REST

WEB SERVICE

Web Service:

A method of communication between two electronic devices over a network.
A software function provided at a network address over the web, with the service always on.

Used to exchange data

W3C definition of web service:

***A software system designed to support interoperable machine-to-machine interaction over a network*.**

ALTERNATIVES

SOAP

Simple Object Access Protocol
Protocol for sending and receiving messages
XML

WSDL

Web Service Description Language
Model for describing web services
XML

REST

REpresentational State Transfer web service
Architectural style for web resources
JSON

RESTFUL WEB SERVICE

REpresentational State Transfer
Has become one of the most important technologies for web applications.
REST Server provides access to resources and REST client accesses and modifies the resources.
Resources can be text files, html pages, images, videos or dynamic business data and each resource is identified by URLs.
API oriented / Maintainable / Scalable / Light weight communication
HTTP methods are used to extract / manipulate resources: GET, POST, PUT, DELETE

Representational
Clients possess the information necessary to identify, modify, and/or delete a web resource.
A resource can consist of other resources.
Resources are represented by a format and identified using URLS.
Resources can be represented by formats, such as json and xml.
Both client and server should be able to comprehend communication format.
State
No state information is stored on the server / All state information is stored on the client
Transfer
Client state is passed from the client to the service through HTTP

Architectural constraints
Client-Server

- The clients and the server are separated from each other:
- The client is not concerned with the data storage thus the portability of the client code is improved

- The server is not concerned with the client interference, thus the server is simpler and easy to scale.

Stateless

- Each request can be treated independently.
- REST interactions store no client context on the server between requests.
- All information necessary to service the request is contained in the URL, query parameters, body or headers.
- The client holds session state.

Cacheable

- The responses must define themselves as, cacheable or not, to prevent the client from sending the inappropriate data in response to further requests.
- Caching can be controlled using HTTP headers.

Uniform interface

- The uniform interface constraint is fundamental to the design of any REST service.
- The uniform interface simplifies and decouples the architecture.
- Each resource has at least one URI.

Layered System (Resources are decoupled from their representation)

- At any time clients cannot tell if they are connected to the end server or to an intermediate.
- Neither can clients see (and should not consider), the technologies used to implement a REST API
- When resources are decoupled from their representation their content can be accessed in a variety of formats.

REST API URL EXAMPLE

To create a new customer:

POST - HTTP://WWW.EXAMPLE.COM/CUSTOMERS

To read, update and delete a customer with Customer ID# 33245:

GET - HTTP://WWW.EXAMPLE.COM/CUSTOMERS/33245
PUT - HTTP://WWW.EXAMPLE.COM/CUSTOMERS/33245
DELETE - HTTP://WWW.EXAMPLE.COM/CUSTOMERS/33245

To create a new product:

POST HTTP://WWW.EXAMPLE.COM/PRODUCTS

JAX-RS

JAX-RS stands for JAVA API for RESTful Web Services.
JAX-RS is a Java programming language API designed to make it easy to develop applications that use the REST architecture.
The JAX-RS API uses Java programming language annotations to simplify the development of RESTful web services.
JAX-RS annotations are runtime annotations; therefore, runtime reflection will generate the helper classes and artifacts for the resource.

JERSEY

Open source framework for implementing RESTful web services.
Consist of components such as core server, core client, JAXB support and JSON support.
JAX-RS -> Specification
JERSEY -> Implementation

REST IN NETBEANS

1. New maven web application
2. Add dependency org.glassfish.jersey.bundles : jax-rs-ri
3. Add dependency com.google.code.gson : gson
4. Create package rest
5. Create new restful web service from pattern (json)

CONNECTING JPA

1. Add dependency mysql-connector-java
2. Create database
3. Create connection to database
4. Add persistence unit
5. Create entity, facade, facadeinterface
6. Generate schema
7. Use facade to connect restful web service and jpa

APPLICATIONCONFIG

Automatically updated with resource classes when adding new restful web services

ApplicationPath (Where to access server root REST API)

ANNOTATIONS

Annotations are used in the restful web service to configure the communication between server and client.

ApplicationPath (Server root REST API path)

```
@javax.ws.rs.ApplicationPath("api")
```

Path (Resource path) - Can be used both on complete class and individual methods

```
@Path("person/all")
```

Get / Post/ Put / Delete (HTTP method used)

```
@GET / @POST / @PUT / @DELETE
```

Produces / Consumes (Body type: JSON / XML / HTML)

MediaType.APPLICATION_JSON / MediaType.APPLICATION_XML / MediaType.TEXT_HTML

```
@Consumes(MediaType.APPLICATION_JSON)
@Produces(MediaType.APPLICATION_JSON)
```

PathParam (Path parameters)

```
@Path("all/{id}")
@PathParam("id") int id
```

QueryParam (Query parameters)

```
?job=None
@QueryParam("job") String job
```

DefaultValue (Default values if missing)

```
@DefaultValue("Worker")
```

Context

```
@Context
private UriInfo context;
        System.out.println(context.getQueryParameters().toString());
        System.out.println(context.getQueryParameters().get("id"));
@Context
private HttpHeaders headers
        System.out.println(headers.getMediaType());
SecurityContext / Request / …
```

Receive JSON Method

```
@POST
@Consumes(MediaType.APPLICATION_JSON)
public void postJson(String content)
{}
```

JSON

```
{ "name":"John", "age": 31, "member": false }
```

CONVERSION (GSON / JSON)

When working with REST, there is a need to convert json string / java object, when communication occurs.

From json string to java object

```
String json1 = "{\"firstName\":\"Ole\",\"lastName\":\"Olsen\",\"phoneNumber\":12345678}";
Person p1 = new Gson().fromJson(json1, Person.class);
```

Json property names must match class property names

To json string from java object

```
Person p2 = new Person("Mads", "Madsen", 87654321);
String json2 = new Gson().toJson(p2);
```

Creating a json object

```
JsonObject jo3 = new JsonObject();
jo3.addProperty("firstName", "Hans");
jo3.addProperty("lastName", "Hansen");
jo3.addProperty("phoneNumber", 11223344);
jo3.addProperty("id", 999);
Person p3 = new Gson().fromJson(jo3, Person.class);
```

JsonParser

```
JsonObject body = new JsonParser().parse(json1).getAsJsonObject();
System.out.println(body.has("fName"));
System.out.println(body.has("firstName"));
System.out.println(body.get("firstName").getAsString());
System.out.println(body.get("id").getAsInt());
```

JsonArray to json string

```
JsonArray ja = new JsonArray();
ja.add(jo3);
ja.add(jo3);
String jsonArrayString = new Gson().toJson(ja);
```

Java list to json string

```
ArrayList<Person> Persons = new ArrayList();
Persons.add(p1);
Persons.add(p2);
Persons.add(p3);
String json = new Gson().toJson(Persons);
```

JPA <-> FACADE <-> REST <-> JQUERY

Make connection from JPA entities to facades and use the facades in REST web services

Use Javascript fetch api to access REST web services

```
fetch("api/person", {
  method: "post",
  body: JSON.stringify({firstName:”Johnny”}),
  headers: new Headers({'content-type': 'application/json'})
})
    .then(function (response) {
      return response.json();
    })
    .then(function (json) {
      alert(json);
    })
    .catch(function (error) {
      alert("Error occured");
    });
```

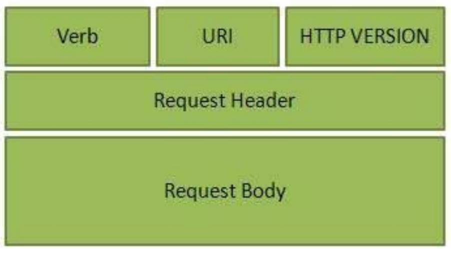
POSTMAN

Postman can be used to send, receive and inspect responses to urls.

Method / Headers / Body

HTTP

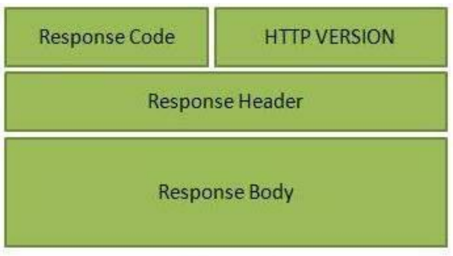
HTTP REQUEST



HTTP Request

- Verb
  Indicate HTTP methods such as GET, POST, DELETE, PUT etc.
- URI
  Uniform Resource Identifier (URI) to identify the resource on server
- HTTP Version
  Indicate HTTP version, for example HTTP v1.1 .
- Request Header
  Contains metadata for the HTTP Request message as key-value pairs. For example, client (or browser) type, format supported by client, format of message body, cache settings etc.
- Request Body
  Message content or Resource representation.

HTTP RESPONSE



HTTP Response

- Status/Response Code
  Indicate Server status for the requested resource. For example 404 means resource not found and 200 means response is ok.
- HTTP Version
  Indicate HTTP version, for example HTTP v1.1 .
- Response Header
  Contains metadata for the HTTP Response message as key-value pairs. For example, content length, content type, response date, server type etc.
- Response Body
  Response message content or Resource representation.

HTTP STATUS CODES

SUCCESSFUL
200, OK
201, Created
202, Accepted
204, No Content
205, Reset Content
206, Partial Content

REDIRECTION
301, Moved Permanently
302, Found
303, See Other
304, Not Modified
305, Use Proxy
307, Temporary Redirect

CLIENT_ERROR
400, Bad Request
401, Unauthorized
402, Payment Required
403, Forbidden
404, Not Found
405, Method Not Allowed
406, Not Acceptable
407, Proxy Authentication Required
408, Request Timeout
409, Conflict
410, Gone
411, Length Required
412, Precondition Failed
413, Request Entity Too Large
414, Request-URI Too Long
415, Unsupported Media Type
416, Requested Range Not Satisfiable
417, Expectation Failed

SERVER_ERROR
500, Internal Server Error
501, Not Implemented
502, Bad Gateway
503, Service Unavailable
504, Gateway Timeout
505, HTTP Version Not Supported

DEPLOYMENT

- Connect to remote mysql server via workbench and create database
- Create new persistence unit for deployment database
- Compile and upload war file via tomcat manager

FileZilla

FTP File manager
New place
SFTP / LoginType -> Key file / User / KeyFile -> C:\Users\user\.ssh\rsa.ppk

MySQL

Access remote mysql server by uncommenting bind-address = 127.0.0.1 in /etc/mysql/mysql.conf.d/mysqld.cnf file
Use standard tcp/ip over ssh in mysql workbench
Store passwords in vault

Add Tomcat environment variable

Edit file /etc/init.d/tomcat8 and add two new lines for environment variable…

```
set -e
PATH=/bin:/usr/bin:/sbin:/usr/sbin
NAME=tomcat8
DESC="Tomcat servlet engine"
DEFAULT=/etc/default/$NAME
JVM_TMP=/tmp/tomcat8-$NAME-tmp
DODeployment=true
export DODeployment
```

Restart Tomcat service afterwards…

```
sudo service tomcat8 restart
```

DO

target/file.war
0.0.0.0/manager/html
Upload war

ERRORS / EXCEPTIONS

Wrong requests / Bad URLs / Exceptions thrown
Errors can be reported to client by…

Creating and returning response object / Throwing exception

REST error handling: Take existing exception and map it to http response with status code and json error message

Thrown exceptions are handled by JAX-RS if an exception mapper has been registered
Use json for error messages / Use http status codes

```
return Response.status(Response.Status.LENGTH_REQUIRED).build();
return Response.status(404).build();
return Response.status(500).entity(gson.toJson(err)).type(MediaType.APPLICATION_JSON).build();
```

Only show original error / exception / stack trace in debug mode
Web.xml can be used to declare debug mode

TESTING REST ENDPOINTS

Unit tests / Integration tests
Test early / Test often
Purpose: Show no errors exist / Find errors
Develop test cases / expectations / results
Execute tests and correct code
Maven requires all tests to be passed in order to build project.
Basic junit tests do not require server to be running
REST-Assured junit tests require server to be running

Server cannot be running before project is compiled
Project cannot be compiled unless server is running.

Plugins can be added in pom.xml to use an embedded tomcat server

JUNIT

Add dependencies…

junit : junit 4.12
org.hamcrest : java-hamcrest 2.0.0.0

- Tools -> Create / Update tests
- Set up junit tests

REST-ASSURED

REST Assured can be used together with Junit
Simple Java library for programmatically performing requests up against REST services with focus on testing
Supports XML and JSON Request / Responses
Supports POST, GET, PUT, DELETE, OPTIONS, PATCH and HEAD http methods
Specify and validate parameters, headers, cookies and body easily
given()

What payload our method is going to have (JSON data representing a Student)
What kind of ContentType our payload has (XML, PlainText, JSON, …)
What kind of authentication we are having (basic, token, Oauth, …)

when()

The method we are going to call as well as the path
POST, GET, PUT, DELETE, OPTIONS, PATCH or HEAD
URL path (/user, /api/person/add, …)

then()

After we executed our method, we need to test on the results we get back
Statuscode (200OK, 401NotFound, …)
Messages returned - JSON, XML

REST-ASSURED IN NETBEANS

1. Add dependency io.rest-assured : rest-assured 3.0.3

2. Add plugins to pom.xml
3. Create junit tests with rest assured code

Plugins for pom.xml…

```
<plugin>
<groupId>org.apache.maven.plugins</groupId>
<artifactId>maven-surefire-plugin</artifactId>
<version>2.20</version>
<configuration>
<excludes>
<exclude>**/*IntegrationTest*</exclude>
</excludes>
</configuration>
</plugin>

<plugin>
<groupId>org.apache.maven.plugins</groupId>
<artifactId>maven-failsafe-plugin</artifactId>
<version>2.20</version>
<configuration>
<argLine>-Dfile.encoding=UTF-8</argLine>
<includes>
<include>**/*IntegrationTest*</include>
</includes>
</configuration>
<executions>
<execution>
<goals>
<goal>integration-test</goal>
<goal>verify</goal>
</goals>
</execution>
</executions>
</plugin>

<plugin>
<groupId>org.apache.tomcat.maven</groupId>
<artifactId>tomcat7-maven-plugin</artifactId>
<version>2.2</version>
<configuration>
<path>/</path>
</configuration>
<executions>
<execution>
<id>start-tomcat</id>
<phase>pre-integration-test</phase>
<goals>
<goal>run</goal>
</goals>
<configuration>
<fork>true</fork>
</configuration>
</execution>
<execution>
<id>stop-tomcat</id>
<phase>post-integration-test</phase>
<goals>
<goal>shutdown</goal>
</goals>
</execution>
</executions>
</plugin>
```

DATABASE MOCKING / APACHE DERBY

- Add dependency org.apache.derby : derby 10.13.1.1
- Add derby persistence unit to persistence unit xml file with same database name as mysql database name