BUILDING AN API BACKEND WITH MICROPROFILE

WRITTEN BY
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This book is for

This book is for Java developers that want to quickly learn how to create a REST API using MicroProfile.

What you need for this book

To try the code samples in this book you will need this.

- JDK 8+
- Maven

What Is MicroProfile?

MicroProfile is an Open Source project hosted by Eclipse Foundation and is dedicated to optimize the Enterprise Java for microservice based architectures. The first release was in 2016.

MicroProfile consist of following specifications:

Open Tracing	Open API	Rest Client	Config
Fault Tolerance	Metrics	JWT Propagation	Health Check
CDI	JSON-P	JAX-RS	JSON-B

MicroProfile Implementations

TomEE	http://tomee.apache.org/
Payara	https://www.payara.fish/
Open Liberty	https://openliberty.io/
Thorntail	https://thorntail.io/
KumuluzEE	https://ee.kumuluz.com/
Helidon	https://helidon.io
SmallRye	https://www.smallrye.io/
Hammock	https://hammock-project.github.io/
Launcher	https://github.com/fujitsu/launcher

Getting Started

Preparation

Before you can start, you need to install JDK and Maven.

1. JDK: Download the JDK from https://openjdk.java.net/install/index.html
2. Follow the instructions at https://maven.apache.org/download.cgi to install Maven.

BookStore

Generating the project

We will use the Kodnito MicroProfile Archetype to generate our project. Open your terminal and type in the following command to generate our project.

```
mvn archetype:generate -DarchetypeGroupId=com.kodnito -DarchetypeArtifactId=kodnito
-microprofile-archetype -DarchetypeVersion=1.0.1 -DgroupId=com.kodnito.bookstore.rest
-DartifactId=book-store -Dversion=1.0-SNAPSHOT
```

Type Enter and you will have your new project generated. Now go to the project directory and type the following command for downloading the dependencies and when it's done, open the project in your favourite IDE. Open the pom.xml and add the following:

```
    <dependency>
    <groupId>com.h2database</groupId>
        <artifactId>h2</artifactId>
        <version>1.4.196</version>
        <scope>runtime</scope>
    </dependency>
    <dependency>
        <groupId>org.eclipse.persistence</groupId>
        <artifactId>eclipselink</artifactId>
        <version>2.7.4</version>
    </dependency>
    <dependency>
        <groupId>javax.transaction</groupId>
        <artifactId>javax.transaction-api</artifactId>
        <version>1.3</version>
    </dependency>

    <plugins>
        <plugin>
            <groupId>fish.payara.maven.plugins</groupId>
            <artifactId>payara-micro-maven-plugin</artifactId>
            <version>1.0.1</version>
            <configuration>
                <payaraVersion>${version.payara.micro}</payaraVersion>
                <deployWar>true</deployWar>
                <commandLineOptions>
                    <option>
                        <key>--autoBindHttp</key>
                    </option>
                </commandLineOptions>
            </configuration>
        </plugin>
    </plugins>
```

Your pom.xml should look like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation=
"http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.kodnito.bookstore.rest</groupId>
    <artifactId>book-store</artifactId>
    <version>1.0-SNAPSHOT</version>
    <packaging>war</packaging>
    <dependencies>
        <dependency>
            <groupId>org.eclipse.microprofile</groupId>
            <artifactId>microprofile</artifactId>
            <version>2.0.1</version>
            <type>pom</type>
            <scope>provided</scope>
        </dependency>
        <dependency>
            <groupId>com.h2database</groupId>
            <artifactId>h2</artifactId>
            <version>1.4.196</version>
            <scope>runtime</scope>
        </dependency>
        <dependency>
            <groupId>org.eclipse.persistence</groupId>
            <artifactId>eclipselink</artifactId>
            <version>2.7.4</version>
        </dependency>
        <dependency>
            <groupId>javax.transaction</groupId>
            <artifactId>javax.transaction-api</artifactId>
            <version>1.3</version>
        </dependency>
    </dependencies>
    <build>
        <finalName>restapi</finalName>
        <plugins>
         <plugin>
                <groupId>fish.payara.maven.plugins</groupId>
                <artifactId>payara-micro-maven-plugin</artifactId>
                <version>1.0.1</version>
                <configuration>
                    <payaraVersion>${version.payara.micro}</payaraVersion>
                    <deployWar>true</deployWar>
                    <commandLineOptions>
                        <option>
                            <key>--autoBindHttp</key>
                        </option>
                    </commandLineOptions>
                </configuration>
```

```
            </plugin>
        </plugins>
    </build>
    <properties>
        <maven.compiler.source>1.8</maven.compiler.source>
        <maven.compiler.target>1.8</maven.compiler.target>
        <failOnMissingWebXml>false</failOnMissingWebXml>
    <version.payara.micro>5.183</version.payara.micro>
    </properties>
</project>
```

We added dependencies for H2 database, JPA , Payara Micro Maven runtime and javax transaction API. Now open the terminal and navigate to the project directory and type the following command to download the dependencies :

```
mvn clean install
```

Payara Micro Config

Create a new directory called `WEB-INF` inside `src/main/webapp` and inside `WEB-INF` directory create the `glassfish-resources.xml` file and add the following to configure DataSource:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE resources PUBLIC "-//GlassFish.org//DTD GlassFish Application Server 3.1
Resource Definitions//EN" "http://glassfish.org/dtds/glassfish-resources_1_5.dtd">
<resources>
    <jdbc-resource
            pool-name="H2Pool"
            jndi-name="java:app/jdbc/restapi"/>
    <jdbc-connection-pool
            name="H2Pool"
            res-type="javax.sql.DataSource"
            datasource-classname="org.h2.jdbcx.JdbcDataSource">

        <property name="user" value="sa"/>
        <property name="password" value=""/>
        <property name="url" value="jdbc:h2:mem:restapiDB"/>
    </jdbc-connection-pool>
</resources>
```

We use the open source H2 database, which can be embedded in Java applications or run in the client mode. It's really easy to getting started with H2 database, but I don't think it's a good idea to use it in production. This config will create an in memory based database called `restapiDB`. Now that we have our PayaraMicro DataSource configured it's time to create our `persistence.xml` file. Inside `src/main/resources` create the `persistence.xml` file and add the following:

```
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="1.0"
             xmlns="http://java.sun.com/xml/ns/persistence"
             xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xsi:schemaLocation="http://java.sun.com/xml/ns/persistence
http://java.sun.com/xml/ns/persistence/persistence_1_0.xsd">
    <persistence-unit name="restapi_PU" transaction-type="JTA">
        <provider>org.eclipse.persistence.jpa.PersistenceProvider</provider>
        <jta-data-source>java:app/jdbc/restapi</jta-data-source>
        <properties>
            <property name="eclipselink.ddl-generation" value="create-tables"/>
            <property name="eclipselink.ddl-generation.output-mode" value="database"/>
        </properties>
    </persistence-unit>
</persistence>
```

`persistence.xml` is the standard configuration file for JPA and it has to be included in the `META-INF` directory. The `persistence.xml` file defines what provider to be used, the name of the persistence

unit, how classes should be mapped to database tables. `eclipselink.ddl-generation` will create the database and tables.

Now that we have everything configured, it's time to start working on our API.

Entity

An Entity is a Java class that is marked with annotations that represent objects in a database. Create a new file called Book.java inside com.kodnito.bookstore.entity and make it look like this:

```
package com.kodnito.bookstore.entity;

import java.io.Serializable;
import javax.persistence.Entity;
import javax.persistence.GeneratedValue;
import javax.persistence.GenerationType;
import javax.persistence.Id;
import javax.persistence.NamedQueries;
import javax.persistence.NamedQuery;
import javax.persistence.Table;

@Entity
@Table(name = "books")
@NamedQueries({
    @NamedQuery(name = "Book.findAll", query = "SELECT b FROM Book b")
})
public class Book implements Serializable {

    private static final long serialVersionUID = 1L;

    @Id
    @GeneratedValue(strategy = GenerationType.AUTO)
    private Long id;
    private String title;
    private String description;
    private String isbn;
    private String publisher;
    private String language;
    private String author;
    private float price;
    private int pages;

    public Long getId() {
        return id;
    }

    public void setId(Long id) {
        this.id = id;
    }

    public String getTitle() {
        return title;
    }

    public void setTitle(String title) {
```

```
        this.title = title;
    }

    public String getDescription() {
        return description;
    }

    public void setDescription(String description) {
        this.description = description;
    }

    public String getIsbn() {
        return isbn;
    }

    public void setIsbn(String isbn) {
        this.isbn = isbn;
    }

    public String getPublisher() {
        return publisher;
    }

    public void setPublisher(String publisher) {
        this.publisher = publisher;
    }

    public String getLanguage() {
        return language;
    }

    public void setLanguage(String language) {
        this.language = language;
    }

    public static long getSerialVersionUID() {
        return serialVersionUID;
    }

    public String getAuthor() {
        return author;
    }

    public float getPrice() {
        return price;
    }

    public void setPrice(float price) {
        this.price = price;
    }
```

```
    public int getPages() {
        return pages;
    }

    public void setPages(int pages) {
        this.pages = pages;
    }

}
```

- `@Entity` annotation indicates that it is a JPA entity
- `@Table` annotation is used to name the table in the database
- `@NamedQueries` annotation is used to add multiple queries
- `@NamedQuery` annotation defines query with a name
- `@Id` annotation is used to define the primary key and the Id property is also annotated with `@GeneratedValue` to indicate that the Id should be generated automatically.

Business Logic

It's time to concentrate on the business logic code. It's always best to separate the code that each class does its own job. We will now create the BookService.java file for interacting with the database. Now create the BookService.java file inside com.kodnito.bookstore.service package and make it look like:

```
package com.kodnito.bookstore.service;

import com.kodnito.bookstore.entity.Book;
import java.util.List;
import javax.enterprise.context.ApplicationScoped;
import javax.persistence.EntityManager;
import javax.persistence.PersistenceContext;
import javax.transaction.Transactional;

@ApplicationScoped
public class BookService {

    @PersistenceContext(unitName = "restapi_PU")
    EntityManager em;

    public List getAll() {
        return em.createNamedQuery("Book.findAll", Book.class).getResultList();
    }

    public Book findById(Long id) {
        return em.find(Book.class, id);
    }

    @Transactional
    public void update(Book book) {
        em.merge(book);
    }

    @Transactional
    public void create(Book book) {
        em.persist(book);
    }
    @Transactional
    public void delete(Book book) {
        if (!em.contains(book)) {
            book = em.merge(book);
        }
        em.remove(book);
    }
}
```

What does everything mean in this file, we start at the beginning of the file with the

`@ApplicationScoped` annotation. When an object is annotated with the `@ApplicationScoped` annotation, is created once for the duration of the application. `@PersistenceContext` annotated injects the EntityManager to be used at runtime. We have created five method to interact with the database. getAll method will get all the objects from the books table, when we want a single object we will use the findById method with an id. Update method like it says will update an existing object, create method will create a new Book object and delete will delete an existing Book object from the database. The `@Transactional` annotation provides the application the ability to control the transaction boundaries.

Summary

In this chapter, we created our application from maven archetype, added the dependencies we need for our application, configured our application, created entities classes and created our business logic code for interacting with the database.

Building REST APIs Using MicroProfile

REST stands for representational state transfer and is a software architecture style for creating web services. The primary used HTTP verbs are GET, POST, PUT, PATCH and DELETE.

GET	Get a list of resources or a single resources
POST	Create a new resource
PUT	Update/Replace an existing resource
PATCH	Update/Modify an existing resource
DELETE	Delete an existing resource

Now how should we define URIs for our book store application:

GET	http://localhost:8080/restapi/books	Return a list of all Books
GET	http://localhost:8080/restapi/books/1	Return the Book whose ID is 1
POST	http://localhost:8080/restapi/books	Create a new Book resource
PUT	http://localhost:8080/restapi/books/1	Update the Book whose ID is 1
DELETE	http://localhost:8080/restapi/books/1	Delete the Book whose ID is 1

Now that we have defined the book store URIs, it's time to start coding. Create a new file called `BookStoreEndpoint.java` inside `com.kodnito.bookstore.rest`. We start creating the GET methods, open the `BookStoreEndpoint.java` file and add the following:

```
package com.kodnito.bookstore.rest;

import com.kodnito.bookstore.entity.Book;
import com.kodnito.bookstore.service.BookService;
import javax.enterprise.context.RequestScoped;
import javax.inject.Inject;
import javax.ws.rs.Consumes;
import javax.ws.rs.GET;
import javax.ws.rs.POST;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;
import javax.ws.rs.core.Response;


@RequestScoped
@Path("books")
@Produces(MediaType.APPLICATION_JSON)
@Consumes(MediaType.APPLICATION_JSON)
public class BookStoreEndpoint {

    @Inject
    BookService bookService;

    @GET
    public Response getAll() {
        return Response.ok(bookService.getAll()).build();
    }

    @GET
    @Path("{id}")
    public Response getBook(@PathParam("id") Long id) {
        Book book = bookService.findById(id);

        return Response.ok(book).build();
    }
}
```

We start with the annotations we have added, the `@RequestScoped` annotation indicates that this class will be created once every request. `@Path` annotation identifies the URI path to which the resource responds. `@Produces` annotation will automatically convert the response to JSON format and `@Consumes` annotation will automatically convert the posted JSON string here to Book object. We inject the BookService with the `@Inject` annotation. We annotated the getAll method with `@GET` annotation, which maps /books HTTP GET request to the method and will retrieve all the books from the database and return the entire list. Parameters are accessed with the `@PathParam` annotation.

Next, we will create the POST method, add the following to the BookStoreEndpoint.java:

```
@POST
public Response create(Book book) {
    bookService.create(book);
    return Response.ok().build();
}
```

The create method is annotated with the `@POST` annotation, which indicates that HTTP POST request are mapped to this method. Now that we have GET and POST methods done we can test that our application works. Open the terminal and navigate to the project directory and type the following command to start our application.

```
mvn clean package payara-micro:start
```

We start with the GET method.

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8080/restapi/books
```

Because we don't have any objects in the database, we will only get an empty list.

Output

```
[]%
```

Time to create Book objects in the database.

```
curl -i -X POST -H "Content-Type:application/json" \
  --data '{"title":"This is my test book","description":"this is my book description",
            "isbn": "12xxxxxxxx", "publisher": "None Yet",
"language":"English","author":"Hayri Cicek",
             "price": "0.00","pages":"0"}' http://localhost:8080/restapi/books
```

Output

```
HTTP/1.1 200 OK
Server: Payara Micro #badassfish
Content-Length: 0
X-Frame-Options: SAMEORIGIN
```

Now that we have created one book object, we can go back and try the GET method again to see that we get the book object from the database.

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8080/restapi/books
```

Output

```
HTTP/1.1 200 OK
Server: Payara Micro #badassfish
Content-Type: application/json
Content-Length: 171
X-Frame-Options: SAMEORIGIN

[{"description":"this is my book
description","id":1,"isbn":"12xxxxxxxx","language":"English","pages":0,"price":0.0,"pu
blisher":"None Yet","title":"This is my test book"}]%
```

Now, we have a list with one object returned to us from the database. Create another one and try to get a single object back.

```
curl -i -X POST -H "Content-Type:application/json" \
  --data '{"title":"This is my second test book","description":"this is my second book
description",
            "isbn": "13xxxxxxxx", "publisher": "None Yet",
"language":"English","author":"Hayri Cicek",
             "price": "0.00","pages":"0"}' http://localhost:8080/restapi/books
```

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8080/restapi/books/2
```

Output

```
HTTP/1.1 200 OK
Server: Payara Micro #badassfish
Content-Type: application/json
Content-Length: 183
X-Frame-Options: SAMEORIGIN

{"description":"this is my second book
description","id":2,"isbn":"13xxxxxxxx","language":"English","pages":0,"price":0.0,"pu
blisher":"None Yet","title":"This is my second test book"}%
```

The GET and the POST methods seems to work and it's time to create the rest of the methods, PUT and DELETE. Open BookStoreEndpoint and add the following for updating an existing object.

```
@PUT
@Path("{id}")
public Response update(@PathParam("id") Long id, Book book) {
    Book updateBook = bookService.findById(id);

    updateBook.setIsbn(book.getIsbn());
    updateBook.setDescription(book.getDescription());
    updateBook.setLanguage(book.getLanguage());
    updateBook.setPages(book.getPages());
    updateBook.setPrice(book.getPrice());
    updateBook.setPublisher(book.getPublisher());
    updateBook.setTitle(book.getTitle());

    bookService.update(updateBook);

    return Response.ok().build();
}
```

Here we annotate the update method with `@PUT` annotation, which maps HTTP PUT verb request to this method and the method takes two parameters, id and Book object. Next is to add the Delete method to the API, open BookStoreEndpoint.java and add the following:

```
@DELETE
@Path("{id}")
public Response delete(@PathParam("id") Long id) {
    Book getBook = bookService.findById(id);
    bookService.delete(getBook);
    return Response.ok().build();
}
```

Here we annotate the delete method with `@DELETE` annotation, which maps HTTP DELETE verb request to this method. We pass an id to this method, which finds and deletes the Book objects whose id match. Now in the terminal, if you don't already have quite the Payara Micro server, then quit by Ctrl+c and start again using the same mvn clean package payara-micro:start command.

Open another terminal window and try both the Update and Delete functions.

```
curl -H 'Content-Type: application/json' -X PUT \
-d '{"title":"This is my second test book updated","description":"this is my second
book description updated",
            "isbn": "13xxxxxxxx", "publisher": "None Yet",
"language":"English","author":"Hayri Cicek",
             "price": "1.00","pages":"0"}' http://localhost:8080/restapi/books/2
```

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8080/restapi/books/2
```

Output

```
HTTP/1.1 200 OK
Server: Payara Micro #badassfish
Content-Type: application/json
Content-Length: 199
X-Frame-Options: SAMEORIGIN

{"description":"this is my second book description
updated","id":2,"isbn":"13xxxxxxxx","language":"English","pages":0,"price":1.0,"publis
her":"None Yet","title":"This is my second test book updated"}%
```

Here, I will update the Book with id 2 and if you don't have Book object with id 2 then take one that you have in your database, now if you get all objects again you will see that the object is updated. Next is to try the DELETE method, open a new terminal tab and use the command below.

```
curl -X DELETE http://localhost:8080/restapi/books/2
```

Now when you get the book list again, now the book object is deleted.

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8080/restapi/books
```

Output

```
HTTP/1.1 200 OK
Server: Payara Micro #badassfish
Content-Type: application/json
Content-Length: 171
X-Frame-Options: SAMEORIGIN

[{"description":"this is my book
description","id":1,"isbn":"12xxxxxxxx","language":"English","pages":0,"price":0.0,"pu
blisher":"None Yet","title":"This is my test book"}]%
```

Summary

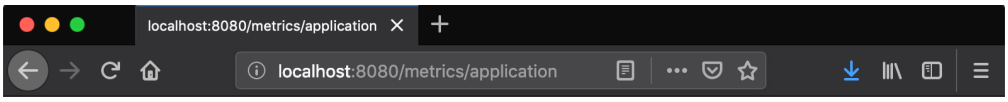
In this chapter we learned how to create a REST API using MicroProfile and curl to test our API.

MicroProfile Metrics

When we build micro services or web applications, we need to monitor our application that it's running, have memory or disk space and for that we have MicroProfile Metrics which is very easy to get started with and use. Open the BookStoreEndpoint.java file and make the getAll method to look like this.

```
@Timed(name = "getAllBooks",
            description = "Monitor the time getAll Method takes",
            unit = MetricUnits.MILLISECONDS,
            absolute = true)
@GET
public Response getAll() {
        return Response.ok(bookService.getAll()).build();
}
```

`@Timed` annotation will monitor how long the process take. The metadata fields on `@Timed` annotation are optional, but we have added a few name field is the name of the metric, description is used to describe the metric, unit sets the unit of the metric and absolute is used to determine if the name specified in the name field is the exact name. Now Kill the Payara Micro server and start it again using the command `mvn clean package payara-micro:start` and first navigate to the http://localhost:8080/restapi/books, because we need to time it and see how long the process will take, now open another tab and go to http://localhost:8080/metrics/application and voila you have some metrics.




```
# TYPE application:get_book counter
# HELP application:get_book Monitor how many times getBook method was called
application:get_book 2
# TYPE application:create_books_total counter
# HELP application:create_books_total Monitor the rate events occured
application:create_books_total 2
# TYPE application:create_books_rate_per_second gauge
application:create_books_rate_per_second 0.0010272954851753117
# TYPE application:create_books_one_min_rate_per_second gauge
application:create_books_one_min_rate_per_second 3.1020285506000993E-13
# TYPE application:create_books_five_min_rate_per_second gauge
application:create_books_five_min_rate_per_second 2.95834602852581E-5
# TYPE application:create_books_fifteen_min_rate_per_second gauge
application:create_books_fifteen_min_rate_per_second 3.4742539510852473E-4
# TYPE application:get_all_books_rate_per_second gauge
application:get_all_books_rate_per_second 0.002568243075597919
# TYPE application:get_all_books_one_min_rate_per_second gauge
application:get_all_books_one_min_rate_per_second 2.880528958059601E-10
# TYPE application:get_all_books_five_min_rate_per_second gauge
application:get_all_books_five_min_rate_per_second 4.3993110623390927E-4
# TYPE application:get_all_books_fifteen_min_rate_per_second gauge
application:get_all_books_fifteen_min_rate_per_second 0.023986553903088032
# TYPE application:get_all_books_mean_seconds gauge
application:get_all_books_mean_seconds 1871.9183086086873
# TYPE application:get_all_books_max_seconds gauge
application:get_all_books_max_seconds 57441.92
# TYPE application:get_all_books_min_seconds gauge
application:get_all_books_min_seconds 881.682
# TYPE application:get_all_books_stddev_seconds gauge
application:get_all_books_stddev_seconds 85.52434777596713
# TYPE application:get_all_books_seconds summary
# HELP application:get_all_books_seconds Monitor the time getAll Method takes
application:get_all_books_seconds_count 5
application:get_all_books_seconds{quantile="0.5"} 1873.259
application:get_all_books_seconds{quantile="0.75"} 1873.259
application:get_all_books_seconds{quantile="0.95"} 1873.259
application:get_all_books_seconds{quantile="0.98"} 1873.259
application:get_all_books_seconds{quantile="0.99"} 1873.259
application:get_all_books_seconds{quantile="0.999"} 1873.259
```

Here we have a list of metrics and if we want a single metric then we could use the name we specified in the name field and navigate to http://localhost:8080/metrics/application/get-all-books.

@Metered

`@Metered` annotation will monitor the rate events occurred. The meta fields are optional, but it makes the life easy if we add some data to the meta fields. Change the create method to look like this.

```
@Metered(name = "create-books",
            unit = MetricUnits.MILLISECONDS,
            description = "Monitor the rate events occured",
            absolute = true)
@POST
public Response create(Book book) {
        bookService.create(book);
        return Response.ok().build();
}
```

Like the `@Timed` annotation, we have name, unit, description and absolute, which is almost identical.

@Counted

`@Counted` annotation will monitor how many times a method got invoked, and the `@Counted` annotation have a few meta fields and are optional. Update the getBook method to look like this.

```
@Counted(unit = MetricUnits.NONE,
            name = "getBook",
            absolute = true,
            monotonic = true,
            displayName = "get single book",
            description = "Monitor how many times getBook method was called")
@GET
@Path("{id}")
public Response getBook(@PathParam("id") Long id) {
        Book book = bookService.findById(id);

        return Response.ok(book).build();
}
```

Here, like the other metrics, we have name, absolute, monotonic, displayName and description, the table below show what everything is for:

unit	sets the unit of the metric.
absolute	is used to determine if the name specified in the name field is the exact name.
monotonic	is set to true, which means the counter increases monotonically.
displayName	the display name of the counter
description	describe the metric

@Gauge

`@Gauge` annotation is used to return just a value The metadata fields on @Counted annotation are optional

Example:

```
@GET
@Path("/get-int-value")
@Gauge(unit = MetricUnits.NONE, name = "intValue", absolute = true)
public int getIntValue() {
        return 3;
}
```

unit	sets the unit of the metric.
name	the name of the gauge.
absolute	is used to determine if the name specified in the name field is the exact name.

Start the application server and go to http://localhost:8080/metrics/application, you should see all your metrics.

Summary

In this chapter, we learned how to add MicroProfile Metrics to our application.

MicroProfile Rest Client

With MicroProfile Rest Client we can invoke RESTful services over HTTP, and in this tutorial we will create another service, which will call our Book Store application. Open a new terminal window and create a new MicroProfile Maven project using Kodnito MicroProfile Archetype, using the following command:

```
mvn archetype:generate -DarchetypeGroupId=com.kodnito
-DarchetypeArtifactId=kodnito-microprofile-archetype -DarchetypeVersion=1.0.1
-DgroupId=com.kodnito.bookstore.rest -DartifactId=book-store-client -Dversion=1.0
-SNAPSHOT
```

We should have 2 projects now. Now cd into book-store-client application and type mvn clean install to download and install dependencies. Open book-store-client application in your IDE and add the following dependencies to the pom.xml: In the build section add the TomEE Maven runtime:

```
<plugins>
    <plugin>
        <groupId>org.apache.tomee.maven</groupId>
        <artifactId>tomee-maven-plugin</artifactId>
        <version>${tomee.version}</version>
        <configuration>
            <tomeeVersion>${tomee.version}</tomeeVersion>
            <tomeeClassifier>microprofile</tomeeClassifier>
        </configuration>
    </plugin>
</plugins>
```

And in the properties section add the version for the TomEE:

```
<tomee.version>8.0.0-M3</tomee.version>
```

Your pom.xml should look like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation=
"http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.kodnito.bookstore.rest</groupId>
    <artifactId>book-store-client</artifactId>
    <version>1.0-SNAPSHOT</version>
    <packaging>war</packaging>
    <dependencies>
        <dependency>
            <groupId>org.eclipse.microprofile</groupId>
            <artifactId>microprofile</artifactId>
            <version>2.0.1</version>
            <type>pom</type>
            <scope>provided</scope>
        </dependency>
    </dependencies>
    <build>
        <finalName>restapi</finalName>
        <plugins>
            <plugin>
                <groupId>org.apache.tomee.maven</groupId>
                <artifactId>tomee-maven-plugin</artifactId>
                <version>${tomee.version}</version>
                <configuration>
                    <tomeeVersion>${tomee.version}</tomeeVersion>
                    <tomeeClassifier>microprofile</tomeeClassifier>
                </configuration>
            </plugin>
        </plugins>
    </build>
    <properties>
        <tomee.version>8.0.0-M3</tomee.version>
        <maven.compiler.source>1.8</maven.compiler.source>
        <maven.compiler.target>1.8</maven.compiler.target>
        <failOnMissingWebXml>false</failOnMissingWebXml>
    </properties>
</project>
```

Now in the terminal type `mvn clean install` to download dependencies. It's time to code our book-store-client service which will call our book-store. Inside `com.kodnito.bookstore.response` package create a new file called `BookResponse.java` and add the following.

```
package com.kodnito.bookstore.response;

public class BookResponse {

    private Long id;
```

```
    private String title;
    private String description;
    private String isbn;
    private String publisher;
    private String language;
    private String author;
    private float price;
    private int pages;

    public Long getId() {
        return id;
    }

    public void setId(Long id) {
        this.id = id;
    }

    public String getTitle() {
        return title;
    }

    public void setTitle(String title) {
        this.title = title;
    }

    public String getDescription() {
        return description;
    }

    public void setDescription(String description) {
        this.description = description;
    }

    public String getIsbn() {
        return isbn;
    }

    public void setIsbn(String isbn) {
        this.isbn = isbn;
    }

    public String getPublisher() {
        return publisher;
    }

    public void setPublisher(String publisher) {
        this.publisher = publisher;
    }

    public String getLanguage() {
        return language;
```

```
    }

    public void setLanguage(String language) {
        this.language = language;
    }

    public String getAuthor() {
        return author;
    }

    public void setAuthor(String author) {
        this.author = author;
    }

    public float getPrice() {
        return price;
    }

    public void setPrice(float price) {
        this.price = price;
    }

    public int getPages() {
        return pages;
    }

    public void setPages(int pages) {
        this.pages = pages;
    }

}
```

The response from BookStore service will be mapped using this class. We will create two more files, create a new interface called `BookStoreService.java` inside `com.kodnito.bookstore.service` and add the following:

```
package com.kodnito.bookstore.service;

import com.kodnito.bookstore.response.BookResponse;
import java.util.List;
import javax.enterprise.context.Dependent;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;
import org.eclipse.microprofile.rest.client.inject.RegisterRestClient;

@Dependent
@RegisterRestClient
@Path("books")
@Produces(MediaType.APPLICATION_JSON)
public interface BookStoreService {

    @GET
    public List<BookResponse> getAll();
}
```

Here we create an interface with method(s) that represent RESTful APIs endpoint, and we can use this interface to invoke, the remote service. Using `@Dependent` and `@RegisterRestClient` on the interface, will make that this interface will be mapped by the CDI. Next thing to do is to create a new resource that will use this interface and invoke our book-store service. Inside `com.kodnito.bookstore.rest` package create `BookStoreEndpoint.java` file and add the following:

```
package com.kodnito.bookstore.rest;

import java.net.MalformedURLException;
import java.net.URL;
import javax.enterprise.context.ApplicationScoped;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.MediaType;
import org.eclipse.microprofile.rest.client.RestClientBuilder;
import com.kodnito.bookstore.service.BookStoreService;
import javax.ws.rs.core.Response;

@ApplicationScoped
@Path("/books")
public class BookStoreEndpoint {

    @Inject
    @RestClient
    private BookStoreService bookStoreService;

    @GET
    @Produces(MediaType.APPLICATION_JSON)
    public Response books() throws MalformedURLException {
        return Response.ok(bookStoreService.getAll()).build();
    }
}
```

This is almost identical to the one we have in our book-store application, when we invoke this endpoint on the book-store-client service, it will call the book-store service and retrieve all the books. Before we start the service, we need to add URL to the service we call to the `microprofile-config.properties` file.

```
com.kodnito.bookstore.service.BookStoreService/mp-
rest/url=http://localhost:8080/restapi
```

Now open a new terminal tab and start the `book-store` service first and when the service is up, navigate to the directory where you have the `book-store-client` application and start the application using `mvn clean package tomee:run -Dtomee-plugin.http=8081` and now open your browser and go to http://localhost:8081/restapi/books, and we can see that our services talks to each other.

Summary

In this chapter, we learned how to add MicroProfile Metrics to our application.

MicroProfile Config

MicroProfile Config API can be used to retrieve configuration information from different sources.

When we generated our Maven project we got an empty `microprofile-config.properties` file created in the `src/main/resources` package. MicroProfile Config files are created in this package as default. We will now add new properties and make our application read the properties from our config file. Open `microprofile-config.properties` file and add the following.

```
username=root
password=secret
microprofile.apis={"config", "cdi", "jax-rs", "json-p", "fault tolerance", "healt
check", "jwt auth", "metrics", "openapi", "opentracing","rest client"}
```

Now open the `BookStoreEndpoint.java` and make it look like this:

```
@ApplicationScoped
@Path("/books")
public class BookStoreEndpoint {

    @Inject
    @ConfigProperty(name="username", defaultValue="admin")
    private String username;

    @GET
    @Path("mp-config")
    @Produces(MediaType.APPLICATION_JSON)
    public Response mpConfig() {
        Map<String, Object> configProperties = new HashMap<>();

        configProperties.put("username", username);

        return Response.ok(configProperties).build();
    }
}
```

`@Inject @ConfigProperty` is used for injecting a single configuration property. We could also use `@Inject Config` and use `getValue` to retrieve configuration properties like this:

```
@ApplicationScoped
@Path("/books")
public class BookStoreEndpoint {

    @Inject
    @ConfigProperty(name="username", defaultValue="admin")
    private String username;

    @Inject
    Config config;

    @GET
    @Path("mp-config")
    @Produces(MediaType.APPLICATION_JSON)
    public Response mpConfig() {
        Map<String, Object> configProperties = new HashMap<>();

        configProperties.put("username", username);
        configProperties.put("password", config.getValue("password", String.class));
        configProperties.put("microprofile-apis", config.getValue("microprofile.apis",
String[].class));

        return Response.ok(configProperties).build();
    }
}
```

Start the `BookStoreClient` service if not already started and type the following in a new terminal windows:

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8081/restapi/books/mp-config
```

Output

```
{"password":"secret","microprofile-apis":["{\"config\"","\"cdi\"","\"jax-
rs\"","\"json-p\"","\"fault tolerance\"","\"healt check\"","\"jwt
auth\"","\"metrics\"","\"openapi\"","\"opentracing\"","\"rest
client\"}"],"username":"root"}%
```

Summary

In this chapter, we learned how to use MicroProfile Config API.

MicroProfile Open API

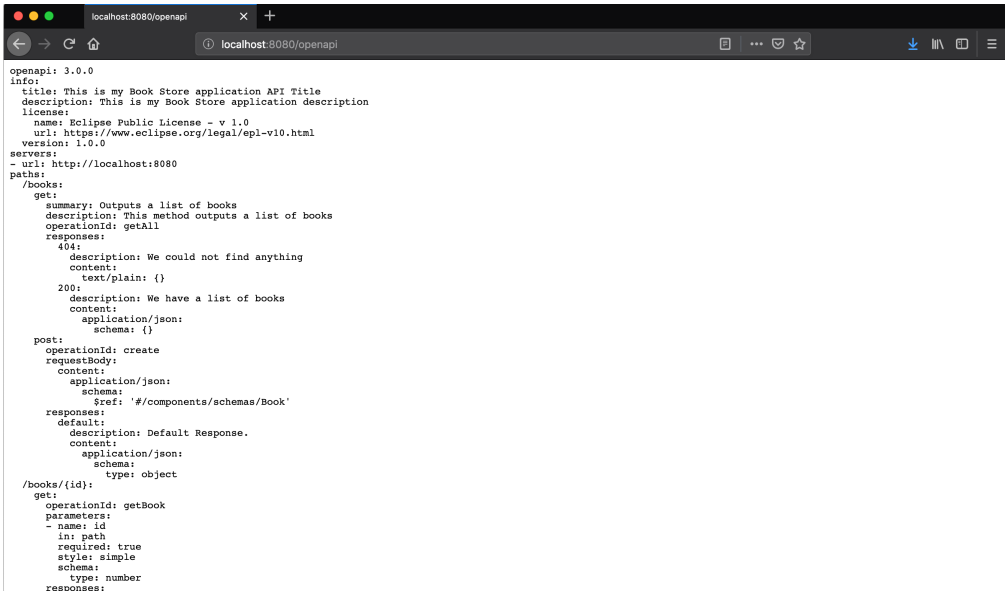
In this chapter, we will learn how to document our RESTful APIs. MicroProfile OpenAPI defines interfaces to produces OpenAPI documentation from JAX-RS applications. We will add documentation to our `book-store` service application. Inside `src/main/resources/META-INF` create the `openapi.yaml` file and add the following :

```
openapi: 3.0.0
info:
  title: This is my Book Store application API Title
  description: This is my Book Store application description
  license:
    name: Eclipse Public License - v 1.0
    url: https://www.eclipse.org/legal/epl-v10.html
  version: 1.0.0
servers:
- url: http://localhost:8080
```

This is our configuration for our API documentation, here we add title, description and license if we want. Restart the `book-store` application and go to http://localhost:8080/openapi, and you will see your RESTful API documentation generated, it doesn't say much about the endpoint and we can add more to the generated documentation. Open `BookStoreEndpoint.java` and make the `getAll()` method to look like this:

```
@APIResponses(
        value = {
            @APIResponse(
                    responseCode = "404",
                    description = "We could not find anything",
                    content = @Content(mediaType = "text/plain"))
            ,
    @APIResponse(
                    responseCode = "200",
                    description = "We have a list of books",
                    content = @Content(mediaType = "application/json",
                            schema = @Schema(implementation = Properties.class)))})
@Operation(summary = "Outputs a list of books",
        description = "This method outputs a list of books")
@Timed(name = "get-all-books",
        description = "Monitor the time getAll Method takes",
        unit = MetricUnits.MILLISECONDS,
        absolute = true)
@GET
public Response getAll() {
    return Response.ok(bookService.getAll()).build();
}
```

Restart the `book-store` service and refresh the http://localhost:8080/openapi endpoint and see the new generated OpenAPI documentation.



`@APIResponses` annotation describes multiple responses `@APIResponse` annotation describes a single response `@Operation` annotation describes a single operation on a path `@Parameter` annotation describes a single operation parameter

Phillip Krüger have an excellent blog post on how to add Swagger UI to your OpenAPI documentation. https://www.phillip-kruger.com/post/microprofile_openapi_swaggerui/

Summary

In this chapter, we learned how to document our RESTful APIs using MicroProfile OpenAPI.

MicroProfile Fault Tolerance

With MicroProfile Fault Tolerance, we can build services which will work even when something failed. `@Timeout` annotation is used to avoid waiting forever for the response.

```
@Timeout(0)
@GET
public Response getAll() {
    return Response.ok(bookService.getAll()).build();
}
```

`@Fallback` annotation is used when something went wrong with the call then it will still operate without throwing an exception.

```
@Timeout(0)
@Fallback(fallbackMethod = "getAllFallbackMethod")
@GET
public Response getAll() {
    return Response.ok(bookService.getAll()).build();
}

public Response getAllFallbackMethod() {
    return Response.ok(Stream.of("Book One", "Book Two").collect(toList())).build();
}
```

`@Retry` annotation is used to repeat the call when something failed.

```
@Retry(maxRetries = 3, delay = 300)
@GET
public Response getAll() {
    return Response.ok(bookService.getAll()).build();
}
```

With `@Bulkhead` annotation you can limit the number of concurrent request that are made to the method

```
@GET
@Bulkhead(10)
public Response getAll() {
    return Response.ok(bookService.getAll()).build();
}
```

`@CircuitBreaker` annotation is used to immediately interrupt the call if the called services previously failed.

```
@GET
@CircuitBreaker(delay = 2000, requestVolumeThreshold = 2, failureRatio=0.65,
successThreshold = 3)
public Response getAll() {
    return Response.ok(bookService.getAll()).build();
}
```

Summary

In this chapter, we learned how to use MicroProfile Fault Tolerance.

MicroProfile Health

Health checks are used to determine if service is running, shutdown, lack of disk space or maybe issues with the database connection. Because we added all the MicroProfile dependencies in our services, we have an endpoint called `/health` by default and if we visit that endpoint it will show us `UP` indicating that the service is up and running. We can add custom health checks if we want. In your terminal windows, start the `BookStoreClient` service if not already running and type the following to invoke the `/health` endpoint:

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8081/restapi/health
```

`Output`

```
{"checks":[],"outcome":"UP","status":"UP"}
```

Create a new file called `BookStoreClientHealthCheck.java` inside `com.kodnito.bookstore.rest` package and make it look like the following

```
package com.kodnito.bookstore.rest;

import javax.enterprise.context.ApplicationScoped;
import org.eclipse.microprofile.health.Health;
import org.eclipse.microprofile.health.HealthCheck;
import org.eclipse.microprofile.health.HealthCheckResponse;

@Health
@ApplicationScoped
public class BookStoreClientHealthCheck implements HealthCheck {

    @Override
    public HealthCheckResponse call() {
        return HealthCheckResponse.
                named("diskspace").
                up().
                withData("free", "900MB").
                build();
    }

}
```

Beans annotated with `@Health` and paired with `@ApplicationScoped` are discovered automatically. We implement the `HealthCheck` interface, and we override the `call()` method. Restart the `BookStoreClient` service and invoke the `/health` endpoint.

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8081/restapi/health
```

Output

```
{"checks":[{"data":{"free":"900MB"},"name":"diskspace","state":"UP"}],"outcome":"UP","
status":"UP"}
```

Now we have our data in the checks list. We are not limited with hardcoded data, this is only for test purpose only. We could add check for database connection, disk space, or we could invoke `BookStore` service and check if the service is in maintenance or the service is down. Add the following property to the `microprofile-config.properties` file.

```
bookservice.url=http://localhost:8080/restapi
```

And now update the `BookStoreClientHealthCheck.java` to look like the following

```
@Health
@ApplicationScoped
public class BookStoreClientHealthCheck implements HealthCheck {

    @Inject
    @ConfigProperty(name = "bookservice.url")
    private String bookServiceUrl;

    @Override
    public HealthCheckResponse call() {

        boolean isHealthy = false;

        try {
            Client client = ClientBuilder.newClient();
            Response response = client.target(bookServiceUrl).request(MediaType
.APPLICATION_JSON)
                    .get();
            if (response.getStatus() != 200) {
                isHealthy = false;
            }
            isHealthy = true;
        } catch (Exception e) {
            isHealthy = false;
        }

        if (!isHealthy) {
            return HealthCheckResponse.named("bookservice")
                    .withData("service", "not available")
                    .down().build();
        }

        return HealthCheckResponse.named("bookservice")
                .withData("service", "available")
                .up().build();
    }

}
```

Here we inject the `bookservice.url` property, and then we invoke the `BookStore` service. We check the response code we get back and if it's not 200 (`OK`) then we return `service not available`. Kill the `BookService` and start the `BookServiceClient`, if it's not already started. In your terminal window type the following to invoke the `/health` endpoint.

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8081/restapi/health
```

`Output`

```
{"checks":[{"data":{"service":"not
available"},"name":"bookservice","state":"DOWN"}],"outcome":"DOWN","status":"DOWN"}%
```

Now, because we stopped the `BookService`, we see that `service is not available` and the status is `DOWN`, if we start the `BookService` and invoke the `/health` again then we see that the output shows that the service is available and status is `UP`.

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8081/restapi/health
```

`Output`

```
{"checks":[{"data":{"service":"available"},"name":"bookservice","state":"UP"}],"outcom
e":"UP","status":"UP"}
```

Here is an example of how to check database connection health:

```
@Log
@Health
@ApplicationScoped
public class MembershipHealthCheck implements HealthCheck {

    @Inject
    private DataSource datasource;

    @Override
    public HealthCheckResponse call() {

        HealthCheckResponseBuilder responseBuilder = HealthCheckResponse.named(
"membership");
        try {
            Connection connection = datasource.getConnection();
            boolean isValid = connection.isValid(timeout);

            DatabaseMetaData metaData = connection.getMetaData();

            responseBuilder = responseBuilder
                    .withData("databaseProductName", metaData.getDatabaseProductName(
))
                    .withData("databaseProductVersion", metaData
.getDatabaseProductVersion())
                    .withData("driverName", metaData.getDriverName())
                    .withData("driverVersion", metaData.getDriverVersion())
                    .withData("isValid", isValid);

            return responseBuilder.state(isValid).build();


        } catch(SQLException  e) {
            log.log(Level.SEVERE, null, e);
            responseBuilder = responseBuilder
                    .withData("exceptionMessage", e.getMessage());
            return responseBuilder.down().build();
        }
    }

    @Inject @ConfigProperty(name = "health.membership.dbtimeout", defaultValue = "5")
    private int timeout;


}
```

Example

Phillip Krüger, **GitHub**

Example

Example to check free memory

```
@Override
public HealthCheckResponse call() {
    return HealthCheckResponse
            .named("book-store-client")
            .state(true)
            .withData("memory", Runtime.getRuntime().freeMemory())
            .build();
}
```

```
curl -i -H "Accept: application/json" -H "Content-Type: application/json" -X GET
http://localhost:8081/restapi/health
```

Output

```
{"checks":[{"data":{"memory":129470808},"name":"book-store-
client","state":"UP"}],"outcome":"UP","status":"UP"}
```

Summary

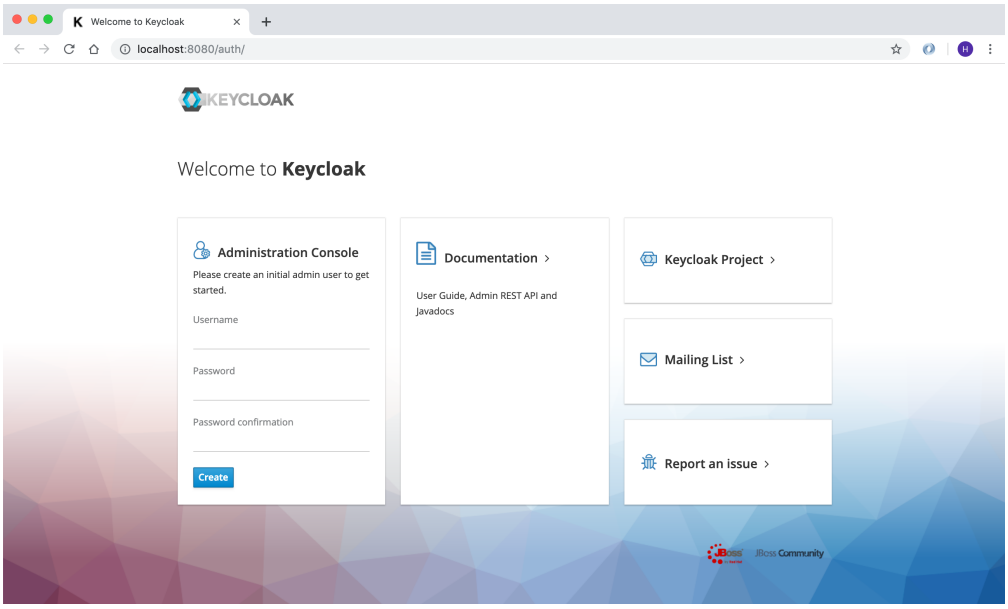
In this chapter, we learned how to use MicroProfile Health in our application.

MicroProfile JWT

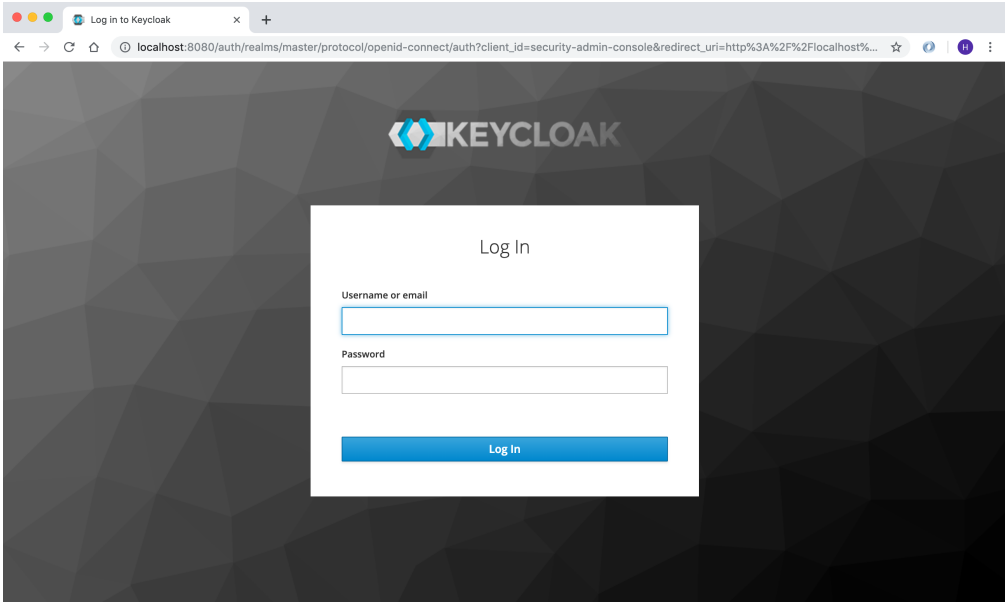
In this chapter, we will learn how to secure our services using MicroProfile JWT and Keycloak. Go to https://www.keycloak.org/downloads.html and download latest Standalone server distribution. Unzip the zip file and open a new terminal window and navigate to the keycloak folder. Now type following command to start the Keycloak server:

```
./bin/standalone.sh -Djboss.http.port=8084
```

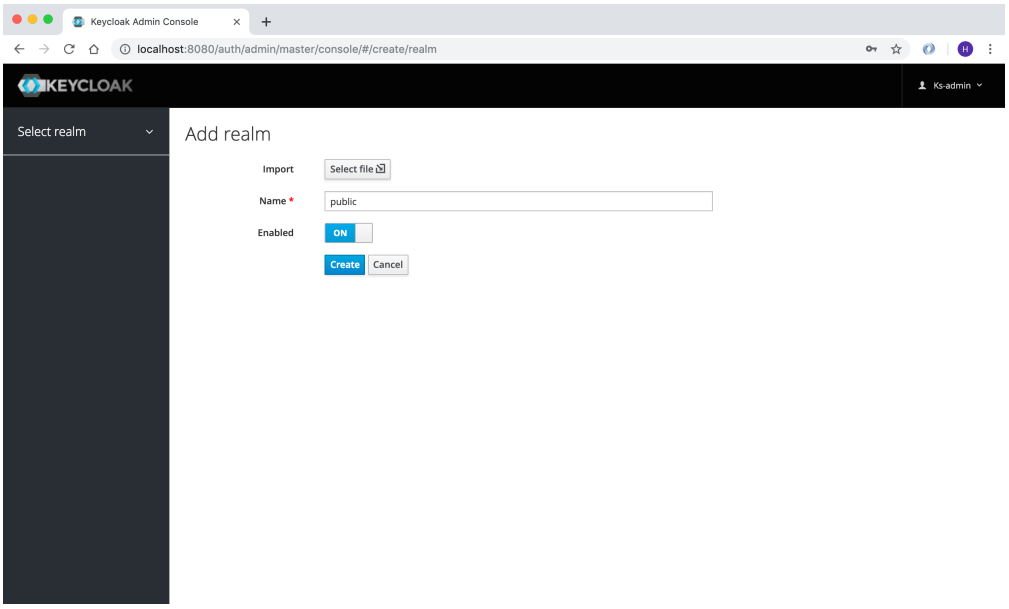
First thing we will do is to create a new user, open your browser and navigate to http://localhost:8084/auth/ and create a new user with admin access.



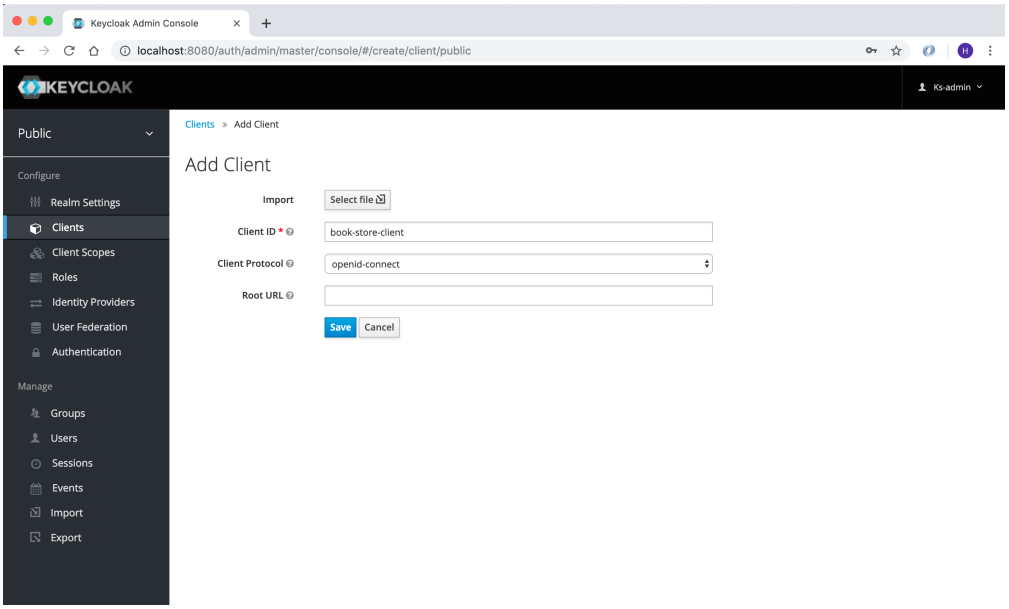
Now go to http://localhost:8084/auth/admin/ and login with the newly created user.



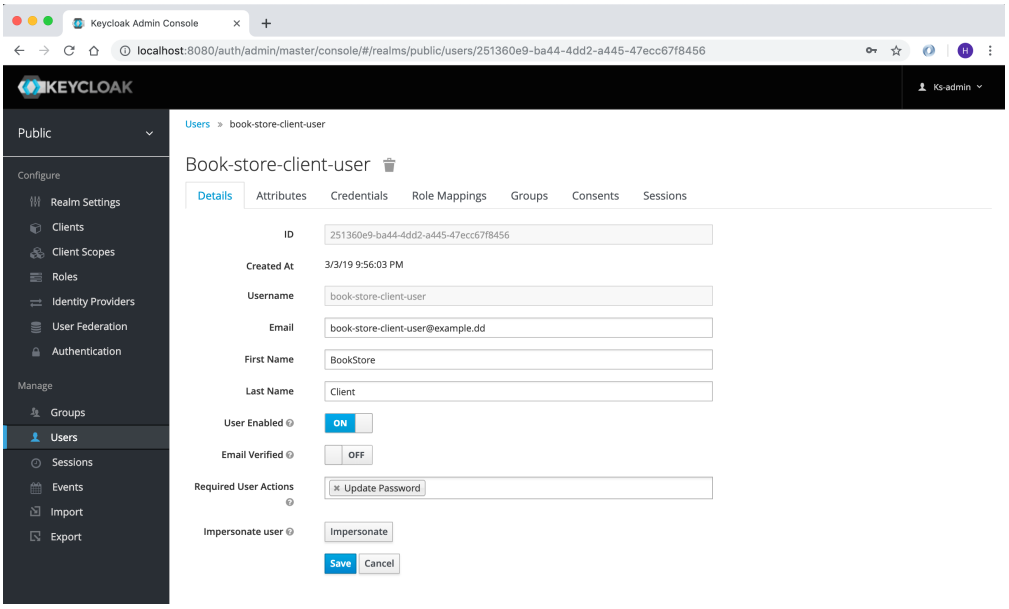
Click on Select Realm and click on Add Realm and create a new realm called public.



Now click on `Client` and create a new client called `book-store-client`, which we will use in our services.



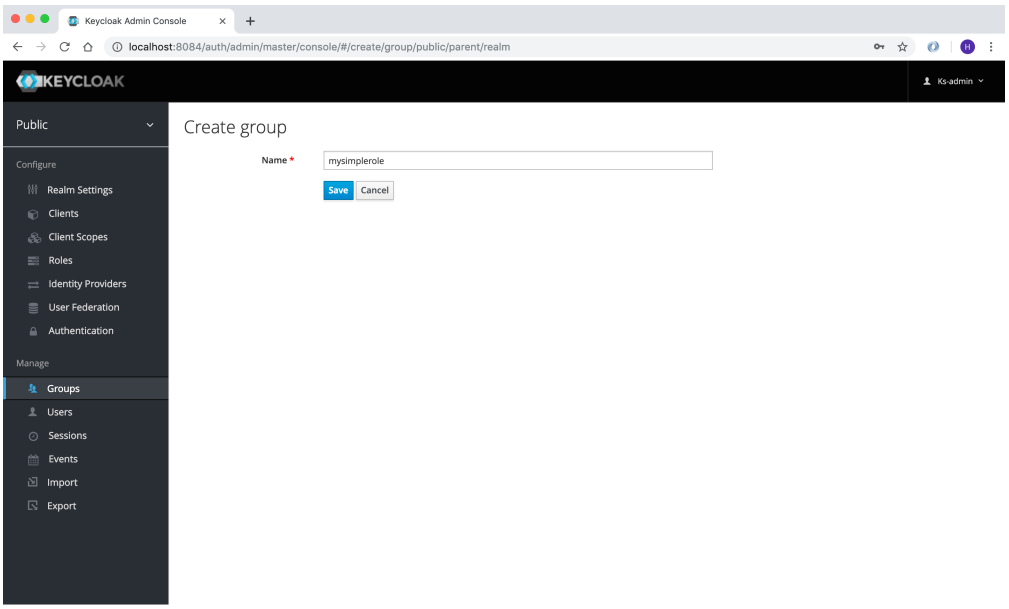
Now, we need to create another user which will be used by our services. Click on `Users` and create a new user called `book-store-client-user`. Update the Email, First Name and Last Name fields and click Save.



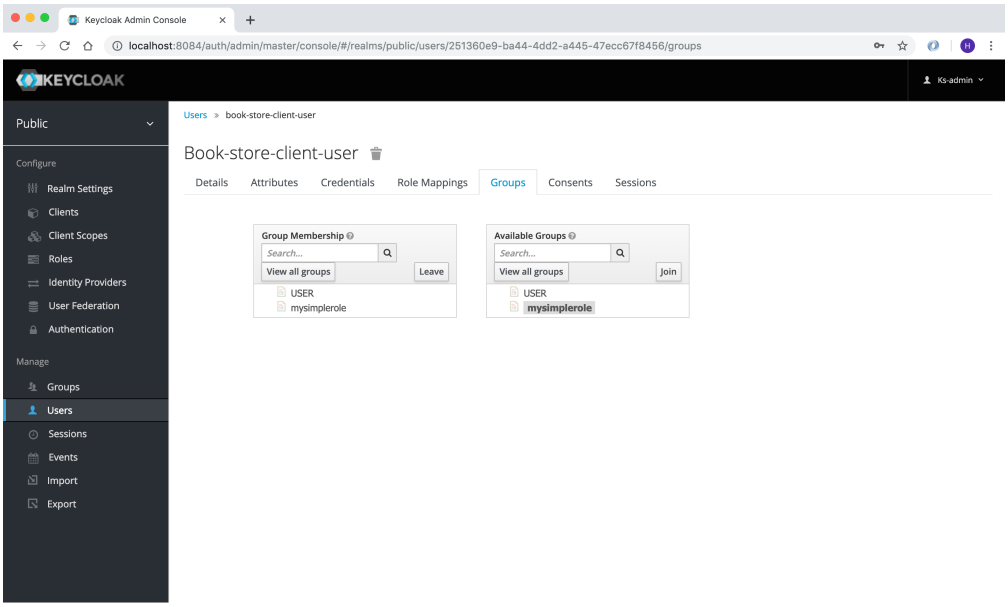
Now click on `Credentials` and create a new password and click on Reset password, now we are done with the Keycloak setup for the user we will use.

Before we implement security in our services, we need to configure Keycloak.

- Click on `Groups` and create a new group called `mysimpleservice`



- Click on `Users` and find the `book-store-client-user` and click on `Group` and click on the `mysimpleservice` and click `join`.



It's time to implement Keycloak authentication in our services.

Open `microprofile-config.properties` in `book-store-client` and add the following:

```
mp.jwt.verify.publickey.location=/META-INF/keycloak-public-key.pem
mp.jwt.verify.issuer=http://localhost:8084/auth/realms/public
```

And create a new file called `keycloak-public-key.pem` inside `src/main/resources/META-INF` and store the public key.

```
-----BEGIN PUBLIC KEY-----
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAmDmSR9FxmQdjy7lLColVAILD3Gxj8uV5O9PS32CbVN
KC1pTh/LvUUigCq5SVVyLb8Ctw4wcC+Ax/AK0GgN76P6bEy9C3k22AqV8TZ7P41oPUSf7OhKBDHpPT2KBz/7tc
NTaWHaJQu29ZnlIzqds+0EotjMAQCBU/wz/DwWesM0L/6nN99/mTtYm2ODoFBAyJkLH0x0wyaHPiFTWz+jxUsH
YEEPaSFncsWrOY3M+x8AmeI63Wo8D6qTkgvDhjVq/zFTg2E0vb3d86X8sb1nYqLR4aInzQq+qzMFhUZQT9j/rg
eLKdmneL8gYSiF4Yt0nPWBTygmwizYOU/86Db6cGawIDAQAB
-----END PUBLIC KEY-----
```

You find the public key here http://localhost:8084/auth/realms/public/

Now open the `ApplicationConfig.java` in `book-store-client` application and make it look like this:

```
@LoginConfig(authMethod = "MP-JWT")
@ApplicationPath("/")
@DeclareRoles({"mysimplerole", "ADMIN"})
public class ApplicationConfig extends Application {

}
```

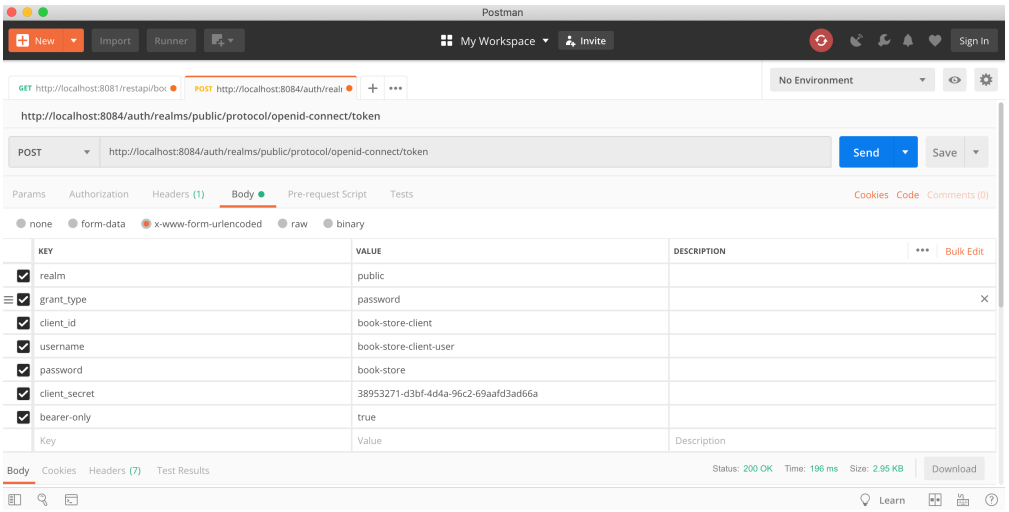
`@LoginConfig` annotation describe what associated realm name will be used in the application. `@DeclareRoles` annotation is used to declare security roles.

Now open the `BookStoreEndpoint.java` file and add `@RolesAllowed("mysimplerole")` to the `mpConfig()` method.

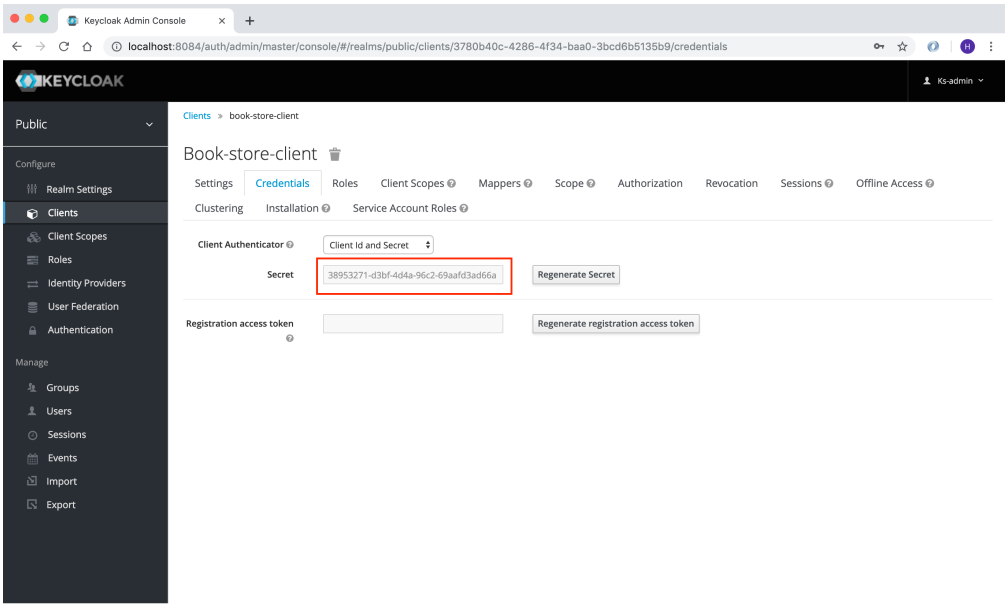
```
@GET
@Path("mp-config")
@Produces(MediaType.APPLICATION_JSON)
@RolesAllowed("mysimplerole")
public Response mpConfig() {
    Map<String, Object> configProperties = new HashMap<>();

    configProperties.put("username", username);
    configProperties.put("password", config.getValue("password", String.class));
    configProperties.put("microprofile-apis", config.getValue("microprofile.apis",
String[].class));

    return Response.ok(configProperties).build();
}
```

`@RolesAllowed` annotation is used to declare security roles and specifies a list of roles to access methods in the application.

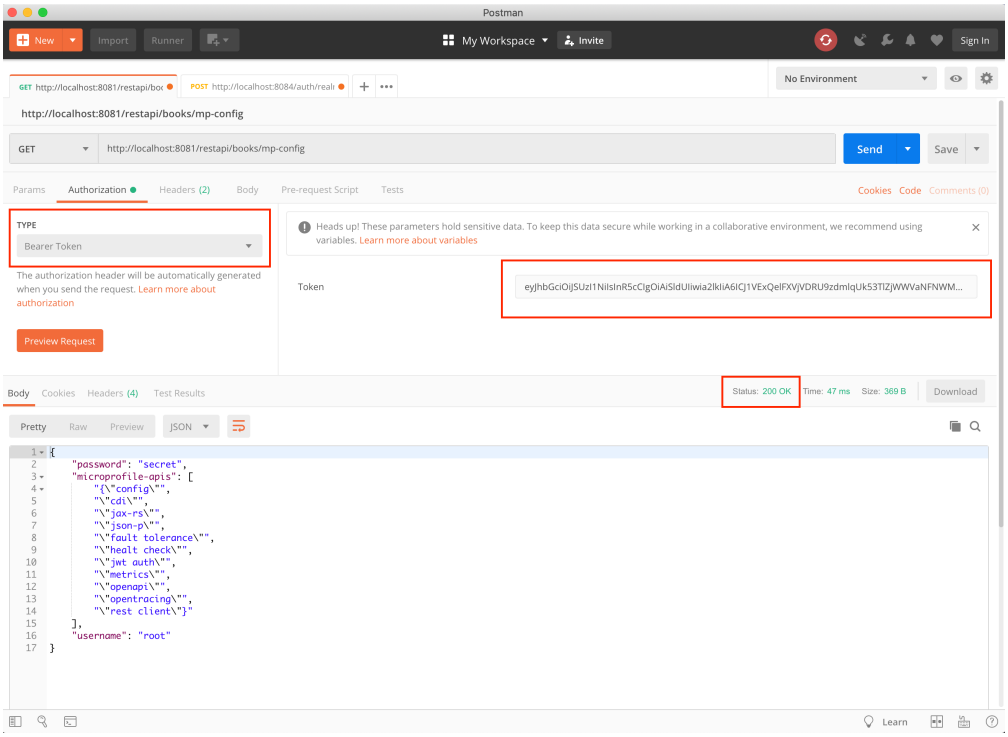
Download Postman, if you don't already have it installed. We will now invoke the Keycloak auth token endpoint to retrieve the access token to use in our service. Open Postman and add the following to retrieve access token.



POST: http://localhost:8084/auth/realms/public/protocol/openid-connect/token
realm: public
grant_type: password
client_id: book-store-client
username: the_username_of_the_user
password: the_password_of_the_user
client_secret: the book store client secret
You find this in the `Credentials` menu.



Now click on `Send` and you will retrieve access token. Copy the access token and open a new Postman tab. Now, make an `GET` request to `http://localhost:8081/restapi/books/mp-config`, if you don't send the request with access token, you will get `401 Unauthorized`.
In `Type` dropdown menu, choose `Bearer Token` and paste the token in `Token` field.
Now click on `Send` again and you will now get `200 OK`.



And that's it, we have secured our `/mp-config` endpoint.

Summary

In this chapter, we learned how to add MicroProfile JWT security to our service.

MicroProfile OpenTracing

OpenTracing is a standardized API that allows developers to instrument their own services for distributed tracing. With distributed tracing, you can troubleshoot your services by logging the requests.

`@Traced` annotation specify a class or method to be traced and has two arguments, which are optional.

value	Defaults to true
operationName	Name of the span, default is ""

```
@GET
@Produces(MediaType.APPLICATION_JSON)
@Traced(operationName = "booksOperation")
public Response books() throws MalformedURLException {
    return Response.ok(bookStoreService.getAll()).build();
}
```

We can use tracing tools like Zipkin or Jaeger to monitor and troubleshoot latency problems in distributed systems.

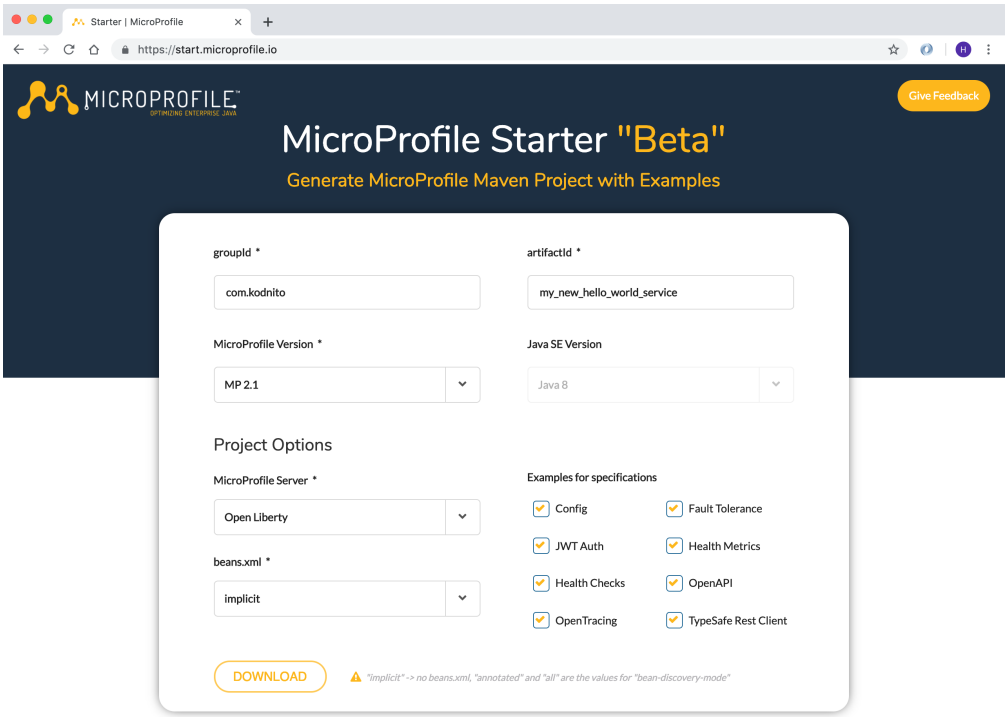
Zipkin	https://zipkin.apache.org/
Jaeger	https://www.jaegertracing.io/

Summary

In this chapter, we learned how to troubleshoot services using MicroProfile OpenTracing.

Eclipse MicroProfile Starter

We used the Kodnito MicroProfile Archetype to generate our projects, but there is a new way and it's to use the new Eclipse MicroProfile Starter. Go to https://start.microprofile.io and follow the steps below to generate your new application.



groupId: com.kodnito
artifactId: my_new_hello_world_service
MicroProfile Version: MP 2.1
MicroProfile Server: Choose server
Choose Beans Discovery Mode
In Examples for specifications section, choose what examples you want to be generated.

That's it, now click Download button and your new project will be downloaded.
Unzip the zip file and open your terminal and go to the directory where the project is.
Depends on which server you choose, use one of the following commands to start the application.

Open Liberty

```
mvn clean package && java -jar target/hello_microprofile_world.jar
```

Thorntail

```
mvn clean package && java -jar target/hello_microprofile_world-thorntail.jar
```

Payara

```
mvn clean package && java -jar target/hello_microprofile_world-microbundle.jar
```

Apache TomEE

```
mvn clean package && java -jar target/hello_microprofile_world-exec.jar
```

KumuluzEE

```
mvn clean package && java -jar target/hello_microprofile_world.jar
```

You will find the test page at http://localhost:8080/index.html

Summary

In this chapter we learned how to use Eclipse MicroProfile Starter.

Useful Links

MicroProfile Starter	https://start.microprofile.io/
MicroProfile	https://microprofile.io
TomEE	http://tomee.apache.org/
Payara	https://payara.fish
Tomitribe	https://tomitribe.com
Thorntail	https://thorntail.io
Helidon	https://helidon.io
KumuluzEE	https://ee.kumuluz.com/
Open Liberty	https://openliberty.io
Eclipse Foundation	https://www.eclipse.org/
OpenJDK	https://openjdk.java.net/
Maven	http://maven.apache.org/
NetBeans	http://netbeans.apache.org/