

Web 2.0

Lecture 1: Introduction to JavaScript

doc. Ing. Tomáš Vitvar, Ph.D.

tomas@vitvar.com • @TomasVitvar • <http://vitvar.com>



Czech Technical University in Prague

Faculty of Information Technologies • Software and Web Engineering • <http://vitvar.com/courses/w20>



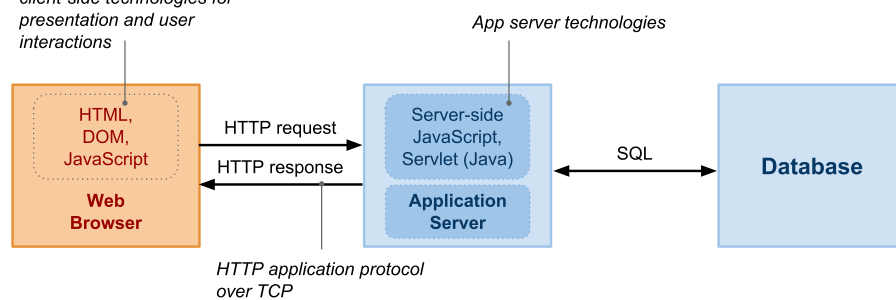
Evropský sociální fond
Praha & EU: Investujeme do vaší budoucnosti

Modified: Tue Feb 20 2018, 11:09:05
Humla v0.3

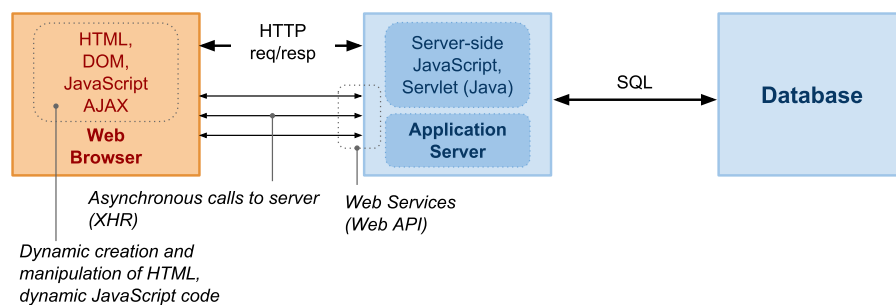
Web 2.0 Application Architecture

Web Application

client-side technologies for presentation and user interactions



Web 2.0 Application



JavaScript

- Lightweight, interpreted, object-oriented language
- Standard
 - *Current stable release is ECMAScript 2017 (standard ECMA-262)*
- Major characteristics
 - *First-class functions*
 - *functions as first-class citizens*
 - *language supports: passing functions as arguments to other functions, returning functions as values from other functions, assigning functions to variables or storing them in data structures.*
 - *Anonymous functions*
 - *declared without any named identifier to refer to it*
 - *Closures*

Overview

- **JavaScript Basics**
- Server-side JavaScript

Objects and Arrays

- Objects and Arrays

```
1 // objects - key/value pairs
2 var obj = { name: "Tomas", "main-city" : "Innsbruck", value : 3 };
3 obj.name = "Peter"; // assign the name property another value
4 obj["main-city"] = "Prague"; // another way to access object's values; it's not an array
5
6 // arrays
7 var a = ["Tomas", "Peter", "Alice"];
8 for (var i = 0; i < a.length; i++)
9     // do something with a[i]
10
11 // combinations of arrays and objects
12 var obj_a = [
13     { name: "Tomas", city: "Innsbruck" },
14     { name: "Peter", city: "Prague" },
15     { name: "Alice", cities: ["Prague", "Brno"] } ];
16
17 for (var j = 0; j < obj_a.length; j++)
18     // do something with obj_a[j].name, ...
```

- Functions

```
1 // assign a function to a variable
2 var minus = function(a, b) {
3     return a - b;
4 }
5
6 // call the function;
7 // now you can pass 'minus' as a parameter to another function
8 var r2 = minus(6, 4);
```

Functions

- Function Callbacks

– *You can use them to handle asynchronous events occurrences*

```
1 // function returns the result through a callback, not directly;
2 // this is not a non-blocking I/O, just demonstration of the callback
3 function add(a, b, callback) {
4     callback(a + b);
5 }
6
7 // assign the callback to a variable
8 var print = function(result) {
9     console.log(result);
10 };
11
12 // call the function with callback as a parameter
13 add(7, 8, print);
```

- Functions as values in object

```
1 var obj = {
2     data : [2, 3, "Tomas", "Alice", 4 ],
3
4     getIndexDof : function(val) {
5         for (var i = 0; i < this.data.length; i++)
6             if (this.data[i] == val)
7                 return i;
8         return -1;
9     }
10 }
11
12 obj.getIndexDof(3); // will return 1
```

Closures

- Closures

– *A function value that references variables from outside its body*

```
1  function adder() {  
2      var sum = 0;  
3      return function(x) {  
4          sum += x;  
5          return sum;  
6      }  
7  }  
8  
9  var pos = adder();  
10  
11 console.log(pos(3)); // returns 3  
12 console.log(pos(4)); // returns 7  
13 console.log(pos(5)); // returns 12
```

Objects

- **this** problem

– *A new function defines its own **this** value.*

```
1  function Person() {  
2      // The Person() constructor defines `this` as an instance of itself.  
3      this.age = 0;  
4  
5      setInterval(function growUp() {  
6          // the growUp() function defines `this` as the global object,  
7          // which is different from the `this`  
8          // defined by the Person() constructor.  
9          this.age++;  
10     }, 1000);  
11 }  
12  
13 var p = new Person();
```

– *Solution*

```
1  function Person() {  
2      var that = this;  
3      that.age = 0;  
4  
5      setInterval(function growUp() {  
6          // The callback refers to the `that` variable of which  
7          // the value is the expected object.  
8          that.age++;  
9      }, 1000);  
10 }
```

Arrow Functions

- Arrow function expression
 - defined in ECMAScript 2015
 - shorter syntax than a function expression
 - non-binding of **this**

```
1 function Person(){
2   this.age = 0;
3
4   setInterval(() => {
5     this.age++; // |this| now refers to the person object
6   }, 1000);
7 }
8
9 var p = new Person();
```

- Syntax, function body

```
1 // concise body syntax, implied "return"
2 var func = x => x * x;
3
4 // with block body, explicit "return" needed
5 var func = (x, y) => { return x + y; };
6
7 // remember to wrap the object literal in parentheses
8 var func = () => ({foo: 1});
```

Promise

- Promise
 - An object representing completion or failure of an asynchronous operation.
- Example **Promise** object

```
1 function myAsyncFunction(url) {
2   return new Promise((resolve, reject) => {
3     const xhr = new XMLHttpRequest();
4     xhr.open("GET", url);
5     xhr.onload = () => resolve(xhr.responseText);
6     xhr.onerror = () => reject(xhr.statusText);
7     xhr.send();
8   });
9 }
10
11 myAsyncFunction("http://www.cvut.cz").then(successCallback, failureCallback);
```

Overview

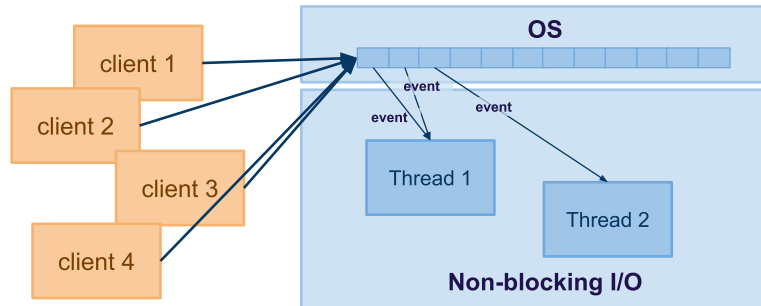
- JavaScript Basics
- **Server-side JavaScript**

Recall: Application Server

- Environment that runs an application logic
 - *Client communicates with AS via an application protocol*
 - *Client – Browser, application protocol – HTTP*
- Terminology
 - *Application Server × Web Server × HTTP Server*
 - *AS is a modular environment; provides technology to realize enterprise systems*
 - *AS contains a Web server/HTTP server*
 - *We will deal with Web server only*
- Two major models to realize communication
 - *Blocking I/O (also called synchronous I/O)*
 - *Non-blocking I/O (also called asynchronous I/O)*
- A technology we will look at
 - *Node.js – runs server-side Javascript*

Non-Blocking I/O Model

- Connections maintained by the OS, not the Web app
 - *The Web app registers events, OS triggers events when occur*



- Characteristics
 - *Event examples: new connection, read, write, closed*
 - *The app may create working threads, but controls the number!*
 - *much less number of working threads as opposed to blocking I/O*

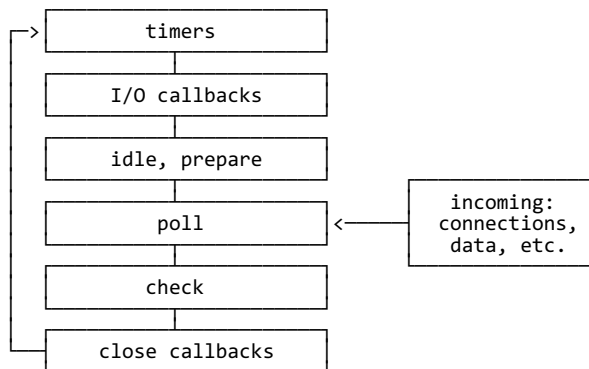
Node.js

- Node.js [🔗](#)
 - *Web server technology, very efficient and fast!*
 - *Event-driven I/O framework, based on JavaScript V8 engine*
 - *Any I/O is non-blocking (it is asynchronous)*
 - *One worker thread to process requests*
 - *You do not need to deal with concurrency issues*
 - *More threads to realize I/O*
 - *Open sourced, @GitHub [🔗](#), many libraries [🔗](#)*
 - *Future platform for Web 2.0 apps*
- Every I/O as an event
 - *reading and writing from/to files*
 - *reading and writing from/to sockets*

```
1 // pseudo code; ask for the last edited time of a file
2 stat( 'somefile', function( result ) {
3   // use the result here
4 } );
```

Node.js Event Loop

- Allows Node.js to perform non-blocking I/O operations.



- Six phases, each phase has a FIFO queue of callbacks to execute.
 - **timers** – executes callbacks scheduled by `setTimeout()` and `setInterval()`
 - **I/O callbacks** – executes all I/O callbacks except close callbacks.
 - **idle/prepare** – used internally
 - **poll** – retrieve new I/O events
 - **check** – invokes `setImmediate()` callbacks
 - **close callbacks** – executes close callback, e.g. `socket.on('close', ...)`.

HTTP Server in Node.js

- HTTP Server implementation
 - server running at **138.232.189.127**, port **8080**.

```
1 // http library
2 var http = require("http");
3
4 http.createServer(function(req, res) {
5   // check the value of host header
6   if (req.headers.host == "company.cz") {
7     res.writeHead(201, "Content-Type: text/plain");
8     res.end("This is the response...");
9   } else ;
10   // handle enterprise.com app logic...
11 }).listen('0.0.0.0', 8080);
```

- Test it using Telnet

```
1 telnet 138.232.189.127 8080
2 # ...lines omitted due to brevity
3 GET /orders HTTP/1.1
4 Host: company.cz
5
6 HTTP/1.1 201 OK
7 Content-Type: plain/text
8
9 This is the response...
```


Google Apps Script

- Google Apps Script
 - *JavaScript cloud scripting language*
 - *easy ways to automate tasks across Google products and third party services*
- You can
 - *Automate repetitive processes and workflows*
 - *Link Google products with third party services*
 - *Create custom spreadsheet functions*
 - *Build rich graphical user interfaces and menus*

```
1  // create spreadsheet menu
2  function onOpen() {
3      var ss = SpreadsheetApp.getActiveSpreadsheet();
4      var menuEntries = [ {name: "Say Hi", functionName: "sayHi"},
5                          {name: "Say Hello", functionName: "sayHello"} ];
6      ss.addMenu("Tutorial", menuEntries);
7  }
8
9  function sayHi() {
10     Browser.msgBox("Hi");
11 }
12
13 function sayHello() {
14     Browser.msgBox("Hello");
15 }
```

Rhino

- Rhino
 - *open-source implementation of JavaScript written entirely in Java*
 - *managed by the Mozilla Foundation*
 - *also provides another implementation of JavaScript engine written in C named SpiderMonkey*
 - *typically embedded into Java applications to provide scripting to end users*
 - *core language only and doesn't contain objects or methods for manipulating HTML documents*
 - *enabling development of webapps with JavaScript in containers like Jetty, Tomcat, and Google AppEngine*

```
1  $ cat echo.js
2  for (i in arguments) {
3      print(arguments[i])
4  }
5  $ java org.mozilla.javascript.tools.shell.Main echo.js foo bar
6  foo
7  bar
8  $
```