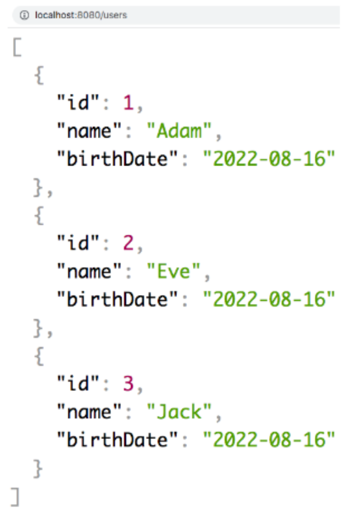
Building REST API with Spring Boot

Building REST API with Spring Boot - Goals

- **WHY** Spring Boot?
  - You can build REST API WITHOUT Spring Boot
  - What is the need for Spring Boot?
- **HOW** to build a great REST API?
  - Identifying Resources (/users, /users/{id}/posts)
  - Identifying Actions (GET, POST, PUT, DELETE, ...)
  - Defining Request and Response structures
  - Using appropriate Response Status (200, 404, 500, ..)
  - Understanding REST API Best Practices
    - Thinking from the perspective of your consumer
    - Validation, Internationalization - i18n, Exception Handling, HATEOAS, Versioning, Documentation, Content Negotiation and a lot more!

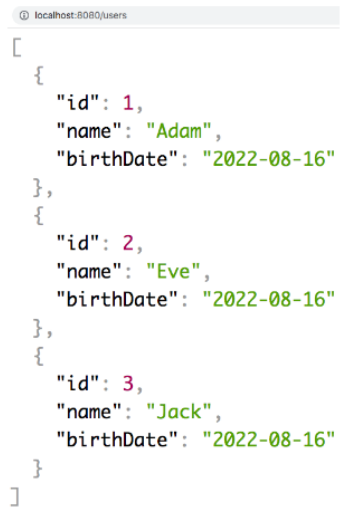


localhost:8080/users

```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

Building REST API with Spring Boot - Approach

- **1:** Build 3 Simple Hello World REST API
  - Understand the magic of Spring Boot
  - Understand fundamentals of building REST API with Spring Boot
    - @RestController, @RequestMapping, @PathVariable, JSON conversion
- **2:** Build a REST API for a Social Media Application
  - Design and Build a Great REST API
    - Choosing the right URI for resources (/users, /users/{id}, /users/{id}/posts)
    - Choosing the right request method for actions (GET, POST, PUT, DELETE, ..)
    - Designing Request and Response structures
    - Implementing Security, Validation and Exception Handling
  - Build Advanced REST API Features
    - Internationalization, HATEOAS, Versioning, Documentation, Content Negotiation, ...
- **3:** Connect your REST API to a Database
  - Fundamentals of JPA and Hibernate
  - Use H2 and MySQL as databases



localhost:8080/users

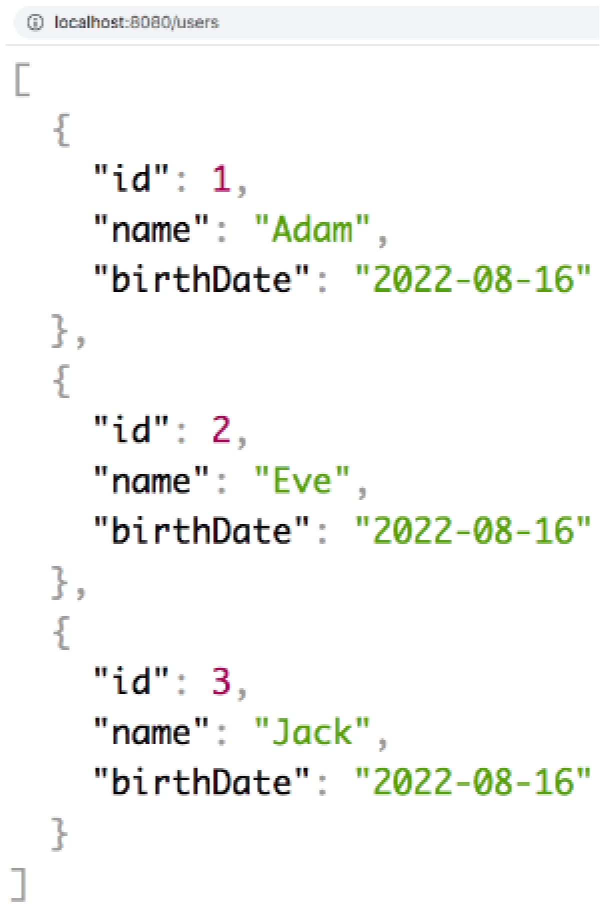
```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

What's Happening in the Background?

- Let's explore some **Spring Boot Magic**: Enable Debug Logging
  - **WARNING**: Log change frequently!
- **1**: How are our requests handled?
  - **DispatcherServlet** - Front Controller Pattern
    - `Mapping servlets: dispatcherServlet urls=[/]`
    - **Auto Configuration** (`DispatcherServletAutoConfiguration`)
- **2**: How does **HelloWorldBean** object get converted to JSON?
  - @ResponseBody + JacksonHttpMessageConverters
    - **Auto Configuration** (`JacksonHttpMessageConvertersConfiguration`)
- **3**: Who is configuring error mapping?
  - **Auto Configuration** (`ErrorMvcAutoConfiguration`)
- **4**: How are all jars available(Spring, Spring MVC, Jackson, Tomcat)?
  - **Starter Projects** - Spring Boot Starter Web (spring-webmvc, spring-web, spring-boot-starter-tomcat, spring-boot-starter-json)

Social Media Application REST API

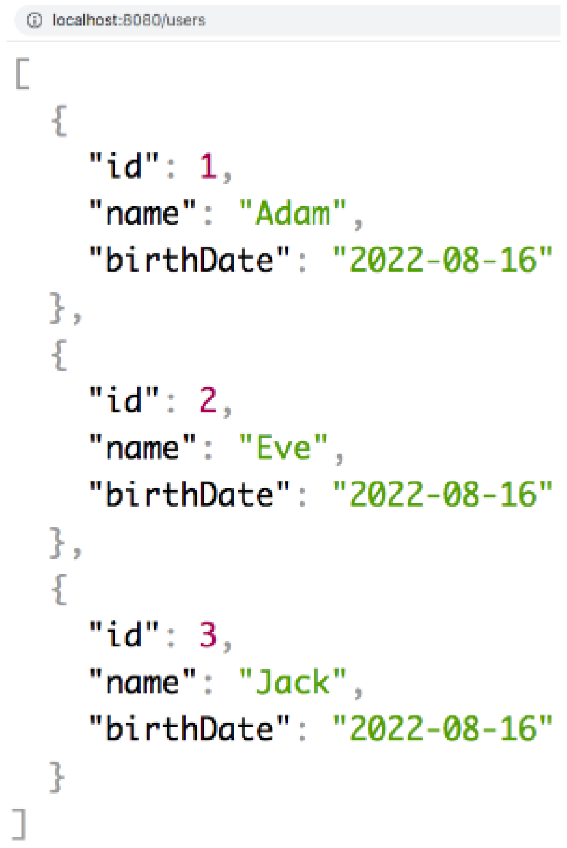
- Build a REST API for a Social Media Application
- **Key Resources:**
  - Users
  - Posts
- **Key Details:**
  - User: id, name, birthDate
  - Post: id, description



```
localhost:8080/users
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

Request Methods for REST API

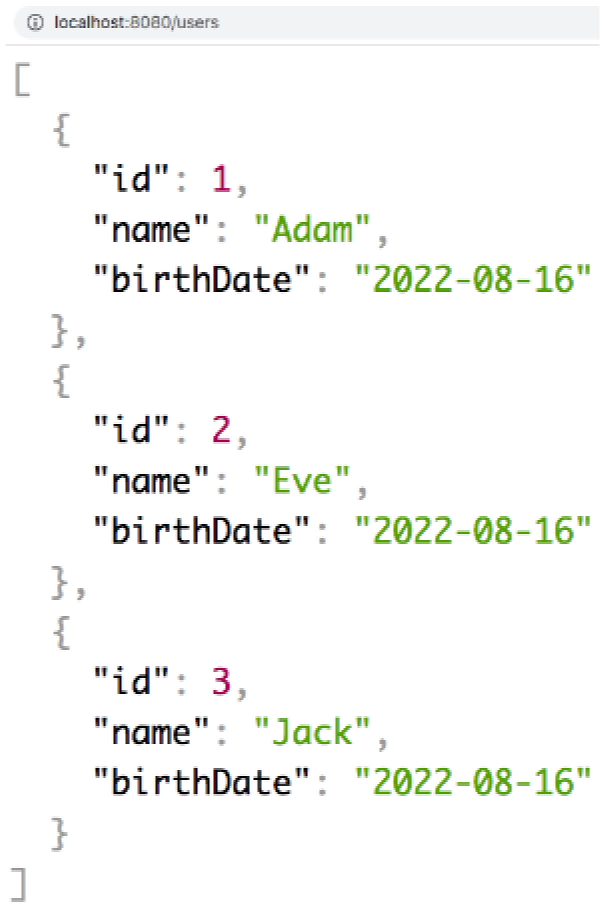
- **GET** - Retrieve details of a resource
- **POST** - Create a new resource
- **PUT** - Update an existing resource
- **PATCH** - Update part of a resource
- **DELETE** - Delete a resource


localhost:8080/users

```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

Social Media Application - Resources & Methods

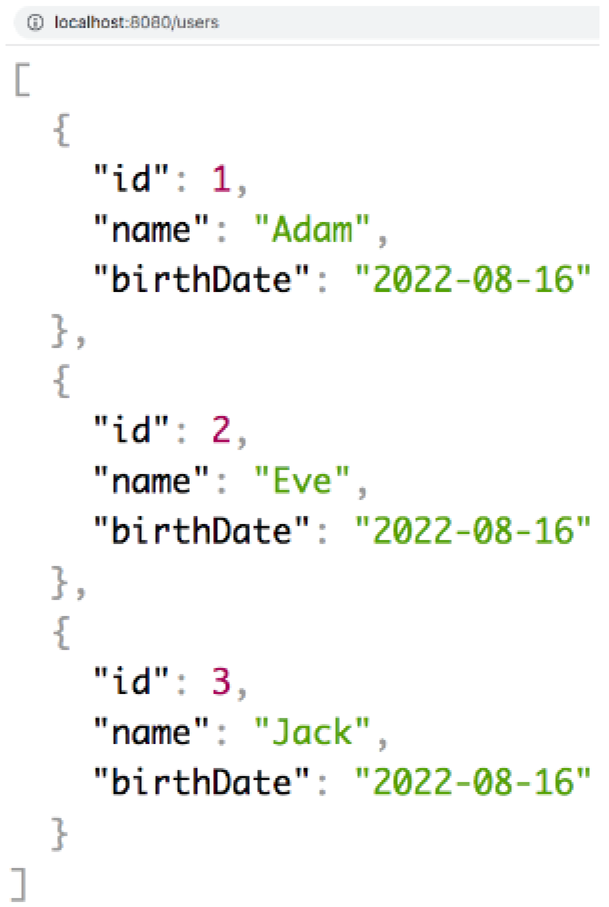
- **Users REST API**
  - Retrieve all Users
    - **GET /users**
  - Create a User
    - **POST /users**
  - Retrieve one User
    - **GET /users/{id} -> /users/1**
  - Delete a User
    - **DELETE /users/{id} -> /users/1**
  - **Posts REST API**
    - Retrieve all posts for a User
      - **GET /users/{id}/posts**
    - Create a post for a User
      - **POST /users/{id}/posts**
    - Retrieve details of a post
      - **GET /users/{id}/posts/{post_id}**


localhost:8080/users

```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

Response Status for REST API

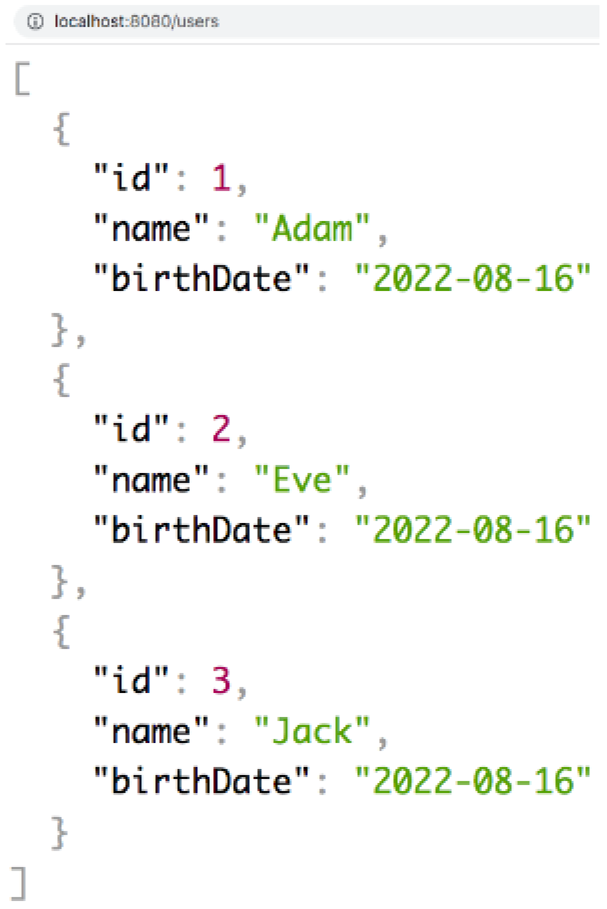
- Return the **correct response status**
  - Resource is not found => 404
  - Server exception => 500
  - Validation error => 400
- **Important Response Statuses**
  - **200** — Success
  - **201** — Created
  - **204** — No Content
  - **401** — Unauthorized (when authorization fails)
  - **400** — Bad Request (such as validation error)
  - **404** — Resource Not Found
  - **500** — Server Error



```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

Advanced REST API Features

- Documentation
- Content Negotiation
- Internationalization - i18n
- Versioning
- HATEOAS
- Static Filtering
- Dynamic Filtering
- Monitoring
- ....

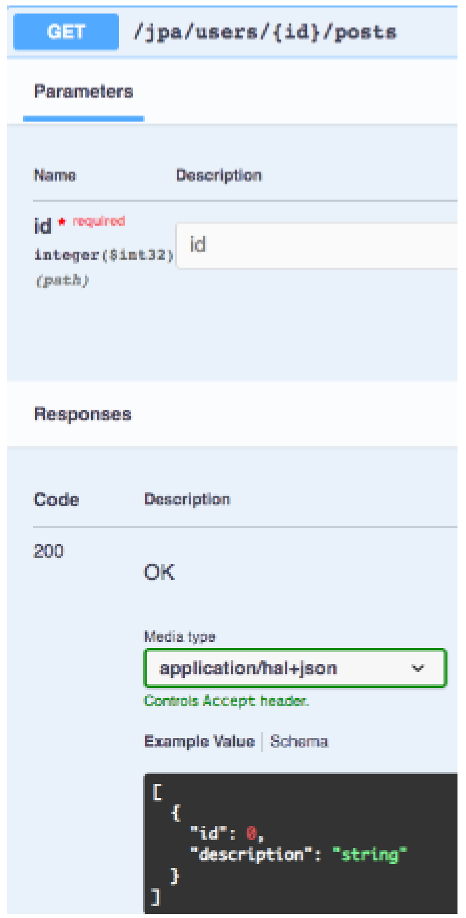

localhost:8080/users

```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

REST API Documentation

In28 Minutes

- Your REST API consumers need to understand your REST API:
  - Resources
  - Actions
  - Request/Response Structure (Constraints/Validations)
- **Challenges:**
  - Accuracy: How do you ensure that your documentation is upto date and correct?
  - Consistency: You might have 100s of REST API in an enterprise. How do you ensure consistency?
- **Options:**
  - **1**: Manually Maintain Documentation
    - Additional effort to keep it in sync with code
  - **2**: Generate from code



GET /jpa/users/{id}/posts

Parameters

Name	Description
id * required integer($int32) (path)	id

Responses

Code	Description
200	OK

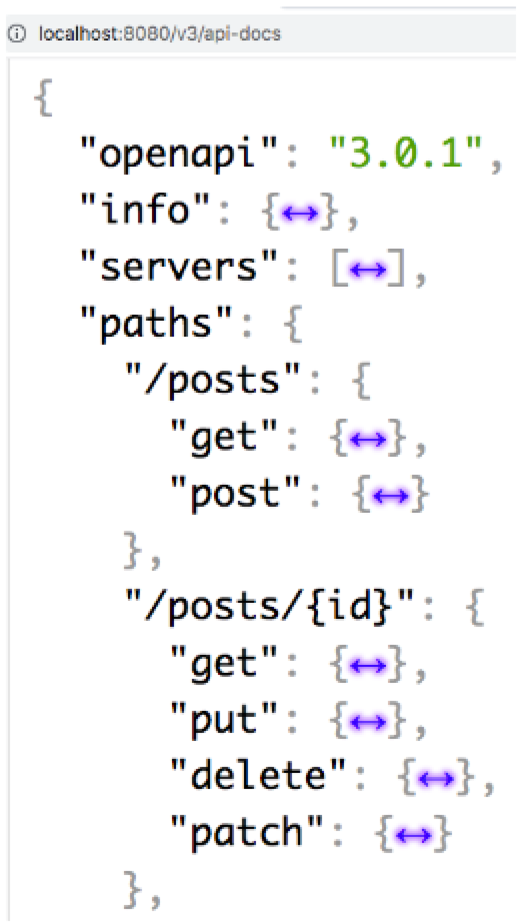
Media type: application/hal+json
Controls Accept header.

Example Value | Schema

```
[
  {
    "id": 0,
    "description": "string"
  }
]
```

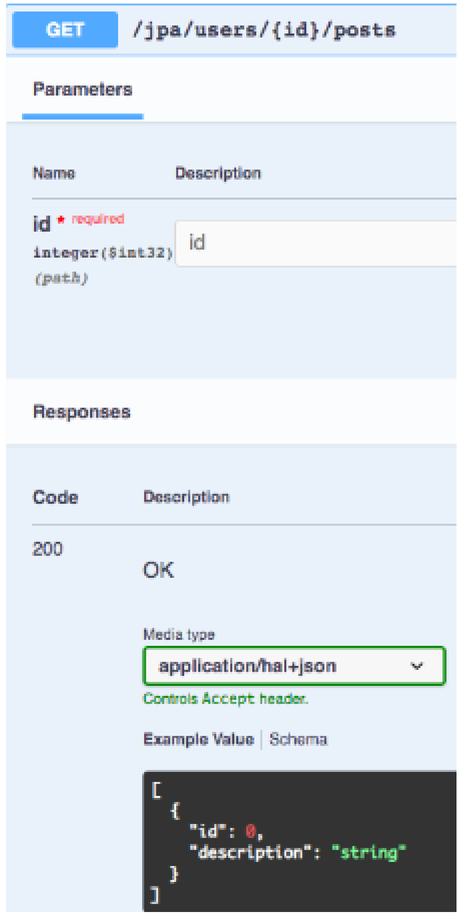
REST API Documentation - Swagger and Open API

- **Quick overview:**
  - **2011:** Swagger Specification and Swagger Tools were introduced
  - **2016:** Open API Specification created based on Swagger Spec.
    - Swagger Tools (ex:Swagger UI) continue to exist
  - **OpenAPI Specification:** Standard, language-agnostic interface
    - Discover and understand REST API
    - Earlier called Swagger Specification
  - **Swagger UI:** Visualize and interact with your REST API
    - Can be generated from your OpenAPI Specification



localhost:8080/v3/api-docs

```
{
  "openapi": "3.0.1",
  "info": {↔},
  "servers": [↔],
  "paths": {
    "/posts": {
      "get": {↔},
      "post": {↔}
    },
    "/posts/{id}": {
      "get": {↔},
      "put": {↔},
      "delete": {↔},
      "patch": {↔}
    },
```



GET /jpa/users/{id}/posts

Parameters

Name	Description
id * required integer($int32) (path)	id

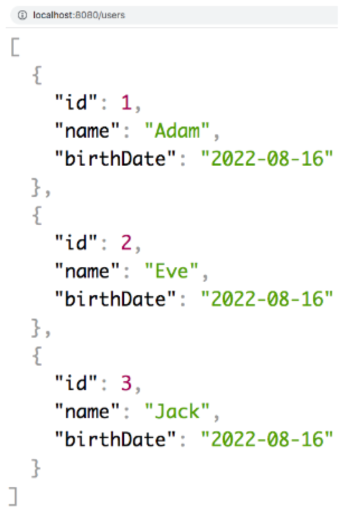
Responses

Code	Description
200	OK Media type: application/hal+json Controls Accept header. Example Value | Schema

```
[
  {
    "id": 0,
    "description": "string"
  }
]
```

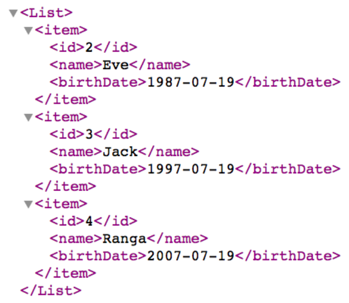
Content Negotiation

- **Same Resource** - Same URI
  - HOWEVER **Different Representations** are possible
    - Example: Different Content Type - XML or JSON or ..
    - Example: Different Language - English or Dutch or ..
- How can a consumer tell the REST API provider what they want?
  - **Content Negotiation**
- Example: Accept header (MIME types - application/xml, application/json, ..)
- Example: Accept-Language header (en, nl, fr, ..)



localhost:8080/users

```
[
  {
    "id": 1,
    "name": "Adam",
    "birthDate": "2022-08-16"
  },
  {
    "id": 2,
    "name": "Eve",
    "birthDate": "2022-08-16"
  },
  {
    "id": 3,
    "name": "Jack",
    "birthDate": "2022-08-16"
  }
]
```

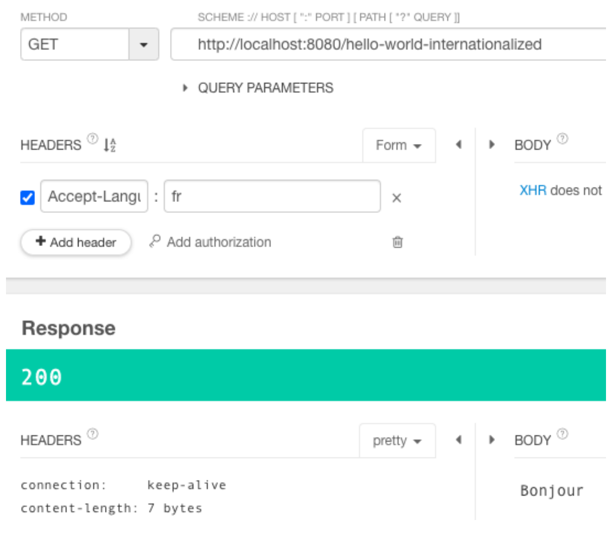


```
▼<List>
  ▼<item>
     <id>2</id>
     <name>Eve</name>
     <birthDate>1987-07-19</birthDate>
   </item>
  ▼<item>
     <id>3</id>
     <name>Jack</name>
     <birthDate>1997-07-19</birthDate>
   </item>
  ▼<item>
     <id>4</id>
     <name>Ranga</name>
     <birthDate>2007-07-19</birthDate>
   </item>
 </List>
```

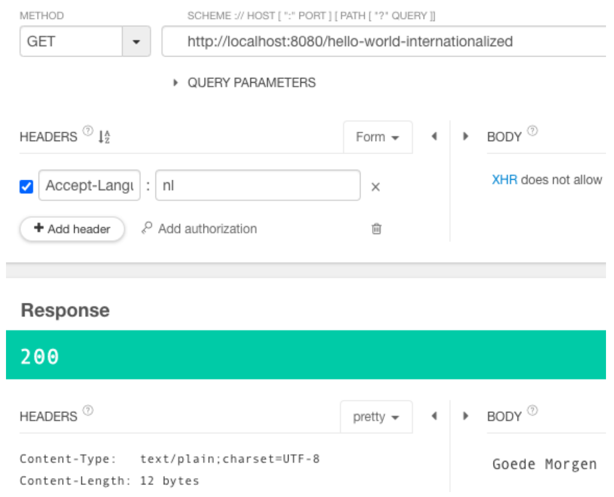
Internationalization - i18n

In28 Minutes

- Your REST API might have consumers from around the world
- How do you customize it to users around the world?
  - **Internationalization - i18n**
- Typically **HTTP Request Header - `Accept-Language`** is used
  - `Accept-Language` - indicates natural language and locale that the consumer prefers
  - Example: `en` - English (Good Morning)
  - Example: `nl` - Dutch (Goedemorgen)
  - Example: `fr` - French (Bonjour)
  - Example: `de` - Deutsch (Guten Morgen)


METHOD: GET
SCHEME :// HOST [":" PORT] [PATH ["?" QUERY]]: http://localhost:8080/hello-world-internationalized
QUERY PARAMETERS
HEADERS: Accept-Langu : fr

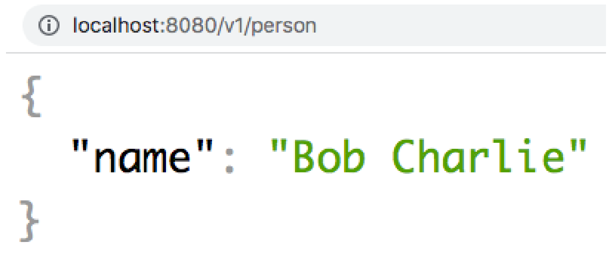
Response
200
HEADERS
```
connection:     keep-alive
content-length: 7 bytes
```
BODY
```
Bonjour
```


METHOD: GET
SCHEME :// HOST [":" PORT] [PATH ["?" QUERY]]: http://localhost:8080/hello-world-internationalized
QUERY PARAMETERS
HEADERS: Accept-Langu : nl

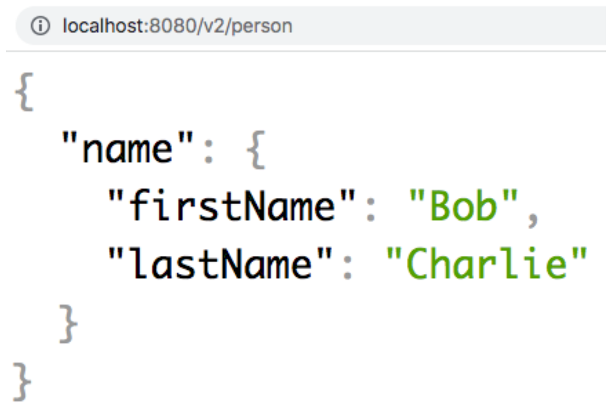
Response
200
HEADERS
```
Content-Type:   text/plain;charset=UTF-8
Content-Length: 12 bytes
```
BODY
```
Goede Morgen
```

Versioning REST API

- You have built an amazing REST API
  - You have 100s of consumers
  - You need to implement a breaking change
    - Example: Split name into firstName and lastName
- **SOLUTION**: Versioning REST API
  - **Variety of options**
    - URL
    - Request Parameter
    - Header
    - Media Type
  - **No Clear Winner!**


localhost:8080/v1/person

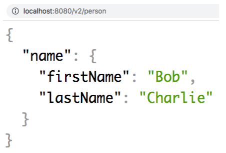
```
{
  "name": "Bob Charlie"
}
```


localhost:8080/v2/person

```
{
  "name": {
    "firstName": "Bob",
    "lastName": "Charlie"
  }
}
```

Versioning REST API - Options

- **URI Versioning** - Twitter
  - ***http://localhost:8080/v1/person***
  - ***http://localhost:8080/v2/person***
- **Request Parameter versioning** - Amazon
  - ***http://localhost:8080/person?version=1***
  - ***http://localhost:8080/person?version=2***
- **(Custom) headers versioning** - Microsoft
  - SAME-URL headers=[X-API-VERSION=1]
  - SAME-URL headers=[X-API-VERSION=2]
- **Media type versioning** (a.k.a “content negotiation” or “accept header”) - GitHub
  - SAME-URL produces=application/vnd.company.app-v1+json
  - SAME-URL produces=application/vnd.company.app-v2+json


localhost:8080/v2/person

```
{
  "name": {
    "firstName": "Bob",
    "lastName": "Charlie"
  }
}
```

Versioning REST API - Factors

- **Factors to consider**
  - URI Pollution
  - Misuse of HTTP Headers
  - Caching
  - Can we execute the request on the browser?
  - API Documentation
  - **Summary:** No Perfect Solution
- **My Recommendations**
  - Think about versioning even before you need it!
  - One Enterprise - One Versioning Approach

URI Versioning - Twitter
- *http://localhost:8080/v1/person*
- *http://localhost:8080/v2/person*

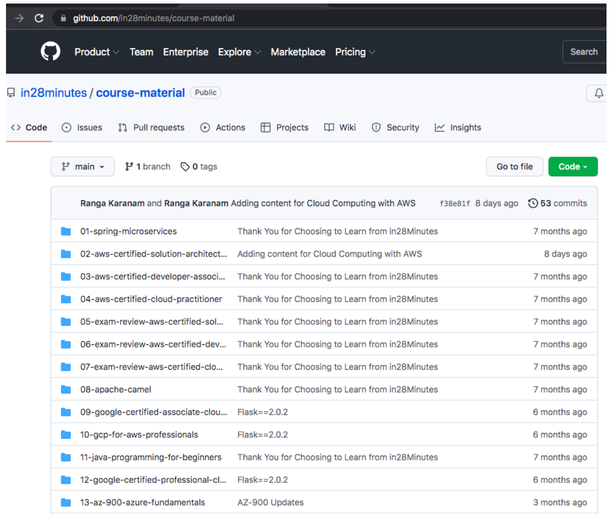
Request Parameter versioning - Amazon
- *http://localhost:8080/person?version=1*
- *http://localhost:8080/person?version=2*

(Custom) headers versioning - Microsoft
- SAME-URL headers=[X-API-VERSION=1]
- SAME-URL headers=[X-API-VERSION=2]

Media type versioning - GitHub
- SAME-URL produces=application/vnd.company.app-v1+json
- SAME-URL produces=application/vnd.company.app-v2+json

HATEOAS

- **Hypermedia as the Engine of Application State (HATEOAS)**
- Websites allow you to:
  - See **Data** AND Perform **Actions** (using links)
- How about enhancing your REST API to tell consumers how to perform subsequent actions?
  - **HATEOAS**
- **Implementation Options:**
  - **1:** Custom Format and Implementation
    - Difficult to maintain
  - **2:** Use Standard Implementation
    - **HAL (JSON Hypertext Application Language)**: Simple format that gives a consistent and easy way to hyperlink between resources in your API
    - **Spring HATEOAS**: Generate HAL responses with hyperlinks to resources



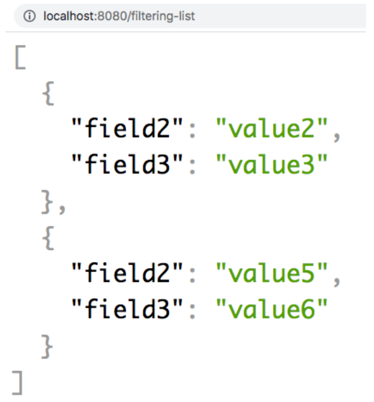
Ranga Karanam and Ranga Karanam Adding content for Cloud Computing with AWS f38e81f 8 days ago 53 commits

01-spring-microservices	Thank You for Choosing to Learn from in28Minutes	7 months ago
02-aws-certified-solution-architect...	Adding content for Cloud Computing with AWS	8 days ago
03-aws-certified-developer-associ...	Thank You for Choosing to Learn from in28Minutes	7 months ago
04-aws-certified-cloud-practitioner	Thank You for Choosing to Learn from in28Minutes	7 months ago
05-exam-review-aws-certified-sol...	Thank You for Choosing to Learn from in28Minutes	7 months ago
06-exam-review-aws-certified-dev...	Thank You for Choosing to Learn from in28Minutes	7 months ago
07-exam-review-aws-certified-clo...	Thank You for Choosing to Learn from in28Minutes	7 months ago
08-apache-camel	Thank You for Choosing to Learn from in28Minutes	7 months ago
09-google-certified-associate-clou...	Flask==2.0.2	6 months ago
10-gcp-for-aws-professionals	Flask==2.0.2	6 months ago
11-java-programming-for-beginners	Thank You for Choosing to Learn from in28Minutes	7 months ago
12-google-certified-professional-cl...	Flask==2.0.2	6 months ago
13-az-900-azure-fundamentals	AZ-900 Updates	3 months ago

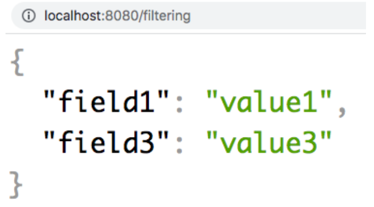
```
{
  "name": "Adam",
  "birthDate": "2022-08-16",
  "_links": {
    "all-users": {
      "href": "http://localhost:8080/users"
    }
  }
}
```

Customizing REST API Responses - Filtering and more..

- **Serialization**: Convert object to stream (example: JSON)
  - Most popular JSON Serialization in Java: Jackson
- How about customizing the REST API response returned by Jackson framework?
- **1:** Customize field names in response
  - @JSONProperty
- **2:** Return only selected fields
  - **Filtering**
  - Example: Filter out Passwords
  - **Two types**:
    - **Static Filtering**: Same filtering for a bean across different REST API
      - @JsonIgnoreProperties, @JsonIgnore
    - **Dynamic Filtering**: Customize filtering for a bean for specific REST API
      - @JsonFilter with FilterProvider


localhost:8080/filtering-list

```
[
  {
    "field2": "value2",
    "field3": "value3"
  },
  {
    "field2": "value5",
    "field3": "value6"
  }
]
```


localhost:8080/filtering

```
{
  "field1": "value1",
  "field3": "value3"
}
```

Get Production-ready with Spring Boot Actuator

- **Spring Boot Actuator**: Provides Spring Boot's production-ready features
  - Monitor and manage your application in your production
- **Spring Boot Starter Actuator**: Starter to add Spring Boot Actuator to your application
  - **spring-boot-starter-actuator**
- Provides a number of endpoints:
  - **beans** - Complete list of Spring beans in your app
  - **health** - Application health information
  - **metrics** - Application metrics
  - **mappings** - Details around Request Mappings
  - and a lot more ....

Explore REST API using HAL Explorer

- 1: **HAL (JSON Hypertext Application Language)**
  - Simple format that gives a consistent and easy way to hyperlink between resources in your API
- 2: **HAL Explorer**
  - An API explorer for RESTful Hypermedia APIs using HAL
  - Enable your non-technical teams to play with APIs
- 3: **Spring Boot HAL Explorer**
  - Auto-configures HAL Explorer for Spring Boot Projects
  - spring-data-rest-hal-explorer