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JavaScript

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Further materials

- Chuck Easttom: *Advanced JavaScript*. 3rd Edition, Jones & Bartlett Publishers, 2007, 616 p. ISBN 1598220330.
- Stoyan Stefanov: *Object-Oriented JavaScript: Create scalable, reusable high-quality JavaScript applications and libraries*. Packt Publishing, 2008, 356 p. ISBN 1847194141.
- Frank Zammetti: *Practical JavaScript, DOM Scripting and Ajax Projects.* Apress, 2007, 576 p. ISBN 1590598164.
- JavaScript Tutorial, http://www.w3schools.com/JS/
- Standard ECMA-262 - ECMAScript Language Specification http://www.ecma-international.org/publications/standards/Ecma-262.htm
- Wikipedia
  - JavaScript, http://en.wikipedia.org/wiki/JavaScript
  - JavaScript syntax, http://en.wikipedia.org/wiki/JavaScript_syntax
  - JSON, http://en.wikipedia.org/wiki/JSON
  - AJAX, http://en.wikipedia.org/wiki/Ajax_(programming)

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Content

- Language basics
  - variables
  - expressions, operators
  - statements
  - functions
- Object oriented programming in JavaScript
- JavaScript API
- DOM API
- Creation of applications in JavaSript, debugging
- Ajax, JSON

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JavaScript language

- Script language
  - Prototype based – object oriented approach
  - Dynamic
  - Weakly-typed
  - Functions as variable values – first-class value
  - Syntax similar with C, Java (not OOP parts)
- JavaScript is mostly used in web browser – client-side JavaScript
- *"Java is to JavaScript what Car is to Carpet"*

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History

- Created by Netscape as LiveScript
- Later renamed to JavaScript (Sun Microsystems) thanks to Java popularity
- March 1996 – Netscape Navigator 2.0
- August 1996 – Internet Explorer 3.0 JScript
- 1996 standard by ECMA - ECMAScript – 3 base dialects
  - JavaScript
  - ActionScript
  - JScript

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DOM – Document Object Model

- Object representation of document
- Allows for manipulation with document and provides platform-independend interface for interacting with document in web browser
  - travers document, find out its structure
  - modify document
  - catch events (e.g. click)
  - Interaction with web browser – window, frames, forms, status bar, history, navigation

JavaScript HelloWorld – internal script

```
<html>
  <head>
    <title>simple page</title>
  </head>
  <body>
    <script type="text/javascript">
       document.write('Hello World!');
    </script>
    <noscript>
      <p>Your browser either does not support
    JavaScript, or you have JavaScript turned
    off.</p>
    </noscript>
  </body>
</html>
```

JavaScript HelloWorld – external script

```
<html>
  <head><title>simple page</title></head>
  <body>
    <script type="text/javascript"
       src="test.js">
    </script>
    <noscript>
      <p>Your browser either does not support
    JavaScript, or you have JavaScript turned
    off.</p>
    </noscript>
  </body>
</html>
```

test.js

```
document.write('Hello World Other!');
```

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Language basics

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Comments

- Same as language Java (C, C++)
- One-line comment

```
// a short, one-line comment
```

- Multi-line comments

```
/* this is a long,
   multi-line comment,
   spanning multiple lines. */
```

- Embedding of comments is not supported – cannot put multi-line comment into another multi-line comment

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Variables

- Variable is named cell, which serves for storing a specified value
- Variable does not have defined type – weakly-typed system
- Value carries own type information
- One variable can store different types (not at once)
- Keyword `var` serves for declaration of variable with local scope

```
var variable = 3;
variable = "Jano";
variable = 3.8;
```

- Redeclaration of variable does not cancel its previous value

```
var x = 5;
var x;
```

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Identifiers

- JavaScript is **case sensitive** in names of identifiers
  - First character must be a letter or an underscore _
  - Next charactes can be a letter, number, underscore or number (0 to 9).
  - Identifier cannot be a reserved word (keyword)
- Variables mostly use lowercase letters, words are separated with “camel case” or underscores

```
number_of_digits
numberOfDigits
```

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Data types

- Primitive data types
  - **undefined** value
  - **null**
  - **Number**
  - **String**
  - **Boolean**
- Objects
- Arrays (specific type of object)

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Undefined type, Null type

- **Undefined** value
  - Declared, not assigned value

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

- Type **null**
  - Contains only one value – `null`
  - Value `null` is not from any other type

```
console.log(undefined == null) // true
console.log(undefined === null) //false
```

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Number type

- The only numerical type in Javascript for representation of integers and decimal numbers, IEEE-754 Double
- Literals for numbers

```
345
34.5
3.45e2
0377        octal notation
0xFF        hexadecimal notation
Infinity          positive infinity
-Infinity         negative infinity
NaN               Not a Number, e.g. after conversion
```

- Inaccuracy with big numbers

```
var a = 12345678901234567
console.log(a)
```

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String type

- String is a sequence of characters
- String literals

```
var s1 = "Hello, world!";
var s2 = 'Greetings';
var s3 = '"Hello!" he said.';
var s4 = 'Hello"; wrong!!!
```

- String is not changeable (immutable)
- Escape sequences for strings
  - \n \t \\ \' \"

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Boolean type

- Logical values
- Data type defines 2 values and appropriate literals
  - **`false`** and **`true`**
- It is not recommended to use numbers as logical values (as it is required in some other languages e.g. C language)

```
console.log(0 == false)   //true
console.log(1 == true)    //true
console.log(0 === false) //false
console.log(1 === true)   //false
```

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Operators

- Used in expressions
  - aritmetic
  - assignment
  - comparative
  - logic
  - bitwise
  - string

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Arithmetic operators

+	addition
–	subtraction
*	multiplication
/	division
%	remainder of division (modulo)
+	unary plus
–	unary minus
++	increment (prefix, postfix)
––	decrement (prefix, postfix)

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Assignment operators

=	assignment
+=	addition and assignment
-=	subtraction and assignment
*=	multiplication and assignment
/=	division and assignment
%=	modulo and assignment

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Comparison and logic operators

==	equals
!=	not-equals
>	larger than
>=	larger or equals than
<	lower than
<=	lower or equals than
===	equals and same type
!==	not equals or not same type
&&	logical conjunction (and)
||	logical disjunction (or)
!	logical negation

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Bitwise and string operators

&	bitwise and
|	bitwise or
^	xor
<<	shift left (adds zeroes)
>>	shift right (adds sign bit)
>>>	shift right (adds zeroes)
~	bit inversion (not)
+	string concatenation
+=	string concatenation and assignment

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Conditional operator

- Similar to *if...then...else*
- Result is a value

```
condition ? expression : expression
```

- Notation

```
result = (condition) ? expression :
   alternative;
```

- is equal with

```
if (condition)
   result = expression;
else
   result = alternative;
```

- Example

```
console.log(x > 6 ? "large" : "small");
```

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Special operators

- Operator `typeof` allows to determine type of value (variable)

```
var a = 10;
console.log(typeof a); //"number"
if (typeof a === "number") {. . .}
```

- Operator `instanceof` allows to determine if value is of some specific Object
- Operator `void` evaluates any expression to `undefined` value, effectively discarding expression's return value

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Comparison of types in JS - problems ahead

Always use === for comparison of any type

use of == is more dangerous - automatic type casting!!!

```
'' == '0'                  // false
0 == ''                 // true
0 == '0'                   // true
false == 'false'           // false
false == '0'               // true
false == undefined // false
false == null              // false
null == undefined          // true
' \t\r\n ' == 0 // true
```

Javascript type conversion explained

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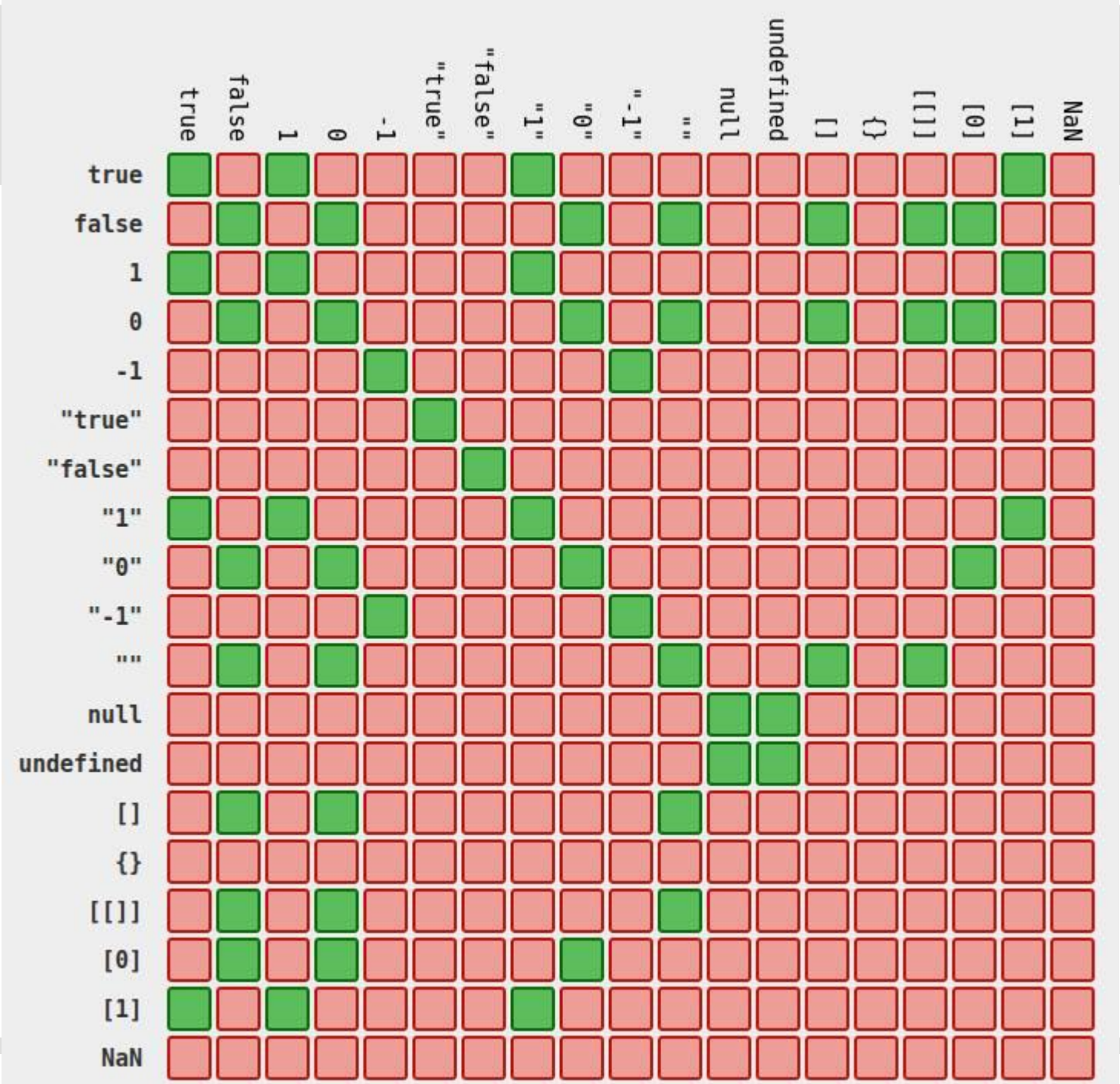
Equality table



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Statements

- Usage of semicolon at the end of each statement is recommended but not required when each statement is on own line
- Block of statements (sequence of statements) can be created with curly brackets `{ a }`
- Example

```
{
   var x;
   x = 7 + x;
   document.write(x);
}
```

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Statement `if`

- Conditional statement

```
if(expression)
   statement
```

- If `expression` is evaluated as `true` value then `statement` is executed
- Example

```
if (x <= 10)
   document.write("small");
```

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Statement `if...else`

- Conditional statement with `else` branch

```
if(expression)
   statement1
else
   statement2
```

- If `expression` is evaluated to `true` value than `statement1` is executed otherwise `statement2` is executed
- Example

```
if (x <= 10)
   document.write("small");
else
   document.write("large");
```

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Loop statement `while`

- Loop statement with condition specified at the beginning

```
while (expression)
    statement
```

- `statement` is executed as long as specified condition (`expression`) is evaluated to `true`
- Example

```
var i = 0;
while (i < 10) {
    document.write("*");
    i++;
}
```

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Loop statement `do...while`

- Loop statement with condition specified at the end

```
do
    statement
while (expression)
```

- `statement` is executed at least once and as long as a specified condition (`expression`) is evaluated to `true` value
- Example

```
var i = 0;
do {
    document.write("*");
    i++;
} while (i < 10);
```

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Loop statement `for`

- Loop statement

```
for (initial; condition; operation)
    statement
```

- Shorter and more advanced version of `while`. Before loop starts statement `initial` is executed and after each iteration statement `operation` is executed
- Example

```
for (var i = 0; i < 10; i++)
 document.write("*");
```

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Loop statement `for...in`

- Loop statement

```
for (var prop-name in object-name)
    statement using object-name[prop-name];
```

- Statement for iterating over all items of array or properties of object
- Example

```
var x = [1, 2, 3, 5, 7, 9];
for (var i in x) {
    document.write(x[i]);
}
```

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Statements
`break` and `continue`

- Statement `break` ends execution of any loop or `switch` statement. It "jumps out" of a loop.

```
var i = 0;
for(;;){
    if (i == 5)
        break;
    i++;
    document.write(i);
}
```

- Statement `continue` breaks one iteration and continues with the next iteration in the loop
- With `labels` it is possible to ends any block or loop in the code.

```
label: statement
```

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Statement `switch`

- `switch` statement is used to perform different action based on different conditions.

```
var theDay = 3;
switch (theDay)
{
case 5:
  document.write("Finally Friday");
  break;
case 6:
  document.write("Super Saturday");
  break;
case 0:
  document.write("Sleepy Sunday");
  break;
default:
  document.write("I'm looking forward to this
   weekend!");
}
```

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Statement `try...catch...finally`

- Errors will happen! ☺
- Catching errors in block

```
try {
  console.log(x); //error
} catch (err) {
  alert(err.description);
} finally {
  console.log("Always done");
}
```

- If there is an exception during execution of `try` block it is possible to react with statements inside `catch` block
- Block `finally` is optional part but is executed always

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Statement `throw`

- Statement for propagation of exception (error)

  ```
  throw expression
  ```

- Value of `expression` can be String, Number, Boolean or Object
- Example

```
try {
  throw "error";
} catch (e) {
  console.log(e);
}
```

- Exception is propagated to the exception handler block in the opposite direction of function calls

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Statement `with`

- Statment `with` allows to set predefined object on which next statements will be executed
- NOT RECOMMENDED to use as it introduces confusion and some bugs
- Example

```
with(document) {
    var a = getElementById('a');
    var b = getElementById('b');
    var c = getElementById('c');
};
```

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Dialog box

- Alert Box

```
alert("I am an alert box!");
```

- Confirm Box

```
var r = confirm("Press a button");
if (r == true)
    document.write("Pressed OK!");
else
    document.write("Pressed Cancel!");
```

- Prompt Box

```
var name = prompt("Enter your name",
   "Bond");
if (name != null && name != "")
  document.write("Hello " + name);
```

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Function

- Function is a parametrized block of statements
- Function has a body (usually not empty block os statements) and list of arguments (can be empty)
- In case that function is not ended with `return` statement the returned value is `undefined`
- Example

```
function sum(x, y) {
  return x + y;
}

console.log(sum(2, 3));
```

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Variables – local and global

```
x = 0; //A global variable
var y = 'Hello!'; //A global variable

function f(){
  var z = 'foxes'; //A local variable
  twenty = 20; //twenty is global
     //because declared without var
  return x; //x here is global
}

// The value of z is no longer available
f();  //Call function f
var f = twenty; //twenty is global
```

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Closures

- Inner function can use „hidden“ data from outer (parent) function
- Usefull for data hiding

```
var digit_name = function() {
  var names = ["zero", "one", "two",
   "three", "four", "five", "six", "seven",
   "eight", "nine"];

  return function(n) {
     return names[n];
  };
}();

alert(digit_name(3)); // "three"
```

Automatic semicolon

- Javascript adds semicolon at the end of line when error

```
return
{
    ok: false
};
```

Bad style
bad results

```
return;
{
    ok:
false;
}
```

```
return {
    ok: false
};
```

Correct style,
correct result
☺

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Test your code

- Javascript allows many bad practices in code
- Try to avoid them by using practices recommended by developers
  - Test your code: http://www.jslint.com/

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Object oriented programming in JavaScript

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Objects

- Object oriented programming is based on prototypes (slots)
- Object – structure of **data and functions**
- Variables of object = field or property

  `objectReference.propertyName`

  or

  `objectReference["propertyName"]`
- Functions of object – methods

  `objectReference.methodName([arguments])`

  resp.

  `objectReference["methodName"]([arguments])`
- Example

```
document.write("hello!")
document["write"]("hello!")
```

Constructors and creation of objects

- Constructor is a special function for defining default values of created object
- Keyword `this` – reference to actual object – object on which the method was called

```
function Student(name, age)
{
  this.name = name;
  this.age = age;
}

var student1 = new Student("Jano", 16);
console.log(student1.name
   + " " + student1.age);
```

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Removing objects

- Performed automatically – garbage collector
- Can be deleted manually with `delete`

```
var student1 = new Student("Jano", 16);
console.log(student1.name + " " + student1.age);

student1.nick = "John";
console.log(student1.name + " " +
   student1.nick);

delete student1.nick;
console.log(student1.nick);

delete student1;
```

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Function as a value

- Function is also a value and can be assigned to variable

```
function sum(x, y) {
  return x + y;
}

var f1 = sum;

var f2 = function (x, y) { return x + y; }

console.log("sum " + sum(2,3));
console.log("f1 " + f1(2,3));
console.log("f2 " + f2(2,3));
```

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Definition of method

- Method is a function on object

```
function displayStudent()
{
    var result = "";
    result += this.name + " - " + this.age;
    result += "<BR>";
    document.write(result);
}

function Student(name, age)
{
    this.name = name;
    this.age = age;
    this.display = displayStudent;
}

var student1 = new Student("Jano", 16);
student1.display();
```

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Inheritance

- Inheritance is realized using the prototypes
- Each object has property `prototype`

```
function Base() {
  this.anOverride = function() {};

  this.aBaseFunction = function() {};
}

function Derive() {
  this.anOverride = function() {};
}

var base = new Base();
Derive.prototype = base;
var der = new Derive();
der.aBaseFunction();
```

Objects – literals

- Objects are represented as associative array (map) – named slots

```
var student1 = {
   "name" : "James",
   age : 33,
   nick : "Bond"
};

console.log(student1.name + " " +
   student1.age);

console.log(student1["name"] + " " +
   student1["age"]);
```

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JavaScript API

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Global object

- Created before first script execution
- Reserved values
  `NaN, Infinity, undefined`
- Evaluation of string as script (NOT SAFE)
  `eval (x)`
- Transformation of string to number
  `parseInt(string, radix), parseFloat(string)`
- Testing number for specific value: NaN, Infinity
  `isNaN(number), isFinite(number)`
- URI manipulation
  `decodeURI(encodedURI), encodeURI(uri)`
- Constructors for predefined object types
  `Object, Function, Array, String, Boolean, Number, Date, RegExp`
- Object for mathematic operations
  `Math`

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Arrays

- Array is structured data type
- The individual items are accessed using the index (0 … array size - 1)

```
var myArray = [];
myArray.push("hello world");
alert(myArray[0]);
alert(myArray.length);
myArray[100] = 88;
alert(myArray[100]);
alert(myArray.length);
```

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`Array` object prototype

- Length of the array
  `length`
- Conversion to string
  `toString()`
- Taking out the last element of the array
  `pop()`
- Inserting element to the end of the array
  `push(`*`item`*`)`
- Joining arrays to one array (concatenation)
  `concat([`*`item1`*`[, `*`item2`*`[, … ]]])`
- Joining elements of array to String, each element is separated by specified separator
  `join(`*`separator`*`)`
- Changing the order of elements in the array to oppossite
  `reverse()`
- Taking out the first element of the array
  `shift()`

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`Array` object prototype

- Selecting part of the array - sub-array
  `slice(start, end)`
- Inserting elements to the front of the array
  `unshift([item1[, item2[, …]]])`
- Getting the first index of specified element in the array
  `indexOf(searchElement[, fromIndex])`
- Getting the last index of specified element in the array
  `lastIndexOf(searchElement[, fromIndex])`
- Testing each element of the array to fulfill the predicate
  `every(callbackfn[, thisArg])`
- Testing elements of the array if at least one fulfulls the predicate
  `some(callbackfn[, thisArg])`
- Executing action for each element of the array
  `forEach(callbackfn[, thisArg])`

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`Array` object prototype

- Filter elements which fulfill to predicate
  `filter(callbackfn[, thisArg])`
- Mapping elements of the array to new array
  `map(callbackfn[, thisArg])`
- Reduces elements of array to single value
  `reduce(callbackfn[, initialValue])`
- Reduces elements starting from last element
  `reduceRight(callbackfn[, initialValue])`
- Callback functions should be in form
  `function(item, index, object)`
  or for `reduce`, `reduceRight`:
  `function(previousItem, actualItem, index, object)`

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Object representing arguments

- It is possible to create function with variable number of arguments
- Array contains all arguments, which have been used for calling the function

```
function test() {
  console.log("len = " + arguments.length)

  for(var i = 0; i < arguments.length; i++) {
     console.log("item" + i + " = "
          + arguments[i]);
    }
}

test(1,2,3);
```

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`String` object prototype

- Length of string

  `length`
- Getting the character from position

  `charAt(`*`pos`*`)`
- Joining (concatenation) of strings

  `concat([`*`string1`*`[, `*`string2`*` [, …]]])`
- Getting the first starting index of substring in string

  `indexOf(`*`searchString`*`, `*`position`*`)`
- Getting the last starting index of substring in string

  `lastIndexOf(`*`searchString`*`, `*`position`*`)`

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`String` object prototype

- Getting substring from string

  `substring(`*`start, end`*`)`
- Transforming string to lowercase letters

  `toLowerCase()`
- Transforming string to uppercase letters

  `toUpperCase()`
- Spliting string to substrings according to defined separator; result is an array of strings

  `split(`*`separator[, limit]`*`)`

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`Number` object prototype

- Greatest positive number
  `Number.MAX_VALUE`
- Lowest positive number
  `Number.MIN_VALUE`
- Not a Number
  `Number.NaN`
- Negative infinity
  `Number.NEGATIVE_INFINITY`
- Positive infinity
  `Number.POSITIVE_INFINITY`
- Transformation to string with optional radix specification
  `toString([radix])`
- Transformation to localized string
  `toLocaleString()`
- Transformation to string with fixed numbers of digits after floating point
  `toFixed(fractionDigits)`

`Math` object

- Mathematic functions and constants

```
Math.PI, Math.E
Math.abs(v)
Math.ceil(v), Math.round(v),
Math.floor(v)
Math.pow(v1, v2), Math.sqrt(v)
Math.sin(v), Math.cos(v),
Math.tan(v)
Math.random()
Math.max([value1[, value2[, … ]]])
Math.min([value1[, value2[, … ]]])
```

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`Date` object prototype

- Working with date and time
- Constructor

```
new Date([year, [month [, date
[, hours [, minutes [, seconds
[, ms ]]]]]]])
```

- Conversion to string

```
toString(), toDateString(),
toTimeString(),
toLocaleString(),
toLocaleDateString(),
toLocaleTimeString()
```

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RegExp objects

- Serves for testing string conformity to defined pattern (regular expression)
- Designed according to Perl regular expressions
- Regular expressions in JavaScript can be written in form of literals in form:

```
/pattern/modifiers
```

- Example

```
var r = /[0-9]+/g;
var s = "abc12def345gh";
//["12", "345"]
console.log(s.match(r));
```

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Regular expressions – modifiers, properties

- Modifiers (flags)
  - `g` – global – next execution uses last position (without this flag it starts from beginning)
  - `m` – multiline – changes behavior for beginning and end of line to allow more lines to match between characters ("^" and "$")
  - `i` – ignoreCase – ignores letter size
- Vlastnosti
  - `source` – original regular expression
  - `lastIndex` – last checked index of matching operation

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Regular expressions

[abc]	only character a or b or c
[^abc]	every character but a, b, c
[a-zA-Z]	a to z or A to Z
^	Line start
$	Line end
X?	X once or not at all
X*	X zero, once or multiple times
X+	X once or multiple times
X{n}	X exactly n-times
X{n,}	X at least n-times
X{n,m}	X at least n-times and maximum m-times
XY	X following with Y
X|Y	X or Y
(X)	capturing group
(?:X)	non-capturing group
\d \D \w \W\s \S	predefined character sets

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JavaScript Timers

- `setTimeout`
  - Execute operation **once** with a delay
  - `setTimeout (expression, timeout);`
  - returns ID – can be used to cancel with `clearTimeout(ID);`
- `setInterval`
  - Execute operation in loop in specified interval
  - `setInterval (expression, interval);`
  - returns ID – can be used to cancel with `clearInterval(ID);`

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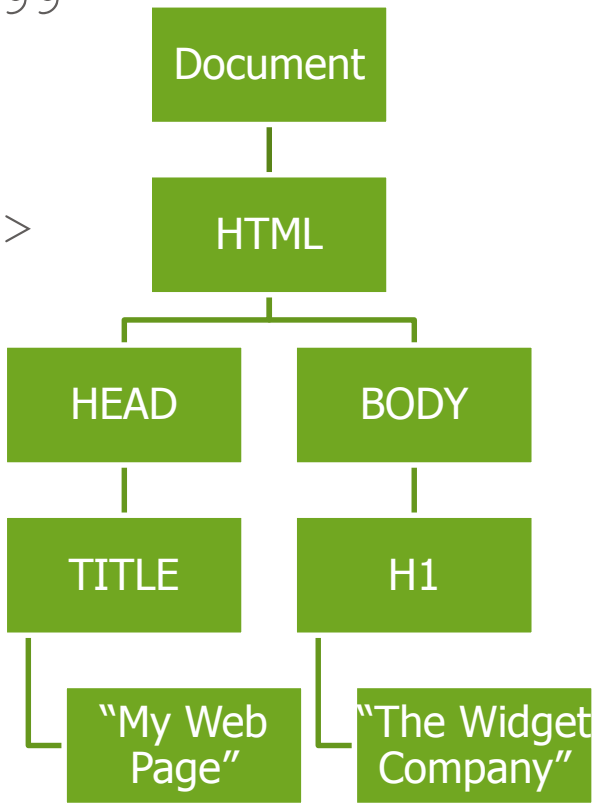
Document Object Model

Example of DOM of HTML

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0
    Strict//EN"
    "http://www.w3.org/TR/xhtml1/DTD/xhtml1-
    strict.dtd">
<html
    xmlns="http://www.w3.org/199
    9/xhtml" xml:lang="en"
    lang="en">
  <head>
    <title>My Web Page</title>
  </head>
  <body>
    <h1 class="intro">The
   Widget Company</h1>
  </body>
</html>
```



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Events and processing of events

- Every element in documents can create set of events, which can used as trigger for executing Javascript code
- Using the attribute of element it is possible to define code, which will be executed in case of event – event handler
- Examples of events
  - mouse button pressed
  - mouse movement over the element
  - selecting an item from list
  - pressing a button on keyboard
  - sending a form

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Types of events

- `onabort` – Interuption of image loading
- `onblur` – Loosing the focus on an element
- `onchange` – Change of value in an element
- `onclick` – Mouse button click
- `ondblclick` – Mouse button double click
- `onerror` – Error during loading of page or image
- `onfocus` – Getting the focus on an element
- `onkeydown` – Keyboard key went down
- `onkeypress` – Keyboard key was pressed (and released)
- `onkeyup` – Keyboard key was released
- `onload` – Successful loading of page or image

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Typu udalostí

- `onmousedown` – Mouse button pressed
- `onmousemove` – Mouse moved
- `onmouseout` – Mouse cursor left an element
- `onmouseover` – Mouse cursor went over an element
- `onmouseup` – Mouse button released
- `onreset` – Reset button pressed (on form)
- `onresize` – Window size changed
- `onselect` – Text selected
- `onsubmit` – Form submitted
- `onunload` – Leaving the web page

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Handling the event – example

```
<html>
<head>
<script type="text/javascript">
function upperCase() {
 var x = document.getElementById("fname").value
 document.getElementById("fname").value = x.toUpperCase()
}
</script>
</head>

<body>
    Enter your name:
    <input type="text" id="fname" onblur="upperCase()">
</body>
</html>
```

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Events `onload` and `onunload`

- Are created when user opens(leave) page
- `onload`
  - handling browser detection
  - initialization settings
  - reading/setting of cookies
- `onunload`
  - setting of cookies

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Event `onsubmit`

- Handling of this event is mostly to validate data for submittion
- Return value can be
  - true – if form was validated successfully and can be submitted to server
  - false – if form didn't pass validation and won't be submitted to server

```
<form method="post"
  action="cde.html"
  onsubmit="return checkForm()">
```

CDE Services

HTML DOM

- HTML DOM defines standard set of objects for representation and manipulation of HTML document
- Every part of HTML is accessible through DOM also with content and attributes
  - Everything can be changed
- HTML DOM is interface not dependent on any language
  - We are using Javascript, but it is possible to use DOM even with other languages as VBScript, Java etc.

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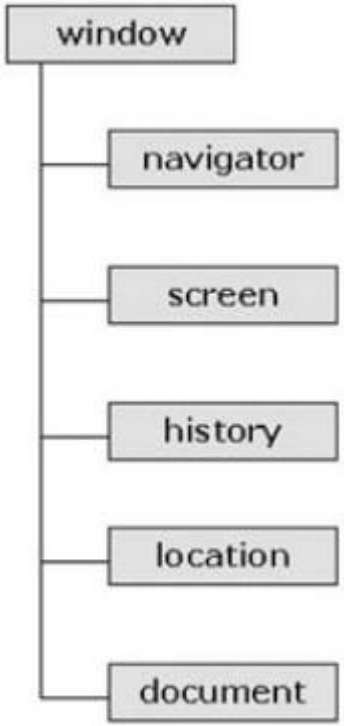
DOM object types

- Anchor
- Document
- Event
- Form
- Frame, Frameset, IFrame
- Image
- Location
- Navigator
- Option a Select
- Screen
- Table, TableHeader, TableRow, TableData
- Window object



Getting HTML object with identifier

- Every HTML object with unique identifier can be accessed using following method

  `document.getElementById()`
- Returns one object (element)

```
function getElement() {
    var x = document.getElementById("myHeader");
    alert("I am a " + x.tagName + " element");
}
```

```
<h1 id="myHeader" onclick="getElement()">Click
    to see what element I am!</h1>
```

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Getting HTML object by name inside form

- Objects with specified name (usually inside form) can be accessed with following method `document.getElementsByName()`
- Returns multiple objects (elements)

```
function getElements() {
    var x = document.getElementsByName("myInput");
    var message = "Count = " + x.length + "\n";
    for(var i = 0; i < x.length; i++) {
        message += "Value = " + x[i].value + "\n";
    }
    alert(message);
}

<input name="myInput" type="text" size="20"><br />
<input name="myInput" type="text" size="20"><br />
<input name="myInput" type="text" size="20"><br />
<br />
<input type="button" onclick="getElements()"
    value="Test it">
```

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Getting and modifying the content of element

- DOM object property `innerHTML` can be used to fully manipulate HTML code inside of this element

```
function changeContent() {
    var element =
        document.getElementById("testDiv");
    alert(element.innerHTML);
    element.innerHTML =
        "<h1>This is new content</h1>";
}

<div id="testDiv">
    This is default value.
</div>

<input type="button" onclick="changeContent()"
    value="Test it">
```

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Forms

- Forms are accessible through its name, same applies to subelements – possible to use dotted notation
- Property `value` contains actual value of `input` element

```
function validate() {
    var fname = document.testForm.fname.value;
    var age = document.testForm.age.value;
    var email = document.testForm.email.value;
    //Do validation
}

<form name="testForm" onsubmit="return validate()">
    Name (max 10 chararcters):
    <input type="text" id="fname" size="20"><br />
    Age (from 1 to 100):
    <input type="text" id="age" size="20"><br />
    Email:
    <input type="text" id="email" size="20"><br />
    <br />
    <input type="submit" value="Submit">
</form>
```

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DOM

- Everything is DOM node
  - Document
  - Elements
  - Attributes
  - Text
  - Comments (in HTML)
- Watch out for whitespaces
  - also text node

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DOM – properties of nodes

- Every DOM node contains properties
  - `nodeType`
    - It is number representing type of node (element, attribute, text...)
  - `nodeName`
    - Name of node, e.g. name of `h1` element is `"H1"`
  - `nodeValue`
    - Value of node, for elements it is `null`, for textual nodes it is textual content, for attributes it is value assigned to attribute

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DOM – node types (constants)

Value	Constant
1	**Node.ELEMENT_NODE**
2	**Node.ATTRIBUTE_NODE**
3	**Node.TEXT_NODE**
4	Node.CDATA_SECTION_NODE
5	Node.ENTITY_REFERENCE_NODE
6	Node.ENTITY_NODE
7	Node.PROCESSING_INSTRUCTION_NODE
8	**Node.COMMENT_NODE**
9	**Node.DOCUMENT_NODE**
10	Node.DOCUMENT_TYPE_NODE
11	Node.DOCUMENT_FRAGMENT_NODE
12	Node.NOTATION_NODE

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DOM – relations between nodes

- Every node has property for accessing related nodes
  - `childNodes`
  - `firstChild`
  - `lastChild`
  - `nextSibling`
  - `previousSibling`
  - `parentNode`
- Attibutes can be accessed by
  - property `attributes`
  - `getAttributeNode(name);` //node
  - `getAttribute(name);` //value

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Changing DOM - adding

- Adding element to DOM
  - `elementVar = document.createElement( tagName );`
  - `element.appendChild( elementVar );`
    - Adds element to end of parent element
- Example:

```
var welcome = document.getElementById( "welcome" );
var horizRule = document.createElement( "hr" );
var paragraph = welcome.firstChild;
welcome.insertBefore( horizRule, paragraph );
```

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Changing DOM

- Removing an element
  - `removedElement = element.removeChild( elementToRemove );`
- Replacing an element
  - Remove + add on the same place
  - `element.replaceChild(newElem, oldElem);`
- Example

```
var welcome = document.getElementById( "welcome" );
var horizRule = welcome.lastChild;
var newPara = document.createElement( "p" );
newPara.appendChild( document.createTextNode( "Feel free to have a browse." ) );
welcome.replaceChild( newPara, horizRule );
```

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Changing DOM

- Element can be only on one place in DOM
- Moving element
  - Getting element from its place
  - Inserting element to new place
  - Element is automatically moved to the new place – removed from the previous place

```
<ul>
  <li id="widget1"><a
    href="superwidget.html">SuperWidget</a></li>
  <li id="widget2"><a
    href="megawidget.html">MegaWidget</a></li>
  <li id="widget3"><a
    href="wonderwidget.html">WonderWidget</a></li>
</ul>

var superWidget = document.getElementById( "widget1" );
var ul = superWidget.parentNode;
ul.appendChild( superWidget );
```

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Changing attributes in DOM

- `Att = getAttributeNode( name );`
  - `Att.value`
- `document.createAttribute( attributeName );`
- `element.setAttributeNode( attributeNode );`
- `element.removeAttributeNode( attributeNode );`
- Shorter and cleaner way
  - `element.setAttribute( name, value );`
  - `element.removeAttribute( name );`

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JSON

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JSON

- **JSON** - JavaScript Object Notation
- Format for exchange of structured data
  - Textual – easy to read
  - Easy processing
  - Language independent
  - Subset of ECMAScript – object literals
- http://www.json.org/
- http://www.json.org/json2.js
- JSON is subset of YAML

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Data types

- Simple data types: string, number, boolean
- Structured data types
  - arrays
  - objects
- Does not allow to serialize cyclic structures

```
{
   "name" : "James Bond",
   "age" : 33,
   "agent" : true,
   "hobbies" : ["cars", "women"]
};
```

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Serialization – object to JSON text

- Transformation of Javascript values (objects) to JSON
  - It skips functions

```
var str =
  JSON.stringify(object);
```

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Deserialization – JSON text to object

- Transformation of JSON text to object/array

```
try {
   object = JSON.parse(str);
} catch(e) {
   //catch parsing exception
}
```

- Transformation with `eval` function is dangerous !

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HTML5

Dominik Lakatoš

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HTML revisited

- HTML5 is combination of
  - HTML
  - CSS
  - Javascript
- New features
  - Canvas – for drawing
  - Local storage – small browser database for each page
  - Video – play and control video
  - Manipulate history
- Great further reading: http://diveintohtml5.info/
  - Games: http://bombermine.com, http://play-ttd.com/

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Dominik Lakatoš

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Features of jQuery

- **Javascript library**
- **Cross browser support**
- DOM manipulation made easy
- Reuse CSS selector knowledge
- Change CSS / classes simply
- Great AJAX support
- Easy to learn and adapt
- Extensible – plenty of plugins
- NOT for static pages

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jQuery

- http://jquery.com/

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Include jQuery

Online

```
<html>
 <head>
   <script
     src="http://code.jquery.com/jquery-
1.10.2.min.js">
   </script>
 </head>
 <body>
   …
 </body>
</html>
```

Downloaded

```
<script src="jquery-1.10.2.min.js"></script>
```

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jQuery selectors

- Similar to CSS3 selectors + added functionality
- Use `$("selector")` function
  - `$` is function name (shortcut for `jQuery`)
- Returns set of corresponding elements
  - jQuery functions works natively on set of elements
- Example (jQuery selector API) :

`$("h2")` – get elements by tag name

`$("#tagId")` – get elements by ID

`$(".className")` – get elements by class name

`$("h1.title")` – any combination

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Example – jQuery works on sets

- Change of innerHTML for all <p> elements
- Classical Javascript

```
  var elementy =
document.getElementsByTagName("p");
  for (var i=0; i < elementy.length; i++) {
    elementy[i].innerHTML = "zmeneny text";
   }
```

- jQuery

```
$("p").html("zmeneny text");
```

jQuery after load

- Running JS after page has loaded
  - Cannot change DOM before finished loading
  - Have to wait to draw full web page

```
$(document).ready(function()
{
    console.log("ready!");
});
```

alebo

```
$(function() {…});
```

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Attributes

- Get and set usually use the same function with different parameters
- Example
  - Get attribute:

```
var a =
$("h2").attr("name");
```

  - Set attribute:

```
$("h2").attr("name","value")
;
```

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Class specific attributes

- Class specific attributes

```
$("selector").hasClass("className");
$("selector").removeClass("className");
$("selector").toggleClass("className");
```

- Access HTML content

```
//get data
 $("selector").html();
 //set html
$("selector").html("html
```

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Events and animations

- Event binding and unbinding

```
$("selector").on("click",
    function(){
    //do something
 });
```

or (some events have shortcuts names)

```
$("selector").click(function…);
```

- Simple animations

```
$("selector").show(speed);
$("selector").hide(speed);
```

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For each

Every next one element will have bigger border

```
var border = 1;
$("selector").each(function(
){
    $(this)

.css("border",border+"px");
    border += 1;
});
```

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Too big API to show all ☺

- jQuery API is quite big
- It can change a little bit with new versions
- Always try to be up to date
- Take a look for what you need
- http://api.jquery.com/

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jQuery UI

- Standalone project with UI components
- Use for rapid prototyping of nice simple UI
- http://jqueryui.com/

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AJAX

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Basic (old) web applications

- **"Press, wait, display"**
  - Every communication with server means reloading of full page
  - **Synchronous communication – request + response**
  - User is forced to wait for response and reload of page
- **Page oriented**
  - Navigation between pages is mostly done by server
- **Loss of context on reload**
  - Page scroll, filled input fields
- **No immediate feedback** for user activity
  - Need to wait for page refresh
- **Low number of control elements**

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Rich Internet Applications

- RIA – Rich Internet Application
- Web applications with properties and functionality of desktop applications
- RIA technologies
  - Java Applet
  - Adobe Flex
  - Java WebStart
  - DHTML
  - Silverlight (Windows only)
  - JavaFX (Java Platform)
  - **AJAX**

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AJAX

- AJAX – Asynchronous JavaScript and XML
- Examples of usage
  - Validation of input on server during filling of form
  - Autocomplete of forms
  - Advanced controls
  - **Dynamic change of part of page** without any page refresh and redrawing of all page content

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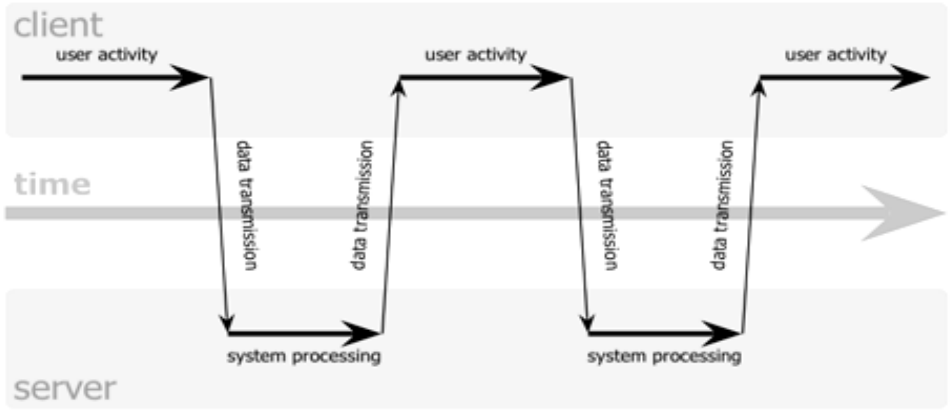
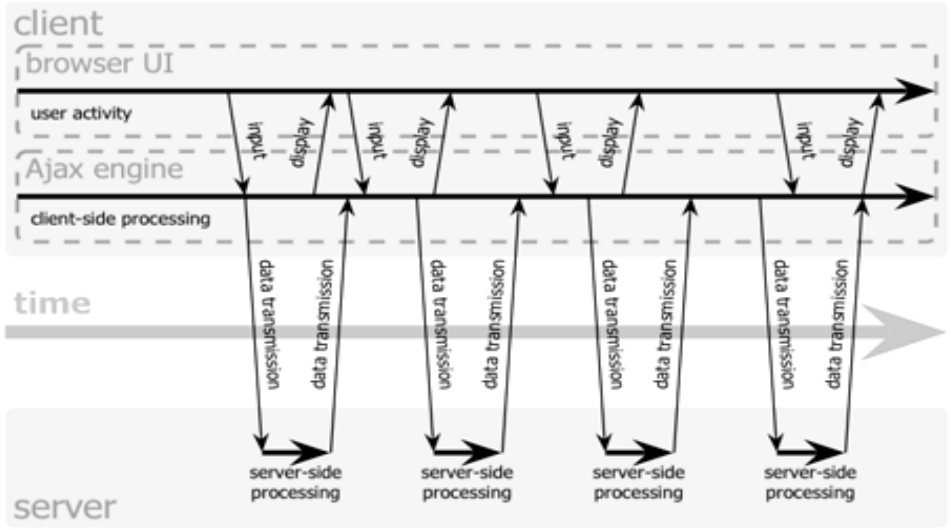
Classic vs. AJAX communication model

classic web application model (synchronous)



Ajax web application model (asynchronous)



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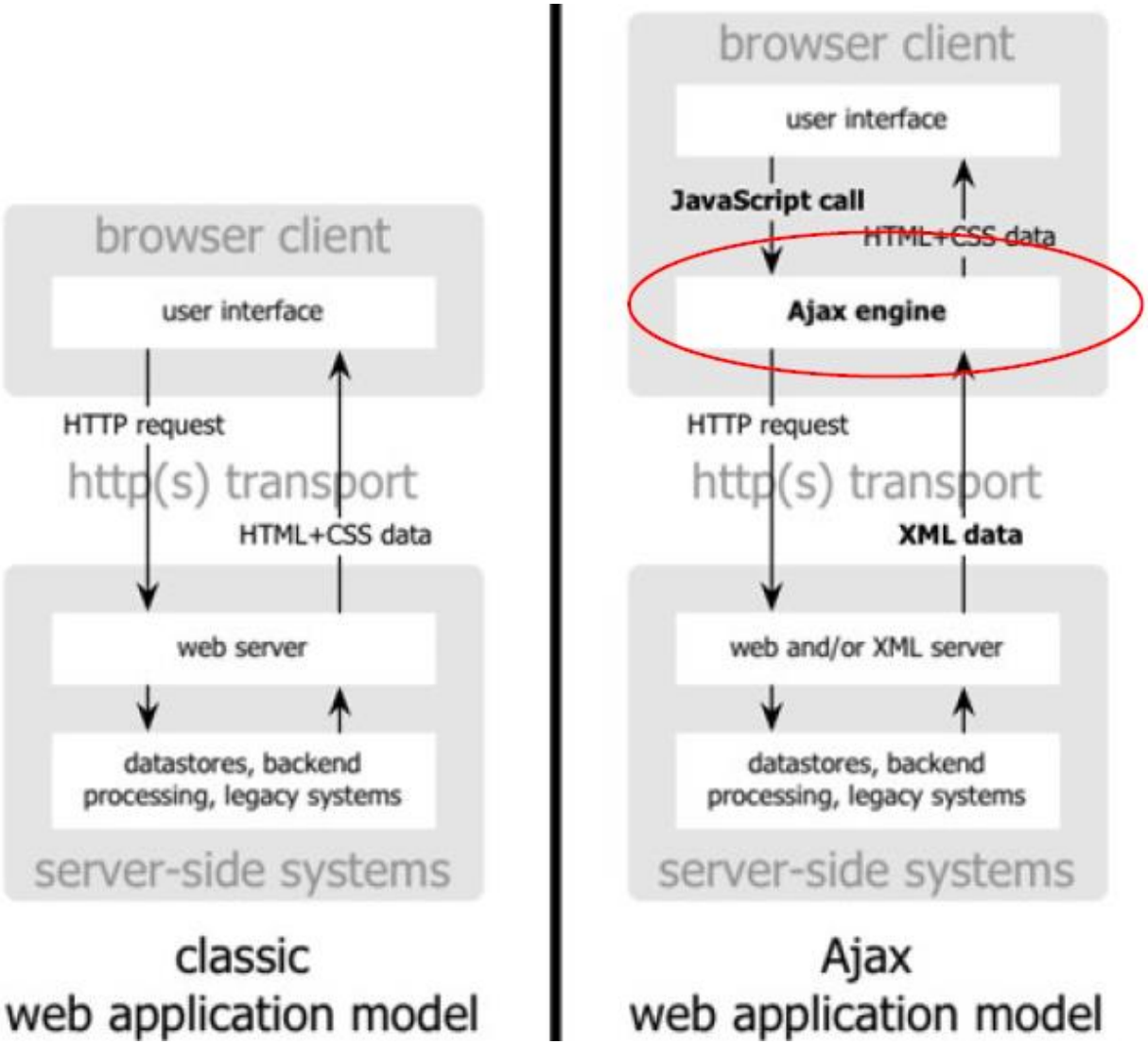
Classic vs. AJAX communication model



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Technologies used in AJAX

- HTML (XHTML)
- CSS
- XML
- Document Object Model (DOM)
- JavaScript
- JavaScript Object Notation (JSON)
- HTTP
- **XMLHttpRequest** (Javascript object type)

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XMLHttpRequest

- JavaScript objekt
- Supported by actual web browsers
- Serves for communication with server though standard HTTP protocol
  - GET/POST methods
- Communication with server can be executed in background – asynchronously
- Does not interrupt user actions
- MIME type of response from server
  - text/xml
  - text/plain
  - text/json
  - text/javascript

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XMLHttpRequest methods

- `open("HTTP metóda", "URL", asyn)`
  - specification of HTTP method, target URL, mode of transfer – asynchronously (true/false)
- `send(content)`
  - Sends request to server
- `abort()`
  - Cancel request
- `getAllResponseHeaders()`
  - Getting reponse headers
- `getResponseHeader("label")`
  - Getting specific response header
- `setRequestHeader("label", "value")`
  - Setting request header value

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XMLHttpRequest properties

- `onreadystatechange`
  - Javascript function, which will be executed on each change of state
- `readyState`
  - contains actual state of request
    - 0 = uninitialized
    - 1 = loading
    - 2 = loaded
    - 3 = interactive (some data have been returned)
    - 4 = complete
- `status`
  - HTTP status code returned by server (200 = OK)
- `responseText`
  - String containing response from server
- `responseXML`
  - XML document representing response data from server (only if data was sent in XML type)
- `statusText`
  - Textual description of server status code

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Example – request creation

```
if (window.XMLHttpRequest) {
  request = new XMLHttpRequest();
} else if (window.ActiveXObject) {
  request = new
      ActiveXObject("Microsoft.XMLHTTP");
}

var url = "./person";
request.onreadystatechange = processRequest;
request.open("GET", url, true);
request.send(null);
```

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Example – response processing

```
function processRequest() {
   if (request.readyState == 4) {
      try{
         if (request.status == 200) {
           var message = request.responseText;
           //Handle message
         }
      } catch (e) {
         //Error
      }
   }
}
```

CDE Services

jQuery AJAX

```
$.ajax({
  url: "/api/getWeather",
  data: {
    zipcode: 97201
  },
  success: function( data ) {
     $( "#weather-temp" ).html( "<strong>" +
   data +
                                "</strong>
   degrees" );
  }
});
```

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☺

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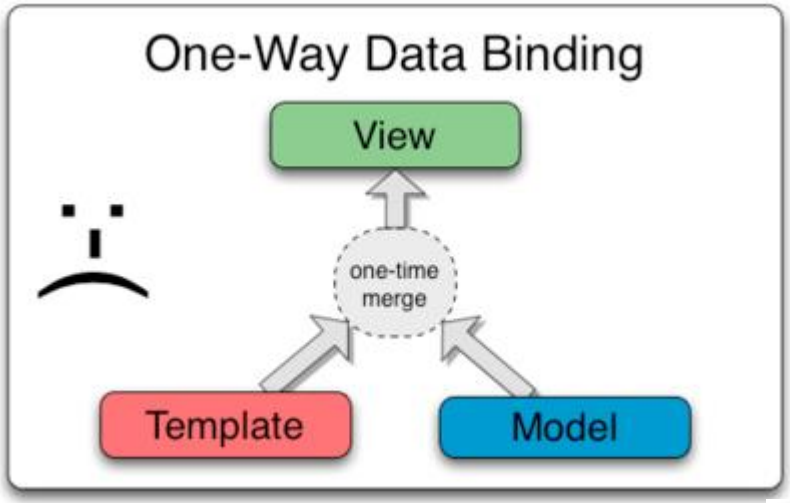
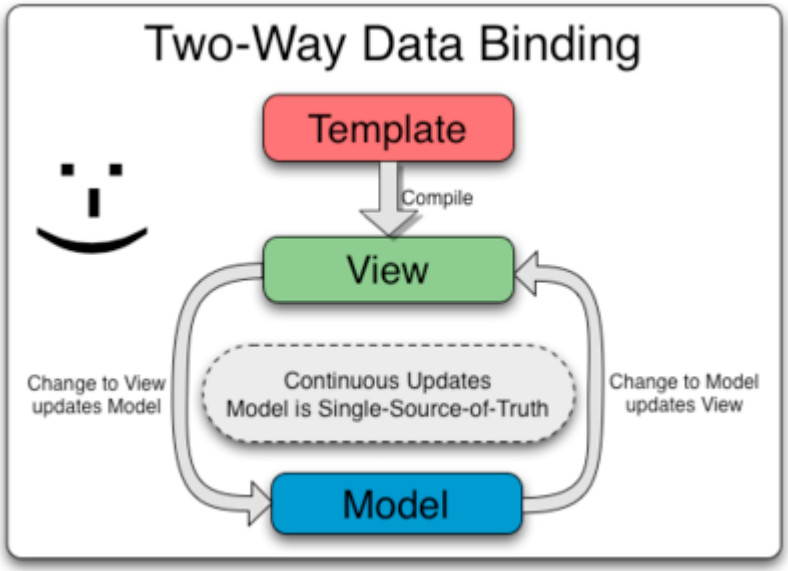
ANGULARJS

by Google

- Frontend web framework
- Templating system with working bidirectional binding
- Uses jQuery subset - jQLite
- Don’t reinvent the wheel, use existing directives of Angular for DOM manipulation
- Take a look: http://angularjs.org/

AngularJS Data Binding





- http://docs.angularjs.org/guide/

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You can also try

BACKBONE.JS