

# JavaScript

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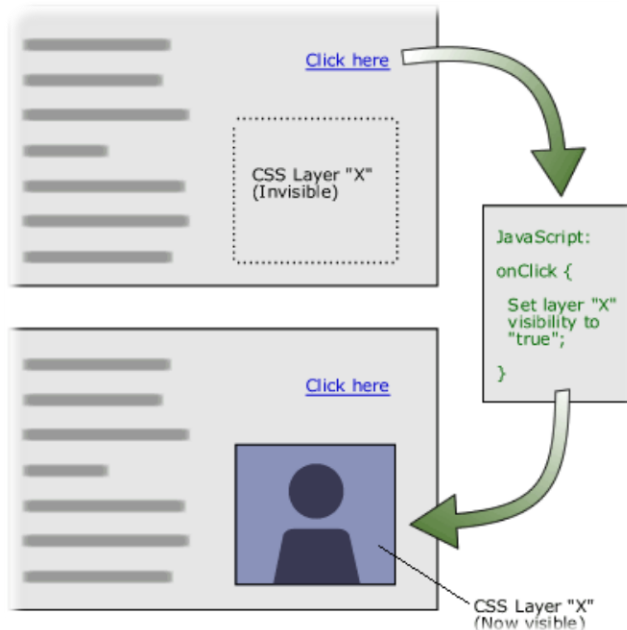
Some of the slides are based on JavaScript course from Telerik  
<http://academy.telerik.com>

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# Introduction to JavaScript

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



# JavaScript

- **JavaScript** is a scripting language for client side and/or server-side programming
  - Lightweight but powerful
  - Interpreted language:
    - Can be embedded in HTML pages and interpreted by the Web browser
    - Can be used outside the browser using Node.js
  - Supports both functional and object-oriented programming style
  - Platform independent (it is supported in desktop, mobile and servers)
- Current Version ES 2016 (aka ECMAScript 2016)

# What Can JavaScript Do?

- **Server Side Web applications**
  - Write server-side application logic (using Node.js)
- **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
- Other usage such as video-game development

# JavaScript Syntax

- The JavaScript syntax is similar to Java and C#
  - Variables (typeless)
  - Operators (+, \*, =, !=, &&, ++, ...)
  - Conditional statements (if, else, switch)
  - Loops (for, while)
  - Arrays (myArray[ ]) and associative arrays (myArray[ 'abc' ])
  - Functions (can return value)
  - 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** or **var**
  - The variable datatype is derived from the assigned value

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

# Primitive types

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

```
var str1 = "Some text saved in a string variable";  
var 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 `Number` function

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

- Use the `parseInt` function

```
num = Number.parseInt(str)
```

- Use the `+` prefix operator

```
num = +str;
```

# String Template

- Templated string is a string with placeholders:

```
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 yet 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
```

# Operators in JavaScript

Arithmetic, Logical, Comparison, Assignment,  
Etc.



# Categories of Operators in JS

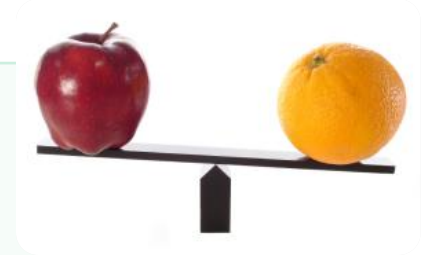
Category	Operators
Arithmetic	+ - * / % ++ --
Logical	&&    ^ !
Binary	&   ^ ~ << >>
Comparison	== != < > <= >= === !==
Assignment	= += -= *= /= %= &=  = ^= <<= >>=
String concatenation	+
Other	. [] () ?: new

[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.

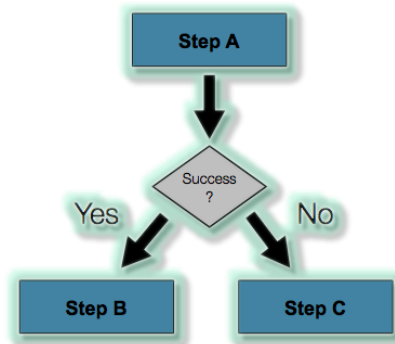
===

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
  - false
  - 0 (zero)
  - "" (empty string)
  - null
  - undefined
  - NaN
- All other values are true



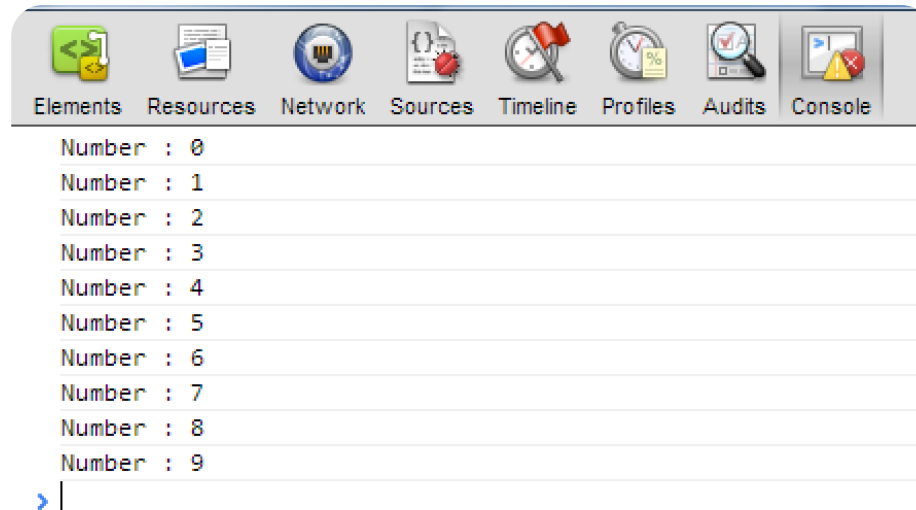
# **while (...)** **do { ... }** **for { ... }** **Loops**

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);
```

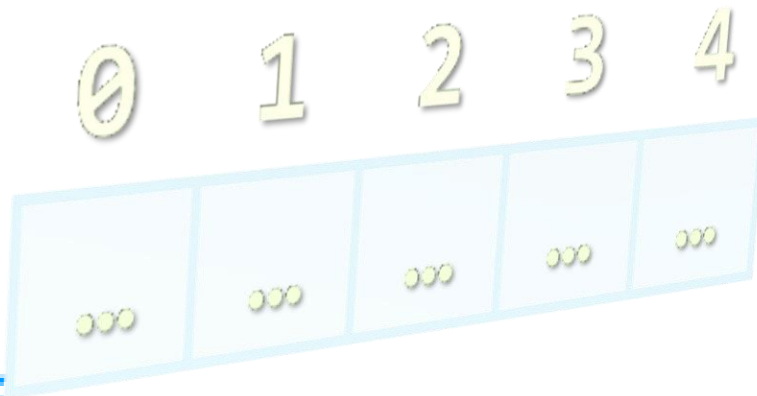
# For-in loop

- 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]);  
}
```

# Arrays

Processing Sequences of Elements



# Declaring Arrays

- Declaring an array in JavaScript

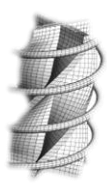
```
// Array holding integers
let numbers = [1, 2, 3, 4, 5];

// 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

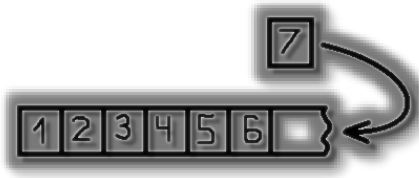
```
let sum = 0;  
for(let number of [1, 2, 3])  
    sum+= number;
```

- 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

# 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)`**

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

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

# Other Array Functions

- `array.sort()`
  - Sorts the elements of the array
- `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

# Other Array Functions (2)

- `array.map`
  - See posted examples
- `array.reduce`
  - See posted examples
- `array.filter(condition)`
  - Returns a new array with the elements that satisfy condition
- `array.forEach(function(item){})`
  - Iterates through the array and executes the function for each item

# Other Array Functions (3)

- `array.indexOf(element)`
  - Returns the index of the first match in the array
  - Returns `-1` if the element is not found
- `array.lastIndexOf(element)`
  - Returns the index of the first match in the array
  - Returns `-1` if the element is not found

# Destructuring Array

- Destructuring assignments allow to set values to objects in an easier way:
  - Destructuring assignments with arrays:

```
let [a, b] = [1, 2]; //a = 1, b = 2
let [x, , y] = [1, 2, 3]; // x = 1, y = 3
let [x, y, ...rest] = [1, 2, 3, 4];
    // x = 1, y = 2, rest = [3, 4]
```

- ◆ Swap values: `[x, y] = [y, x]`
- ◆ Result of method:

```
function get() { return [1, 2]; }
let [x, y] = get();
```



# Sets

- 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

```
let map = new Map();  
map.set(1, 'a');  
map.set(2, 'b');
```

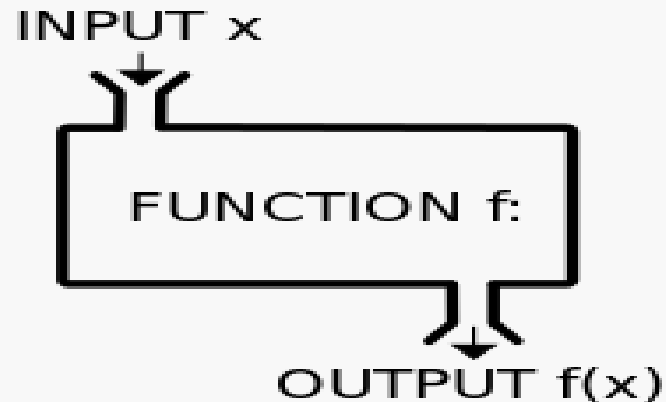
```
for(let pair of map) {  
    console.log(pair)  
}
```

```
for(let key of map.keys()) {  
    console.log(key)  
}
```

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

# Functions

Reusable parts of Code



```
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
```

# 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 i=0; i < arr.length; i++){  
    if (arr[i] == 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

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

# Arrow Functions

- Arrow functions easify the creation of functions:

```
numbers.sort(function(a, b){  
  return b - a;  
});
```

Becomes

```
numbers.sort((a, b) => b - a);
```

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

Becomes

```
var fullnames2 =  
  people.filter(p => p.age >= 18)  
    .map(p => p.fullname);
```

Also called LAMBDA expressions

# Arrow Functions – Example

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



# Online JavaScript Resources

- Best JavaScript tutorial:
  - <http://www.w3schools.com/js>
- Mozilla JavaScript learning links
  - <https://developer.mozilla.org/en-US/learn/javascript>
- Node.js School
  - <https://nodeschool.io/>