



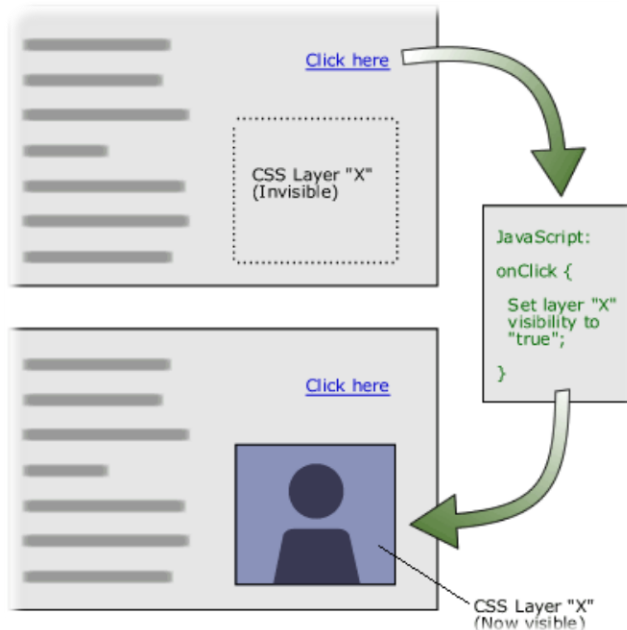
JavaScript

# Table of Contents

1. Introduction to JavaScript
2. Data Types in JavaScript
3. Operators in JavaScript
4. Conditional Statements
5. Loops
6. Functions
7. Arrays

# Introduction to JavaScript

Dynamic Behavior at the **Client Side**  
**Or Server-Side** Web applications



# JavaScript

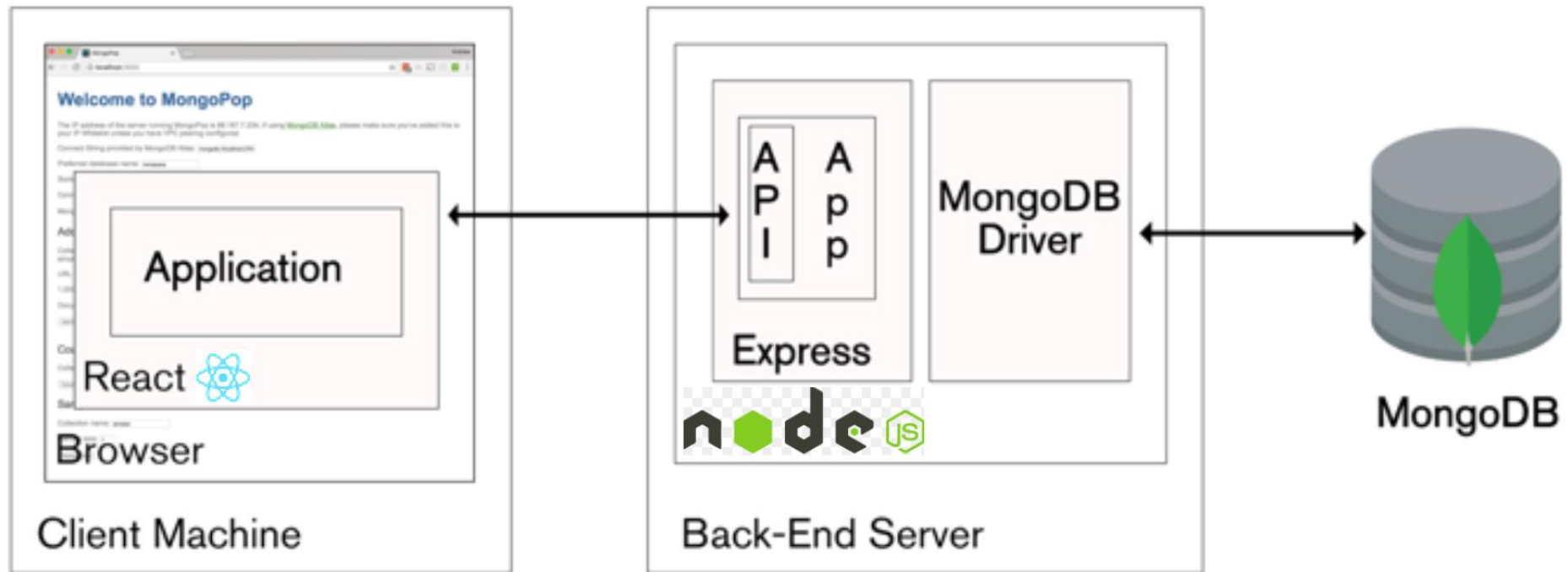
- **JavaScript** is a platform independent **scripting** language
  - Lightweight but a powerful **interpreted** language
  - Supports both **functional** and **object-oriented** programming style
  - Current Version ES 2021 (ECMAScript 2021)
  - Can be used for:
    - **Client-side scripting**: embedded in HTML pages and interpreted by the Web browser
    - **Server-side programming** using **Node.js**
    - **Desktop app development** (e.g., <https://electronjs.org>)
    - **Mobile app development** (e.g., <https://reactnative.dev/>)



# What Can JavaScript Do?

- **Web Client-side Dynamic Behavior**
  - Handle client-side events such as button clicked event
    - e.g., Changing an image on moving mouse over it
  - Manipulate the Document Object Model (DOM) of the page: read, modify, add, delete HTML elements
  - Validate form input values before being submitted to the server
  - Perform computations, sorting and animation
  - Perform asynchronous server calls (AJAX) to load new page content or submit data to the server without reloading the page
- Server-side Web applications development using Node.js
- Other usage such as desktop apps, mobile apps and game development

# MERN (MongoDB, Express, React, Node.js)



**JavaScript** is the common language throughout the MERN stack, and **JSON** is the common data format



# JavaScript Syntax

- JavaScript is syntactically a C family language
  - It differs from C mainly in its type system
- The JavaScript syntax is similar to Java and C#
  - Variables (by dynamically typed in JavaScript)
  - Operators (+, \*, =, !=, &&, ++, ...)
  - Conditional statements (if, else, switch)
  - Loops (for, while)
  - Arrays (myArray[ ]) and associative arrays (myArray[ 'abc' ])
  - Functions
  - Classes
- Although there are **strong outward similarities** between JavaScript and Java, the two are **distinct languages and differ greatly in their design.**

# Data Types in JavaScript



# Declaring Variables

- Names in JavaScript are **case-sensitive**
- The syntax is the following:

```
let <identifier> [= <initialization>];
```

- Example:

```
let height = 200;
```

- let** – creates a block scope variable (accessible only in its scope)

```
for(let number of [1, 2, 3, 4]){  
  console.log(number);  
}  
//accessing number here throws exception
```

# Declaring Variables using **var**

- **var** – creates a variable accessible outside its scope (**avoid using var and use let**)

```
for(var number of [1, 2, 3, 4]){  
    console.log(number);  
}  
console.log(number); //accessing number here is OK
```

## Declaring a Constant

- **const** – creates a constant variable. Its value is read-only and cannot be changed

```
const MAX_VALUE = 16;  
MAX_VALUE = 15; // throws exception
```



# JavaScript Data Types

- JavaScript is a **Loosely Typed** and **Dynamic** language
  - All variables are declared with the keyword **let**
  - The variable datatype is derived from the assigned value

```
let count = 5; // variable holds a number
let name = 'Ali Dahak'; // variable holds a string
let grade = 5.25 // grade holds a number
```

# Primitive types

- There are 6 data types in JavaScript:
  - number
  - string
  - boolean
  - undefined
  - function
  - object (Everything else is an object)
- A string is a sequence of characters enclosed in single ( ' ') or double quotes ( " ")

```
let str1 = "Some text saved in a string variable";  
let str2 = 'text enclosed in single quotes';
```

# String Methods

- `str.length` returns the number of characters
- Indexer (`str[index]`) or `str.charAt(index)`
  - Gets a single-character string at location `index`
  - If index is outside the range of string characters, the indexer returns `undefined`
    - e.g., `string[-1]` or `string[string.length]`
- `str3 = str1.concat(str2)` or `str3 = str1 + str2;`
  - Returns a new string containing the concatenation of the two strings
- Other String methods

[http://www.w3schools.com/jsref/jsref\\_obj\\_string.asp](http://www.w3schools.com/jsref/jsref_obj_string.asp)

# Convert a number to a string

- Use number's method (`toString`)

```
str = num.toString()
```

- Use `String` function

```
str = String(num)
```

# Convert a string to a number

- Use the `parseInt` function

```
num = parseInt(str)
```

- Use the `Number` function

```
num = Number(str)
```

- Use the `+` prefix operator

```
num = +str
```



# Template Literals

- Template Literals allow creating dynamic templated string with placeholders
  - Replaces long string concatenation!

```
let person = {fname: 'Samir', lname: 'Mujtahid'};  
console.log(`Full name: ${person.fname} ${person.lname}`);
```



# undefined vs. null Values

- In JavaScript, undefined means a variable has been declared but **has not been assigned a value**, e.g.,:

```
let testVar; console.log(testVar); //shows undefined  
console.log(typeof testVar); //shows undefined
```

- null is an assignment value. It can be assigned to a variable as a representation of no value:

```
let testVar = null;  
console.log(testVar); //shows null  
console.log(typeof testVar); //shows object
```

=> undefined and null are two distinct types: **undefined** is a value of type “undefined” while null is an **object**



# NaN

- NaN (Not a Number) is an illegal number
- Result of undefined or erroneous operations such **'A' \* 2** will return a **NaN**
- Toxic: any arithmetic operation with **NaN** as an input will have **NaN** as a result
- Use **isNaN()** function determines whether a value is an illegal number (Not-a-Number).
  - **NaN** is not equal to anything, including **NaN**

**NaN === NaN** is **false**

**NaN !== NaN** is **true**

# Checking a Variable Type

- The variable type can be checked at runtime:

```
let x = 5;
console.log(typeof(x)); // number
console.log(x); // 5

let person = {fname: 'Samir', lname: 'Mujtahid'};
console.log(typeof(person)); // object
console.log(person); //{fname: 'Samir', lname: 'Saghir'}

x = null;
console.log(typeof(x)); // object

x = undefined;
console.log(typeof(x)); // undefined
```

# Comments

*// slash slash line comment*

*/\**

*slash star  
block  
comment*

*\*/*

# Operators in JavaScript

Arithmetic, Logical, Comparison, Assignment,  
Etc.



# Categories of Operators in JS

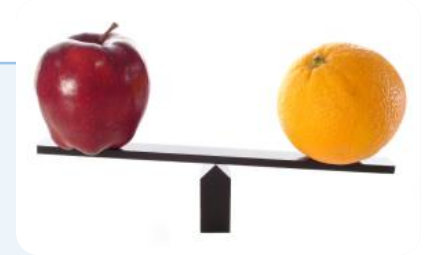
Category	Operators
Arithmetic	+ - * / % ++ --
Logical	&&    ^ !
Binary	&   ^ ~ << >>
Comparison	== != < > <= >= === !==
Assignment	= += -= *= /= %= &=  = ^= <<= >>=
String concatenation	+
Other	. [] () ?: new

[http://www.w3schools.com/js/js\\_operators.asp](http://www.w3schools.com/js/js_operators.asp)

# Comparison Operators

- Comparison operators are used to compare variables
  - `==`, `<`, `>`, `>=`, `<=`, `!=`, `===`, `!==`
- Comparison operators example:

```
let a = 5;  
let b = 4;  
console.log(a >= b); // True  
console.log(a != b); // True  
console.log(a == b); // False  
  
console.log(0 == ""); // True  
console.log(0 === ""); //False
```





# == VS. ===

!=

Non-equality comparison:  
Returns true if the operands are  
not equal to each other.

==

Equality comparison:  
Returns true when both operands are  
equal. The operands are converted to  
the same type before being compared.

!==

Non-equality comparison without type  
conversion:  
Returns true if the operands are not  
equal OR they are different types.

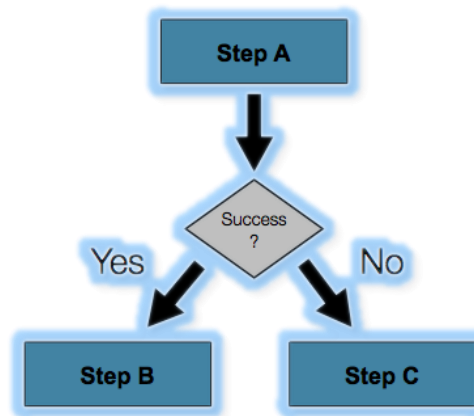
===

Equality and type comparison:  
Returns true if both operands are  
equal and of the same type.

- See Examples

[http://www.w3schools.com/js/js\\_comparisons.asp](http://www.w3schools.com/js/js_comparisons.asp)

# Conditional Statements





# if-else Statement – Example

- Checking a number if it is odd or even

```
let number = 10;

if (number % 2 === 0)
{
    console.log('This number is even');
}
else
{
    console.log('This number is odd');
}
```

# switch-case Statement

- Selects for execution a statement from a list depending on the value of the **switch** expression

```
switch (day)
{
    case 1: console.log('Monday'); break;
    case 2: console.log('Tuesday'); break;
    case 3: console.log('Wednesday'); break;
    case 4: console.log('Thursday'); break;
    case 5: console.log('Friday'); break;
    case 6: console.log('Saturday'); break;
    case 7: console.log('Sunday'); break;
    default: console.log('Error!'); break;
}
```



# False-like conditions

- These values are always false (when used in a condition)
  - false
  - 0 (zero)
  - "" (empty string)
  - null
  - Undefined
  - NaN
- All other values are true



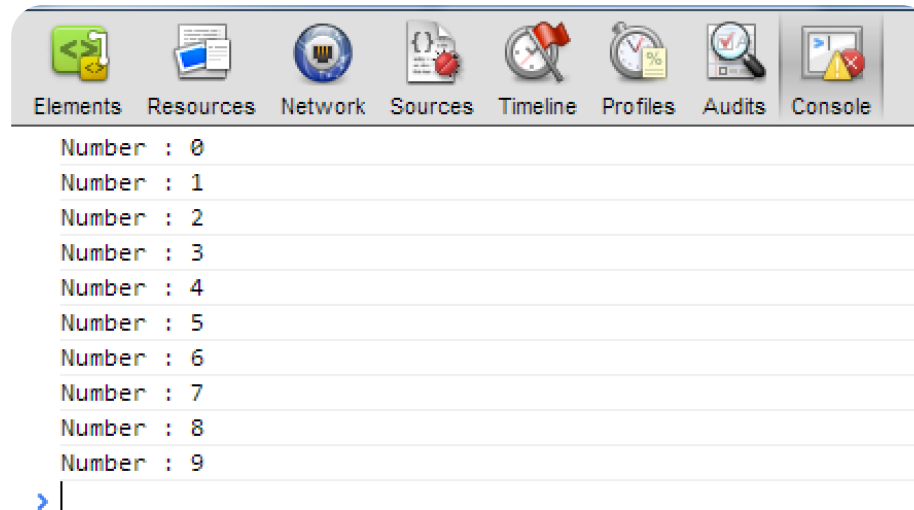
# while (...) do { ... } for { ... } Loops

Execute Blocks of Code Multiple Times



# While Loop – Example

```
let counter = 0;  
while (counter < 10){  
    console.log(`Number : ${counter}`);  
    counter++;  
}
```



# Other loop structures

- Do-While Loop:

```
do {  
    statements;  
}  
while (condition);
```



- **For** loop:

```
for (initialization; test; update) {  
    statements;  
}
```

# Simple for Loop – Example

- A simple for-loop to print the numbers 0...9:

```
for (let number = 0; number < 10; number++){  
  console.log(number + " ");  
}
```

- A simple for-loop to calculate **n!**:

```
let factorial = 1;  
for (let i = 1; i <= n; i++){  
  factorial *= i;  
}
```



# For-of loop

- For-of loop iterates over a list of values

```
let sum = 0;  
for(let number of [1, 2, 3])  
    sum += number;  
console.log(sum);
```

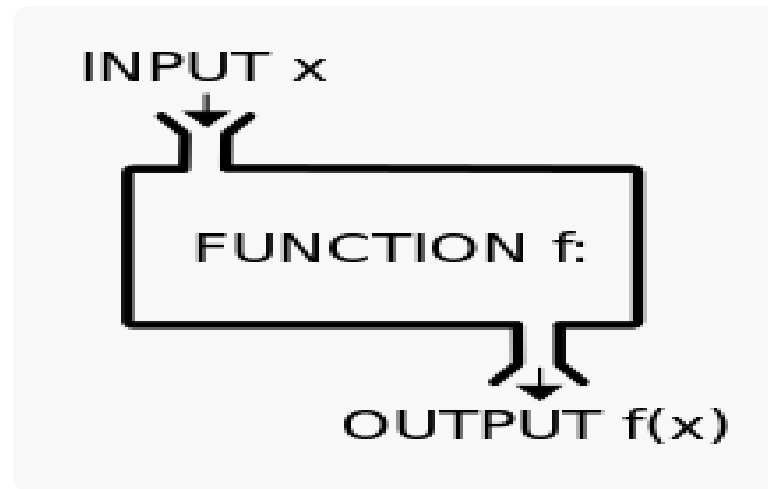
# For-in loop

- For-in loop iterates over the properties of an object

```
let obj = { fName: "Ali", lName: "Mujtahid" };  
for (let prop in obj) {  
    console.log(prop , ':' , obj[prop]);  
}
```



# Functions



```
function (parameter) {  
    return expression;  
}
```

```
function double (number) { return number * 2; }  
double(212); // call function
```

```
let average = function (a, b) {  
    return (a + b) / 2;  
}  
average(10, 20); // call function
```

*OR*

```
let average = (a, b) => (a + b) / 2;  
average(10, 20); // call function
```

**Arrow Function**  
Also called LAMBDA  
expressions

# Sum Even Numbers – Example

- Calculate the sum of all even numbers in an array

```
function sum(numbers){  
  let sum = 0;  
  for (let num of numbers) {  
    if( num % 2 === 0 ){  
      sum += num;  
    }  
  }  
  return sum;  
}
```

# Function Scope

- Every variable has its scope of usage
  - A scope defines where the variable is accessible
  - Generally there are local and global scope

```
let arr = [1, 2, 3, 4, 5, 6, 7];  
function countOccurrences (value){  
  let count = 0;  
  for (let num of arr){  
    if (num == value){  
      count++;  
    }  
  }  
  return count;  
}
```

**arr** is in the global scope  
(it is accessible from anywhere)

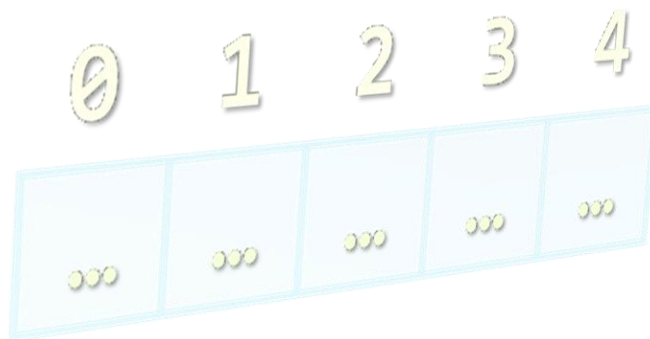
**count** is declared inside  
countOccurrences and it  
can be used only inside it

**num** is declared inside the  
for loop and it can be used  
only inside it

# Arrays

Processing Sequences of Elements

<https://sdras.github.io/array-explorer/>



# Declaring Arrays

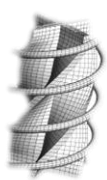
- Declaring an array in JavaScript

```
// Array holding integers
let numbers = [1, 2, 3, 4, 5];

// Array holding strings
let weekDays = ["Monday", "Tuesday", "Wednesday",
    "Thursday", "Friday", "Saturday", "Sunday"]

// Array of different types
let mixedArr = [1, new Date(), "hello"];

// Array of arrays (matrix)
let matrix = [
    [1,2],
    [3,4],
    [5,6]
];
```



# Processing Arrays Using for Loop

★ The for-of loop iterates over a list of values

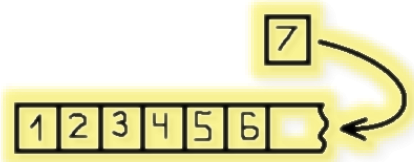
```
let sum = 0;  
for(let number of [1, 2, 3])  
    sum+= number;
```

- Printing array of integers in reversed order:

```
let array = [1, 2, 3, 4, 5];  
for (let i = array.length-1; i >= 0; i--) {  
    console.log(array[i]);  
} // Result: 5 4 3 2 1
```

- Initialize an array:

```
for (let index = 0; index < array.length; index++) {  
    array[index] = index;  
}
```



# Dynamic Arrays

- All arrays in JavaScript are dynamic
  - Their size can be changed at runtime
  - New elements can be inserted to the array
  - Elements can be removed from the array
- Methods for array manipulation:
  - `array.push(element)`
    - Inserts a new element at the tail of the array
  - `array.pop()`
    - Removes the element at the tail
    - Returns the removed element



# Insert/Remove at the head of the array

- `array.unshift(element)`
  - Inserts a new element at the head of the array
- `array.shift()`
  - Removes and returns the element at the head

```
let numbers = [1, 2, 3, 4, 5];  
console.log(numbers.join("|")); // result: 1|2|3|4|5  
  
let tail = numbers.pop();        // tail = 5;  
console.log(numbers.join("|")); // result: 1|2|3|4  
  
numbers.unshift(0);  
console.log(numbers.join("|")); // result: 0|1|2|3|4  
  
let head = numbers.shift();      // head = 0;  
console.log(numbers.join("|")); // result: 1|2|3|4
```



# Deleting Elements

- Splice removes item(s) from an array and returns the removed item(s)
- This method changes the original array
- Syntax:

**`array.splice(index, howmany)`**

```
let myArray = ['a', 'b', 'c', 'd'];  
let removed = myArray.splice(1, 1);  
// myArray after splice ['a', 'c', 'd']
```



# map, reduce, filter and find functions

- **array.map**
  - Applies a function to each array element
- **array.reduce**
  - Applies a function against an accumulator and each value of the array to reduce it to a single value.
- **array.filter(condition)**
  - Returns a new array with the elements that satisfy the condition
- **array.find(condition)**
  - Returns the first array element that satisfy the condition



# Map, Filter and Reduce Examples

```
let arr = [1, 2, 3];  
let sum = arr  
  .map(x => x * 2)  
  .reduce( (sum, x) => sum + x );  
console.log(sum); // ==> 12
```

Use an arrow  
function for a  
**more concise**  
syntax

```
let fullnames =  
  people.filter(function (p) {  
    return p.age >= 18;  
  }).map(function (p) {  
    return p.fullname;  
  });
```

**Becomes**

```
let fullnames =  
  people.filter(p => p.age >= 18)  
  .map(p => p.fullname);
```

# Other Array Functions

- `nums.sort((a, b) => a - b)`
  - Sorts the elements of the `nums` array in ascending order
- `nums.sort((a, b) => b - a)`
  - Sorts the elements of the `nums` array in descending order
- `array.reverse()`
  - Returns a new array with elements in reversed order
- `array.concat(elements)`
  - Inserts the elements at the end of the array and returns a new array
- `array.join(separator)`
  - Concatenates the elements of the array



# Destructuring assignment

- The destructuring assignment makes it easier to **extract** data from arrays or objects into distinct variables

```
let colors = ["red", "green", "blue", "yellow"];
```

*//Extracting array elements and assigning them to variables*

```
let [primaryColor, secondaryColor, ...otherColors] = colors;
```

*primaryColor = 'red' , secondaryColor = 'green' and  
otherColors = [ 'blue', 'yellow' ]*

**3 dots ... is called the rest operator**



# Spread Operator

- **Spread Operator (3 dots ... )** allows converting an array into consecutive arguments in a function call

```
let nums = [5, 4, 23, 2];  
//Spread could be used to convert the array  
//into multiple arguments
```

```
let max = Math.max(...nums);  
console.log("max:", max);
```

- Spread Operator can also be used to **concatenate** arrays

```
let cold = ['autumn', 'winter'];  
let warm = ['spring', 'summer'];  
// construct an array  
let seasons = [...cold, ...warm];  
// => ['autumn', 'winter', 'spring', 'summer']
```

# Sets

- A collection of values **without duplicates**
  - Sets do not allow duplicate values to be added

```
let names = new Set();
names.add('Samir');
names.add('Fatima');
names.add('Mariam');
names.add('Ahmed');
names.add('Samir'); // won't be added
```

```
for (let name of names) {
    console.log(name);
}
```



# Maps

- Map is a **collection** of key-value pairs

```
let map = new Map();
```

```
map.set(1, 'a');
```

```
map.set(2, 'b');
```

```
for(let pair of map) {  
    console.log(pair);  
}
```

```
for(let key of map.keys()) {  
    console.log( key, numbersMap.get(key) );  
}
```

```
for(let value of map.values()) {  
    console.log(value);  
}
```

# JavaScript Resources

- Mozilla JavaScript learning links
  - <https://developer.mozilla.org/en-US/learn/javascript>
- JavaScript features
  - <https://github.com/mbeaudru/modern-js-cheatsheet> & <https://zellwk.com/blog/es6/>
  - <https://exploringjs.com/>
- Modern JavaScript Tutorial
  - <https://javascript.info/>
- Node.js School
  - <https://nodeschool.io/>