Software Architecture

Project Stub IDE Example

Laboratory

Bachelor's degree in Techniques for Software Application Development (GTAS)
Computer Science and Multimedia Faculty
March 2025
Version 5.0en

Table of Contents

About this project

This is the lab project for the SA course at the UOC. This project is available in the GitHub organization https://github.com/UOC-SA-SPRING-2025 .

Lab Project is made up of 3 elements (each one in its own GIT repository):

- A docker-compose.yml file to start up the basic infrastructure needed to run the services
- A folder for the ProductCatalog microservice
- A folder for the User microservice
- A folder for the Notification microservice

Made with:

- Docker / Docker Compose
- Spring / Spring Boot
- Maven
- Apache Kafka
- PostgreSQL / Adminer

Before starting:

To set up the containers that are part of the basic infrastructure of the project, the following ports will be used:

- 22181 - Apache Kafka (Zookeeper)
- 19092 - Apache Kafka (Server)
- 54320, 54321 - PostgreSQL
- 18080 - Adminer
- 18081 - Used by the productcatalog microservice
- 18082 - Used by the user microservice

To avoid conflicts with other installed applications, the default ports of all applications have been modified. Still, if there is a conflict over a port already in use, simply modifying the ports specified in the docker-compose.yml file will fix the problem. This link to the official docker compose documentation explains how to modify this configuration using the *ports*: Networking in Compose option.

IMPORTANT NOTICE: *The modified ports will also have to be changed in the microservices configuration (usually defined in the Spring application.properties file).*

Docker

Installation

Docker Desktop / Docker Compose installation

Proceed to install Docker Compose following the steps described in the following guide: https://docs.docker.com/compose/install/ (according to your OS).

Under Windows, registration may be required, as Docker Desktop requires it for educational/personal/non-commercial projects. On the plus side, it will not be necessary to install anything else because it already includes *Compose*.

It is important that you carefully review the hardware and software requirements described in the installation guides. If your system fails to meet them, even after a successful installation, you will see errors when trying to start containers. An alternative for those with slightly older systems is Docker Toolbox or also Podman.

Once Docker Compose is installed, we will continue with the project stub. It is recommended to set up a folder structure like so:

```
Spring-2025
├ README.md
├ docker-compose.yml
├ spring-2025-notification
├ spring-2025-productcatalog
└ spring-2025-user
```

Basic infrastructure (dockers)

Download the code in ZIP format or just clone the spring-2025 (https://github.com/UOC-SA-SPRING-2025/spring-2025) repository in the working folder (spring-2025 if the recommendation has been followed).

From the work folder, run the command:

> *docker compose up* - d (Win)
> *docker-compose up* -d (Linux)

The following containers should start:

- *spring-adminer_1 (*adminer, an SQL client)
- *spring-kafka_1 (*the Kafka server)
- *spring-productdb_1* (the PostgreSQL database for the productcatalog service)
- *spring-userdb_1 (*the PostgreSQL database for the user service)

- *spring-zookeeper_1* (Kafka zookeeper)

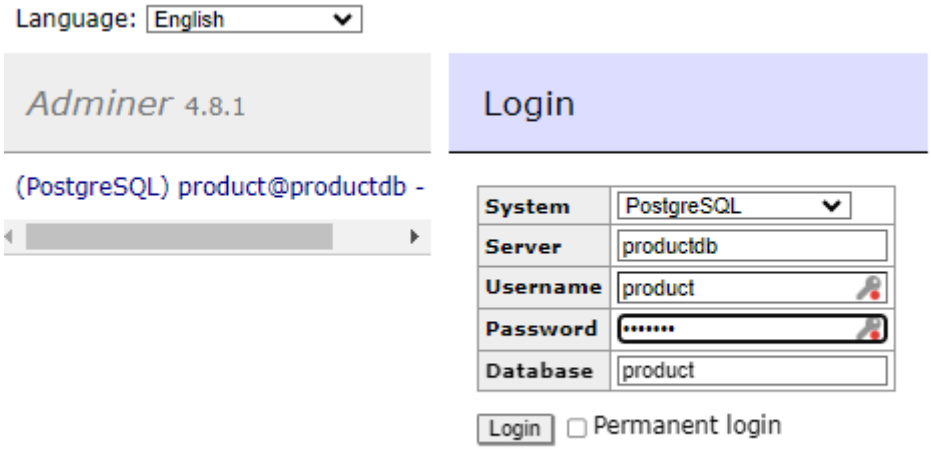
To verify that all containers are up and running, we will execute the following command in a different terminal session:

docker ps -a

We should see something like this:

To check the operation, you can access the *Adminer* panel at http://localhost:18080/ and make a query against the PostgreSQL DB that we have just instantiated with the following connection data:

- *System: PostgreSQL*
- *Server: productdb*
- *Username: product*
- *Password: product*
- *Database: product*



Microservices IDE

In order to carry out the Microservices part, **you can set up the work environment most appropriate to your preferences or knowledge**.

Here, and as an example, a work environment based on Eclipse another on IntelliJ is presented.

To do this, we need to install the following software:

- Open JDK
- Eclipse
- IntelliJ
- Spring Tools
- Lombok project

Open JDK

This IDE uses OpenJDK version 11.0.20.8. Any other version will surely work too.

To install it, you must first download the program from its website: https://jdk.java.net/archive/ , or from https://www.openlogic.com/openjdk-downloads

For the Windows version you can find the .msi at: https://builds.openlogic.com/downloadJDK/openlogic-openjdk-jre/11.0.20+8/openlogic-openjdk-jre-11.0.20+8-windows-x64.msi or the ZIP at:

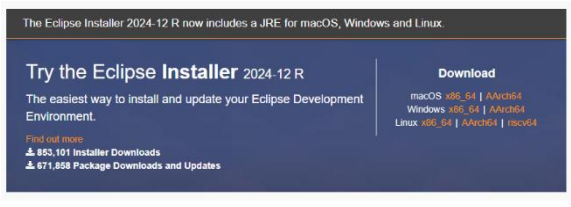
https://download.java.net/java/GA/jdk11/9/GPL/openjdk-11.0.2_windows-x64_bin.zip

Eclipse

Installation

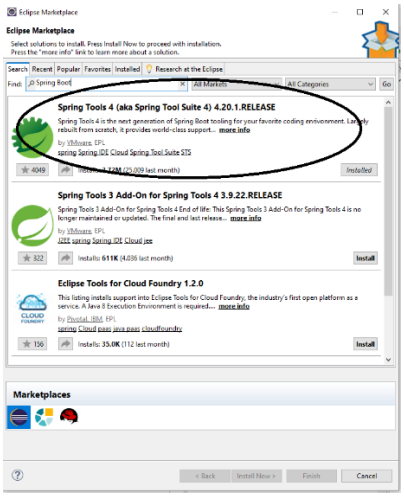
Eclipse can be obtained on the web: https://www.eclipse.org/downloads/packages/ Specifically, this tutorial uses the *Eclipse IDE for Enterprise Java and Web Developers version 2024-12-R*, which can be found at:

https://www.eclipse.org/downloads/download.php?file=/technology/epp/downloads/release/2024-12/R/eclipse-jee-2024-12-R-win32-x86_64.zip

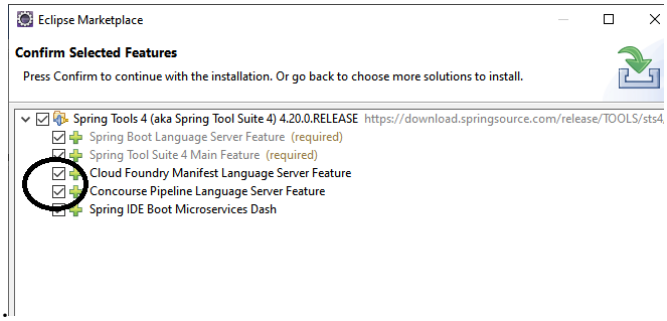


Spring Boot Tools

To install *Spring Boot Tools*, we go to the Eclipse Menu and select: *Help → Eclipse Marketplace →Find → Spring Tools 4*

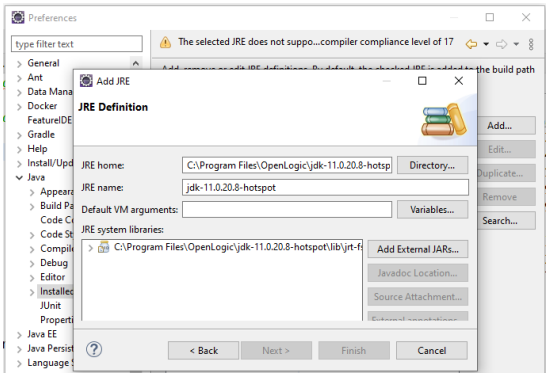


During the installation it is necessary to select the features ***Cloud and Concourse*** **for** ***Language Server Feature*** **and finally** ***Select all Trust Authorities***.



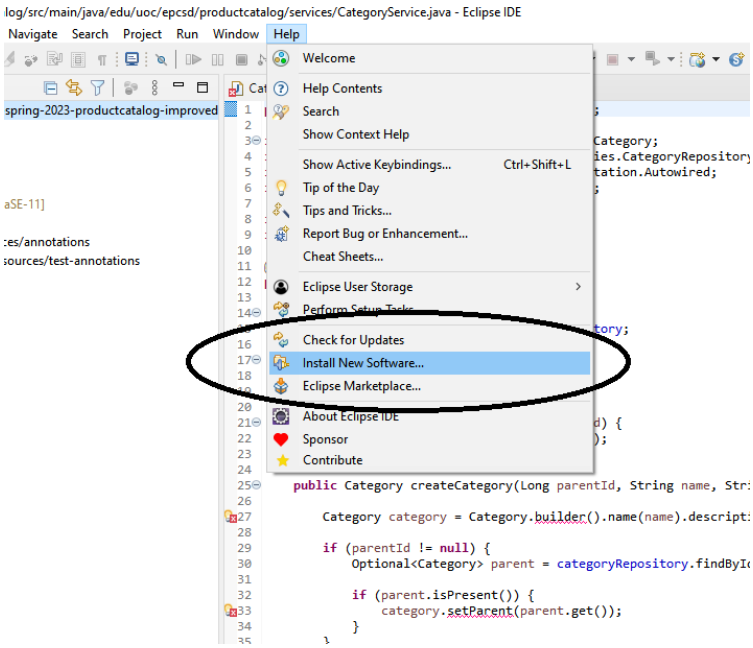
Java JDK

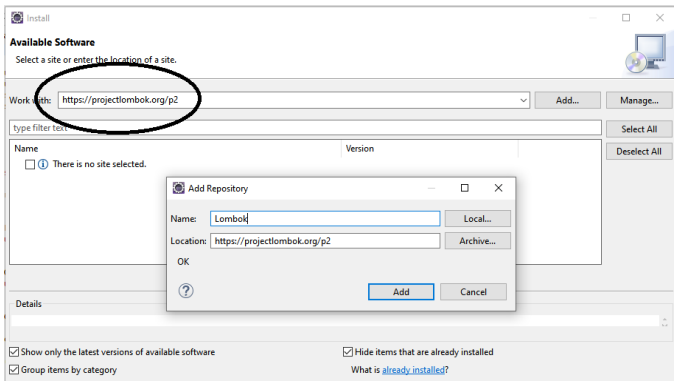
We also need to indicate which Java JDK we are going to use. For this we are going to: *Window → Preferences → Java → Installed JREs → Add → Standard VM → Directory where our JDK is:*



Lombok Project

We also need to install Lombok Project. For this we are going to: *Help → Install New Software → Add → Name: Lombok → Location: https://projectlombok.org/p2*



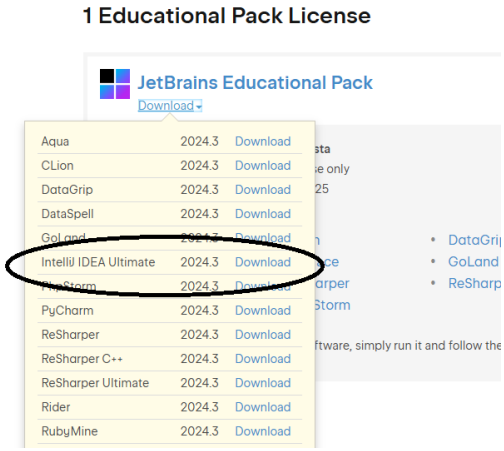


We can get more help at: https://projectlombok.org/setup/eclipse

IntelliJ IDEA Ultimate

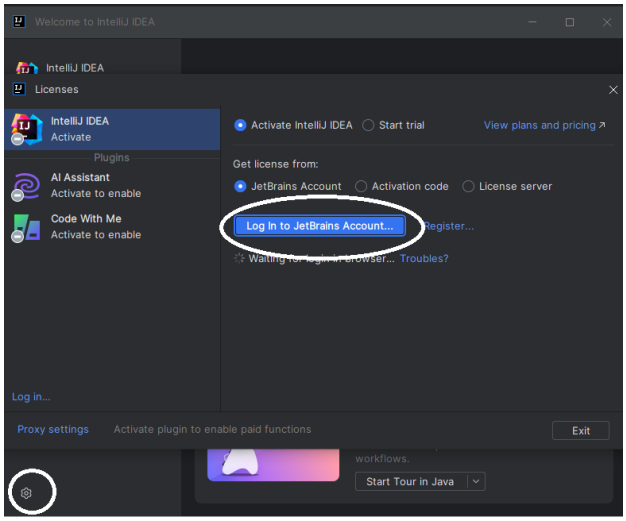
Installation

For the correct functioning of our work environment, we need the version of IntelliJ *Ultimate*, which is the one that allows us to use Spring Tools and Hibernate. This version is paid, but there is a student license with which we can download *Ultimate* for free. To do this, we need to go to https://www.jetbrains.com/community/education/ and register.



From there we will proceed to download and install the *Ultimate* version:

The license must be activated before it can be used:



Microservices Stubs

To insert, modify, deploy, and run the microservices from Eclipse and IntelliJ, we will follow the next steps:

- Download the code in ZIP format or just clone from https://github.com/UOC-SA-SPRING-2025 , in the repositories:

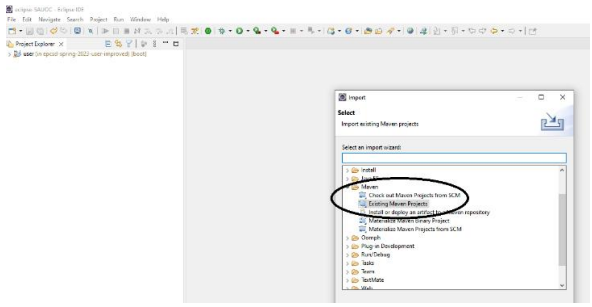
  - spring-2025-productcatalog
  - spring-2025-user
  - spring-2025-notification

  into the working folder on your computer (*spring-2025* if the recommendation has been followed)

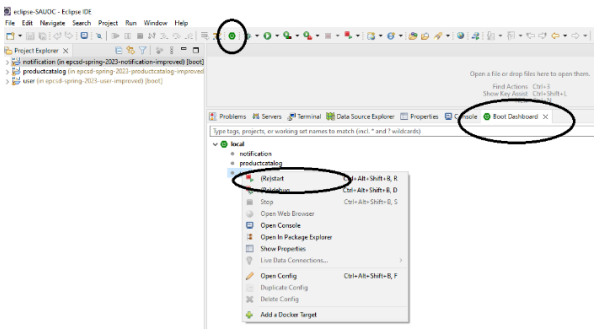
- Make sure that the Docker containers are running.

Run with Eclipse

- Import each microservice into Eclipse as a Maven project: *File* → *New* → *Project* → *Import existing Maven Project*, from your folder computer.

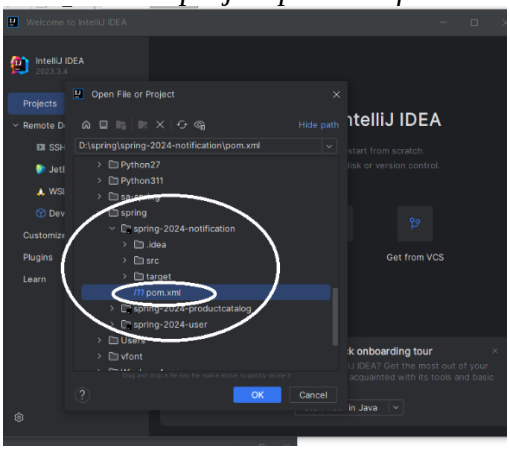


- Boot each microservice as a *Spring Boot project* using the Eclipse option *Boot Dashboard*:

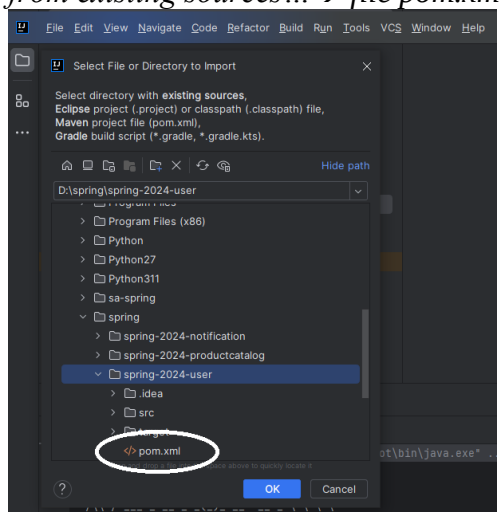


Run with IntelliJ

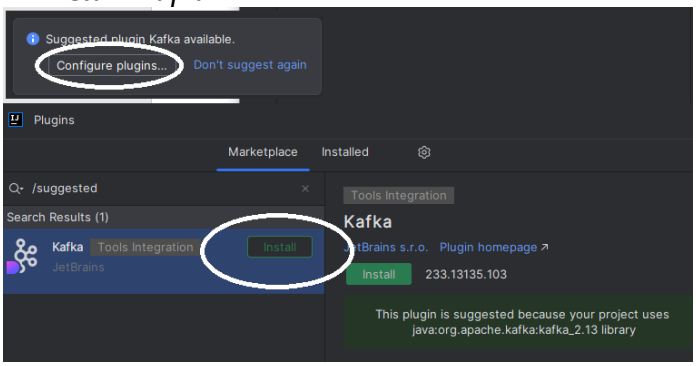
- In the *Welcome* window click on: *Projects → Open → Search your Microservice project pom.xml file*:



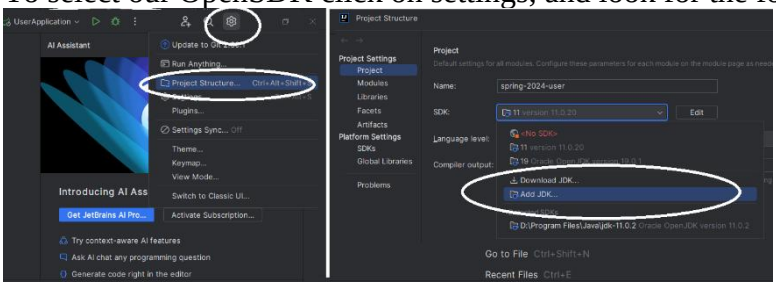
- For the rest of the Microservices click on: *Main Menu → File → New → Project from existing sources… → file pom.xml from Microservice → New window.*



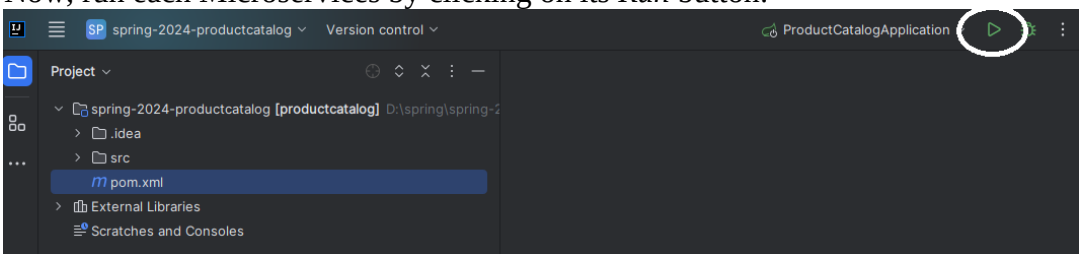
- If the system suggests installing Kafka plugin, you click on: *Configure plugins → Install Kafka*



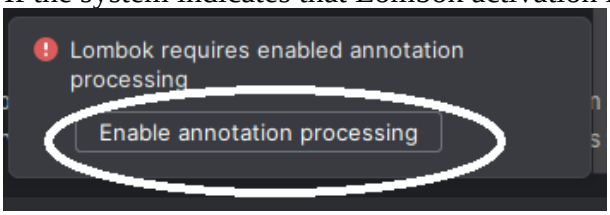
- To select our OpenSDK click on settings, and look for the folder where it is:



- Now, run each Microservices by clicking on its *Run* button:



- If the system indicates that Lombok activation is required, click on *"Enable…"*



Test if they work

Verify that they work correctly by calling the following URLs:

- http://localhost:18081/swagger-ui/index.html
- http://localhost:18082/swagger-ui/index.html

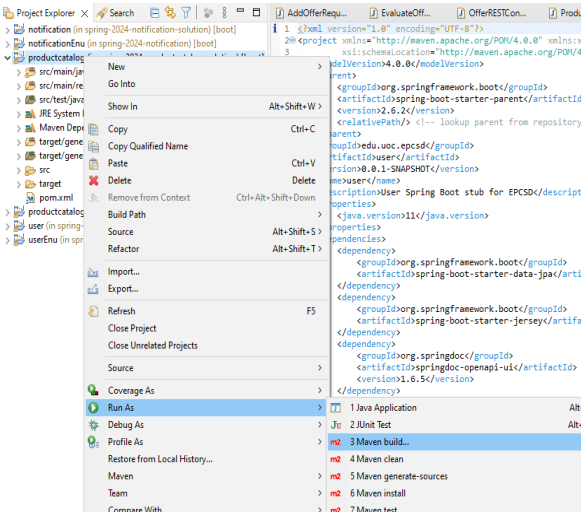
How to generate the .jar

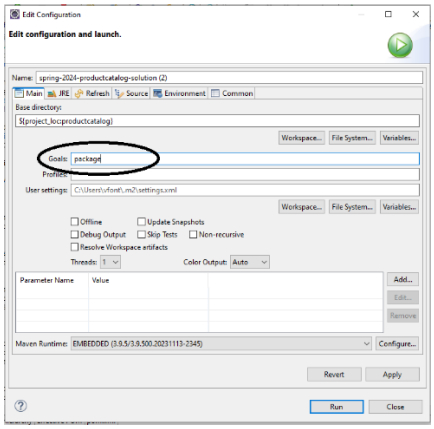
To generate the jar it is necessary to have the Docker images running.

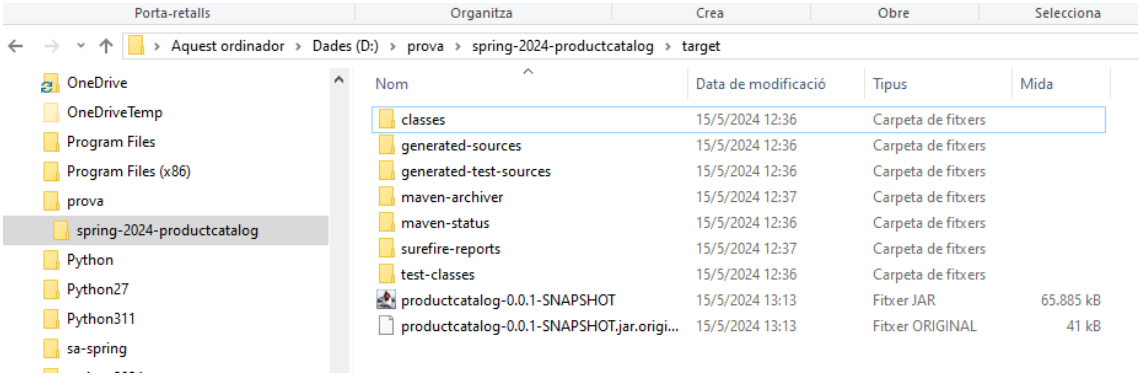
From Eclipse

To generate the jar from Eclipse, open the "Maven build" option in "Run as", and in the Goal option you put "package". Once executed, you can find your jar in the target directory of your project: *C:\spring-2025-productcatalog-solution\target*.

Executing, for example: *C:\spring-2025-productcatalog-solution\target>java -jar productcatalog-0.0.1-SNAPSHOT.jar* should work for you.

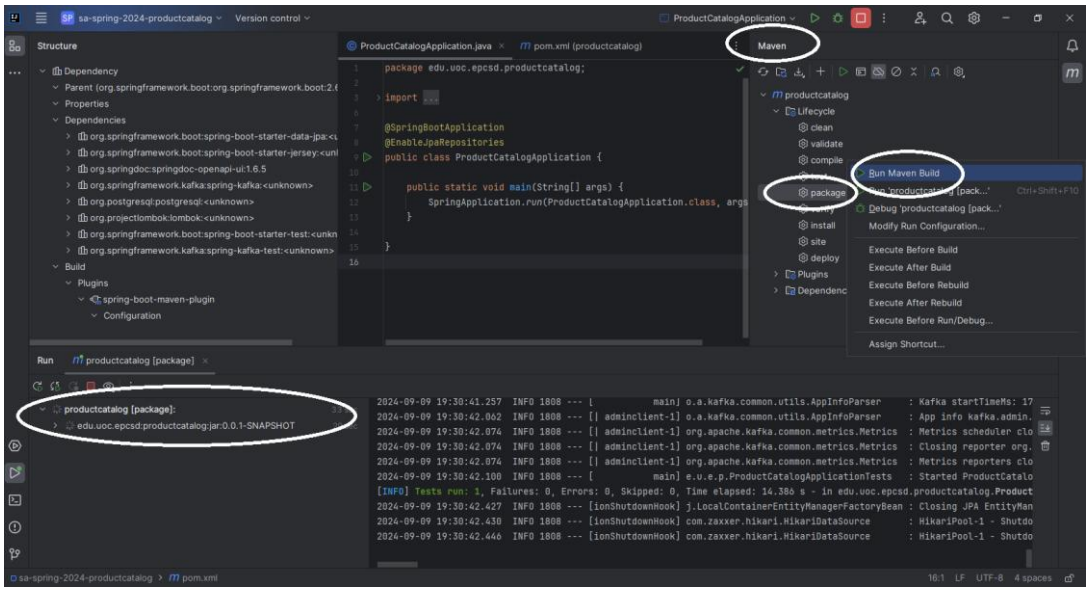


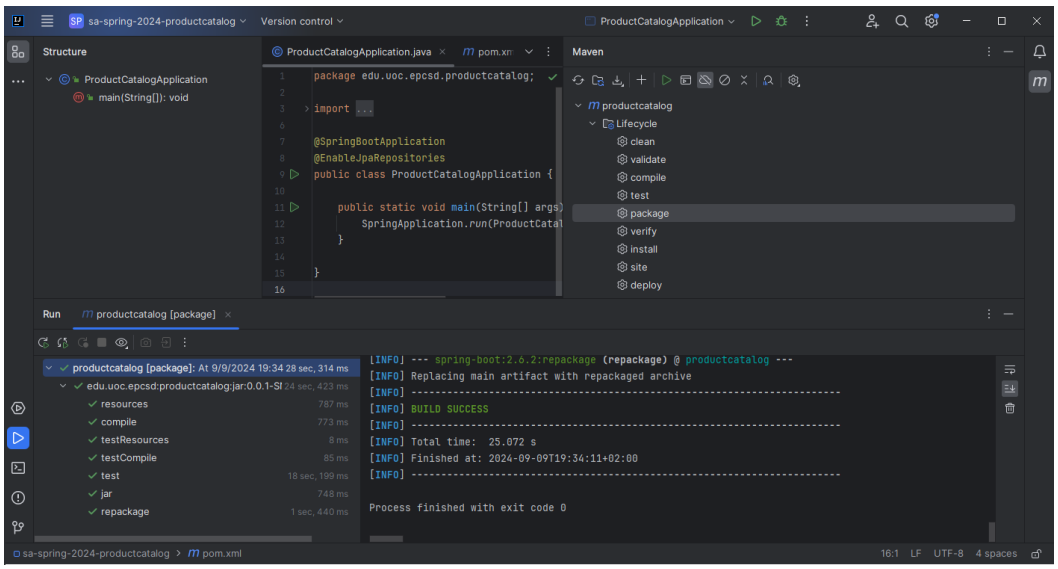




From IntelliJ

To generate the jar from IntelliJ, you must go to the Maven window, expand Lifecycle and select: *Package → right click → Run Maven Build*





Once executed, you can find your jar in the target directory of your project: *D:\spring-2025-productcatalog\target*.

Executing, for example: *D:\spring-2025-productcatalog\target>java -jar productcatalog-0.0.1-SNAPSHOT.jar* , should work for you.

Postman / Swagger Installation

In addition, taking advantage of the fact that the stubs have their own embedded HTTP server, a *springdoc-openapi* module has been added to auto-generate and publish the microservice definition (API) file in *JSON/OpenAPI v3* format, as well as a simple *SwaggerUI* web interface that allows making calls to the operations of the microservices.

The URLs to access these functionalities are:

- service definition files:
  - *Product Catalog*: http://localhost:18081/v3/api-docs
  - *User*: http://localhost:18082/v3/api-docs
- SwaggerUI web interfaces for testing:
  - *Product Catalog*: http://localhost:18081/swagger-ui/index.html
  - *User*: http://localhost:18082/swagger-ui/index.html

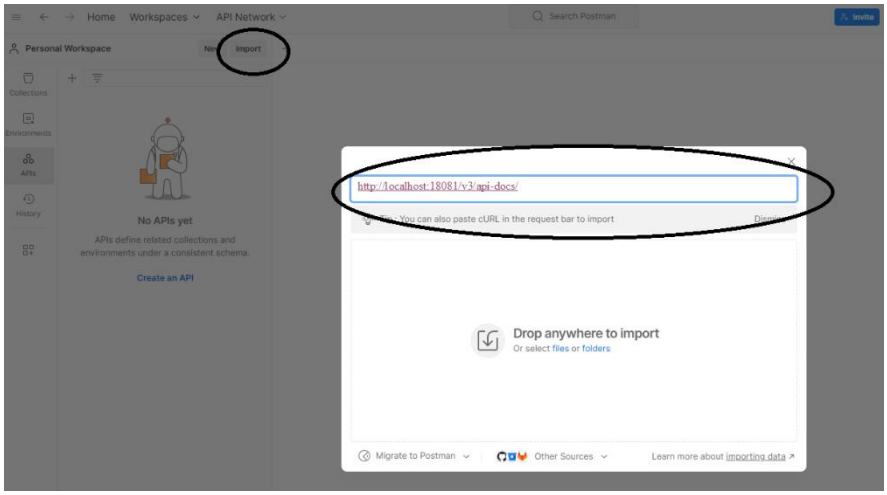
Postman

As we have already said, once the implementation is completed, you can obtain the "contract" or definition of each of the services in JSON format at v3/api-docs.

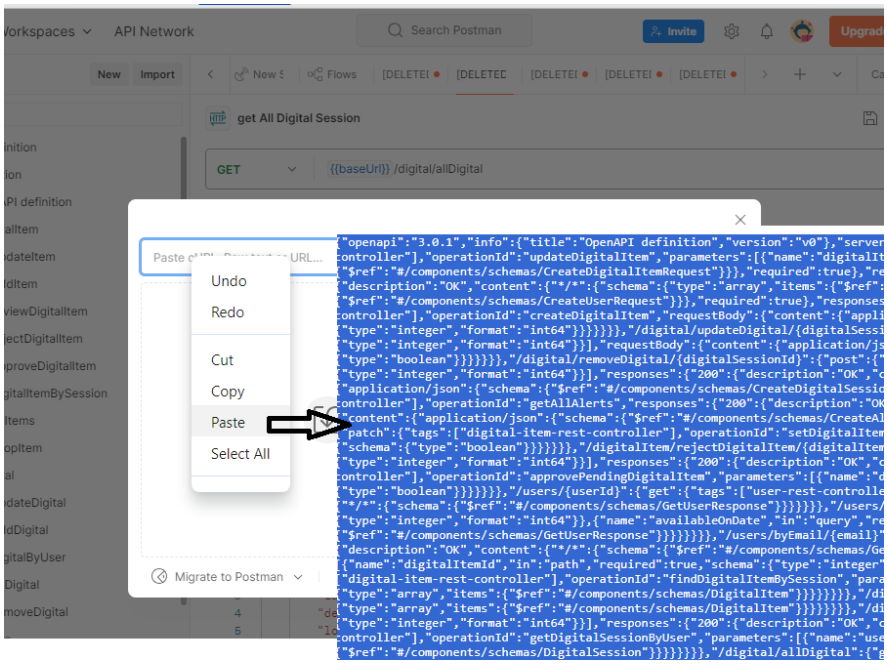
This JSON file can be downloaded or imported directly into an external tool, such as Postman, from where it will be much easier to execute all the necessary tests to verify the correct operation of the different services.

You can find information about Postman in https://www.postman.com/ , and if you want to use the Postman App, you can find it in:
https://www.postman.com/downloads/?utm_source=postman-home

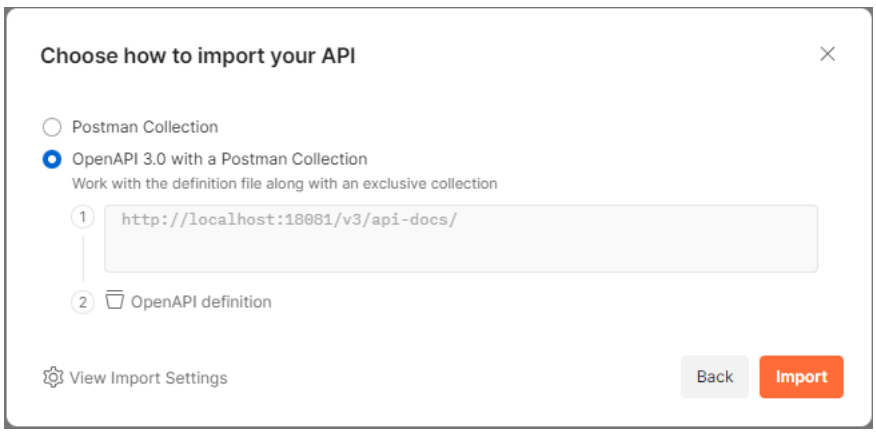
For example, you can import the service definition file of Product Catalog like this:



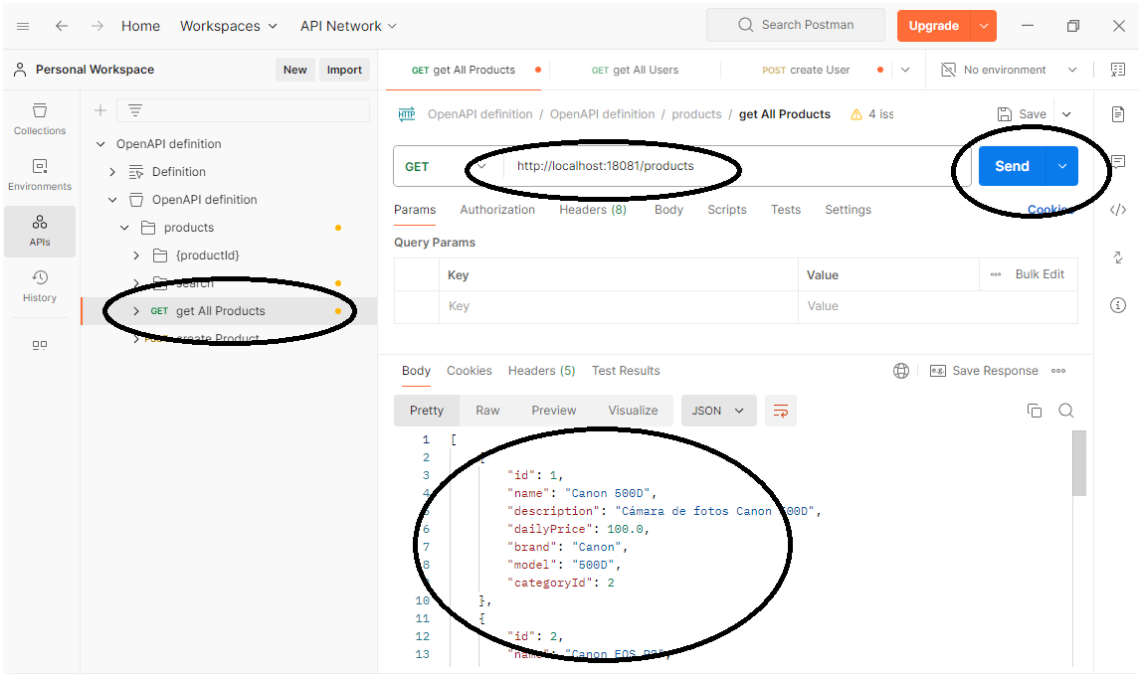
Or *Paste* de json file:



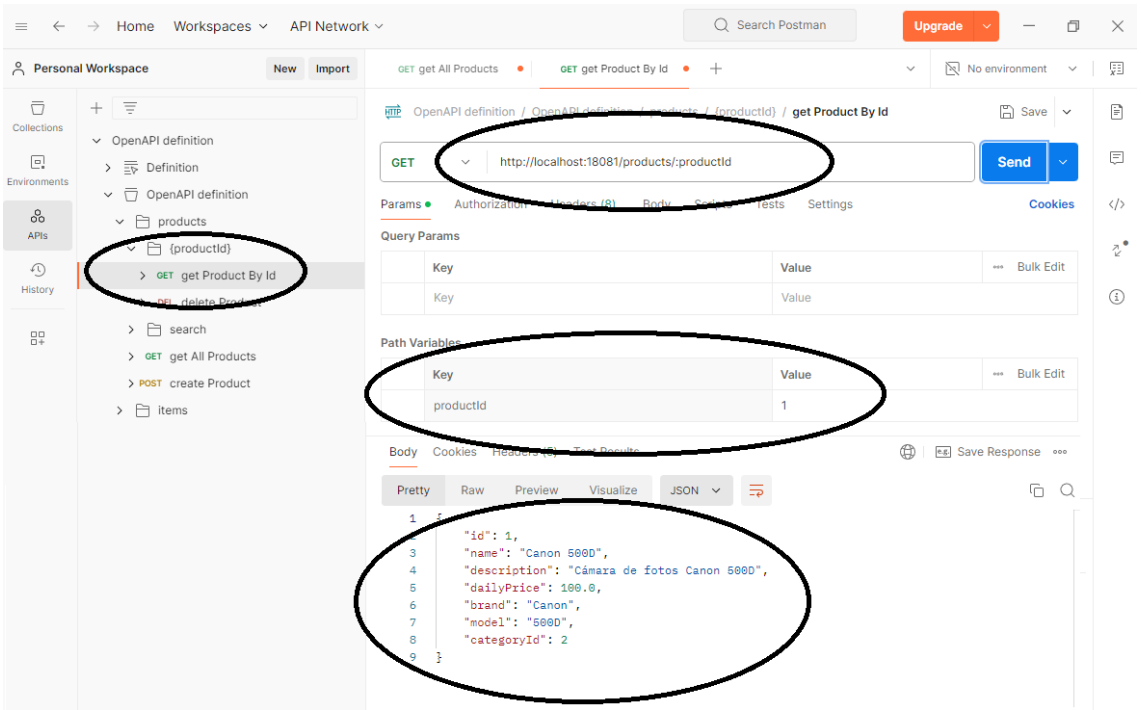
You can choose how to import your API:



And then calling: *get All Products*:

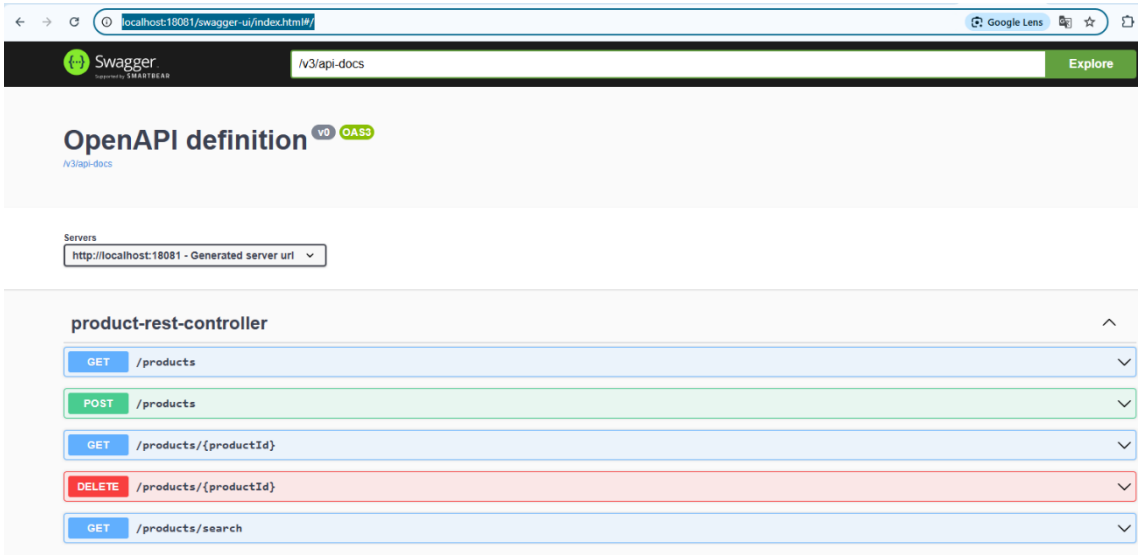


Or *get Products By Id*:



Swagger

In order to test the operations of the microservices with Swagger, you just need to click on the link. For example: http://localhost:18081/swagger-ui/index.html



Installing and running Tests

Installing

In order to run the tests, it is necessary to have the following programs installed with their respective dependencies: **JUnit**, **Spring Boot Test**, **Mockito**, **AssertJ**, **and ArchUnit.**

You can install them by indicating their dependencies in the file *pom.xml* of the corresponding microservice project.

For example:

```
<dependency>
	<groupId>org.springframework.boot</groupId>
	<artifactId>spring-boot-starter-test</artifactId>
	 <scope>test</scope>
</dependency>
<dependency>
	<groupId>com.tngtech.archunit</groupId>
	<artifactId>archunit-junit5</artifactId>
	<version>1.3.0</version>
	<scope>test</scope>
</dependency>
```

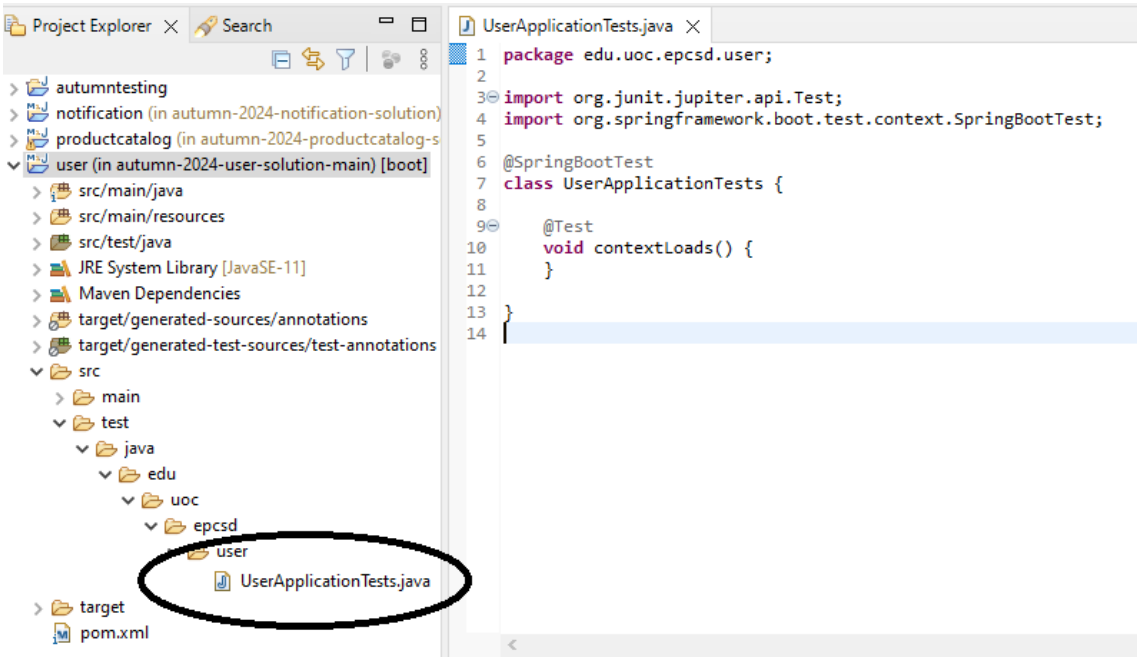
For more information, you can access to these links:

- https://github.com/anirban99/hexagonal-architecture/tree/master/src/test/java/com/example/hexagonal/architecture
- https://github.com/eugenp/tutorials/blob/master/spring-boot-modules/spring-boot-testing/src/test/java/com/baeldung/boot/testing/EmployeeServiceImplIntegrationTest.java
- https://spring.io/guides/gs/testing-web/
- https://docs.spring.io/spring-boot/docs/current/reference/html/features.html#features.testing.spring-boot-applications.with-mock-environment
- https://github.com/eugenp/tutorials/tree/master/spring-boot-modules/spring-boot-testing/src/test/java/com/baeldung/boot/testing
- https://www.archunit.org/userguide/html/000_Index.html#_introduction
  https://github.com/tng/archunit-examples/tree/main/example-junit5/src/test

Running

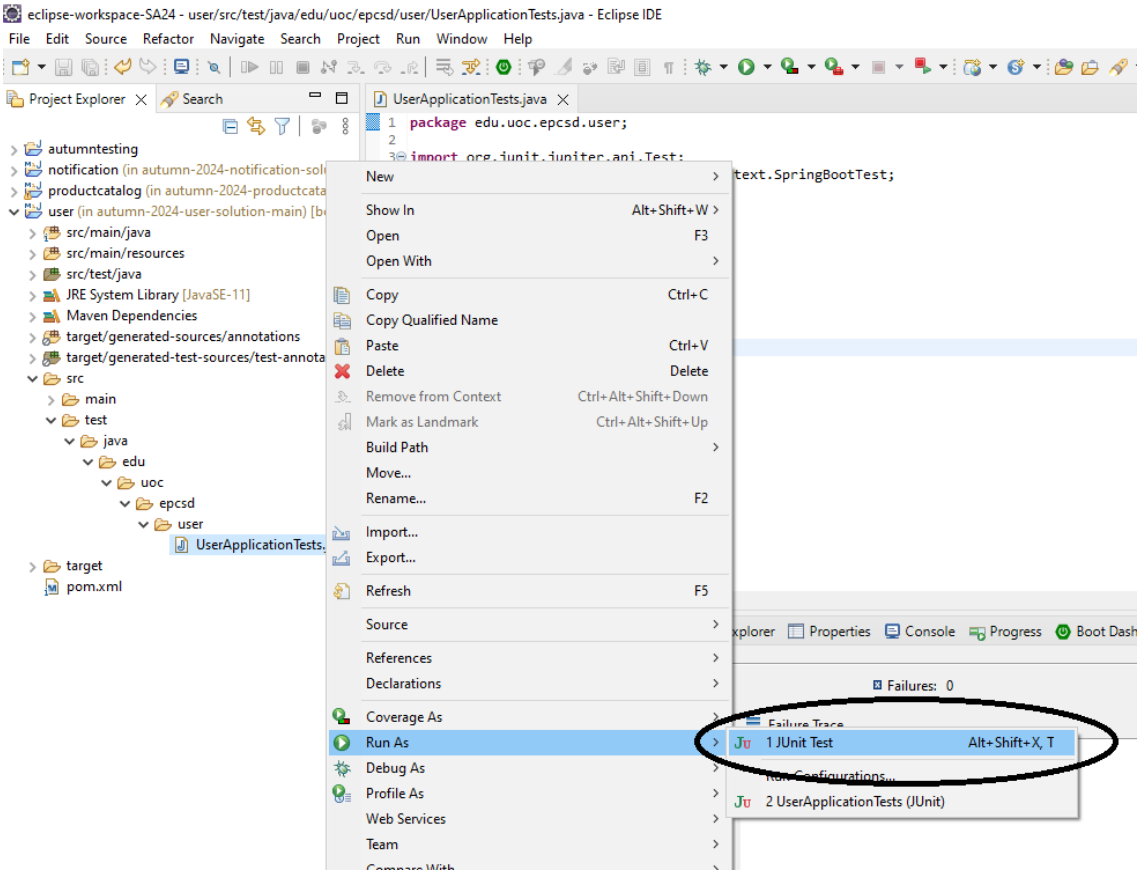
Now, as an example, we will create a class that tests the context loads. The name of file is *UserApplicationTests.java*, and put it in *\src\test\java\edu\uoc\epcsd\user* :

```
package edu.uoc.epcsd.user;

import org.junit.jupiter.api.Test;
import org.springframework.boot.test.context.SpringBootTest;

@SpringBootTest
class UserApplicationTests {

    @Test
    void contextLoads() {
    }

}
```

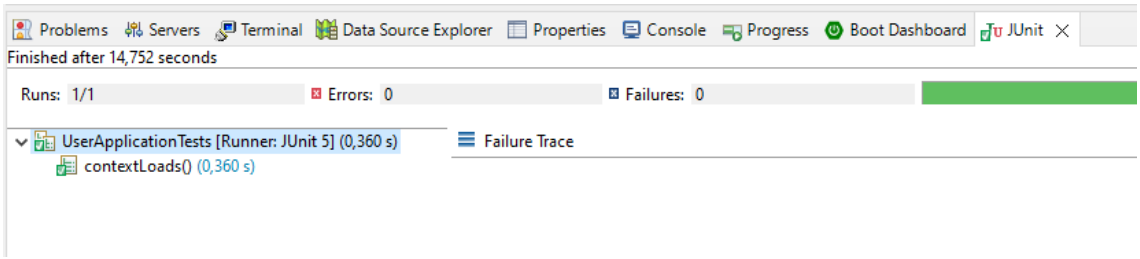


Running from Eclipse

If you want to run the test with Eclipse, you need to click on the project: *Run as → JUnit Test*



And you can see the result in the tab Junit:



Running from IntelliJ

If you want to run the test in IntelliJ, you must click on the project, and then you must click on *Run 'All Tests'* :