('3') // returns true Boolean(0) // returns false Boolean(3) // returns true  Boolean(3 / 2) // returns true Boolean(3 / 'd') // returns false Boolean('0') // returns true Boolean('') // returns false Boolean([]) // returns true; BUT [] == true returns false Boolean({}) // returns true Boolean(null) // returns falseBoolean(undefined) // returns false |
| Type Coercion | '' + 3 // returns '3' `${3}` // returns '3' + '3' // returns 3 2 \* '10' // returns 20 4 < '14' // returns true if (3) { ... } // 3 coerced to true |  |

# DECLARE DATA. ASSIGN VALUES

## DECLARE A VARIABLE

|  |  |  |
| --- | --- | --- |
| Assignment Operators | = // assigns a value to a variable += // adds to previous value -= // subtracts from previous value \*= // multiplies previous value \*\*= // raises the value of a variable to the value of the right operand /= // divides previous value %= // assigns a remainder | [Python](Python.docx#DeclareAVariable) C++ C# Java |
| Declare a Variable without a Value | let undefinedVariable;  let undefinedVariable = undefined; // both value and type are undefined |
| Declare a String Variable | let text = 'A'; var text = 'A'; // function scope; not recommended |
| Declare a Number | let num = 6; // accurate up to 15 digits  let num = 6.25; |
| Declare a Boolean | let isFound = true; |
| Declare Multiple Variables | let person = 'John Doe', carName = 'Volvo', price = 200;  let [person, carName, price] = ['John Doe', 'Volvo', 200];  let x, y; |
| Assign the Same Value to Multiple Variables | let x = y = z = 5; |  |

## LIFE OF A VARIABLE

|  |  |  |
| --- | --- | --- |
| Global Scope (*var*, *let* and *const* outside a Function) | let firstName = 'John'; // code here can use firstName function functionName() {  // code here can use firstName  } // code here can use firstName | [Python](Python.docx#LifeOfAVariable) C++ C# Java |
| Function Scope (*var*, *let* and *const* in a Function) | // code here CANNOT use firstName function functionName() {  let firstName = 'John';  // code here can use firstName  } // code here CANNOT use firstName |
| Block Scope (*let* and *const* in a Code Block) | let i = 5;  for (let i = 1; i < 10; i++) { ... } // another variable with the same name  // i is 5 here |

## CONSTANTS IN JAVASCRIPT

|  |  |  |
| --- | --- | --- |
| Constants in JS | Must be assigned a value when declared.  Recommended use with objects (reference values) when we do not intend to reassign or redeclare them in the same scope. | [Python](Python.docx#LifeOfAVariable) C++ C# Java |
| Constants with Primitive Values | const pi = 3.14;  pi = 3.14159; // will throw an error, constants cannot be reassigned |
| Constants with Reference Values: Arrays | const numbers = [1, 2];  numbers.push(3); // numbers is now [1, 2, 3]  numbers = numbers.slice(0); // not allowed |
| Constants with Reference Values: Objects | const person = { name: 'Peter', age: 23 };  person.name = 'John'; // person is now { name: 'John', age: 23 }  person = { name: 'John', age: 23 }; // not allowed |  |

## DECLARE AN OBJECT (CONST RECOMMENDED)

|  |  |  |
| --- | --- | --- |
| Declare an Object {Property/Key: Value} | const person = {  name: 'John',  age: 35  }; | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Declare an Array Object [List of Values] | const people = ['John', 'Mary', 'George']; |
| Declare a Map Object [[Property/Key, Value]] | const person = new Map([['name', 'John'], ['age', 35]]); |
| Declare a Set Object  [List of Unique Values] | const people = new Set(['John', 'Mary', 'George']); |
| Declare a Class (a Template for Objects) | class Person {  constructor(personName, personAge) {  this.name = personName;  this.age = personAge;  } } |  |

## DECLARE A FUNCTION OBJECT

|  |  |  |
| --- | --- | --- |
| Declare a Function | function functionName() {  // content of the function  } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Declare an Arrow Function (Shorter Syntax, Does NOT Have 'This' Property) | hello = function() {  let name = 'John';  return 'Hello ' + name; } hello() //returns ‘Hello John’  hello = () => {  let name = 'John';  return 'Hello ' + name; } |
| Declare an Arrow Function with Only One Statement | hello = () => 'Hello!';  hello = (name) => 'Hello ' + name;  hello = name => 'Hello ' + name; |

# CONDITIONS

## TRUTHY/FALSY VALUES

|  |  |  |
| --- | --- | --- |
| Truthy Values | Values that coerce to true when evaluated in a boolean context. | [Python](Python.docx#TruthyFalsyValues) C++ C# Java |
| Falsy Values | false, null, undefined, NaN, 0, 0n, '' |

## OPERATORS

|  |  |  |
| --- | --- | --- |
| Comparison Operators | == // equal to  === // equal value and equal type  != // not equal  !== // not equal value or not equal type  > // greater than  < // less than  >= // greater than or equal to  >= // less than or equal to | [Python](Python.docx#Operators) C++ C# Java |
| Logical Operators | && // and; returns the leftmost falsy value or the last truthy value if they are all true  || // or; returns the leftmost truthy value or the last falsy if they are all false  ! // not; returns false if its operand can be converted to true, otherwise true |
| Ternary Operator | *condition* ? *value1* : *value2*  age < 18 ? 'young' : 'old' // returns 'young' if the value of age is < 18, 'old' if age > 18 |

## COMPARE DATA

|  |  |  |
| --- | --- | --- |
| Comparing Numbers | 1 < 2 // returns true | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Comparing a Number to a String | 2 < '12' // returns true, numeric strings are converted to numbers  2 < 'John' // returns false 0 == '' // returns true 0 === '' // returns false |
| Comparing Strings | 'John' <= 'John' // returns true 'a' < 'b' // returns true (alphabetically ordered) '2' < '12' // returns false (alphabetically ordered) |
| Comparing Objects: Always Returns False | [1, 2, 3] == [1, 2, 3] // returns false  { name: 'John' } == { name: 'John' } // returns false |

## CONDITIONAL STATEMENTS

|  |  |  |
| --- | --- | --- |
| If – Else (If) | if (x > y) {  // code to be executed if x > y } else if (x < y) {  // code to be executed if x !> y and x < y } else {  // code to be executed if x !> y and x !< y } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Switch (Case) | switch (num) {  case 1: day = 'Monday'; break; // num == 1  case 2: day = 'Tuesday'; break;  case 3: day = 'Wednesday'; break;  case 4: day = 'Thursday'; break;  case 5: day = 'Friday'; break;  case 6:  case 7: day = 'Weekend'; break; // num == 6 or num == 7  default: day = 'unknown'; break; // optional } |

# LOOPS

## FOR LOOP

|  |  |  |
| --- | --- | --- |
| For Loop | for (let i = 0; i < 10; i++) {  // code block to be executed 10 times  } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| For Loop without the First Statement (Setting a Variable) | let i = 0; for (; i < 10; i++) {  // code block to be executed 10 times  } |
| For Loop without the Second Statement (Setting a Condition) | for (let i = 0; ; i++) {  // code block to be executed  if (i >= 10) {  break;  }  } |
| For Loop without the Third Statement (Changing the Value of the Variable) | for (let i = 0; i < 10;) {  // code block to be executed  i++;  } |
| For Loop with a Condition Statement Only | let cars = ['BMW', 'Audi']; let i = 0; for (; cars[i];) {  // code block to be executed  i++;  } // cars[i] will return false when i == 2 |  |
| For Loop without Any Statement (Set the Code Block in Order to Avoid an Infinite Loop) | let i = 0; for (; ;) {  // code block to be executed  if (i >= 10) {  break;  }  i++;  } |  |

## WHILE LOOP

|  |  |  |
| --- | --- | --- |
| While Loop | while (*condition*) {  // code block to be executed while the condition returns 'true' } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Do/While Loop (Executed at Least Once) | do {  // code block to be executed at least once } while (*condition*) |

## BREAK A LOOP

|  |  |  |
| --- | --- | --- |
| The Break Statement (Breaks the Loop) | for (let i = 0; i < 10; i++) {  if (i == 3) {  break;  }  // code block to be executed 2 times  } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| The Continue Statement (Breaks the Current Iteration Only) | for (let i = 0; i < 10; i++) {  if (i == 3) {  continue;  }  // code block to be executed 9 times, except for when I == 3  } |

# FUNCTIONS

## CALL A FUNCTION. FUNCTION PARAMETERS

|  |  |  |
| --- | --- | --- |
| Parameters and Arguments | function by2(num) { // num is parameter, behaves as variable between {}  return num \* 2; } by2(3); // 3 is argument | [Python](Python.docx#Input) C++ C# Java |
| String Parameters | function greetingByName(firstName, lastName) {  return 'Your name is ' + firstName + lastName; } greetingByName('John', 'Doe'); // 'Your name is John Doe' |
| Number Parameters | function ableToVote(age) {  return 'You will be able to vote in ' + (18 – age) + ' years'; } ableToVote(15); // returns 'You will be able to vote in 3 years' |
| Multiple Inputs (the Spread Operator) | function introducing(...input) {  let name = input[0]; // 'John'  let age = input[1]; // 35  return 'My name is ' + name + 'and I am ' + age + ' years old.' } introducing('John', 35); // returns 'My name is John and I am 35 years old.' |  |
| Array as a Function Parameter | function introducing(input) {  let name = input[0]; // 'John'  let age = input[1]; // 35  return 'My name is ' + name + 'and I am ' + age + ' years old.' } introducing(['John', 35]); // returns 'My name is John and I am 35 years old.' |  |
| Default Parameters | function printStars(count = 5) {  console.log('\*'.repeat(count)); }  printStars(); // prints '\*\*\*\*\*' printStars(2); // prints '\*\*' printStars(3, 5, 8); // prints '\*\*\*' |  |

## FUNCTION CONTEXT. THIS OBJECT

|  |  |  |
| --- | --- | --- |
| Global Invoke | function myFunction() {  return this; }  myFunction(); // returns 'global' in node.js, 'window' in the browser | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Object Method | let myObj = {  name: 'Peter',  func() {  return this;  } };  myObj.func() // returns { name: 'Peter', func: *f* } |
| DOM Event | button.addEventListener('click', onClick);  function onClick(ev) {  console.log(this); } // prints |  |
| Inner Method Context | let myObj = {  name: 'Peter',  func() {  console.log(this); // { name: 'Peter', func: *f* }  function innerFunc() {  console.log(this); // global/window  }  innerFunc();  } };  myObj.func(); // prints { name: 'Peter', func: *f* } and global/window |  |
| Arrow Function Context | let myObj = {  name: 'Peter',  func() {  console.log(this); // { name: 'Peter', func: *f* }  let innerFunc = () => {  console.log(this); // { name: 'Peter', func: *f* }  }  innerFunc();  } };  myObj.func(); // prints { name: 'Peter', func: *f* } twice |  |
| Explicit Binding (Changing the Context) | let myObj = {  name: 'Peter' };  function func(a, b) {  console.log(this);  console.log(a, b); }  func.call(myObj, 2, 3); // prints { name: 'Peter' } and then 2 3 func.apply(myObj, [2, 3]); // prints { name: 'Peter' } and then 2 3 let boundFunc = func.bind(myObj); boundFunc(2, 3); // prints { name: 'Peter' } and then 2 3 |  |
|  | let myObj = {  name: 'Peter' };  function func() {  console.log(`I am ${this}`); }  func(); // prints 'I am undefined' func.call(myObj); // prints 'I am Peter' func.apply(myObj); // prints 'I am Peter' let boundFunc = func.bind(myObj); boundFunc(); // prints 'I am Peter' document.querySelector('button').addEventListener('click', myObj.func); // prints 'I am' document.querySelector('button').addEventListener('click', myObj.func.bind(myObj); // prints 'I am Peter' |  |
|  |  |  |

## FIRST-CLASS AND HIGHER-ORDER FUNCTIONS

|  |  |  |
| --- | --- | --- |
| First-Class Functions (Treated like Any Other Variable) | function sayHello() {  return 'Hello, '; }  const greeting = () => 'Hello!'; console.log(greeting()); // prints 'Hello!' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Higher-Order Functions (Take Other Functions as Arguments or Return a Function) | function sayHello() {  return function () {  console.log('Hello!');  } }  sayHello(); // prints 'Hello!' |
| Callback | a function passed into another function as an argument |  |
| Built-In Higher-Order Functions | array.map(x => x \* 2) array.filter(x => x > 5) array.reduce((acc, curr) => acc + curr, 0) |  |
| Predicates (Return a Boolean) | let array = [2, 4, 12, 37]; let found = array.find(isFound);  function isFound(element) {  return element > 10; }  console.log(found); // prints 12 |  |
| Pure Functions (Same Result Given Same Parameters) | let num = 1; function impure(a) {  return num += a; }  function pure(a, b) {  return a + b; } |  |
| Referential Transparency (Can Be Replaced with Its Corresponding Value) | function sum(a, b) { return a + b } function mult(a, b) { return a \* b } let x = sum(2, mult(3, 4)); // mult(3, 4) can be replaced with 12 |  |
| Closure | The scope of an inner function includes the scope of the outer function. |  |
| IIFE (Immediately Invoked Function Expression) | (function () { let name = 'Peter' })(); // name cannot be used let result = (function () {  return name = 'Peter'; })() // result = 'Peter' |  |
| Partial Application | function pow(num, pow) {  return num \*\* pow; }  function sqr(num) {  return pow(num, 2); }  sqr(3) // returns 9 |  |
| Function Decoration | function pow(pow, num) {  return num \*\* pow; }  const sqr = pow.bind(null, 2); sqr(3) // returns 9 |  |
| Currying (Function Decomposition) | function sum3(a) {  return (b) => {  return (c) => {  return a + b + c;  }  }  }  sum3(5)(6)(8) // returns 19 |  |

# OUTPUT

|  |  |  |
| --- | --- | --- |
| Print Some Data to the Console | console.log('Hi there, John!'); // prints 'Hi there, John!'  console.log(35); // prints 35 | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Print to the Console a Value Stored in a Variable | let name = 'John';  console.log(name); // prints 'John' |
| Display a Message in an Alert Window in the Browser | alert('Hi there!');  window.alert('Hi there!'); |  |
| Ask the User for Confirmation in an Alert Window in the Browser | confirm('Are you sure you want to delete this?'); |  |
| Print Page | window.print(); |  |

# NUMBERS IN JAVASCRIPT

## BASIC MATH

|  |  |  |
| --- | --- | --- |
| Number Storage in JS | JS numbers are always 64-bit floating point, where the number (the fraction) is stored in bits 0 to 51, the exponent in bits 52 to 62, and the sign in bit 63. | [Python](Python.docx#BasicMath) C++ C# Java |
| Operators | + // addition - // subtraction \* // multiplication / // division % // modulus: returns the division remainder (10 % 2 returns 0) ++ // increment: returns previous value + 1 -- // decrement: returns previous value – 1 \*\* // exponentiation: raises the first operand to the power of the second (2 \*\* 3 returns 8) () // parentheses: changes precedence |
| Arithmetic Precision (Accurate Up to 15 Digits) | 9999999999999999; // returns 10000000000000000 0.2 + 0.1 // returns 0.30000000004 (0.2 \* 10 + 0.1 \* 10) / 10 // returns 0.3 2 / 0 // returns Infinity -2 / 0 // returns -Infinity |
| Arithmetic Operations with Strings and Numbers | '100' / '10' // returns 10 '10' \* 10 // returns 100 100 – '10' // returns 90 '100' + 10 // returns 10010 (concatenation) 100 / 'Apple' // returns NaN (Not a Number) |
| Add a Number and a String (Concatenation) | 2 + '3' // returns 23 2 + 3 + 'A' // returns 5A 'A' + 2 + 3 // returns A23 |  |
| Absolute Value | Math.abs(-50) // returns 50 |  |
| Round | Math.round(47.54) // returns 48  47.44.toFixed(0) // returns '47'  47.44.toPrecision(2) // '47'; BUT (9.5).toPrecision(1) returns '1e+1' |  |
| Round Down | parseInt(47.98) // returns 47  Math.trunc(47.98) // returns 47  Math.floor(47.98) // returns 47  47.98 | 0 // returns 47 |  |
| Round Up | Math.ceil(47.01) // returns 48 |  |
| Round to an Exact Number of Digits after the Decimal Point | 47.445.toFixed(2) // returns '47.45'  47.445.toPrecision(4) // '47.45'; BUT (99.5).toPrecision(2) = '1.0e+2' |  |
| Remove Trailing Zeroes | parseFloat(47.9000) // returns 47.9 Number(47.9000) // returns 47.9 |  |
| Find the Largest Number | Math.max(2, 5, -32) // returns 5 |  |
| Find the Smallest Number | Math.min(2, 5, -32) // returns -32 |  |
| Exponentiation | Math.pow(5, 2) // returns 25  5 \*\* 2 // returns 25 |  |
| Square Root | Math.sqrt(36) // returns 6 Math.sqrt(-1) // returns NaN |  |
| Hexadecimal Numbers | 0xFF // returns 255 |  |
| Convert Base 10 Numbers to Another Base | (32).toString(10) // returns '32' (32).toString(16) // returns '20' (32).toString(2) // returns '100000' |  |
| Convert Binary Numbers to Decimals | let binary = parseInt('00001001', 2) // 00001001 binary.toString(10) // returns '9' |  |
| Exponential Notation | (9.656).toExponential() // returns '9.656e+0' (not rounded)  (9.656).toExponential(2) // returns '9.66e+0'  (9.656).toExponential(4) // returns '9.6560e+0' |  |
| Find Number of Digits | (32).toString().length // returns 2 String(32).length // returns 2 |  |
| Extra Large/Small Numbers | let x = 123e5; // 12300000 let y = 123e-5; // 0.00123 |  |
| Pi (π) | Math.PI // returns 3.14159... |  |
| The Largest Possible Number | Number.POSITIVE\_INFINITY // returns Infinity Number.MAX\_SAFE\_INTEGER // returns 9007199254740991 Number.MAX\_VALUE // returns 1.7976931348623157e+308 |  |
| The Smallest Possible Number | Number.NEGATIVE\_INFINITY // returns -Infinity Number.MIN\_SAFE\_INTEGER // returns -9007199254740991 Number.MIN\_VALUE // returns 5e-324 |  |

## RANDOM NUMBERS

|  |  |  |
| --- | --- | --- |
| Random Numbers Lower than 1 | Math.random() // returns a random number between 0 (inclusive) and 1 (exclusive) | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Random Numbers from 0 to 9 | Math.floor(Math.random() \* 10) // returns a random number between 0 and 9 |
| Random Numbers from 0 to 10 | Math.floor(Math.random() \* 11) // returns a random number between 0 and 10 |  |
| Random Numbers from 0 to 99 | Math.floor(Math.random() \* 100) // returns a random number between 0 and 99 |  |
| Random Numbers from 0 to 100 | Math.floor(Math.random() \* 101) // returns a random number between 0 and 100 |  |
| Random Numbers from 1 to 10 | Math.floor(Math.random() \* 10) + 1 // returns a random number between 1 and 10 |  |
| Random Numbers from 1 to 100 | Math.floor(Math.random() \* 100) + 1 // returns a random number between 1 and 100 |  |
| A Function that Returns a Random Number between Min (Included) and Max (Excluded) | function getRndInteger(min, max) {  return Math.floor(Math.random() \* (max – min)) + min;  } |  |
| A Function that Returns a Random Number between Min (Included) and Max (Included) | function getRndInteger(min, max) {  return Math.floor(Math.random() \* (max – min) + 1) + min;  } |  |

# TEXT PROCESSING

## COMBINE STRINGS

|  |  |  |
| --- | --- | --- |
| Concatenate Strings | 'Hello'.concat(' John!') // returns 'Hello John!' 'Hello'.concat(' ', 'John!') // returns 'Hello John!' 'Hello' + ' ' + ' John!' // returns 'Hello John!' | [Python](Python.docx#CombineStrings) C++ C# Java |
| Concatenate Strings Using Variables (Interpolation) | let name = 'John', age = 35;  let sentence = `${name} is ${age} years old.`; // 'John is 35 years old.' |

## ACCESS THE CHARACTERS OF A STRING. STRING LENGTH

|  |  |  |
| --- | --- | --- |
| Access a Character at a Specified Position | 'abcd'[0] // returns 'a' 'abcd'.charAt() // returns 'a' 'abcd'.charAt(3) // returns 'd' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Find the Length of a String | 'abcd'.length // returns 4 |
| Loop through the Characters of a String | for (let i = 0; i < 'word'.length; i++) {  console.log('word'[i]);  } // prints 'w', 'o', 'r', 'd' on separate lines  for (let char of 'word') {  console.log(char);  } // prints 'w', 'o', 'r', 'd' on separate lines |

## CONVERT STRINGS

|  |  |  |
| --- | --- | --- |
| Convert a String to an Array | 'a b c d'.split(' ') //returns ['a', 'b', 'c', 'd'] 'a,b,c,d'.split(',') // returns ['a', 'b', 'c', 'd'] 'abcd'.split('') // returns ['a', 'b', 'c', 'd'] | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Convert a Character into the Corresponding ASCII Code | 'abcd'.charCodeAt() // returns 97 'abcd'.charCodeAt(0) // returns 97 'abcd'.charCodeAt(2) // returns 99 |
| Convert a Character Code into the Corresponding Character | String.fromCharCode(97) // returns 'a' |  |
| Convert a Special Character into a String Character | '\\\_/' // returns '\\_/' |  |

## COMPARE STRINGS

|  |  |  |
| --- | --- | --- |
| Compare the ASCII Code of Strings | 'a' > 'b' // returns false  'a' > 'B' // returns true | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Compare Strings Regardless of Case | 'a'.localeCompare('B') // returns -1  'B'.localeCompare('a') // returns 1  'a'.localeCompare('A') // returns -1  'a'.localeCompare('a') // returns 0 |

## SEARCH FOR A SPECIFIED CHARACTER/STRING PART

|  |  |  |
| --- | --- | --- |
| Find the Position of a Specified Text/Character in a String | 'abcd'.indexOf('c') // returns 2; CANNOT take regular expressions  'abcd'.indexOf('g') // returns -1  'Hello! Hello!'.indexOf('Hello') // returns 0  'Hello! Hello!'.indexOf('Hello', 3) // starts searching from position 3, returns 7  'Hello! Hello!'.search('Hello') // returns 0; can take regular expressions, CANNOT take a start index | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Determine whether a String Contains the Characters of a Specified String | 'abcd'.includes('a') // returns true  'abcd'.includes('g') // returns false |
| Find the Position of the Last Occurrence of a Specified Text/Character in a String | 'Hello! Hello!'.lastIndexOf('Hello') // searches backwards, returns 7  'Hello! Hello!'.lastIndexOf('John') // returns -1  'Hello! Hello!'.lastIndexOf('Hello', 3) // returns 0  'Hello! Hello!'.lastIndexOf('Hello', 7) // returns 7 |  |
| Check if a String Begins with a Specified Character/String | 'Hello'.startsWith('Hell') // returns true  'Hello'.startsWith('hell') // returns false |  |
| Check if a String Ends with a Specified Character/String | 'Hello'.endsWith('lo') // returns true 'Hello'.slice(-'lo'.length) == 'lo' // returns true |  |

## EXTRACT STRING PARTS

|  |  |  |
| --- | --- | --- |
| Extract String Parts (Start Position) | 'Hello John!'.substring(6) // returns 'John'  'Hello John!'.slice(6) // returns 'John' // 'Hello John!'.**substr**(6) returns 'John' (not recommended) | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Extract String Parts (Start Position, End Position + 1) | 'Hello John!'.substring(0, 5) // returns 'Hello'  'Hello John!'.slice(0, 5) // returns 'Hello' |
| Extract String Parts (Start Position, Length of the Extracted String) | 'Hello John!'.substring(6, 6 + 4) // returns 'John'  'Hello John!'.slice(6, 6 + 4) // returns 'John'  // 'Hello John!'.**substr**(6, 4) returns 'John' (not recommended) |  |
| Extract String Parts Counting Backwards (Start Position) | 'Hello John!'.slice(-5) // returns 'John!'  // 'Hello John!'.**substring**(-5) does not work as expected, returns 'Hello John!' // 'Hello John!'.**substr**(-5) returns 'John' (not recommended) |  |
| Extract String Parts Counting Backwards (Start Position, End Position + 1) | 'Hello John!'.slice(-5, -1) // returns 'John'  // 'Hello John!'.**substring**(-5, -1) returns an empty string |  |
| Extract String Parts (End Position + 1, Start Position) | 'Hello John!'.substring(5, 0) // returns 'Hello'  // 'Hello John!'.**slice**(5, 0) returns an empty string |  |

## CONVERT TO LOWER/UPPERCASE

|  |  |  |
| --- | --- | --- |
| Convert to Upper Case | 'John'.toLocaleUpperCase() // returns 'JOHN' (according to the language settings)  'John'.toUpperCase() // returns 'JOHN' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Convert to Lower Case | 'John'.toLocaleLowerCase() // returns 'john' (according to the language settings)  'John'.toLowerCase() // returns 'john' |

## CHANGE STRINGS (RESULT MUST BE SAVED IN ANOTHER VARIABLE)

|  |  |  |
| --- | --- | --- |
| Immutable Strings | let name = 'Mary';  name[0] = 'G';  name // returns 'Mary' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Replace a Character/String Part (Only the First Occrurence) | 'blue house, blue car'.replace('blue', 'red'); // returns 'red house, blue car' |
| Replace All Occurences | 'blue house, blue car'.replace(/blue/g, 'red'); // returns 'red house, blue car' |  |
| Repeat a Character/String | '\*'.repeat(5) // returns '\*\*\*\*\*' |  |
| Add Characters at the Beginning of a String to Reach a Specified Length | '23'.padStart(4, '0') // returns '0023'  ('0'.repeat(4) + '23').slice(-4) // returns '0023' |  |
| Add Characters at the End of a String to Reach a Specified Length | '23'.padEnd(4, '0') // returns '2300'  ('23' + '0'.repeat(4)).slice(0, 4) // returns '2300' |  |
| Remove Whitespace from Both Sides | ' Hello '.trim() // returns 'Hello' |  |
| Remove Whitespace from the Beginning | ' Hello '.trimStart() // returns 'Hello ' |  |
| Remove Whitespace from the End | ' Hello '.trimEnd() // returns ' Hello' |  |

## REGULAR EXPRESSIONS

### MATCHING RULES

|  |  |  |
| --- | --- | --- |
| Match Any Character | **.** | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Match a Single Character of a Given Set | [abc] // matches either 'a', 'b' or 'c'  (a|b|c) // matches either 'a', 'b' or 'c' |
| Match a Single Character Except a Given Set | [^abc] // matches anything but 'a', 'b' or 'c' |  |
| Match a Character in a Range | [0-9] // matches any digit |  |
| Match a Character Not in a Range | [^A-Za-z] // matches anything but letters |  |

### PREDEFINED CLASSES

|  |  |  |
| --- | --- | --- |
| Match Any Alphanumeric Character (Letters, Digits, Underscore) | \w // equals [A-Za-z\_] | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Match Any Non-Alphanumeric Character | \W // equals [^A-Za-z\_] |
| Match Any White-Space Character | \s // equals [ \t\n\r\0] |  |
| Match Any Non-White-Space Character | \S // equals [^ \t\n\r\0] |  |
| Match Any Digit | \d // equals [0-9] |  |
| Match Any Non-Digit Character | \D // equals [^0-9] |  |

### QUANTIFIERS

|  |  |  |
| --- | --- | --- |
| Zero or One of | /a?/ // matches zero or one time 'a' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Zero or More of | /a\*/ // matches zero or more times 'a' |
| One or More of | /a+/ // matches one or more times 'a' |  |
| An Exact Number of | /a{3}/ // matches three times 'a' |  |
| An Exact Number or More of | /a{3,}/ // matches three or more times 'a' |  |
| An Exact Number in a Range of | /a{3,6}/ // matches three to six times 'a' |  |
| Greedy Quantifier | /a\*+/ // matches as many characters as possible |  |
| Lazy Quantifier | /a\*?/ // matches as few characters as possible |  |

### GROUP CONSTRUCTS

|  |  |  |
| --- | --- | --- |
| Capture Everything Enclosed and Create a Group | /(is)/ // matches ‘is’and creates a capture group 'is' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Match Everything Enclosed without Creating a Group | /(?:is)/ // matches 'is' |
| Create a Named Capture Group | /(?<tag>div)/ // matches 'div' and creates a group 'div' named 'tag' |  |
| Match the Value of a Previously Defined Capture Group | \*number* // matches the value of a numbered capture group  \k<*name*> // matches the value of a named capture group |  |
| Match One Character/Sequence or Another | /(a|b)/ // matches either 'a' or 'b' |  |
| Positive Lookahead | /a(?=b)/ // matches any 'a' followed by 'b' (without capturing the 'b') |  |
| Negative Lookahead | /a(?!b)/ // matches any 'a' NOT followed by 'b' |  |
| Positive Lookbehind | /a(?<=b)/ // matches any 'a' preceeded by 'b' (without capturing the 'b') |  |
| Negative Lookbehind | /a(?<!b)/ // matches any 'a' NOT preceeded by 'b' |  |

### FLAGS/MODIFIERS

|  |  |  |
| --- | --- | --- |
| Find All Matches in the Text | g // global | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Find Matches Regardless of Case | i // case insensitive |
| Use ^ and $ to Match at the Beginning/End of Each Line | m // multiline |  |

### ANCHORS

|  |  |  |
| --- | --- | --- |
| Match at the Beginning of a String: ^ | /^\w+/ // matches only the first word of a string | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Match at the End of a String: $ | /\w+$/ // matches only the last word of a string |
| Match at the Beginning/End of a Word: \b | /d\b/g // matches 'd' only at the end of a word, equals /d(?!\w)/ or /d(?=\W)/  /\bd/g // matches 'd' only at the beginning of a word, equals /(?<!\w)d/ or /(?<=\W)/ |  |

### REGEX IN JAVASCRIPT

|  |  |  |
| --- | --- | --- |
| Regular Expression Literal | /[A-Za-z]+/g // escape control characters (+, ^, $) using \ | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| The Constructor Function RegExp | new RegExp('[A-Za-z]+', 'g') // escape control characters (\, ') using \ |
| Check Whether There Is a Match | 'Today is 2015-05-11'.match(/\d{4}-\d{2}-\d{2}/g) // returns ['2015-05-11'] (true in an if statement)  let text = 'Today is 2015-05-11';  let pattern = new RegExp('\\d{4}-\\d{2}-\\d{2}', 'g'); text.match(pattern); // returns ['2015-05-11']  text.match(/@/); // returns null (false in an if statement) |  |
| Check Whether There Is a Match (and Advance the Last Index of the Pattern) | new RegExp('\\d{4}-\\d{2}-\\d{2}', 'g').test('Today is 2015-05-11') // returns true  let text = 'Today is 2015-05-11';  let pattern = new RegExp('\\d{4}-\\d{2}-\\d{2}', 'g'); pattern.test(text); // returns true  pattern.test(text); // next time returns false |  |
| Find the Index of a Match | 'Hello SoftUni'.search(/softuni/i) // returns 6 |  |
| Get an Array of All Matches | let text = 'Peter: 123 Mark: 456';  let pattern = /([A-Z][a-z]+): (\d+)/g; text.match(pattern); // returns ['Peter: 123', 'Mark: 456']  text.match(pattern).length; // returns 2 |  |
| Get an Array of a Match and All Groups in It | let text = 'Today is 15-Apr-2020, not 30-Nov-1988';  let pattern = /\d{2}-(?<month>[A-Za-z]{3})-(?<year>\d{4})/;  text.match(pattern); // returns ['15-Apr-2020', 'Apr', '2020', index: 9, input: 'Today is 15-Apr-2020, not 30-Nov-1988', groups: { month: 'Apr', year: '2020' }]  text.match(pattern).groups.month; // returns 'Apr'  pattern.exec(text); // returns ['2015-Apr-11', 'Apr', '2015', index: 9, input: 'Today is 2015-Apr-11, not 30-Nov-1988', groups: undefined]  pattern.exec(text).groups.month; // returns 'Apr' |  |
| Get an Array of All Matches and All Groups in Them | let text = 'Peter: 123 Mark: 456';  let pattern = /(?<name>[A-Z][a-z]+): \d+/g; pattern.exec(text); // first time returns ['Peter: 123', 'Peter', index: 0, input: 'Peter: 123 Mark: 456', groups: { name: 'Peter' }]  pattern.exec(text).groups.name; // first time returns 'Peter'  pattern.exec(text); // next time returns ['Mark: 456', 'Mark', index: 1, input: 'Peter: 123 Mark: 456', groups: { name: 'Mark' }]  pattern.exec(text).groups.name; // next time returns 'Mark'  text.matchAll(pattern); // returns a string iterator [...text.matchAll(pattern)]; // returns [['Peter: 123', 'Peter', '123'], ['Mark: 456', 'Mark', '456']] |  |

### EXAMPLES

|  |  |  |
| --- | --- | --- |
| Replace All Matches | 'Mr Blue has a blue house and a blue car'.replace(/blue/g, 'red'); // returns 'Mr Blue has a red house and a red car' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Replace All Matches (Case Insensitive) | 'Mr Blue has a blue house and a blue car'.replace(/blue/gi, 'red'); // returns 'Mr red has a red house and a red car' |
| Match All Words (Including \_) | /\w+/ |  |
| Match Dates in Format 12-Jul-1999, 3-Mar-2013 | /\d{1,2}-[A-Za-z]{3}-\d{4}/ |  |
| Match Lower Camel Case | /[a-z]+([A-Z][a-z]+)\*/ |  |
| Match Any HTML Tag | /<(.+)>.+<\/\1>/  /<(?<tag>.+)>.+<\k<tag>>/ |  |

# ARRAY OBJECTS

## JAVASCRIPT ARRAY CHARACTERISTICS

|  |  |  |
| --- | --- | --- |
| Zero-based | let numbers = [1, 2];  numbers[0] // returns 1 | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Dynamic Type of the Elements | let numbers = [1, 2];  numbers = ['one', 'two']; |
| Arrays Holding Elements of Mixed Type (NOT Recommended) | let cars = ['Audi', 2004, { model: 'BMW', year: 2010 }]; |
| Dynamic Length | let numbers = [1, 2]; numbers.length = 4; numbers // returns [1, 2, undefined, undefined] |
| NOT Guaranteed to Be Dense | let numbers = [1, 2];  numbers[4] = 3;  numbers // returns [1, 2, undefined, undefined, 3] |  |

## CREATE AN ARRAY AND ACCESS ITS ELEMENTS

|  |  |  |
| --- | --- | --- |
| Create an Empty Array Object (Declare an Array without Initializing It) | let cars = [];  let cars = new Array(); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Create an Array Object | let cars = ['Audi', 'BMW'];  let cars = new Array('Audi', 'BMW'); |
| Destructuring Assignment | let [car1, car2] = cars; // creates two variables: car1 = 'Audi', car2 = 'BMW' |
| Destructuring with the Rest Operator | let [a, b, ...elements] = [10, 20, 30, 40, 50];  a // returns 10 b // returns 20 elements // returns [30, 40, 50] |  |
| Access the First Element of an Array | cars[0] // returns 'Audi' |  |
| Access the Last Element of an Array | cars[cars.length - 1] // returns 'BMW' |  |
| Access a Non-existing Index of an Array | cars[8] // returns undefined cars[-1] // returns undefined |  |
| Iterate through All Elements in an Array | for (let i = 0; i < cars.length; i++) {  console.log(cars[i]); // prints 'Audi' and 'BMW' on separate lines  }  for (let car of cars) {  console.log(car); // prints 'Audi' and 'BMW' on separate lines  } |  |
| Find the Number of Array Elements | cars.length // returns 2 |  |
| Check whether an Array Contains a Specified Element | cars.includes('Ford') // returns false |  |
| Find the Position of a Specified Array Element | [3, 5].indexOf(3) // returns 0 [3, 5].indexOf(5) // returns 1 [3, 5].indexOf(4) // returns -1 [3, 5, 3].indexOf(3) // returns 0 [3, 5, 3].indexOf(3, 1) // starts searching from position 1, returns 2 |  |
| Find the Position of the Last Occurrence of a Specified Array Element | [3, 5, 3].lastIndexOf(3) // returns 2  [3, 5].lastIndexOf(4) // returns -1 [3, 5, 3].lastIndexOf(3, 1) // returns 0 |  |
| Check if All Array Values Pass a Test | [2, 5, 4].every(x => x < 6); // returns true |  |
| Check if Some Array Values Pass a Test | [2, 5, 4].some(x => x > 6); // returns false |  |
| Find the Index of the First Array Element that Passes a Test | [2, 5, 4].findIndex(x => x < 6); // returns 0 |  |
| Create a Nested Array (Matrix) and Access Its Elements | let matrix = [[1, 2], [3, 4]];  matrix[0][1] // returns 2 |  |

## ACCESSOR METHODS (MUTATOR/ITERATION)

|  |  |  |
| --- | --- | --- |
|  |  | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |

## EXTRACT ARRAY PARTS. FILTER

|  |  |  |
| --- | --- | --- |
| Extract Array Parts (Creates a New Array, Does Not Change the Original Array) | children.slice(1, 3) // returns elements 1 to 2: ['John', 'Mary'] children.slice(1) // returns elements 1 to the end | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Filter an Array (Value, Index, Array) – Must Be Saved in Another Variable | let nums = [45, 2, 4, 3];  let numsFiltered = nums.filter((v) => v > 3); // [45, 4] numsFiltered = nums.filter((v, i) => i % 2 == 1); // [2, 3] numsFiltered = nums.filter((v, i, a) => i == a.length - 1); // [3] |
| Find the Highest Number in an Array | Math.max.apply(null, [3, 5, 30]) // returns 30 |
| Find the Lowest Number in an Array | Math.min.apply(null, [2, 54, -83]) // returns -83 |  |
| Find the First Array Element that Passes a Test | [2, 5, 4].find(x => x < 6); // returns 2 |  |

## CHANGE/ADD/REMOVE/SWAP ARRAY ELEMENTS

|  |  |  |
| --- | --- | --- |
| Change an Array Element | let cars = ['Audi', 'BMW'];  cars[0] = 'Opel';  cars // returns ['Opel', 'BMW'] | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Add an Element to the End of the Array | cars.push('Fiat'); // adds 'Fiat' to the end of the array and returns 3 (new number of elements) cars[cars.length] = 'Fiat'; // adds 'Fiat' |
| Add an Element to the Beginning of the Array | cars.unshift('Fiat'); // adds 'Fiat' to the beginning of the array and returns 3 (the new number of elements) |  |
| Add Elements Anywhere into an Array | cars.splice(1, 0, 'Fiat'); // adds 'Fiat' to index 1, moves the rest of the elements to the right, removes 0 elements and returns an array with the removed elements  cars.splice(1, 0, 'Fiat', 'Ford'); // adds 'Fiat' to index 1 and 'Ford' to index 2, moves the rest of the elements to the right, removes 0 elements and returns an array with the removed elements |  |
| Fill All the Elements (between a Start Index and an End Index) with a Static Value | let numbers = [1, 2, 3, 4]; numbers.fill(0, 2, 4); // returns [1, 2, 0, 0] numbers.fill(5, 1); // returns [1, 5, 5, 5] numbers.fill(6); // returns [6, 6, 6, 6]  Array(4).fill(0); // returns [0, 0, 0, 0] |  |
| Remove the Last Element from an Array | cars.pop(); // removes the last element from the array and returns the removed element |  |
| Remove the First Element from an Array | cars.shift(); // removes the first element from the array and returns the removed element |  |
| Remove Elements from an Array | cars.splice(1, 2); // removes 2 elements starting from position 1 and returns an array with the removed elements |  |
| Swap Elements in an Array | let cars = ['Audi', 'Fiat', 'BMW'];  cars[cars.indexOf('Audi')] = cars.splice(cars.indexOf('BMW'), 1, 'Audi').join(''); // returns ['BMW', 'Fiat', 'Audi'] |  |
| Transpose a Matrix | let matrix = [[1, 2], [3, 4]]; let transpose = matrix[0].map((\_, i) => matrix.map(x => x[i])); // returns [[1, 3], [2, 4]] |  |

## CONVERT AN ARRAY TO STRING. CONCATENATE ARRAYS AND STRINGS

|  |  |  |
| --- | --- | --- |
| Convert an Array to String | ['Audi', 'BMW'].toString() // returns 'Audi,BMW' ['Audi', 'BMW'].join(' \* ') // returns 'Audi \* BMW' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Concatenate Arrays (and Strings): Always Returns a New Array | let boys = ['Peter', 'John']; let girls = ['Mary', 'Jill']; let children = boys.concat(girls, 'Ann'); // returns ['Peter', 'John', 'Mary', 'Jill', 'Ann'] |

## CONVERT A NESTED ARRAY TO AN OBJECT

|  |  |  |
| --- | --- | --- |
|  | const arr = [['name', 'John'], ['age', 23]];  const obj = arr.reduce((a, c) => Object.assign(a, { [c[0]]: c[1] }), {}); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |

## ARRANGE THE ELEMENTS OF AN ARRAY IN CERTAIN ORDER. SORT AN ARRAY

|  |  |  |
| --- | --- | --- |
| Reverse the Order of the Array Elements | ['Peter', 'John'].reverse() // returns ['John', 'Peter'] | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Sort an Array Alphabetically | ['Peter', 'John', 'ann'].sort((a, b) => a.localeCompare(b)) // returns ['ann', 'John', 'Peter'] (regardless of the case)  ['Peter', 'John', 'ann'].sort() // returns ['John', 'ann', 'Peter'] |
| Sort Numbers in an Array (Ascending) | [40, 2, 179].sort(function (a, b) { return a – b }) // returns [2, 40, 179] (if result is > 0, a is sorted after b) |  |
| Sort Numbers in an Array (Descending) | [40, 2, 179].sort(function (a, b) { return b – a }) // returns [179, 40, 2] |  |
| Sort an Array in Random Order | numbers.sort(function (a, b) { return 0.5 – Math.random() }) // not accurate  for (let i = numbers.length - 1; i > 0; i--) {  let j = Math.floor(Math.random() \* i);  let k = numbers[i];  numbers[i] = numbers[j];  numbers[j] = k; } // accurate, the Fisher Yates shuffle |  |
| Sort Objects in an Array | let cars = [  { type: 'Volvo', year: 2016 },  { type: 'Saab', year: 2010 },  { type: 'BMW', year: 2010 } ];  cars.sort(function (a, b) { return a.year – b.year || a.type.localeCompare(b.type) }) // sorts by year (ascending), then alphabetically by type |  |

## CALL A FUNCTION FOR EACH ARRAY ELEMENT

|  |  |  |
| --- | --- | --- |
| Call a Function for Each Array Element | ['John', 'Mark'].forEach((v, i, a) => console.log(`${i}: ${v}`)); // prints '0: John' and '1: Mark' on separate lines | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Create a New Array by Performing a Function on Each Element | let nums = [2, 5]; let numbersBy2 = nums.map(x => x \* 2); // [4, 10] let objNumsBy2 = nums.map(x => ({ num: x, numBy2: x \* 2 }));  // [{ num: 2, numBy2: 4 }, { num: 5, numBy2: 10 }] |
| Run a Function on Each Array Element (Left to Right) to Produce a Single Value | [2, 5, 4].reduce((a, b) => a + b); // returns 11  [2, 5, 4].reduce((a, b) => a + b, 10); // returns 21 (initial value 10)  let average = [2, 5, 4].reduce((acc, curr, i, array) => a + b / array.length, 0); // the average of the array equals 3.(6); the reducer function takes 4 arguments: accumulator, current value, (current index, source array) |  |
| Run a Function on Each Array Element (Right to Left) to Produce a Single Value | [2, 5, 4].reduceRight((a, b) => a + b); // returns 11  [2, 5, 4].reduceRight((a, b) => a + b, 10); // returns 21 (initial value 10)  [2, 5, 4].reduceRight((a, b) => a > b ? a : b); // returns 5 (the biggest number) |  |

# OBJECTS

## DECLARE AN OBJECT AND ACCESS ITS VALUES

|  |  |  |
| --- | --- | --- |
| Declare an Object with a Literal  { Key: Value } – Properties (Elements) with Number Keys First, Ascending, Then the Other Properties in Insertion Order | let townOrCity = 'town';  let person = {  name: 'John',  age: 35,  [townOrCity]: 'London'  }; | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Constructed | function Person(name, age) {  this.name = name;  this.age = age }  let myPerson = new Person('John', 35); |  |
|  | let person = {  name: 'John',  age: 35  };  let myPerson = Object.create(person); myPerson.name = 'Peter'; myPerson.name // returns 'Peter' |  |
| Declare an Empty Object and Then Add Properties | let person = {};  person.name = 'John'; // { name: 'John' }  person.age = 35; // { name: 'John', age: 35 } |  |
| Access the Values in an Object | person.name // returns 'John' person['name'] // returns 'John' (required in case of special symbols)  person.town // returns 'London'  person[townOrCity] // returns 'London' |  |
| Declare an Object with Properties that Already Exist as Variables | let name = 'John';  let age = 35;  let person = { name, age }; // returns { name: 'John', age: 35 } |  |
| Bind an Object Property to a Function (Getter) | let person = {  sex: 'M',  get occupation() { return this.sex == 'M' ? 'actor' : 'actress' }  };  person.occupation // returns 'actor' |  |
| Declare an Associative Array (a Collection of Values of the Same Type) | let contacts = {  'John': 00112345678,  'Peter': 00148716666 }; |  |
| Factory Functions (Create an Object with Given Properties; No Need for 'This') | function createRect(width, height) {  let rect = { width, height };  rect.getArea = () => rect.width \* rect.height;  return rect; }  createRect(2, 7).getArea() // returns 14 |  |
| Decorator Functions (Add New Data and Behavior to Objects) | function canPrint(device) {  device.print = () => {  console.log(`${device.name} is printing a page.`);  } }  let printer = { name: 'ACME Printer' }; canPrint(printer); printer.print(); // prints 'ACME Printer is printing a page.' |  |
| Copy All Properties from One or More Source Objects to a Target Object | const person = { name: 'John', age: 35 }; const anotherPerson = Object.assign({ weight: 80 }, person); // { weight: 80, name: 'John', age: 35 } const thirdPerson = { ...person, weight: 90 }); // { name: 'John', age: 35, weight: 90 } |  |
| Loop through the Properties of an Object | let person = { name: 'John', age: 35 }; for (let [key, value] in person) {  console.log(key); // prints 'name', 'age'  console.log(value); // prints 'John', 35  } |  |
| Check if an Object Has a Specific Property | person.hasOwnProperty('age') // returns true  person[age] // returns 35 (true in an if statement) 'age' in person // returns true |  |

## INTERNAL PROPERTIES

|  |  |  |
| --- | --- | --- |
| Get the Internal Properties of an Object Property | let person = { name: 'John', age: 35 };  Object.getOwnPropertyDescriptor(person, 'name'); // returns { value: 'John', writable: true, enumerable: true, configurable: true } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Create an Non-Enumerable Object Property | Object.defineProperty(person, 'town', { value: 'Sofia', enumerable: false, writable: true }); // default value: false  person.town // returns 'Sofia' person // returns { name: 'John', age: 35 } Object.keys(person).join(' ') // returns 'name age' JSON.stringify(person) // returns |
|  | Object.defineProperty(person, '\_town', { value: 'Sofia', enumerable: false, writable: true });  Object.defineProperty(person, 'town', {  get() { return this.\_town; },  set(value) { this.\_town = value; },  enumerable: true }); |  |
| Non-Writable (if Contains an Object, the Reference to the Object Is Non-Writable, the Object Itself Can Be Modified) |  |  |
| Create an Non-Configurable Object Property | Object.defineProperty(person, 'town', { value: 'Sofia', configurable: false });  delete person.town; // throws error in strict mode person // returns { name: 'John', age: 35, town: 'Sofia' } |  |
| Freeze (Sets All properties to Non-Writable and Non-Configurable) | Object.freeze(person); |  |
| Seal (Sets All properties to Non-Configurable) | Object.seal(person); |  |
|  | Object.defineProperty(this, 'fullName', {  set: function(value) {  // set value + validation  },  get: function() {  // calculate and return value  }  }  ); |  |

## METHODS

|  |  |  |
| --- | --- | --- |
| Declare an Object with a Method (a Function as an Object Property) | let person = {  firstName: 'John',  lastName: 'Doe',  fullName() { return this.firstName + ' ' + this.lastName } }; // this = the owner of the function  person.fullName(); // returns 'John Doe' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Call the Method with Another Object | let person2 = { firstName: 'Don', lastName: 'Johnson' }; person2.fullName(); // returns 'Don Johnson' |
| Declare a Method Outside of the Object | function print() {  return `${this.name} is printing a page.` }  let printer = {  name: 'ACME Printer',  print };  printer.print() // returns 'ACME Printer is printing a page.' |  |
| Override Built-in Methods | let person = {  name: 'Peter',  age: 35,  toString() {  return `${this.name} is ${this.age} years old.`;  } }  person.toString() // returns 'Peter is 35 years old.' console.log(`${person.toString()}`); // prints 'Peter is 35 years old.' console.log('' + person.toString()); // prints 'Peter is 35 years old.' |  |

## DESTRUCTURING SYNTAX

|  |  |  |
| --- | --- | --- |
| Destructuring Syntax | let person = { name: 'John', age: 35 }; let { age, name } = person; // 35, 'John'  let { age: myAge, name } = person; myAge // returns 35 | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Nested Destructuring | let department = {  name: 'Engeneering',  data: {  director: {  name: 'John',  position: 'Engeneering Director'  },  employees: []  } };  let {data: { director } } = department; // returns { name: 'John', position: 'Engeneering Director' } |
| Object and Array Destructuring: an Array of Objects | let employees = [  { name: 'John', position: 'worker' },  { name: 'Jane', position: 'secretary' } ];  let [{ name }] = employees; // returns 'John' |  |
| Object and Array Destructuring: an Object Containing an Array | let company = {  employees: ['John', 'Jane', 'Peter'],  name: 'Quick Build'  };  let { employees: [name] } = company; // returns 'John' |  |

## CONVERT AN OBJECT TO AN ARRAY/A JSON STRING

|  |  |  |
| --- | --- | --- |
| Get an Array with All the Object Keys | let person = { name: 'John', age: 35 };  Object.keys(person); // returns ['name', 'age'] | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Get an Array with All the Object Values | let person = { name: 'John', greeting() { return 'Hi, ' + this.name } };  };  Object.values(person); // returns ['John', f] |
| Get an Array of Tuples (Arrays of Two Elements: [Key, Value]) | let person = { name: 'John', age: 35 };  Object.entries(person); // returns [['name', 'John'], ['age', 35]] |  |
| Convert an Object to a JSON String | JSON.stringify(person) // returns '{"name":"John","age":35}' JSON.stringify(person, null, 2) // formatted with indentation |  |
| Convert a JSON String to Object | JSON.parse('{"name":"John","age":3}') // returns { name: 'John', age: 3 } |  |

## CHANGE AN OBJECT VALUE. DELETE AN OBJECT PROPERTY. SORT AN OBJECT

|  |  |  |
| --- | --- | --- |
| Change an Object Property | let person = { name: 'John', age: 35 };  person.name = 'George'; // { name: 'George', age: 35 } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Delete a Property from an Object | delete person.age; delete person['age']; |
| Sort an Object | let grades = { 'Tim': 4, 'Bill': 6 };  Object.entries(grades).sort((a, b) => a[0].localeCompare(b[0]));  // sorts alphabetically by name and returns [['Bill', 6], ['Tim', 4]] |  |

## PROTOTYPE- AND CLASS-BASED INHERITANCE

|  |  |  |
| --- | --- | --- |
| Prototype-Based Inheritance | JavaScript is a prototype-based language. The class keyword is introduced in ES20215, but it is syntactical sugar – the "classes" we simulate are just a function object.  Objects inherit directly from other objects through a prototype property. Prototype-based programming allows the creation of an object without first defining its class.  When it comes to inheritance, JavaScript only has one construct: objects. Each object has a private property which holds a link to another object called its prototype. That prototype object has a prototype of its own, and so on until an object is reached with NULL as its prototype. By definition, NULL has no prototype, and acts as the final link in this prototype chain.  Nearly all objects in JS are instances of Object which sits on the top of a prototype chain.  JS objects are dynamic "bags" of properties (referred to as own properties). They have a link to a prototype object. When trying to access a property of an object, the property will not only be sought on the object but on the prototype of the object, the prototype of the prototype, and so on until either a property with a matching name is found or the end of the prototype chain is reached. hasOwnProperty is the only thing in JS which deals with properties and does NOT traverse the prototype chain. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Assign Prototype to an Object | class Person { };  const woman = {}; Object.setPrototypeOf(woman, Person.prototype); // or: const woman = Object.create(Person.prototype); // or: const woman = new Person(); |  |
| Get Prototype of an Object | Object.getPrototypeOf(woman) // returns Person {} woman.\_\_proto\_\_ // returns Person {}, the prototype of woman |  |
| Get Prototype of a Function | Person.prototype // returns Person {}, the prototype to be assigned to all instances of objects created by the function when used as a constructor |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Class-Based Inheritance | A class defines a type which can be instantiated at runtime. A child of an ES6 class is another type definiton which extends the parent with new properties and methods, which in turn can be instantiated at runtime.  A class constructor creates an instance of the class. When invoked with the NEW keyword, it assigns its prototype as the prototype of the returned object. JS classes are primarily syntactical sugar over JS's existing prototype-based inheritance. |  |

## DECLARE A CLASS AND CREATE INSTANCES

|  |  |  |
| --- | --- | --- |
| Declare a Class (a Template for Creating Objects) | class Rectangle {  constructor(height, width) {  this.height = height;  this.width = width;  }  } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Declare a Class Using a Constructor Function (Legacy) | function Rectangle(height, width) {  this.height = height;  this.width = width;  } |  |
| Add a Method to a Declared Class | Rectangle.prototype.calcArea = function() {  return this.height \* this.width;  }; |  |
| Create an Instance of a Class | const square = new Rectangle(3, 3); // Rectangle { height: 3, width: 3 } |  |
| Create an Instance Step By Step | function Person(firstName, lastName) {  this.firstName = firstName;  this.lastName = lastName;  }  function newOperator(constructor, ...params) {  const result = {};  Object.setPrototypeOf(result, Person.prototype);  constructor.apply(result, params);  return result;  }  const square = newOperator(Person, 'Jane', 'Smith'); |  |
| Create a Static Method for a Class (Part of the Class, NOT of the Instances) | class MyClass {  static myStaticMethod() {  console.log('from static method');  } }  MyClass.myStaticMethod(); // prints 'from static method' |  |
| Check if an Object is an Instance of a Specified Class | square instanceof Rectangle // returns true square instanceof Object // returns true |  |
| Accessor Properties (Getter and Setter) | class Circle {  constructor(r) {  this.r = r;  }    get diameter() {  return this.r \* 2;  }  set diameter(value) {  if (value <= 0) {  throw new Error('Diameter must be positive');  }  this.r = value / 2;  } }  const myCircle = new Circle(3); myCircle.diameter // returns 6 myCircle.diameter = 10; myCircle.r // returns 5 |  |
| Add Properties to a Class Using Its Prototype | Circle.prototype.color = 'green'; myCircle.hasOwnProperty('color') // returns false myCircle.color // returns 'green' |  |
| Class Inheritance (Does NOT Crwate Copies, Inserts a Reference Instead) | class Person {  constructor(name) {  this.name = name;  }  sayHi() {  console.log(`${this.name} says hi!`);  }  }  class Employee extends Person {  constructor(name, salary) {  super(name);  this.salary = salary;  }    collectSalary() {  console.log(`${this.name} collected ${this.salary}`);  } }  const myEmployee = new Employee('Peter', 60000);  myEmployee // returns Person { name: 'Peter', salary: 60000 } myEmployee.collectSalary() // prints 'Peter collected 60000' myEmployee.sayHi() // prints 'Peter says hi!' |  |
| Overriding Methods and Properties |  |  |
| Class Inheritance (Legacy) | function Person(name) {  this.name = name; }  Person.prototype.sayHi = function() {  console.log(`${this.name} says hi!`); }  function Employee(name, salary) {  Person.call(this, name);  this.salary = salary; }  Employee.prototype = Object.create(Person.prototype); Employee.prototype.collectSalary = function() {  console.log(`${this.name} collected ${this.salary}`); }  const myEmployee = new Employee('Peter', 60000);  myEmployee // returns Person { name: 'Peter', salary: 60000 } myEmployee.collectSalary() // prints 'Peter collected 60000' myEmployee.sayHi() // prints 'Peter says hi!' |  |

## THE FOUR PILLARS OF OBJECT-ORIENTED PROGRAMMING

|  |  |  |
| --- | --- | --- |
| Abstraction |  | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Encapsulation |  |  |
| Inheritance |  |  |
| Polymorphism |  |  |

# MAP OBJECTS

|  |  |  |
| --- | --- | --- |
| Declare a Map | let numbers = new Map([[1, 'one'], [0, 'zero']]);  let books = new Map([['title', 'Harry Potter'], ['author', 'J.K. Rowling']]); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Add Element (Property/Key, Value) | numbers.set(2, 'two'); |
| Element Order (Always in Insertion Order) | numbers // returns {1 => 'one', 0 => 'zero', 2 => 'two'} |  |
| Access Value | numbers.get(1) // returns 'one' |  |
| Find Number of Entries | numbers.size // returns 3 |  |
| Check if a Map Has a Specified Key | numbers.has(0) // returns true numbers.has(4) // returns false |  |
| Change a Value | numbers.set(1, 'two');  numbers // returns {1 => 'two', 0 => 'zero', 2 => 'two'} |  |
| Delete an Element | numbers.delete(0);  numbers.delete(2);  numbers // returns {1 => 'one'} |  |
| Delete All Elements | numbers.clear(); |  |
| Loop through Elements | for (let [number, word] of numbers) {  console.log(`${number} - ${word}`);  } // prints '1 – one', '0 – zero' |  |
| Create a Map Iterator Holding All Entries | numbers // the map is an iterator holding all key => value pairs  numbers.entries() // returns an iterator holding all key => value pairs of the map |  |
| Create a Map Iterator Holding All Keys | numbers.keys() // returns an iterator holding all keys of the map |  |
| Create a Map Iterator Holding All Values | numbers.values() // returns an iterator holding all values of the map |  |
| Convert a Map Iterator to an Array | Array.from(numbers.keys()) // returns [1, 0]  [...numbers.keys()] // returns [1, 0]  [...numbers] // returns [[1, 'one'], [0, 'zero']] |  |
| WeakMap |  |  |

# SET OBJECTS

|  |  |  |
| --- | --- | --- |
| Declare a Set (a List of Unique Values) | let numbers = new Set([1, 2, 2]);  numbers // returns {1, 2} | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Add a Value | numbers.add(6); // adds 6 and returns the new set |
| Check if a Set Has a Specified Value | numbers.has(6) // returns true |  |
| Delete a Value | numbers.delete(6) // deletes 6 and returns true |  |
| Loop through Elements | for (let number of numbers) {  console.log(number);  } // prints 1, 2, 6 |  |
| WeakSet |  |  |

# DATE OBJECTS

## CREATE A DATE OBJECT

|  |  |  |
| --- | --- | --- |
| Create a Date Object | newDate() // returns current date and time | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Create a Date Object with a Specified Date and Time (7 Parameters) | newDate(2020, 6, 1, 9, 36, 0, 0) //returns 'Wed Jul 01 2020 09:36:00 GMT+0300 (Eastern European Summer Time)': year (one and two digit years are interpreted as 19xx), month (counted from 0), day, hour, minute, second, millisecond |
| Use only 2 Parameters | newDate(2020, 6) // returns 'Wed Jul 01 2020 00:00:00 GMT+0300 (Eastern European Summer Time)' |  |
| Use only 1 Parameter | newDate(2020) // returns 'Thu Jan 01 1970 02:00:02 GMT+0200 (Eastern European Standard Time)': only 1 parameter is treated as milliseconds counted from Jan 01 1970 00:00:00 UTC |  |
| Use a String as a Parameter | newDate('2015-03-25T12:00:00Z') // returns 'Wed Mar 25 2015 14:00:00 GMT+0200 (Eastern European Standard Time)': Z for UTC time |  |
| JS Short Dates | newDate('03/25/2015') // returns 'Wed Mar 25 2015 00:00:00 GMT+0200 (Eastern European Standard Time)' |  |
| JS Long Dates | newDate('Mar 25 2015') // returns 'Wed Mar 25 2015 00:00:00 GMT+0200 (Eastern European Standard Time)': MMM DD YYYY or DD MMM YYYY |  |
| JS Long Dates with the Month Written in Full | newDate('October 13, 2014 11:13:00') // returns 'Mon Oct 13 2014 11:13:00 GMT+0300 (Eastern European Summer Time)': case insensitive, commas are ignored |  |

## CONVERT A DATE TO A STRING/NUMBER. COMPARE DATES

|  |  |  |
| --- | --- | --- |
| Convert a Date to a String (UTC, Date and Time) | newDate().toUTCString() | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Convert a Date to a String (without Time) | newDate().toDateString() |
| Convert a Date to a Number (Milliseconds from January 1st, 1970) | Date.now() // returns 1427234400000 (milliseconds from Jan 01 1970 00:00:00 UTC) Date.parse('Mar 25 2015') // returns 1427234400000  Number(new Date('Mar 25 2015')) // returns 1427234400000  new Date('Mar 25 2015').getTime() // returns 1427234400000 |  |
| Compare Dates | new Date('Mar 25 2015') < new Date('Mar 30 2015') // returns true |  |

## ACCESS ONLY PART OF THE DATE

|  |  |  |
| --- | --- | --- |
| Get the Year from a Date Object | new Date('Mar 25 2015').getFullYear() // returns 2015 | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Get the Month from a Date Object (0 to 11) | new Date('Mar 25 2015').getMonth() // returns 2 |
| Get the Month from a Date Object (As a Name) | let months = ['January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December'];  months[new Date('Mar 25 2015').getMonth()] // returns 'March' |  |
| Get the Day from a Date Object (1 to 31) | new Date('Mar 25 2015').getDate() // returns 25 |  |
| Get the Hours from a Date Object (0 to 23) | new Date('Mar 25 2015').getHours() // returns 0 |  |
| Get the Minutes from a Date Object (0 to 59) | new Date('Mar 25 2015').getMinutes() // returns 0 |  |
| Get the Seconds from a Date Object (0 to 59) | new Date('Mar 25 2015').getSeconds() // returns 0 |  |
| Get the Milliseconds from a Date Object (0 to 999) | new Date('Mar 25 2015').getMilliseconds() // returns 0 |  |
| Get the Weekday from a Date Object (0 to 6) | new Date('Mar 25 2015').getDay() // returns 3 (Wednesday; Sunday is counted as 0) |  |

## CHANGE PART OF THE DATE

|  |  |  |
| --- | --- | --- |
| Change the Year (and Optionally the Month and Date) in a Date Object | new Date('Mar 25 2015').setFullYear(2020) // returns 'Wed Mar 25 2020 00:00:00 GMT+0200 (Eastern European Standard Time)'  new Date('Mar 25 2015').setFullYear(2020, 11, 3) // returns 'Thu Dec 03 2020 00:00:00 GMT+0200 (Eastern European Standard Time)' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Change the Month in a Date Object (0 to 11) | new Date('Mar 25 2015').setMonth(11) // returns 'Fri Dec 25 2015 00:00:00 GMT+0200 (Eastern European Standard Time)' |
| Change the Date in a Date Object (1 to 31) | new Date('Mar 25 2015').setDate(15) // returns 'Sun Mar 15 2015 00:00:00 GMT+0200 (Eastern European Standard Time)'  let date = new Date('Mar 25 2015')  date.setDate(date.getDate() + 50) // returns 'Thu May 14 2015 00:00:00 GMT+0300 (Eastern European Summer Time)' |  |
| Change the Hours in a Date Object (0 to 23) | new Date('Mar 25 2015').setHours(22) // returns 'Wed Mar 25 2015 22:00:00 GMT+0200 (Eastern European Standard Time)' |  |
| Change the Minutes in a Date Object (0 to 59) | new Date('Mar 25 2015').setMinutes(22) // returns 'Wed Mar 25 2015 00:22:00 GMT+0200 (Eastern European Standard Time)' |  |
| Change the Seconds in a Date Object (0 to 59) | new Date('Mar 25 2015').setSeconds(22) // returns 'Wed Mar 25 2015 00:00:22 GMT+0200 (Eastern European Standard Time)' |  |

# HTML DOM (DOCUMENT OBJECT MODEL)

## MAIN CONCEPTS

|  |  |  |
| --- | --- | --- |
| Document Object Model | An interface that treats an HTML/XML document as a tree structure. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| DOM Node | Every element of a DOM tree. According to the node type, the Node.nodeType property can have one of the following values: Node.ELEMENT\_NODE, Node.ATTRIBUTE\_NODE, Node.TEXT\_NODE, Node.COMMENT\_NODE, Node.DOCUMENT\_NODE, etc. |
| DOM Element | Every node of the type Node.ELEMENT\_NODE.  Variables holding HTML elements are live: when their content is modified, the DOM is updated, when inserted somewhere in the DOM, the original is moved. |  |
| Node List | A collection of DOM nodes of any type. Accessed using using childNodes (then it is a live, automatically updated collection) or querySelectorAll() (then it is static). Can be indexed and iterated. |  |
| HTML Collection | A collection of only element nodes and is live. Has an extra namedItem method. Accessed using children, getElementsByClassName(), getElementsByTagName(). Can be indexed and iterated. |  |

## IN THE BROWSER

|  |  |  |
| --- | --- | --- |
| From the Folder | Open the 'index.html' file in the browser. Refresh manually (F5). | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| From the Terminal (Using a Local Server) | lite-server // automatically starts and updates 'index.html' from the same folder |

## JAVASCRIPT IN HTML

|  |  |  |
| --- | --- | --- |
| Inline Script in <head> or <body> | <script>  (() => document.getElementById('demo').innerHTML = 'Surprise!')();  </script> | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| External File in <head> or <body> | <script *src*="/js/myScript.js"></script> |

## ACCESS DOM NODES

|  |  |  |
| --- | --- | --- |
| By ID | document.getElementById('title') // returns the element with ID 'title' document.querySelector('#title') // returns the element with ID 'title' | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| By Class Name | document.querySelectorAll('.small) // returns a static node list of all elements with the class 'small' document.getElementsByClassName('small') // returns a live HTML collection of all elements with the class 'small'  document.querySelector('.small) // returns the first element with the class 'small' |
| By Tag Name | document.querySelectorAll('p') // returns a node list of all <p> elements document.getElementsByTagName('p') // returns a live HTML collection of all <p> elements  document.querySelector('p') // returns the first <p> element |  |
| By Tag and Class | document.querySelectorAll('article.list') // returns a static node list of all <article> elements with the class 'list' |  |
| By Name | document.getElementsByName('login') // returns a live node list of all elements with the name 'login'  document.querySelectorAll('input[name="login"]') // returns a static node list of all <input> elements with name 'login' |  |
| By Parent Node | document.querySelectorAll('div p') // returns a static node list of all <p> elements inside <div> elements document.querySelectorAll('#content div') // returns a static node list of all <div> elements inside the element with ID 'content'  element.children // returns a live HTML collection of all the child elements of the element element.childNodes // returns a static node list of all children nodes of the element |  |
| By Parent Node in a Numbered Order | const thirdLi = document.querySelector('ul').querySelector('li')[2]; // third <li> from the first <ul> const thirdLi = document.querySelector('ul li:nth-child(3)'); // third <li> from the first <ul> |  |
| By Child Node | element.parentElement element.parentNode |  |
|  |  |  |
|  |  |  |
|  | .dataset // obtain DOMStringMap of custom data attributes (case-insensitive) |  |
|  |  |  |

## ACCSESS THE ATTRIBUTES OF A DOM NODE

|  |  |  |
| --- | --- | --- |
| Get Text Content | const element = document.getElementById('demo'); element.textContent // if the element has children, returns all text concatenated | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Get Text Content + Children | const element = document.getElementById('demo'); element.innerHTML // if the element has children, returns the HTML code as string |
| Get Input Content | element.value // returns the element value as string |
| Get all Class Values of the Node | element.classList // returns a read-only collection |  |
| Get the Value of a Specified Attribute | element.getAttribute('type'); |  |
| Check if the Node Has a Specified Attribute | element.hasAttribute('type'); // returns true/false |  |

## SORT HTML COLLECTIONS

|  |  |  |
| --- | --- | --- |
|  | Array  .from(collection.children)  .sort((a, b) => a.textContent.localeCompare(b.textContent))  .forEach(g => collection.appendChild(g));  Array  .from(collection.children)  .sort((a, b) => a.childNodes[0].textContent.localeCompare(b.childNodes[0].textContent))  .forEach(g => collection.appendChild(g)); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |

## MODIFY DOM NODES

|  |  |  |
| --- | --- | --- |
| Add Text | element.textContent = 'some text'; // text will be escaped element.innerHTML = 'some text'; // text will be parsed and turned into HTML elements (XSS attacks) | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Hide a Node | element.style.display = 'none'; |
| Reveal a Hidden Node | element.style.display = ''; // or 'block', 'inline-block' |
| Change Background Color | element.style.background = 'teal'; |  |
| Change the Font Size | element.style.fontSize = '35px'; |  |
| Disable a Button | button.setAttribute('disabled', 'true'); |  |
| Add Class Value | liElement.classList.add('myClass'); |  |
| Remove Class Value | liElement.classList.remove('myClass'); |  |
| Set Value to a Specified Attribute | element.setAttribute('type', 'text'); |  |
| Remove Value of a Specified Attribute | element.removeAttribute('spellCheck'); |  |
| Custom Data Attributes | dataset DOMStringMap |  |

## CREATE/DELETE DOM ELEMENTS

|  |  |  |
| --- | --- | --- |
| Create DOM Elements | const paragraph = document.createElement('p'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Create Text Node | const newNode = document.createTextNode('some text'); |
| Create Document Fragment Node | const fragment = document.createDocumentFragment(); |
| Copy/Clone DOM Elements | const newParagraph = paragraph.cloneNode(true); // 'true' for a deep copy |
| Add a New Child (at the End) | document.body.appendChild(paragraph);  parent.insertBefore(newEl, referenceEl); |  |
| Add a New Child (at the Beginning) | document.body.prepend(paragraph); |  |
| Delete DOM Elements from Parent Element | let ulElement = document.querySelector('ul'); let liElement = document.querySelector('li'); ulElement.removeChild(liElement); |  |
| Delete DOM Elements | liElement.remove(); |  |
| Replace one Element with Another | liElement.replaceWith(newElement); |  |
| Insert Element before Selected Node | liElement.before(newElement); |  |
| Insert Element after Selected Node | liElement.after(newElement); |  |

## EVENTS

|  |  |  |
| --- | --- | --- |
| Mouse Events | click, mouseover, mouseout, mouseup, mousedown | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Touch Events | touchstart, touchend, touchmove, touchcancel |
| DOM/UI Events | load, unload, resize, dragstart/drop |
| Keyboard Events | keydown, keypress, keyup |
| Focus Events | focus, blur |
| Form Events | input, change, submit, reset |
| Attach Event Listener to an Element | element.addEventListener('click', (event) => console.log(event)); // addEventListener(*type of event*, *event handler function*) |
| Attach Event Listener to an Element in the HTML | <button *onclick*="console.log('click')">Click me!</button> |
| Attach Event Listener to an Element in the HTML with a <script> Tag | <button *onclick*="sayHi()">Click me!</button>  <script>  function sayHi() {  console.log('Hi!');  }  </script> |
| Attach Event Listener to an Element in an External File | <button *id*="btnGreeting">Click me!</button>  <script *src*="/myScript.js"></script>  // in myScript.js:  const btn = document.getElementById('btnGreeting');  element.addEventListener('click', () => console.log('Hi!')); |
| Access Event Target | event.target // returns element that triggered event event.currentTarget // returns element that has the event listener |
|  | event.offsetX event.target.clientWidth |
| Stop Event Propagation | event.stopPropagation(); // used to stop an event handler for the same type of event attached to a parent node |
| Stop Browser's Default Behavior | event.preventDefault(); // in <a> to stay on the same page, in <form> to stop submitting an HTTP request and refreshing |
| Remove Event Listener | element.addEventListener('click', evHandler); |
|  |  |
|  |  |  |

## GOOGLE APIS

|  |  |  |
| --- | --- | --- |
| Google Maps |  | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Google Fonts |  |
| Google Charts |  |  |

# ERRORS IN JS

## THROWING ERRORS (EXCEPTIONS)

|  |  |  |
| --- | --- | --- |
| General Error | throw new Error('Invalid state'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Range Error | throw new RangeError('Invalid index'); |
| Type Error | throw new TypeError('String expected'); |  |
| Reference Error | throw new ReferenceError('Missing age'); |  |

## TESTING THE CODE

|  |  |  |
| --- | --- | --- |
| Test a Block of Code for Errors | try {  new Array(-1); } catch (err) {  console.log(err); // prints 'RangeError: Invalid array length'  console.log(err.message); // prints 'Invalid array length'  console.log(err.name); // prints 'RangeError' } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Unit Testing |  |
|  |  |  |

# MODULES IN JS

## TYPES OF MODULES

|  |  |  |
| --- | --- | --- |
| Local Modules (Created Locally) | const muModule = require('./myModule'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Core Modules (Node.js Built-in Modules) | const fs = require('fs'); |
| Third-Party Modules (Need Installation from NPM) | npm install express --save-exact // installed from Node Package Manager (NPM)  const express = require('express'); |

## EXPORT AND IMPORT MODULES

|  |  |  |
| --- | --- | --- |
| Export Modules | function sum(a, b) {  return a + b; }  module.exports = sum; | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Export Several Objects (Functions) | function sum(a, b) {  return a + b; }  function mult(a, b) {  return a \* b; }  module.exports = {  sum,  mult }; |
| Import Modules | const sum = require('./myModule'); // executes all code from myModule.js const { mult } = require('./myModule');  sum(4, 6); // returns 10 mult(4, 6); // returns 24 |
| Export Modules Using ES6 Syntax (HTML <script type="module">, local server) | export function sum(a, b) {  return a + b; }  export {  sum,  mult }; |  |
| Import Modules Using ES6 Syntax | import { sum } from './myModule.js'; // does not execute all code from myModule.js, only loads the function sum import { sum, mult } from './myModule.js'; import \* as calculations from './myModule.js'; |  |

## MODULE WRAPPER FUNCTION

|  |  |  |
| --- | --- | --- |
| Parameters | exports, require, module, \_\_filename, \_\_dirname // act as variables global to the module | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |

# MOCHA AND CHAI

## INSTALLATION

|  |  |  |
| --- | --- | --- |
| Type in the VSC Terminal (or in CMD), Then Press Enter | npm install -g mocha --save  npm install -g chai --save | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Check if It Worked | mocha --version |  |
| Set Node Path for Current Session | set NODE\_PATH=%AppData%\npm\node\_modules  + restart IDE |  |
| Set Node Path for Any Future Sessions | setx NODE\_PATH %AppData%\npm\node\_modules  + restart IDE |  |

## WRITE AND RUN TESTS

|  |  |  |
| --- | --- | --- |
| Test File Names | myModule.test.js // tests for file myModule.js | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Load Chai Library | const { expect } = require('chai');  const { assert } = require('chai'); |
| Load File to Be Tested | const { mult } = require('./myModule'); |  |
| Test Code | describe('Mult function', () => {  it('works', () => {  expect(mult(2, 3)).to.equal(6);  });  ); |  |
|  | beforeEach() |  |
| Compare Arrays and Objects | deepEqual |  |
| Run Test (in the Terminal) | mocha myModule.test.js // returns Mult function, works, 1 passing |  |

# HTTP AND REST SERVICES

## HTTP REQUESTS

|  |  |  |
| --- | --- | --- |
| GET Request to Retrieve a Resource | GET /rest/v2/name/Bulgaria HTTP/1.1 // HTTP request line  Host: restcountries.eu  Accept: \*/\*  ... // other HTTP headers  <CRLF> // the request body is empty | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| POST Request to Create/Store a Resource | POST /jsonstore/phonebook/phonebook/ HTTP/1.1  Host: localhost:3030  Content-Type: application/json  <CRLF> // an empty line  {  "name": "John",  "number": "123456789"  }  <CRLF> |  |
| PUT | update a resource |  |
| DELETE | delete a resource |  |
| PATCH | update a resource partially |  |
| HEAD | retrieve the resource's headers |  |

## HTTP RESPONSES

|  |  |  |
| --- | --- | --- |
| GET Request to Retrieve a Resource | HTTP/1.1 200 OK // HTTP response status line  Date: Friday, 11 November 2016 16:09:18 GMT+2  Server: Apache/2.2.14 (Linux)  Content-Type: html/text  <CRLF>  <html>  <head><title>Test</title></head>  <body>Test HTML file.</body>  </html> | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| POST Request to Create/Store a Resource |  |  |

# AJAX

## SET TIME OUT

|  |  |  |
| --- | --- | --- |
|  | console.log('Hello'); // executed first  setTimeout(function () {  console.log('Hi!'); }, 2000); // executed third; if 0, once again after everything else  console.log('Hello again'); // executed second | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |

## XHR OBJECTS (XML HTTP REQUEST)

|  |  |  |
| --- | --- | --- |
|  | const httpRequest = new XMLHttpRequest();  httpRequest.addEventListener('readystatechange', () => {  if (httpRequest.readyState == 4 && httpRequest.status == 200) {  console.log(httpRequest.responseText);  }  });  httpRequest.open('GET');  httpRequest.send(); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |

## FETCH API

|  |  |  |
| --- | --- | --- |
| Fetch API (Uses Promises) | fetch('./api/some.json')  .then(function(response) ...)  .catch(function(error) ...); // The response of a fetch request is a stream object. The reading of the stream happens asynchronously. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| GET Request | fetch('https://.../api/some.json')  .then((response) => response.json())  .then((data) => console.log(data))  .catch((error) => console.log(error)); |  |
| POST Request | fetch(url, {  method: 'post',  headers: { 'Content-Type': 'application/json' },  body: JSON.stringify(data)  })  .then((response) => response.json())  .then((data) => console.log(data))  .catch((error) => console.log(error)); |  |
| Promises: Objects Holding Asynchronous Operations; States – Pending, Fulfilled, Failing | console.log('Hello'); // executed first  new Promise((resolve, reject) {  setTimeout(() => resolve('done'), 500); // resolved after 500 ms  })  .then((result) => console.log('Then returned: ' + result)) // 'Then returned: done'  .catch((error) => console.log(error));  console.log('Hello again'); // executed second |  |
|  | const [response1, response2] = Promise.All({ fetch(url1), fetch(url2) }); |  |

## ASYNC FUNCTIONS

|  |  |  |
| --- | --- | --- |
| Async Functions | Returns a promise that can await other promises in a way that looks synchronous. Contains an await expression that pauses the execution of the function and waits for the promise's resolution. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Promise.then vs. Async/Await | function logFetch(url) {  return fetch(url)  .then(response => response.text)  .then(text => console.log(text))  .catch(err => console.error(err));  }  async function logFetch(url) {  try {  const response = await fetch(url);  console.log(response.text());  } catch (err) {  console.log(err);  } |  |

# REMOTE DATA AND AUTHENTICATION

## SUBTITLE

|  |  |  |
| --- | --- | --- |
| Register | document.querySelector('form').addEventListener('submit', onRegisterSubmit);  async function onRegisterSubmit(event) {  event.preventDefault();  const formData = new FormData(event.target);  // [...formData.entries()] returns an array of all form field names + values   const email = formData.get('email');  const password = formData.get('password');  const rePass = formData.get('rePass');  if (email == '' || password == '') {  return alert('All fields are required!')  } else if (password != rePass) {  return alert('Passwords don\'t match!');  }  const response = await fetch('http://localhost:3030/users/register', {  method: 'post',  headers: { 'Content-Type': 'application/json' },  body: JSON.stringify({ email, password })  });  if (response.ok == false) {  const error = await response.json();  return alert(error.message);  }  const data = await response.json();  sessionStorage.setItem('userToken', data.accessToken);  window.location.pathname = 'index.html'; } | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Login | document.querySelector('form').addEventListener('submit', onLoginSubmit);  async function onLoginSubmit(event) {  event.preventDefault();  const formData = new FormData(event.target);  const email = formData.get('email');  const password = formData.get('password');  const response = await fetch('http://localhost:3030/users/login', {  method: 'post',  headers: { 'Content-Type': 'application/json' },  body: JSON.stringify({ email, password })  });  if (response.ok == false) {  const error = await response.json();  return alert(error.message);  }  const data = await response.json();  sessionStorage.setItem('userToken', data.accessToken);  window.location.pathname = 'index.html'; } |  |
| Logout | const token = sessionStorage.getItem('userToken');    if (token != null) {  document.getElementById('user').style.display = 'inline-block';  document.getElementById('logoutBtn').addEventListener('click', logout);  } else {  document.getElementById('guest').style.display = 'inline-block';  }  async function logout() {  const token = sessionStorage.getItem('userToken');  const response = await fetch('http://localhost:3030/users/logout', {  method: 'get',  headers: { 'X-Authorization': token }  });  if (response.ok == false) {  const error = await response.json();  return alert(error.message);  }  sessionStorage.removeItem('userToken');  window.location.pathname = 'index.html';  } |  |
|  |  |  |

# SINGLE PAGE APPLICATION (SPA)

## SUBTITLE

|  |  |  |
| --- | --- | --- |
|  | <script type="module" src="/src/app.js"></script>  dom.js // export function e() {...}  home.js:  let main;  let section;  export function setupHome(mainTarget, sectionTarget) {  main = mainTarget;  section = sectionTarget;  }  export async function showHome() {  main.innerHTML = '';  main.appendChild(section);  }  app.js:  import { setupHome } from './home';  import { setupDetails } from './details';  import { setupLogin } from './login';  import { setupRegister } from './register';  import { setupCreate } from './create';  import { setupEdit } from './edit'; | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |  |

# JS BACK END

## NODE.JS

|  |  |  |
| --- | --- | --- |
| Initialize a Node Project | npm init // asks questions and creates a package.json file with all dependencies (libraries needed for code execution)  npm init -y // creates a package.json with automatic answers | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Download an External Library and Add It to Dependencies | npm install lodash --save // adds lodash to dependencies  npm install -E lodash // short for --save |
| Download Several External Modules | npm install -E express express-handlebars // downloads both |
| Download All External Libraries Needed for the Project | npm install // downloads all external libraries necessary for the project  npm i // short for 'npm install' |
| Run a Node.js Application | node index.js // when any changes are made, Ctrl + C to stop the server and again node to restart it |  |
| Run and Automatically Update a Node.js Application | npm install -g nodemon  nodemon index.js |  |
| Run and Ignore Updates in a Specific File | nodemon --ignore models/data.json |  |
| Stop the Server | Ctrl + C |  |

## NODE.JS CORE MODULES

### URL MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const url = require('url'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Parse a URL Object | const urlObj = url.parse(req.url); // returns an object with info about the url  const host = urlObj.host; // 'localhost:8080'  const path = urlObj.pathname; // '/home'  const query = urlObj.query // '?year=2017&month=february'  const search = urlObj.search // '?year=2017&month=february' |

### QUERYSTRING MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const queryString = require('querystring'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Parse a Querystring Object (Stream Data) | const qs = queryString.parse('year=2017&month=february');  const year = qs.year; // 2017  const month = qs.month; // 'february' |

### PATH MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const path = require('path'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Parse a Path Object | const pathObj = path.parse(\_\_filename); // \_\_dirname  pathObj.root // 'C:\\'  pathObj.dir // 'C:\\Users\\Project'  pathObj.base // 'myFile.js'  pathObj.ext // '.js'  pathObj.name // 'myFile' |
| Path Methods | path.join(\_\_dirname, '\\Demo', '\\asdf', '..') // 'C:\\Users\\Project\\Demo'  path.normalize('C:\\Demo\\\\temp\\..\\') // 'C:\\Demo' |  |

### OPERATING SYSTEM MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const os = require('os'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Get Total/Free OS Memory | const totalMemory = os.totalmem();  const freeMemory = os.freemem(); |

### FILE SYSTEM MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const fs = require('fs'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Import the FS Promises Property | const fs = require('fs').promises; |
| List Files in a Directory | const files = fs.readdir('./', 'utf-8', (err, files) => {  if (err) {  console.log('Error', err);  return;  } else {  console.log('Result', files); // an array of file and folder names  }  }); |
| List Files with FS Promises Property | (async () => {  const files = await fs.readdir('.');  console.log(files); // an array of file and folder names  })(); |  |
| Read File Synchronously | const data = fs.readFileSync('./package.json');  data // returns buffer data  data.toString() // returns json data |  |
| Read File Asynchronously | fs.readFile(path, 'utf-8', (err, data) => { // second parameter is optional  if (err) console.log('Error', err);  else console.log('Result', data.toString());  }); |  |
| Read File with FS Promises Property | const promise = fs.readFile('./package.json');  promise.then(data => console.log(data.toString())); |  |
| Read File with FS Promises Property in an Async Function | async function handleFiles() {  const data = await fs.readFile('./package.json');  console.log(data.toString());  } |  |
| Read File in Chunks | fs.createReadStream(filePath); |  |
| Create a Directory | fs.mkdir('./myDir', err => {  if (err) {  console.log(err);  return;  }  }); |  |
| Create a Directory with FS Promises Property | (async () => {  await fs.mkdir('./myDir');  })(); |  |
| Delete a Directory | fs.rmdir('./muDir', err => {  if (err) {  console.log(err);  return;  }  }); |  |
| Delete a Directory with FS Promises Property | (async () => {  await fs.rmdir('./myDir');  })(); |  |
| Rename a File/Directory | fs.rename('./oldName', './newName', err => {  if (err) {  console.log(err);  return;  }  }); |  |
| Rename a File/Directory with FS Promises Property | (async () => {  await fs.rename('./myDir', 'myNewDir');  })(); |  |
| Write a File Synchronously | fs.writeFileSync('./package\_copy.json', data); // creates new file with data |  |
| Write a File Asynchronously | fs.writeFile('./data.txt', 'Some text', err => {  if (err) {  console.log(err);  return;  }  }); |  |
| Write a File with FS Promises Property | (async () => {  await fs.writeFile('myFile', 'Some text');  })(); |  |
| Delete a File | fs.unlink('./target.txt', err => {  if (err) {  console.log(err);  return;  }  }); |  |
| Delete a File with FS Promises Property | (async () => {  await fs.unlink('myFile');  })(); |  |

### EVENTS MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const os = require('events'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Register an Event Listener | const publisher = new events.EventEmitter();  publisher.on('ping', (a, b) => console.log(a, b)); // 'Hello world' |
| Raise an Event | publisher.emit('ping', 'Hello', 'world'); // synchronous! |  |

### HTTP MODULE

|  |  |  |
| --- | --- | --- |
| Import It | const http = require('http'); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Create a Web Server (to Handle Web Requests) | http.createServer((req, res) => { // request/response wrappers  res.write('Hello, world!');  res.end();  }).listen(3000, () => console.log('Listening on port 3000...')); // server is an instance of EventEmitter |
| Request Wrapper Properties | req.httpVersion // '1.1' or '1.0'  req.headers // object for request headers  req.method // 'GET', 'POST', etc.  req.url // the URL of the request |  |
| Response Wrapper Methods | res.writeHead(200, { 'Content-Type': 'text/plain' }); // creates response header  res.write('Hello from Node.js'); // sends content to the client (UTF-8 encoding)  res.end(); // ends the response |  |
|  | server.on('connection', (socket) => {  console.log('New connection...');  }); |  |
|  | server.on('request', (req, res) => {  const src = fs.createReadStream('./bigfile.txt');  src.pipe(res);  }); |  |

## EXPRESS.JS

|  |  |  |
| --- | --- | --- |
| Installation | npm install express --save-exact | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Loading | const express = require('express'); const app = express(); // new instance of the application |
| Automatically Added Response Header | { 'X-Powered-By': 'Express' } |  |
| Router (Server?) app.*method*(*path*, *handler*) | app.get('/', (req, res) => {  res.status(200).send('Welcome to Express.js!'); // can only be used once (automatically ends the response) ).listen(3000, () => console.log('Listening on port 3000...')); |  |
| All Methods Route (Used with '\*' for 404 Page) | app.all('/about', (req, res, next) => {  console.log('Middleware execution...');  next();  }, (req, res) => {  res.send('Show about page');  }).listen(3000); |  |
| Create Chainable Route Handlers | app.route('/home')  .get((req, res) => res.send('GET home page'));  .post((req, res) => res.send('POST home page'));  .all((req, res) => res.send(404, '404 Not Found')); // 'all' always at the end, otherwise it cancel the previous methods |  |
| Create Modular Routers (Mounted on a Route/Endpoint) | const router = express.Router();  router.get('/catalog', (req, res) => res.send('Catalog Page')); |  |
| Use Modular Routers | const catalogRouter = require('./catalog')  app.use(catalogRouter); |  |
| Body Parser (Adds a 'body' Property to the Request) | app.use(express.urlencoded({ extended: true })); |  |
| Access Query String | .../?search=alabala&difficulty=3  req.query // returns { search: 'alabala', difficulty: 3 } |  |

### ROUTER PATHS

|  |  |  |
| --- | --- | --- |
| Match Everything (Including an Empty String) | app.get('/catalog/\*', (req, res) => {  res.send('Product Page');  }); | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Use String Patterns | app.get('/ab\*cd', (req, res) => {  res.send('abcd, abANYTHINGcd');  }); |
| Use Regular Expressions | app.get(/.\*fly$/, (req, res) => {  res.send('butterfly, dragonfly');  }); |
| Use Parameters | app.get('/users/:userId', (req, res) => {  const paramsObj = req.params;  res.send(paramsObj); // { userID: '123' }  }); |  |
| Validate Parameters Using RegExp (Not Recommended) | app.get('/users/:userId(\\d+)', (req, res) => {  const paramsObj = req.params;  res.send(paramsObj); // Cannot GET /users/123a  }); |  |

### ROUTER RESPONSES

|  |  |  |
| --- | --- | --- |
| Download a File | app.get('/pdf', (req, res) => {  res.download('./demo.pdf');  }); // adds a header to the response: 'Content-Disposition': attachment; filename="demo.pdf" | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Send a File as an Octet Stream (Open It in the Browser) | app.get('/tos', (req, res) => {  res.sendFile(\_\_dirname + 'demo.pdf');  }); |
| End the Response | res.end(); |
| Send a JSON Response | res.json(); |
| Redirect Request to Another Page | app.get('/contact', (req, res) => {  res.redirect('/about'); // adds a header 'Location': '/about'  }); |  |
| Render a View Template | res.render(); |  |

### MIDDLEWARE (PLUGINS, EXTENSIONS)

|  |  |  |
| --- | --- | --- |
| Definition | A function that has access to the request and respons object and the next middleware in the application's request-response cycle.  between the router and the action; always has to call next() | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Types of Middleware | application, route, error |
| Create Middleware | function isAdmin(req, res, next) {  if (req.headers.hasOwnProperty('x-admin')) next();  else res.status(401).send('Admins only. Please sign in.');  } |
| Use Middleware for a Specific Path | const isAdmin = require('./guard');  app.get('/admin', isAdmin, (req, res) => {  res.send('Admin Page');  }); |  |
| Use Middleware on Application Level (for All Paths) | const logger = require('./logger');  app.use(logger); |  |
| Create Middleware for Error Handling | function fallback(err, req, res, next) {  console.error(err.message);  res.status(500).send('500 Server error');  } |  |
| Use Middleware for Error Handling (Does Not Catch Asynchronous Errors) | const fallback = require('./fallback');  app.get('/', (req, res, next) {  next(new Error('Test error'));  });  app.use(fallback); // at the end |  |
| Third-Party Middleware | app.use(cookieParser());  app.use(session({ secret: 'magic unicorns' }));  app.use(passport.initialize());  app.use(passport.session());  app.use(express.static(config.rootPath + '/public')); |  |

### STATIC FILES

|  |  |  |
| --- | --- | --- |
| Serving Static Files (All Files from the Directory Will Be Public) | app.use(express.static('public')); // all files from the folder 'public' will be considered static | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  | app.use('/static', express.static('public')); // find all files the user tries to access with the url starting with '/static' in folder 'public' instead |
|  | app.use('/static', express.static(\_\_dirname + '/public')); |

### VIEW ENGINES

|  |  |  |
| --- | --- | --- |
| Set File Extension and Default Files/Folders | app.engine('.hbs', hbs({  extname: '.hbs',  layoutsDir: 'myLayouts', // default: 'layouts'  defaultLayout: 'site' // default: 'main'  }));  app.set('view engine', '.hbs'); // default extension if none in render() | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |

## HANDLEBARS

|  |  |  |
| --- | --- | --- |
| Installation | npm install handlebars  npm install express-handlebars //integration in Express | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Loading | const hbs = require('express-handlebars'); |
| Set File Extension for Express and HBS | app.engine('.hbs', hbs({ extname: '.hbs' }));  app.set('view engine', '.hbs'); // default extension if none in render() |  |
| Create Default Layout (Folder Views > Folder Layouts > main.hbs) | default HTML (! + Enter), in <body>:  {{{body}}} |  |
| Create View (Folder Views > home.hbs) | <h1>Home Page</h1> |  |
| Change Default Folder for View Engine | app.set('views', 'templates'); |  |
| Render Created View | app.get('/', (req, res) => res.render('home')); |  |
| Render View with Dynamic Data (Context) | app.get('/', (req, res) => res.render('home', { title, body })); |  |
| When Layouts is Empty | app.get('/', (req, res) => res.render('home', { layout: false })); |  |
| Initialize Expressions in HBS | <h1>{{title}}</h1> |  |
| Comments in HBS | {{!-- This is a comment --}} |  |
| Loop through an Array (Each Helper) | <ul>  {{#each numbers}} {{!-- numbers: [1, 2, 3]) --}}  <li>{{this}}</li>  {{else}} {{!-- if the array is empty --}}  <li>No numbers</li>  {{/each}}  </ul> |  |
| Loop through an Array of Objects | <ul>  {{#each items}} {{!-- items: [{ type, qty }, { type, qty }]) --}}  <li>{{type}}: {{qty}}</li>  {{/each}}  </ul> |  |
| Conditional Statements | {{#if user}}  <span>Hello, {{user.username}}!</span>  {{else}}  <span><a *href*="/login">Login</span>  {{/if}} |  |
| Partials (Folder Views > Partials) | <ul>  {{#each contacts}}  {{> contact}} {{!-- inserts the template contact.hbs --}}  {{else}}  <i>(empty)</i>  {{/each}}  </ul> |  |
| HTML Escaping | {{{title}}} {{!-- 'About <p> Tags' => 'About &lt;p&gt; Tags' --}} |  |
| Change the Context | {{{#with numbers}}}  ...  {{{/with}}} |  |

## EXTERNAL LIBRARIES

|  |  |  |
| --- | --- | --- |
| Mocha |  | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
|  |  |  |
|  |  |  |
| Formidable | npm install -E formidable  const formidable = require('formidable');  const form = new formidable.IncomingForm();  form.parse(req, (err, fields, files) => {  database.addItem(fields); // { name: 'John', age: 23 }  res.writeHead(301, { 'Location': '/' });  res.end();  }); |  |
| Body Parser | npm install -E body-parser  const bodyParser = require('body-parser').urlencoded();  app.use(bodyParser); |  |

## STREAMS

|  |  |  |
| --- | --- | --- |
| Stream Definition | Collection of data that is not available at once (may come continuously in chunks). Obviously asynchronous. We use events to manage them. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Readable Streams | can only be read (process.stdin)  Functions:  read() // get chunks from the stream after pause()  pause() // switch to paused mode  resume() // switch to flowing mode  pipe() // allows a readable stream to output directly to a writable stream  Events: (used when the stream is flowing)  data // chunk is available for reading  end // no more data  error // an exception has occurred  HTTP request is a readable stream:  const http = require('http');  http.createServer((req, res) => {  if (req.method == 'POST') {  let body = '';  req.on('data', data => body += data);  req.on('end', () => console.log(body));  }  }).listen(5000);  ==================================  const fs = require('fs');  const server = require('http').createServer();  server.on('request', (req, res) => {  const src = fs.createReadStream('./bigfile.txt');  src.pipe(res);  });  server.listen(5000); |
| Writable Streams | can only be written to (process.stdout)  Functions:  write() // send chunks to the stream  end() // close the stream  Events:  drain // stream can receive more data  finish // all data has been flushed (buffer is empty)  error // an exception has occurred  HTTP Response is a writable stream  const fs = require('fs');  const server = require('http').createServer();  server.on('request', (req, res) => {  const src = fs.createReadStream('./bigfile.txt');  src.on('data', data => res.write(data));  src.on('end', () => res.end());  });  server.listen(5000); | u |
| Duplex Streams | Implements both readable and writable interfaces (ex. TCP sockets). |  |
| Transform Streams | A special kind of duplex stream where the output is a transformed version of the input (ex. zlib, crypto). |  |

## PUBLISH-SUBSCRIBE PATTERN

|  |  |  |
| --- | --- | --- |
| Publishers | The senders of messages (data) that do not program the messages to be sent directly to specific receivers, but instead categorize published messages into classes without knowledge of which subscribers, if any, there may be. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Subscribers | Express interest in one or more events and only receive messages that are of interest. |  |
| Event Bus (Message Broker) | An intermediary that retrieves published messages and forwards them to the subscribers who are registered to receive them. |  |
| Example | button.addEventListener('click', handler) // the button is publisher, the event handler is subscriber |  |

## DATABASES

### TYPES OF DATABASES

|  |  |  |
| --- | --- | --- |
| Relational (MySQL, Oracle) | Data organized in tables of columns and rows with unique keys identifying each row. SQL is used to extract data (SELECT \* FROM Students), relations between tables are done using Foreign Keys. | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| Non-Relational (NoSQL: MongoDB, Cassandra) | Data stored in key-value pairs. SQL is not used, therefore also called NoSQL. More scalable, provide superior performance. |

### MONGO DB

|  |  |  |
| --- | --- | --- |
| Setup | Create the nested folders "data" > "db" in C:/.  In Program Files > Mongo DB > Server > 42 > bin:  mongod // the primary daemon process for the MongoDB system  mongo // run the MongoDB shell | [Python](Python.docx#BasicSourseCodePython) C++ C# Java |
| In the MongoDB Shell | show dbs // print a list of all databases on the server  use myBD // create a new database called "myDB"  db.courses.insert({"name":"mongoDB course"}) // create a collection called "courses" in "myDB"  show collections // courses  db.courses.find() // { "\_id" : ObjectId("5e56c9f2dc..."), "name" : "mongoDB course" } |
| Configuration | <path to mongod.exe>mongod --dbpath <path to store data> |
| Installation in Node.js | npm install mongodb -g |  |
| Work with MongoDB in NodeJS | const mongodb = require('mongodb');  const MongoClient = mongodb.MongoClient;  const connectionStr = 'mongodb://localhost:27017';  const client = new MongoClient(connectionStr, { useUnifiedTopology: true });  client.connect((err) => {  const db = client.db('testdb');  const people = db.collection('people');  people.insertOne({ name: 'Ivan' }, (err, data) => {  people.find({ name: 'Ivan' }).toArray((err, data) => {  console.log(data);  });  });  }); |  |
| MongoDB Hosting | Go to 'mongo atlas' and register in order to store up to 500 MB of content. |  |
| About Mongoose | An object-document model module in Node.js for MongoDB. Provides a straight-forward, schema-based solution to model the application data. Includes built-in type casting and validation. Extends the native queries (much easier to use). |  |
| Mongoose Installation | npm install mongoose --g |  |
| Load Mongoose | const mongoose = require('mongoose'); |  |
| Connect to the Database | mongoose.connect('mongodb://losalhost:27017/unidb'); |  |
| Use Mongoose | const exampleSchema = new mongoose.Schema({  propString: String,  propNumber: Number,  propObject: {},  propArray: [],  propBool: Boolean  });  const Model = mongoose.model('Example', exampleSchema); |  |
| Model Methods | studentSchema.methods.getInfo = function() { // avoid arrow functions  return `I am ${this.firstName} ${this.lastName}`;  }; |  |
| Model Virtual Properties (Not Persisted to the Database) | studentSchema.virtual('fullName').get(function () {  return this.firstName + ' ' + this.lastName;  }); |  |
| Validate Records | studentSchema.path('firstName')  .validate(function () {  return this.firstName.length >= 2 && this.firstName.length <= 10;  }, 'First name must be between 2 and 10 symbols long!'); |  |
| Exporting Modules | const studentSchema = new mongoose.Schema({  firstName: { type: String, required: true },  lastName: { type: String, required: true },  facultyNumber: { type: String, required: true, unique: true },  age: { type: Number }  });  module.exports = mongoose.model('Student', studentSchema); |  |
| Put Each Model in a Different Module and Load All Models at Start | const Student = require('./models/Student'); |  |
| CRUD with Mongoose | new Student({}).save(callback) // create/persist data  Student.find({}) // read/extract data  Student.findById(id, callback) // update/modify data  Student.findByIdAndUpdate(id, {$set: { prop: newVal }}, callback)  Student.update({ \_id: id, {$set: { prop: newVal }}, callback)  Student.findByIdAndRemove(id, callback) // delete/remove data  Student.remove({ name: studentName }) |  |

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Котки:

* home.js: If we could not handle the current request, we will notify the server of that by returning true (is request not handled - true).
* index.js: require('./handlers') не трябва ли да е ./handlers/index?
* index.js: loop through all handlers and if the right handler is found break the loop?