Ein Blick über den Tellerrand: Was steckt hinter Node.js

Stefan Schuster, IRIAN Solutions GmbH

Über mich

- Stefan Schuster
- Bei IRIAN Solutions seit 2007
- Spezialgebiete:
  - JavaScript (CoffeeScript, TypeScript)
    - Client (Dojo)
    - Server (Node.js)
  - HTML5
    - CSS
    - Canvas
    - …
- Beispiel: mind42.com (komplett in CoffeeScript)

Agenda

- Grundlagen
- Asynchrones Programmieren
- Ökosystem
- Beispiele

Grundlagen

JavaScript als Sprache

- Vorstellung: JavaScript == Webseite
- Man muss trennen
  - JavaScript als API

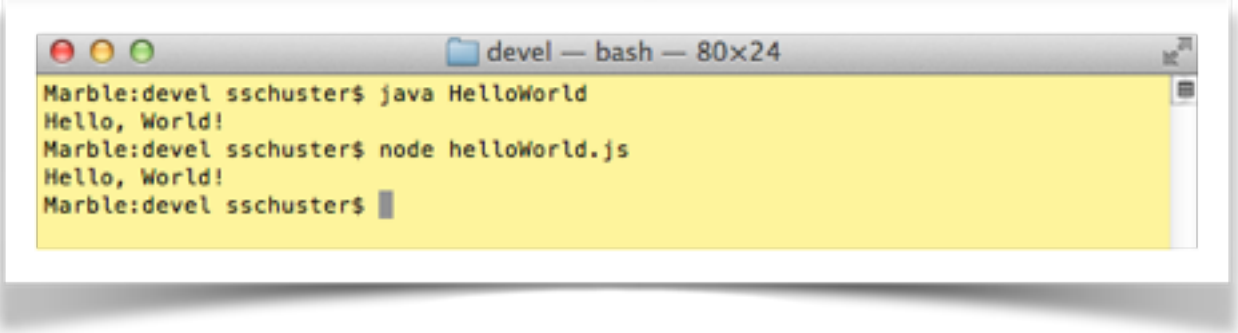
```
document.addEventListener("click", function() {
    console.log("click");
});
document.getElementById("main").style.display = "none";
document.title = "Hello, World!";
```

  - JavaScript als Sprache

```
function Dog() {
    this.name = "Timo";
}
Mammal.prototype = new Mammal();
var dog = new Dog();
```

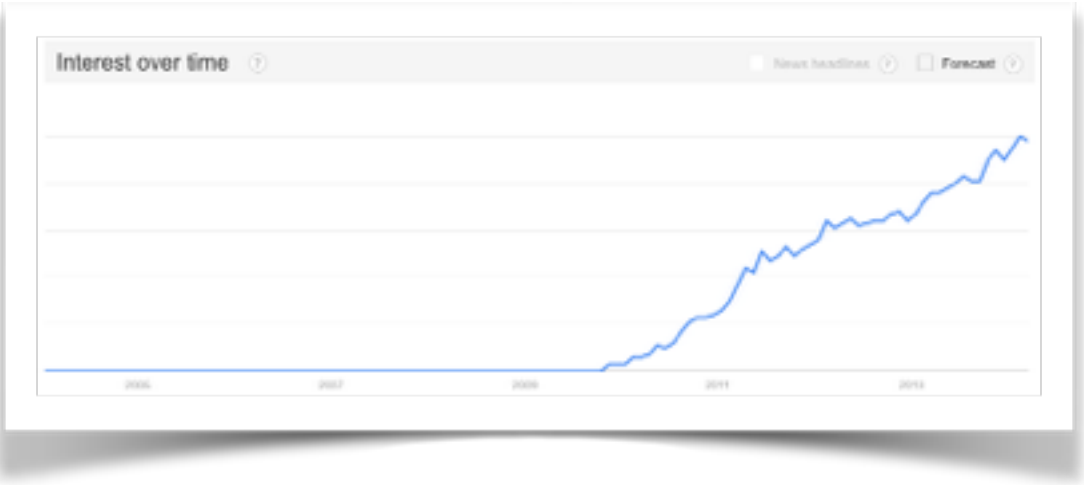
JavaScript am Server

- Was bedeutet JavaScript am Server nun?
  - JavaScript Runtime Environment
    - Headless
    - Keine Browser APIs
    - Alles, was mit JS programmierbar ist, ist machbar
    - Spezielle APIs je nach Runtime Environment
  - Wie Java VM



Node.js

- Open Source JavaScript Runtime Environment
  - Gestartet in 2009
  - Basiert auf Google V8
  - 1.0 am Horizont
  - Bereits in Produktion bewährt
  - Stark wachsende Community



Node.js API

- Anstelle von DOM APIs, Server-relevante APIs
  - Dateisystem
  - Netzwerk
    - TCP/UDP
    - HTTP/HTTPS
    - DNS
  - Crypto
  - OS
    - Prozesse
    - Plattform

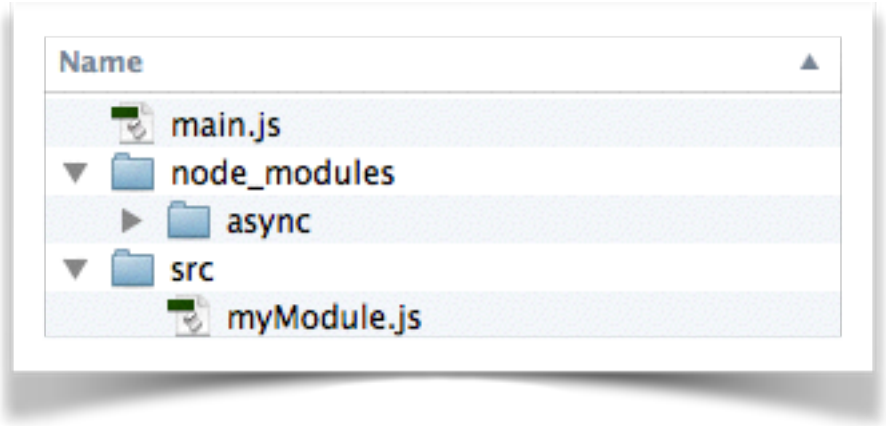
CommonJS

- Spezifikation eines Modulsystems
- Synchrones API
- Implementiert in node.js
- Hauptsächlich verwendet am Server

main.js:

```
var fs = require("fs");
var async = require("async");
var myModule = require("./src/myModule");
```

Verzeichnisstruktur:



AMD

- Spezifikation eines Modulsystems
- Asynchrones API
- Implementiert von z.B. require.js / Dojo
- Hauptsächlich verwendet am Client (funktioniert aber auch am Server)

Mammal.js:

```
declare(function() {
    var mammal = function() { ... }
    mammal.prototype...

    return mammal;
});
```

main.js:

```
require(["jQuery", "./Mammal"], function(jQuery, Mammal) {
    var mammal = new Mammal();
});
```

Node.js: Hello World

- Einfacher Web-Server, der “Hello, World!” zurückgibt
- Basierend auf node.js HTTP API

```
var http = require("http");

http.createServer(function(req, res) {
   res.end("Hello, World!");
}).listen(8080);

console.log("Server running at http://localhost:8080/");
```

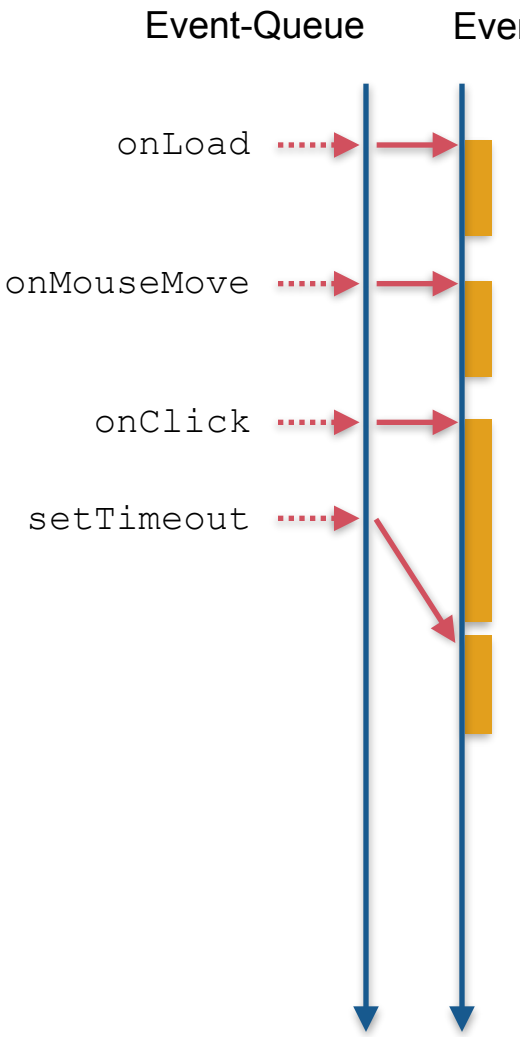
- Vergleichbar mit sehr einfachem Servlet
- Reicht für die Erstellung einfacher Apps
  - Runtime Environment ✔
  - Modulsystem ✔
  - “Servlet” API ✔

Asynchrones Programmieren

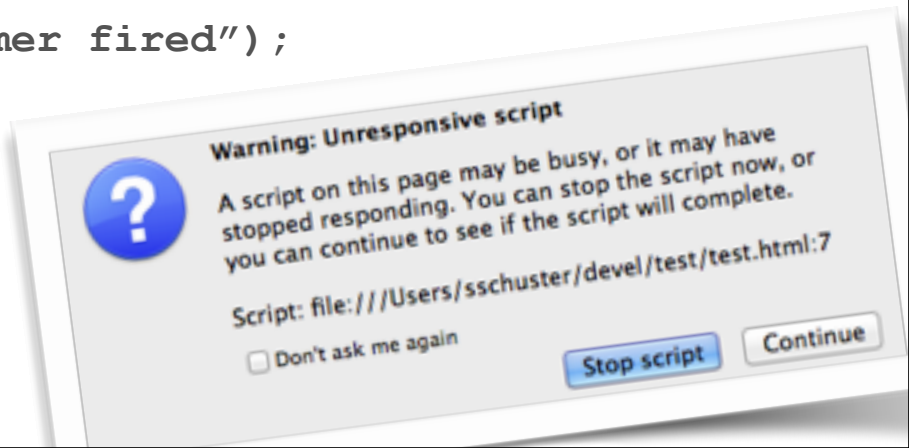
JavaScript = Event-Driven

- JavaScript hat meist nur kurze “Ausführungseinheiten”
- Diese werden durch Events angestoßen
  - onLoad
  - onClick
  - …
- Event-Loop verwaltet Events und Ausführung
- Zwischen Events “idle”

Event-Loop = Event Queue




```
initSomething();

console.log("clicked");

document.getElementById("myForm").submit();

console.log("timer fired");
```



Node.js Event-Loop

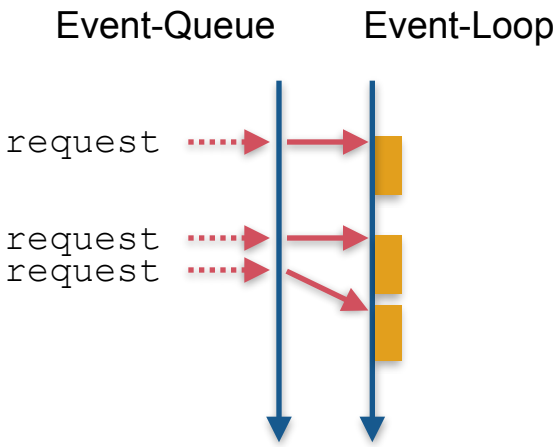
- Selbes Konzept in Node.js
- Konsequenzen
  - Single-Threaded
  - Event-Driven
  - Kein klassisches, blockierendes Programmieren möglich

Hello World - Revisited

Event-Handler wird registriert

"Ausführungseinheit"

```
var http = require("http");

http.createServer(function(req, res) {
    res.end("Hello, World!");
}).listen(8080);

console.log("Server running at http://localhost:8080/");
```



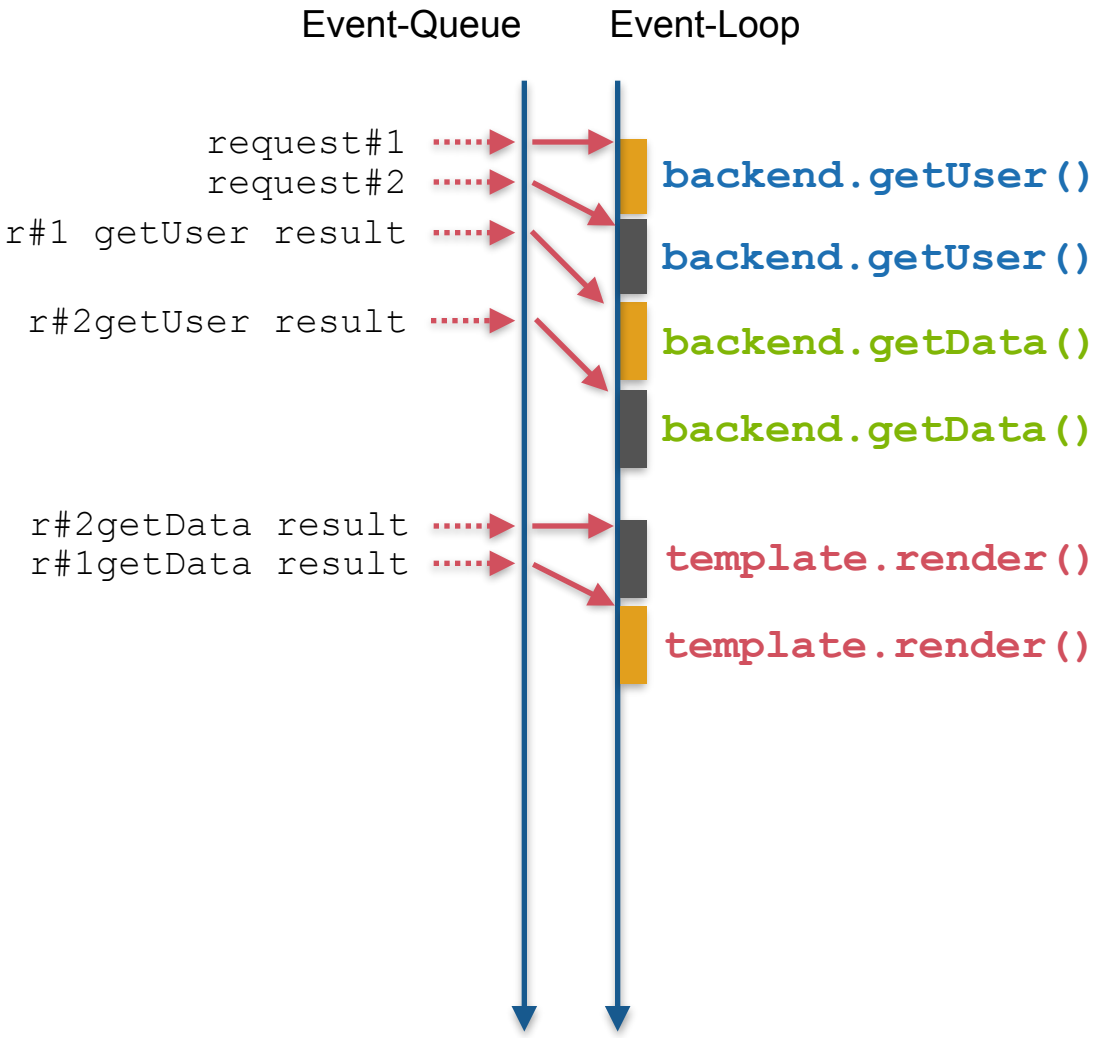
Node.js - Pro/Contra

- Vorteile
  - Kein Overhead
    - 1 Prozess, 1 Thread für alles
    - Kein Thread pro Connection
    - Kann sehr viele gleichzeitige Connections halten
    - Überraschend schnell
- Nachteile
  - Gewöhnungsbedürftig / Komplex
    - “Manuelles” managen des “Schedulings”

Async Webapp mit Node.js?

```
var http = require("http");
var backend = require("./backend");
var template = require("./template");

http.createServer(function(req, res) {
    backend.getUser(req.headers, function(err, user) {
        //Todo: Error checking
        backend.getData(user, function(err, data) {
            //Todo: Error checking
            var html = template.render({ user:user, data:data });
            res.end(html);
        });
    });
}).listen(8080);
```

Async Webapp: Event-Loop



Async Webapp: Leserlicher

```
http.createServer(function(req, res) {
    var user, data;

    async.series([
        function(cb) {
            backend.getUser(req.headers, function(err, fetchedUser) {
                if (!err) user = fetchedUser;
                cb(err);
            })
        },
        function(cb) {
            backend.getData(user, function(err, fetchedData) {
                if (!err) data = fetchedData;
                cb(err)
            }
        }
    ], function(err) {
        if (err) {
            res.statusCode = 500;
            res.end("Server Error");
        }
        else {
            res.end(template.render({ user:user, data:data }));
        }
    });
}).listen(8080);
```

Node.js: Skalierbarkeit

- Single-Threaded
  - Limit ist, was dieser eine Thread = 1 CPU Core schafft
  - Überraschend viel
  - In der Praxis wird viel Zeit mit warten auf DB, … verbracht - Hier spielt Node.js seine Vorteile aus
- Skalierungsoptionen
  - Node.js Cluster Modul
  - Mehrere Instanzen
  - Aufsplitten in mehrere Prozesse

Vert.x

- Open Source Async JVM Runtime Environment
  - Gestartet in 2011
  - Polyglot: JavaScript, Java, Ruby, Groovy, Python
  - Asynchrones Programmiermodell (unter anderem…)

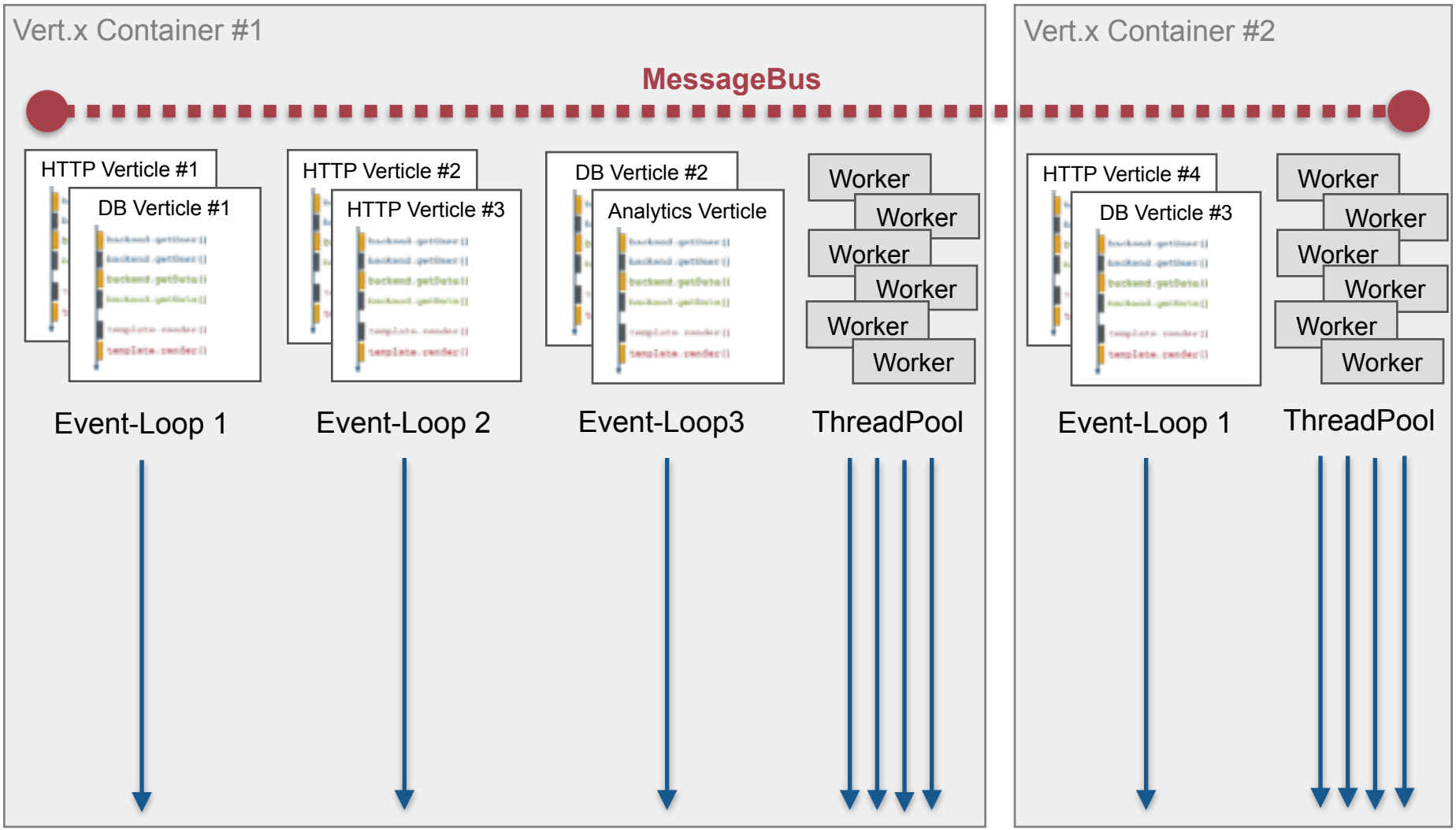
```
var vertx = require("vertx");
var console = require("vertx/console");

vertx.createHttpServer().requestHandler(function(req) {
    req.respone.end("Hello, World!");
}).listen(8080);

console.log("Server running at http://localhost:8080/");
```

Vert.x - Event-Loop

- Vert.x mehr als nur eine Event-Loop
  - Mehrere Event-Loops (1 pro Core)
  - Mehrere “Verticles” per Event-Loop
  - Thread-Pool für Blocking Tasks
  - Message Bus
  - Cluster-fähig (durch Message Bus)

- Spannendes, noch recht junges Projekt

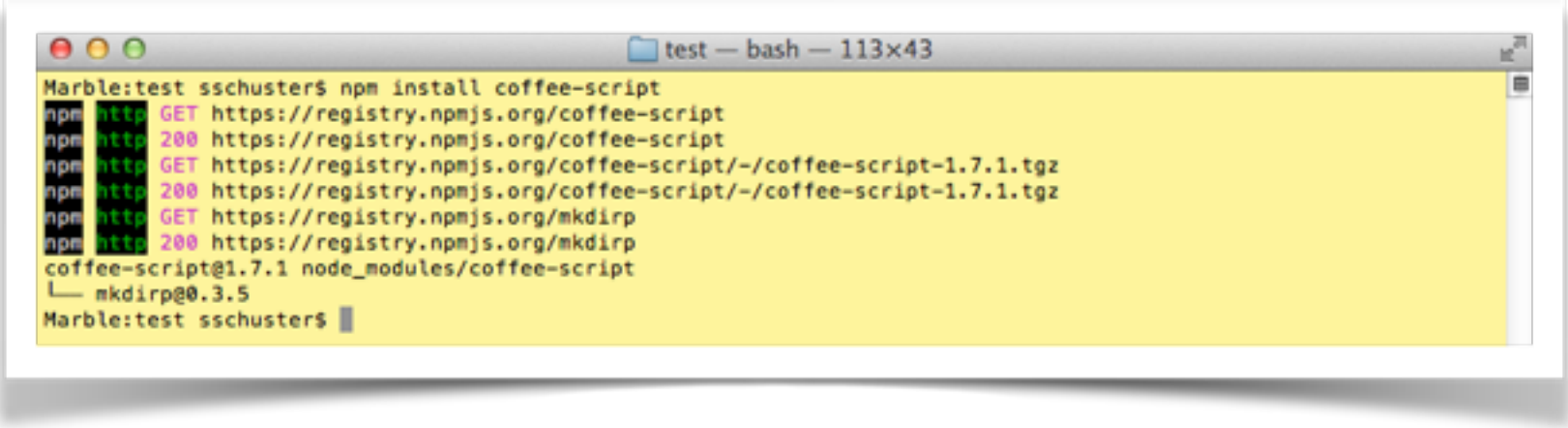
Vert.x - Container



Ökosystem

NPM

- Node Package Management System
  - Vergleichbar mit Maven
  - Teil von Node.js
  - > 60.000 Module
  - Gute Versionsverwaltung von Dependencies
  - package.json



package.json

```
{
    "name": "mind42",
    "version": "2.3.2",
    "private": true,
    "dependencies": {
        "coffee-script": "1.6.3",
        "express": "3.4.0",
        "stylus": "0.38.0",
        "ect": "0.5.2",
        "async": "0.2.9",
        "when": "2.5.1",
        "underscore": "1.5.2",
        "pg": "2.6.2",
        "couchbase": "1.2.0",
        "amqplib": "0.1.0",
        "moment": "2.2.1",
        "node-uuid": "1.4.1",
        "validator": "1.5.1",
        "nodemailer": "0.5.2",
        "libxmljs": "0.8.1",
...
```

NPM Registry

Most Depended Upon

- 5315 underscore
- 4442 async
- 3685 request
- 2551 commander
- 2518 express
- 2485 optimist
- 2298 lodash
- 2040 coffee-script
- 1898 colors
- 1428 mkdirp
- More...

Most Starred

- 223 express
- 116 async
- 100 request
- 94 grunt
- 87 socket.io
- 82 mocha
- 72 lodash
- 69 underscore
- 58 mongoose
- 56 redis
- More...

Pakete

- Web-Frameworks
  - express, stylus, ejs, …
- Datenbank Treiber
  - pg, mysql, redis, couchbase, …
- Libraries / Utilities
  - async, underscore, node-uuid, …
- Datenformate
  - Excel, CSV, ZIP, …

Pakete

- Netzwerk
  - socket.io, amqp, …
- Wrapper
  - Imagemagick, ….
- Testing
  - mocha, chai, …
- Rendering
  - node-canvas, …

Beispiele

Simple CRUD Webapp

- Kleines, praktisches Beispiel
  - Express
  - Templating
  - Async DB

- https://github.com/sschuster/javalandDemo

DEMO

package.json

```
{
    "name": "javalanddemo",
    "version": "0.0.1",
    "private": true,
    "dependencies": {
        "express": "3.5.0",
        "ejs": "0.8.5",
        "async": "0.2.10",
        "sqlite3": "~2.1.5",
        "sequelize": "1.7.0"
    }
}
```

main.js

```
var path = require("path");
var express = require("express");
var server = require("./src/server");

var app = express();
app.set("views", path.join(__dirname, "src/views"));
app.use(express.urlencoded());
app.use(app.router);
app.use(express.static(path.join(__dirname, "public")));
app.use(express.errorHandler());

server.init(app);

var server = app.listen(8080, function() {
    console.log("Listening on port 8080");
});
```

persistence.js

```
var path = require("path");
var Sequelize = require("sequelize");

var persistence = new Sequelize("javalanddemo", "username", "password", {
    dialect: "sqlite",
    storage: "./javalanddemo.sqlite"
});

var Todo = persistence.import(path.join(__dirname, "/model/todo"));
persistence.sync();

module.exports = {
    Todo: Todo
};
```

todo.js

```
module.exports = function(sequelize, DataTypes) {
    return sequelize.define("Todo", {
        description: { type: DataTypes.STRING, allowNull: false, validate: { notEmpty: true}
},
        done: { type: DataTypes.BOOLEAN, allowNull: false, defaultValue: false }
    }, {
        tableName: "todos"
    });
};
```

server.js - GET - /

```
app.get("/", function(req, res, next) {
    var todos;

    async.series([
        function(callback) {
            persistence.Todo.findAll({
                order: "createdAt ASC"
            }).complete(function(err, fetchedTodos) {
                if (!err) {
                    todos = fetchedTodos;
                }
                callback(err);
            });
        }
    ], function(err) {
        if (err) {
            next(err);
        }
        else {
            res.render("todos.ejs", {
                todos: todos
            });
        }
    });
});
```

todo.ejs

```
<body>
  <h1>Todos:</h1>
  <% for(var i=0, todo; (todo = todos[i]); i++) { %>
    <div class="todo">
      <form class="edit" method="post" action="/edit/<%= todo.id %>">
        <input type="text" name="description" value="<%= todo.description %>">
        <input type="checkbox" name="done" value="true" <%= todo.done ? "checked" : "" %>>
        <input type="submit" value="Save">
      </form>
      <form class="delete" method="post" action="/delete/<%= todo.id %>">
        <input type="submit" value="Delete">
      </form>
    </div>
  <% } %>

  <div class="todo new">
    <form class="create" method="post" action="/create">
      <input type="text" name="description" size="50">
      <input type="submit" value="Create">
    </form>
  </div>
</body>
```

server.js - POST - /create

```
app.post("/create", function(req, res, next) {
    async.series([
        function(callback) {
            persistence.Todo.create({
                description: req.body.description
            }).complete(callback);
        }
    ], function(err) {
        if (err) {
            next(new Error("Creating todo failed"));
        }
        else {
            res.redirect("/");
        }
    });
});
```

server.js - POST - /edit

```
app.post("/edit/:todoId", function(req, res, next) {
    var todo;

    async.series([
        function(callback) {
            persistence.Todo.find(req.params.todoId).complete(function(err, fetchedTodo) {
                if (!err) {
                    todo = fetchedTodo;
                }
                callback(err);
            });
        },
        function(callback) {
            todo.description = req.body.description;
            todo.done = (req.body.done && req.body.done == "true") ? true : false;
            todo.save().complete(callback);
        }
    ], function(err) {
        if (err) {
            next(new Error("Updating todo failed"));
        }
        else {
            res.redirect("/");
        }
    });
});
```

server.js - POST - /delete

```
app.post("/delete/:todoId", function(req, res, next) {
    var todo;

    async.series([
        function(callback) {
            persistence.Todo.find(req.params.todoId).complete(function(err, fetchedTodo) {
                if (!err) {
                    todo = fetchedTodo;
                }
                callback(err);
            });
        },
        function(callback) {
            todo.destroy().complete(callback);
        }
    ], function(err) {
        if (err) {
            next(new Error("Deleting todo failed"));
        }
        else {
            res.redirect("/");
        }
    });
});
```

Vielen Dank für Ihre Aufmerksamkeit!

Fragen?