

RESTful java with JAX-RS

Pieter van den Hombergh
Thijs Dorsseers
Stefan Sobek

Fontys Hogeschool voor Techniek en Logistiek

April 12, 2018

RESTful java with JAX-RS
HOM,DOS,SBK

Intro

Motivation

Sockets and socket exercise reviewed

API's everywhere

Tooling API console

Tooling Netbeans

Tooling curl

Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

HOM,DOS,SBK,/FHTw& RESTful java with JAX-RS April 12, 2018 1/25

Topics

- Motivation
- Look back at the client-server socket example
- API's everywhere.
- Tooling
- Basics
- Example
- Exercise

RESTful java with JAX-RS
HOM,DOS,SBK

Intro

Motivation

Sockets and socket exercise reviewed

API's everywhere

Tooling API console

Tooling Netbeans

Tooling curl

Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

HOM,DOS,SBK,/FHTw& RESTful java with JAX-RS April 12, 2018 2/25

Motivation

- To build distributed services.
- To use the web to realize access to data sources.
- Divide and conquer simplifies complex systems.
- Replaces complex solutions like SOAP, CORBA and Java RMI.
- It is a modern protocol that is used in contemporary websites and in communication between apps and servers.

RESTful java with JAX-RS
HOM,DOS,SBK

Intro

Motivation

Sockets and socket exercise reviewed

API's everywhere

Tooling API console

Tooling Netbeans

Tooling curl

Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

HOM,DOS,SBK,/FHTw& RESTful java with JAX-RS April 12, 2018 3/25

Sockets reviewed

Server and client are applications which both own a socket.

Exercise Simple RESTapi like protocol:
<https://java2.fontysvenlo.org/pdf/simplerestapiprotocol.pdf>

RESTful java with JAX-RS
HOM,DOS,SBK

Intro

Motivation

Sockets and socket exercise reviewed

API's everywhere

Tooling API console

Tooling Netbeans

Tooling curl

Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

HOM,DOS,SBK,/FHTw& RESTful java with JAX-RS April 12, 2018 4/25

Some nice applications of RESTful api's in the evil outside world.

Youtube video Published on Jul 14, 2014.
 This video introduces the viewer to some API concepts by making example calls to Facebook's Graph API, Google Maps' API, Instagram's Media Search API, and Twitter's Status Update API.
<https://www.youtube.com/watch?v=7YcW25PHnAA&feature=youtu.be>
 Apart from the access tokens you have to get familiar with the addressed subjects.

HOM.DOS.SBK /FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
- Tooling API console
 - Tooling Netbeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

5/25

API console

In the previous video an api console was used. Instead we are going to use the app, **Advanced REST Client**, which is based on the same technology as Atom, VS-Code: electron-js installation guide:

- visit <https://install.advancedrestclient.com/> and press the install button **if you are** on Mac or Windows. (You will want the **dmg** or **exe** file)
- If you are on a Linux (like me) do NOT press the install button, but instead select Other Platforms and choose the package for you distro. For me, with my debian based Ubuntu it is arc-linux-12.1.2-amd64.**deb**. If you are on Redhat or derivative, choose the appropriate **rpm** package.

You will use ARC to test your own RESTful api service. Stack overflow (actually stackexchange) has a rest API:
<http://api.stackexchange.com/2.2/search?order=desc&sort=activity&tagged=java&site=stackoverflow>.
 If you use the URL on the command line, make sure to escape the & (ampersand) characters, because they otherwise have a special meaning in the command shell.

HOM.DOS.SBK /FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
- Tooling API console
 - Tooling Netbeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

6/25

Application server and Netbeans

Like a website needs a webserver to be hosted, RESTful api's need a so called application server. We are going to use Payara Server version 5. This is the improved version of Glassfish, which is the reference implementation of the Java EE standard. Brief installation guide:

- Download Payara Server from <http://www.payara.fish>, unzip it in some folder, **NOT** like "Program Files" in Windows. Path with spaces are problematic. On Linux you would place in **/opt** so C backslash opt might be a good place too.
- In Netbeans, select "Service" tab -> "Servers"
- If present delete the current GlassFish Server
- Next right click on "Servers" and select "Add Server" and find the payara5 folder.

HOM.DOS.SBK /FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
- Tooling API console
 - Tooling Netbeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

7/25

Curl

curl is a command line tool for transferring data with URL's and very handy for testing rest api requests. Mac and linux have **curl** preinstalled. Window users should google for curl-7.40.0-openssl-libssh2-zlib-x64. Take <https://sourceforge.net/> to download a copy.



HOM.DOS.SBK /FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
- Tooling API console
 - Tooling Netbeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

8/25

Friendlier CURL: Meet HTTPIE

More user friendly than curl is httpie. I will demo that. You can find it at <https://httpie.org/>



It is probably curl on dreadlocks.

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

9/25

curl examples

skip this frame, target website is not maintained.

- get only one item:

```
curl -X GET https://dosedemo.mybluemix.net/api/CoffeeShops/1
```

- get all items:

```
curl -X GET https://dosedemo.mybluemix.net/api/CoffeeShops
```

- post an item:

```
curl -X POST --header 'Content-Type: application/json' \
--header 'Accept: application/json' \
-d '{"name": "AB", "city": "Venlo", "country": "NL"}' \
https://dosedemo.mybluemix.net/api/CoffeeShops
```

Curl is the standard. Same for wget

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

10/25

Basic understanding

The architectural principles of REpresentational State Transfer are defined as below in Roy Fielding's PhD thesis:

- Addressable resources, addressable through a specific URI.
- A uniform constrained interface
- Representation-oriented: Representations are exchanged between client and service, think about current state of a resource. Format of this representations could be XML, JSON etc.
- Communicate statelessly, no client **session data** stored on the server.
- Hypermedia As The Engine Of Application State (HATEOAS)

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

11/25

Uniform constrained interface

Which sticks to a small set of operations, the most important are:

- GET (like sql-select) safe and **idempotent**
- PUT (like sql-update) **idempotent**
- DELETE (like sql-delete) **idempotent**
- POST (like sql-insert) **not** idempotent

Idempotent means that no matter how many times you apply the operation, the result is always the same.

Safe means invoking does not change the state of the server.

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

12/25

JAX-RS

JAX-RS is a framework that focuses on applying Java annotations to plain java objects. It has annotations to bind specific URI patterns and HTTP operations to methods of java classes.

- @PATH
- @POST
- @GET
- @DELETE
- @PUT

These annotations will be explained in the next slides.

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS

HOM.DOS.SBK

Intro

Motivation
 Sockets and socket exercise reviewed
 API's everywhere
 Tooling API console
 Tooling Netbeans
 Tooling curl
 Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

13/25

JAX-RS

In Netbeans start creating a Java Web - Web Application.
 Select no frameworks, because we don't need them, everything we need is already available because we selected the Glassfish server.
 Your source code contains at least the ApplicationConfig.java source:

```
package service;

import javax.ws.rs.core.Application;
import javax.ws.rs.ApplicationPath;

@ApplicationPath("webresources")
/** Indeed, an empty class. */
public class ApplicationConfig extends Application {
}
```

and a service and an entity, see next slides.

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS

HOM.DOS.SBK

Intro

Motivation
 Sockets and socket exercise reviewed
 API's everywhere
 Tooling API console
 Tooling Netbeans
 Tooling curl
 Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

14/25

Service

```
@Stateless
@Path("employee")
public class EmployeeREST {

    @GET
    @Path("{id}")
    @Produces({ MediaType.APPLICATION_JSON })
    public Response find(@PathParam("id") Integer id) {
    }

    @POST
    @Consumes({ MediaType.APPLICATION_JSON })
    public Response create(Employee employee,
        @Context UriInfo info) {
    }

    @GET
    @Produces({ MediaType.APPLICATION_JSON })
    public List<Employee> getAllEmployees() {
    }
}
```

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS

HOM.DOS.SBK

Intro

Motivation
 Sockets and socket exercise reviewed
 API's everywhere
 Tooling API console
 Tooling Netbeans
 Tooling curl
 Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

15/25

POST-GET

Live demo, source code is available:

- SimpleRESTful
- EmployeeClient

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS

HOM.DOS.SBK

Intro

Motivation
 Sockets and socket exercise reviewed
 API's everywhere
 Tooling API console
 Tooling Netbeans
 Tooling curl
 Tooling curl

Basic understanding

Uniform constrained interface

JAX-RS

JAX-RS

Service

Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

16/25

Server response

Response codes examples:

- 200 OK
- 201 created
- 404 not found

See for more codes:

- a comprehensive list:
http://www.restpatterns.org/HTTP_Status_Codes
- a brief list:
<http://www.restapitutorial.com/lessons/httpmethods.html>

Apart from the code a response mostly contains more. For example, the POST response must contain the created entity. In JAX-RS the Response class has a set of methods to help the programmer in building a response object. So study the Response class documentation and the link above.

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS
Service
Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

Only Java Object when you need them

- Most examples on the net demoing a restful service with Java show it using Java Business Objects (PoJo) like in the previous examples.
- However even more applications are largely CRUD, backed by a database.
- So the examples degrade to
 - 1 Get the records from the database
 - 2 Turn them into PoJos
 - 3 Have Jax-RS turn the PoJos into JSON and send that to the client
 - 4 On the way back: the same, but in reverse order.
- even in the case of generated code, you are burning useless cpu-cycles.



HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS
Service
Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

Even worse. . .

- Typically the business object are fetched with a query per type and then joined in the Java application.
 - So if you have 5 types, you would have 5 queries equalling 5 round trips.
- The database typically can do this in one statement using the appropriate joins.
 - Ergo: **one** round trip for all you need on your page.



HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS
Service
Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

So: Let someone else do the work

Like the database.

- **PostgreSQL** not only understands JSON as a type but also has functions to turn records or arrays of records (as in full result set) into a JSON object. Your "Business Layer" only has to forward this as a string.
- You can still use your normal statements, with a trick (CTE).
- Doing it in the database (actually: doing as much as possible in the database) has the additional advantage that you can exchange the business and/or presentation layer quite effortless. Think dot-net, Node.js, ruby, php, and python as examples.
- The technique shown is applicable to all these platforms.

HOM.DOS.SBK/FHTwL

RESTful java with JAX-RS

April 12, 2018

RESTful java with JAX-RS
HOM.DOS.SBK

Intro

Motivation

Sockets and socket exercise reviewed
API's everywhere
Tooling API console
Tooling NetBeans
Tooling curl
Tooling curl

Basic understanding

Uniform constrained interface
JAX-RS

JAX-RS
Service
Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A

Commercial¹

Sound Bite



"The most popular open source database"
"The web database"



"The world's most advanced open source database"
"The open source Oracle"

¹Only: there is no money involved.

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
 - Tooling API console
 - Tooling NetBeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

bag of tricks

- pack your query in a common table expression (CTE or WITH clause).

SQL magic

```
with _t as (select p.* from president p where id=44 )
select to_jsonb(_t) from _t;
```

result (beautified by hand)

```
{
  "id": 44,
  "name": "TRUMP D J",
  "party": "REPUBLICAN",
  "death_age": null,
  "birth_year": 1946,
  "years_served": 0,
  "state_id_born": 46
}
```

The Java code that does this, avoiding code repetition (DRY) is in the repo under lessondemo.

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
 - Tooling API console
 - Tooling NetBeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

Exercise

Exercise:

Create a RESTful API service for the entity business case President-Marriage, using of the President's database.

- alter the table `pres_marriage` to have a column `divorce_year`
- The usecase and API should support: add a spouse and update the divorce column of the previous wife. It is a **State** operation on said table.

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
 - Tooling API console
 - Tooling NetBeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

Any open issues?

Not all understood? See:

- API documentation on: <https://docs.oracle.com/javase/7/api/javax/ws/rs/package-summary.html>

Because we rather not want to auto generate our rest api, use sources like the one below only as background:

- <https://netbeans.org/kb/docs/websvc/rest.html>

Book:

- Burke, B. (2014). RESTful Java with JAX-RS 2.0. Sebastopol, CA: O'Reilly.

Youtube:

- Simple Restful Payara example: <https://www.youtube.com/watch?v=F26jcZrgGMk>
- Introduction Developing RESTful APIs with JAX-RS: <https://youtu.be/xkKcdK1u95s>

RESTful java with JAX-RS
HOM.DOS.SBK

- Intro
- Motivation
 - Sockets and socket exercise reviewed
 - API's everywhere
 - Tooling API console
 - Tooling NetBeans
 - Tooling curl
 - Tooling curl
- Basic understanding
 - Uniform constrained interface
 - JAX-RS
- JAX-RS
 - Service
 - Service
- Protocol
- Be Lazy, Not Slow
- Exercise
- Q&A

Q and A

Questions?

Questions or remarks?

RESTful java with JAX-RS

HOM,DOS,SBK

Intro

- Motivation
- Sockets and socket exercise reviewed
- API's everywhere
- Tooling API Console
- Tooling Netbeans
- Tooling curl
- Tooling curl

Basic understanding

- Uniform constrained interface
- JAX-RS

JAX-RS

- Service
- Service

Protocol

Be Lazy, Not Slow

Exercise

Q&A