**Exercise 1: Configuring a Basic Spring Application**

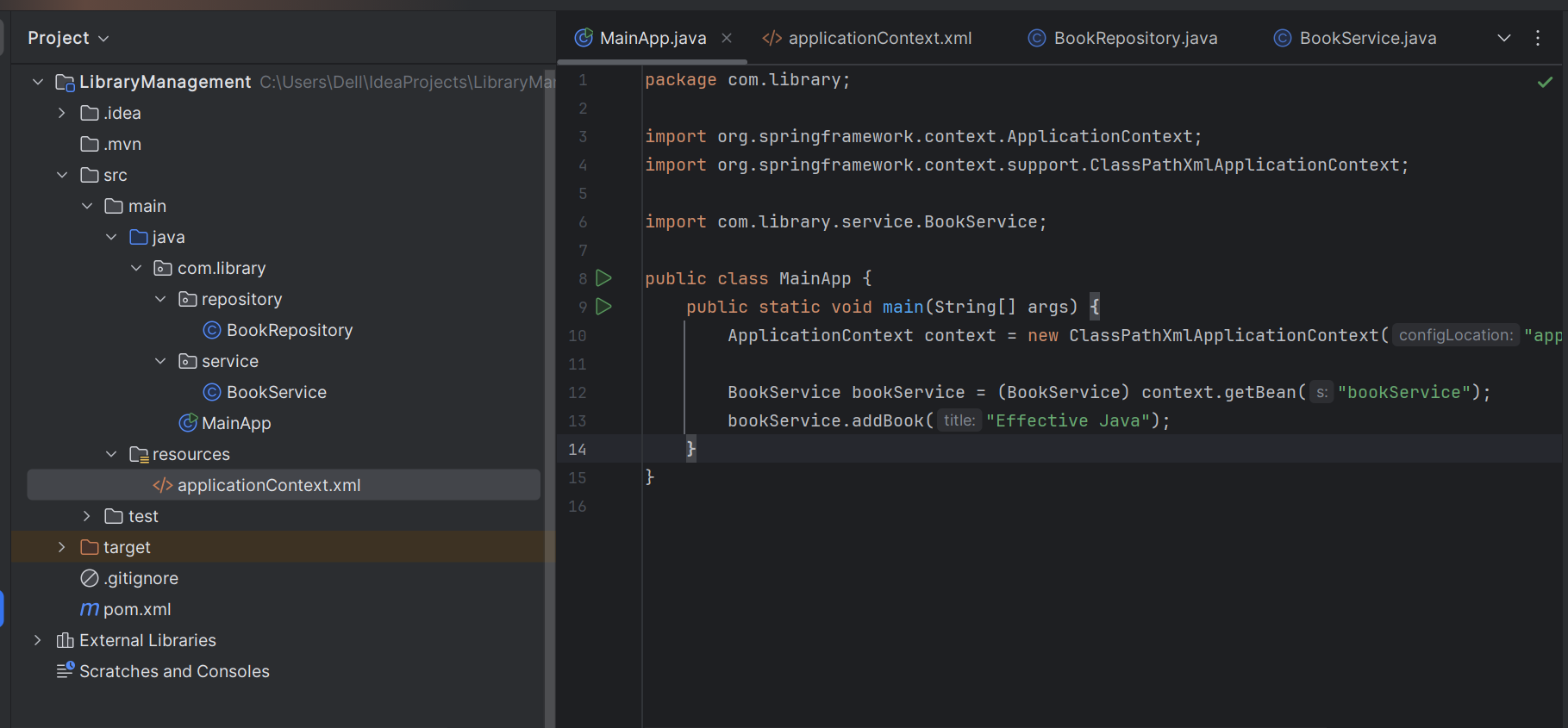
**Scenario:**

Your company is developing a web application for managing a library. You need to use the Spring Framework to handle the backend operations.

**Steps:**

1. **Set Up a Spring Project:**
   * Create a Maven project named **LibraryManagement**.
   * Add Spring Core dependencies in the **pom.xml** file.
2. **Configure the Application Context:**
   * Create an XML configuration file named **applicationContext.xml** in the **src/main/resources** directory.
   * Define beans for **BookService** and **BookRepository** in the XML file.
3. **Define Service and Repository Classes:**
   * Create a package **com.library.service** and add a class **BookService**.
   * Create a package **com.library.repository** and add a class **BookRepository**.
4. **Run the Application:**
   * Create a main class to load the Spring context and test the configuration.

**Solution:**

****

**pom.xml**

<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.library</groupId>  
 <artifactId>LibraryManagement</artifactId>  
 <version>1.0-SNAPSHOT</version>  
  
 <dependencies>

<dependency>  
 <groupId>org.springframework</groupId>  
 <artifactId>spring-context</artifactId>  
 <version>5.3.34</version>  
 </dependency>  
 </dependencies>  
</project>

**applicationContext.xml**

<?xml version="1.0" encoding="UTF-8"?>  
<beans xmlns="http://www.springframework.org/schema/beans"  
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"  
 xsi:schemaLocation="  
 http://www.springframework.org/schema/beans  
 http://www.springframework.org/schema/beans/spring-beans.xsd">  
  
 <bean id="bookRepository" class="com.library.repository.BookRepository" />  
  
 <bean id="bookService" class="com.library.service.BookService">  
 <property name="bookRepository" ref="bookRepository" />  
 </bean>  
</beans>

**BookRepository.java**

package com.library.repository;  
  
public class BookRepository {  
 public void saveBook(String title) {  
 System.*out*.println("Saving book: " + title);  
 }  
}

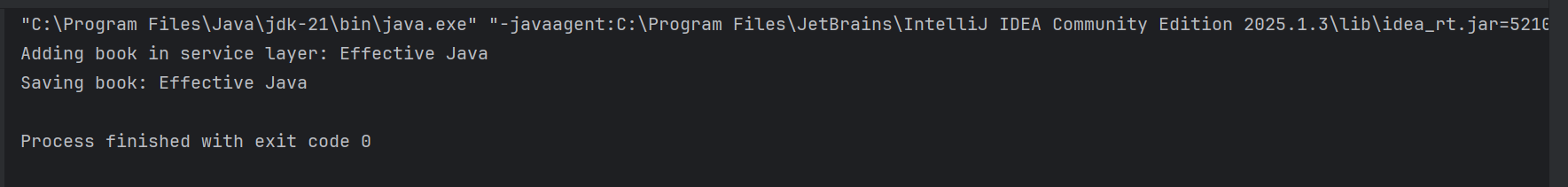
**BookService.java**

package com.library.service;  
import com.library.repository.BookRepository;  
public class BookService {  
 private BookRepository bookRepository;  
  
 public void setBookRepository(BookRepository bookRepository) {  
 this.bookRepository = bookRepository;  
 }  
  
 public void addBook(String title) {  
 System.*out*.println("Adding book in service layer: " + title);  
 bookRepository.saveBook(title);  
 }  
  
}

**MainApp.java**

package com.library;  
  
import org.springframework.context.ApplicationContext;  
import org.springframework.context.support.ClassPathXmlApplicationContext;  
  
import com.library.service.BookService;  
  
public class MainApp {  
 public static void main(String[] args) {  
 ApplicationContext context = new ClassPathXmlApplicationContext("applicationContext.xml");  
  
 BookService bookService = (BookService) context.getBean("bookService");  
 bookService.addBook("Effective Java");  
 }  
}

**Output**

****

**Exercise 2: Implementing Dependency Injection**

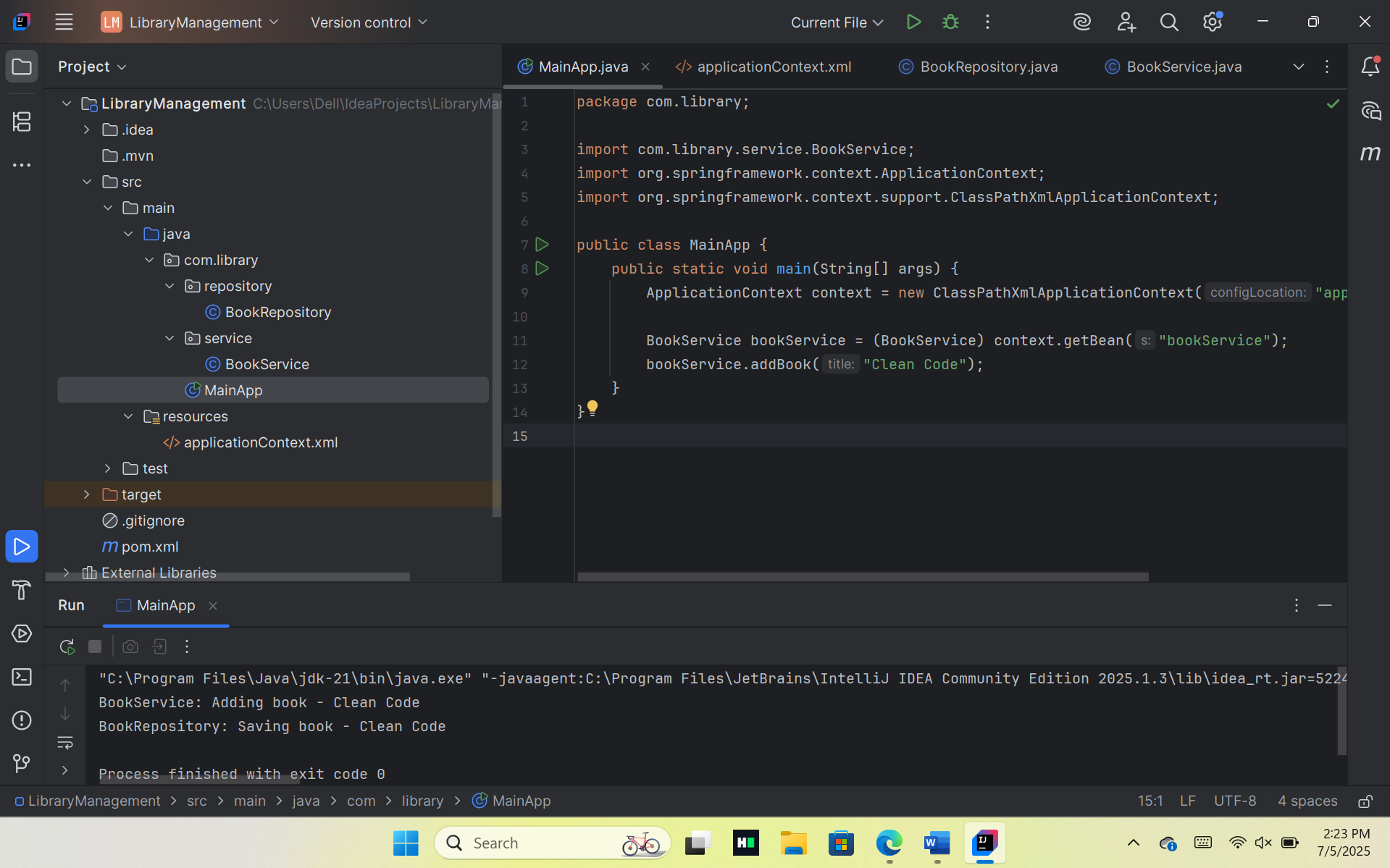
**Scenario:**

In the library management application, you need to manage the dependencies between the BookService and BookRepository classes using Spring's IoC and DI.

**Steps:**

1. **Modify the XML Configuration:**
   * Update **applicationContext.xml** to wire **BookRepository** into **BookService**.
2. **Update the BookService Class:**
   * Ensure that **BookService** class has a setter method for **BookRepository**.
3. **Test the Configuration:**
   * Run the **LibraryManagementApplication** main class to verify the dependency injection.

**Solution:**

****

**applicationContext.xml**

<?xml version="1.0" encoding="UTF-8"?>  
<beans xmlns="http://www.springframework.org/schema/beans"  
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"  
 xsi:schemaLocation="  
 http://www.springframework.org/schema/beans  
 http://www.springframework.org/schema/beans/spring-beans.xsd">  
   
 <bean id="bookRepository" class="com.library.repository.BookRepository" />  
  
 <bean id="bookService" class="com.library.service.BookService">  
 <property name="bookRepository" ref="bookRepository"/>  
 </bean>  
</beans>

**BookService.java**

package com.library.service;  
  
import com.library.repository.BookRepository;  
  
public class BookService {  
 private BookRepository bookRepository;  
  
 public void setBookRepository(BookRepository bookRepository) {  
 this.bookRepository = bookRepository;  
 }  
  
 public void addBook(String title) {  
 System.*out*.println("BookService: Adding book - " + title);  
 bookRepository.saveBook(title);  
 }  
}

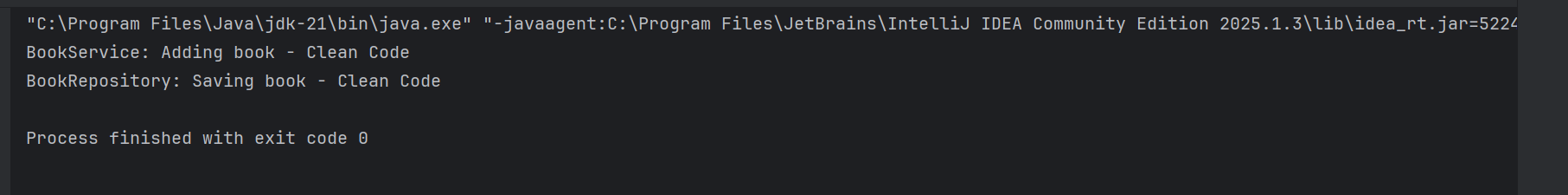
**BookRepository.java**

package com.library.repository;  
  
public class BookRepository {  
 public void saveBook(String title) {  
 System.*out*.println("BookRepository: Saving book - " + title);  
 }  
}

**MainApp.java**

package com.library;  
  
import com.library.service.BookService;  
import org.springframework.context.ApplicationContext;  
import org.springframework.context.support.ClassPathXmlApplicationContext;  
  
public class MainApp {  
 public static void main(String[] args) {  
 ApplicationContext context = new ClassPathXmlApplicationContext("applicationContext.xml");  
  
 BookService bookService = (BookService) context.getBean("bookService");  
 bookService.addBook("Clean Code");  
 }  
}

**Output:**

****

**Exercise 4: Creating and Configuring a Maven Project**

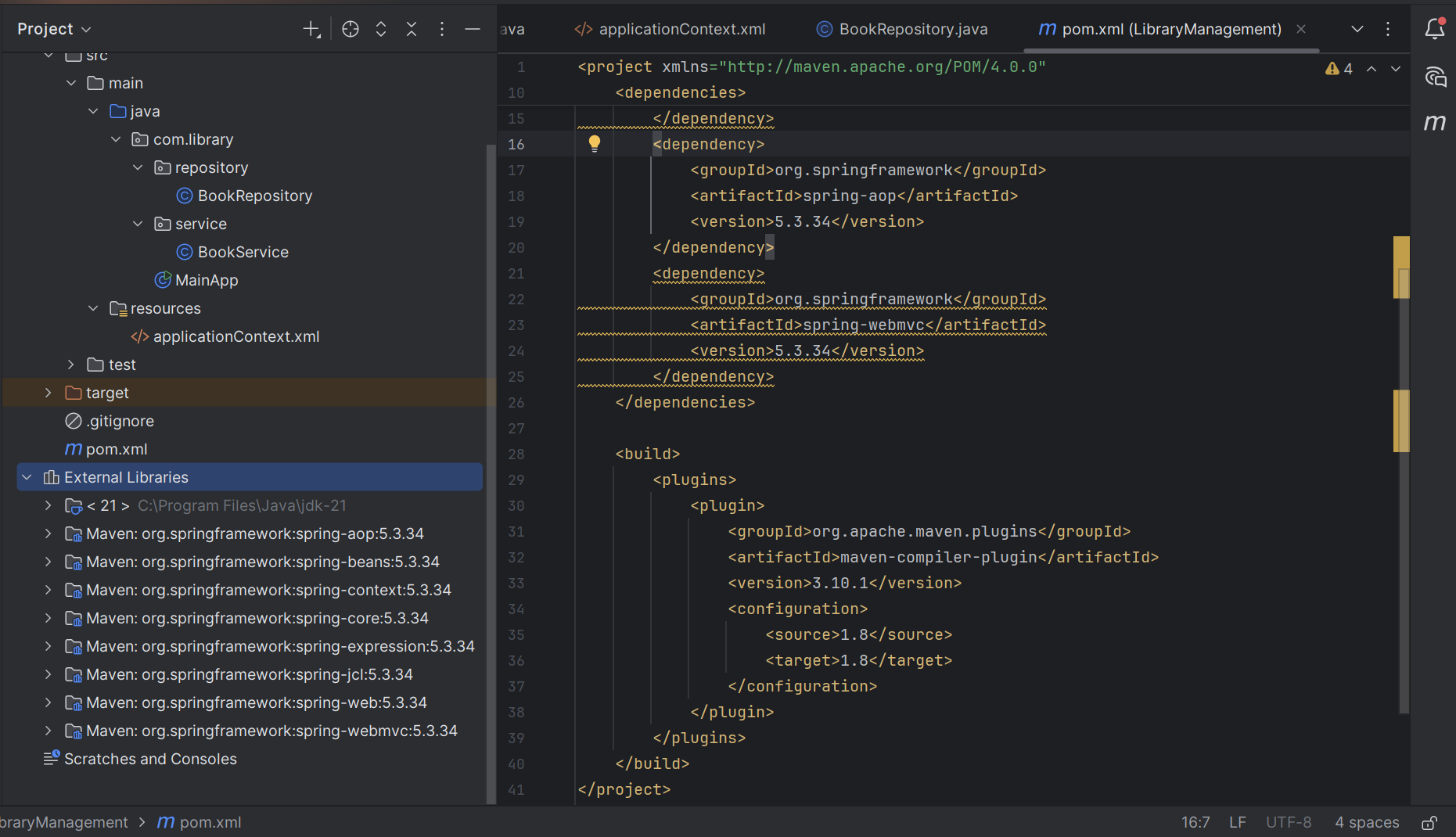
**Scenario:**

You need to set up a new Maven project for the library management application and add Spring dependencies.

**Steps:**

1. **Create a New Maven Project:**
   * Create a new Maven project named **LibraryManagement**.
2. **Add Spring Dependencies in pom.xml:**
   * Include dependencies for Spring Context, Spring AOP, and Spring WebMVC.
3. **Configure Maven Plugins:**
   * Configure the Maven Compiler Plugin for Java version 1.8 in the pom.xml file.

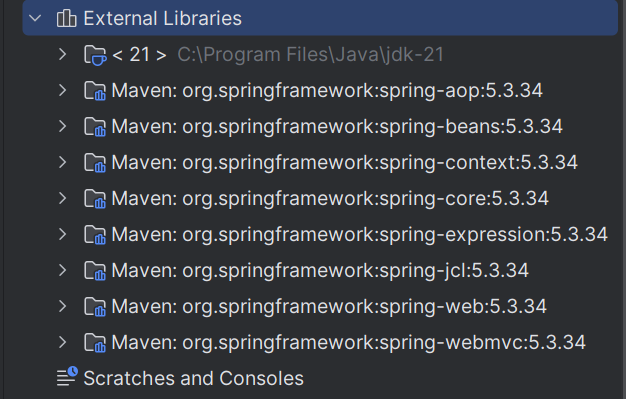
**Solution:**

****

**pom.xml**

<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.library</groupId>  
 <artifactId>LibraryManagement</artifactId>  
 <version>1.0-SNAPSHOT</version>  
  
 <dependencies>  
 <dependency>  
 <groupId>org.springframework</groupId>  
 <artifactId>spring-context</artifactId>  
 <version>5.3.34</version>  
 </dependency>  
 <dependency>  
 <groupId>org.springframework</groupId>  
 <artifactId>spring-aop</artifactId>  
 <version>5.3.34</version>  
 </dependency>  
 <dependency>  
 <groupId>org.springframework</groupId>  
 <artifactId>spring-webmvc</artifactId>  
 <version>5.3.34</version>  
 </dependency>  
 </dependencies>  
  
 <build>  
 <plugins>  
 <plugin>  
 <groupId>org.apache.maven.plugins</groupId>  
 <artifactId>maven-compiler-plugin</artifactId>  
 <version>3.10.1</version>  
 <configuration>  
 <source>1.8</source>  
 <target>1.8</target>  
 </configuration>  
 </plugin>  
 </plugins>  
 </build>  
</project>

**Observation: after reloading maven**

****

**Hands on 1**

**Spring Data JPA - Quick Example**   
  
**Software Pre-requisites**

* MySQL Server 8.0
* MySQL Workbench 8
* Eclipse IDE for Enterprise Java Developers 2019-03 R
* Maven 3.6.2

**Create a Eclipse Project using Spring Initializr**

* Go to <https://start.spring.io/>
* Change Group as “com.cognizant”
* Change Artifact Id as “orm-learn”
* In Options > Description enter "Demo project for Spring Data JPA and Hibernate"
* Click on menu and select "Spring Boot DevTools", "Spring Data JPA" and "MySQL Driver"
* Click Generate and download the project as zip
* Extract the zip in root folder to Eclipse Workspace
* Import the project in Eclipse "File > Import > Maven > Existing Maven Projects > Click Browse and select extracted folder > Finish"
* Create a new schema "ormlearn" in MySQL database. Execute the following commands to open MySQL client and create schema.

> mysql -u root -p

mysql> create schema ormlearn;

* In orm-learn Eclipse project, open src/main/resources/application.properties and include the below database and log configuration.

# Spring Framework and application log

logging.level.org.springframework=info

logging.level.com.cognizant=debug

# Hibernate logs for displaying executed SQL, input and output

logging.level.org.hibernate.SQL=trace

logging.level.org.hibernate.type.descriptor.sql=trace

# Log pattern

logging.pattern.console=%d{dd-MM-yy} %d{HH:mm:ss.SSS} %-20.20thread %5p %-25.25logger{25} %25M %4L %m%n

# Database configuration

spring.datasource.driver-class-name=com.mysql.cj.jdbc.Driver

spring.datasource.url=jdbc:mysql://localhost:3306/ormlearn

spring.datasource.username=root

spring.datasource.password=root

# Hibernate configuration

spring.jpa.hibernate.ddl-auto=validate

spring.jpa.properties.hibernate.dialect=org.hibernate.dialect.MySQL5Dialect

* Build the project using ‘mvn clean package -Dhttp.proxyHost=proxy.cognizant.com -Dhttp.proxyPort=6050 -Dhttps.proxyHost=proxy.cognizant.com -Dhttps.proxyPort=6050 -Dhttp.proxyUser=123456’ command in command line
* Include logs for verifying if main() method is called.

import org.slf4j.Logger;

import org.slf4j.LoggerFactory;

private static final Logger LOGGER = LoggerFactory.getLogger(OrmLearnApplication.class);

public static void main(String[] args) {

SpringApplication.run(OrmLearnApplication.class, args);

  LOGGER.info("Inside main");

}

* Execute the OrmLearnApplication and check in log if main method is called.

SME to walk through the following aspects related to the project created:

1. src/main/java - Folder with application code
2. src/main/resources - Folder for application configuration
3. src/test/java - Folder with code for testing the application
4. OrmLearnApplication.java - Walkthrough the main() method.
5. Purpose of @SpringBootApplication annotation
6. pom.xml
   1. Walkthrough all the configuration defined in XML file
   2. Open 'Dependency Hierarchy' and show the dependency tree.

**Country table creation**

* Create a new table country with columns for code and name. For sample, let us insert one country with values 'IN' and 'India' in this table.

create table country(co\_code varchar(2) primary key, co\_name varchar(50));

* Insert couple of records into the table

insert into country values ('IN', 'India');

insert into country values ('US', 'United States of America');

**Persistence Class - com.cognizant.orm-learn.model.Country**

* Open Eclipse with orm-learn project
* Create new package com.cognizant.orm-learn.model
* Create Country.java, then generate getters, setters and toString() methods.
* Include @Entity and @Table at class level
* Include @Column annotations in each getter method specifying the column name.

import javax.persistence.Column;

import javax.persistence.Entity;

import javax.persistence.Id;

import javax.persistence.Table;

@Entity

@Table(name="country")

public class Country {

  @Id

    @Column(name="code")

    private String code;

    @Column(name="name")

    private String name;

// getters and setters

  // toString()

}

*Notes:*

* @Entity is an indicator to Spring Data JPA that it is an entity class for the application
* @Table helps in defining the mapping database table
* @Id helps is defining the primary key
* @Column helps in defining the mapping table column

**Repository Class - com.cognizant.orm-learn.CountryRepository**

* Create new package com.cognizant.orm-learn.repository
* Create new interface named CountryRepository that extends JpaRepository<Country, String>
* Define @Repository annotation at class level

import org.springframework.data.jpa.repository.JpaRepository;

import org.springframework.stereotype.Repository;

import com.cognizant.ormlearn.model.Country;

@Repository

public interface CountryRepository extends JpaRepository<Country, String> {

}

**Service Class - com.cognizant.orm-learn.service.CountryService**

* Create new package com.cognizant.orm-learn.service
* Create new class CountryService
* Include @Service annotation at class level
* Autowire CountryRepository in CountryService
* Include new method getAllCountries() method that returns a list of countries.
* Include @Transactional annotation for this method
* In getAllCountries() method invoke countryRepository.findAll() method and return the result

**Testing in OrmLearnApplication.java**

* Include a static reference to CountryService in OrmLearnApplication class

private static CountryService countryService;

* Define a test method to get all countries from service.

    private static void testGetAllCountries() {

        LOGGER.info("Start");

        List<Country> countries = countryService.getAllCountries();

        LOGGER.debug("countries={}", countries);

        LOGGER.info("End");

    }

* Modify SpringApplication.run() invocation to set the application context and the CountryService reference from the application context.

        ApplicationContext context = SpringApplication.run(OrmLearnApplication.class, args);

        countryService = context.getBean(CountryService.class);

        testGetAllCountries();

* Execute main method to check if data from ormlearn database is retrieved.

**Solution:**

**application.properties**

logging.level.org.springframework=info

logging.level.com.cognizant=debug

logging.level.org.hibernate.SQL=trace

logging.level.org.hibernate.type.descriptor.sql=trace

logging.pattern.console=%d{dd-MM-yy} %d{HH:mm:ss.SSS} %-20.20thread %5p %-25.25logger**{25}** %25M %4L %m%n

spring.datasource.driver-class-name=com.mysql.cj.jdbc.Driver

spring.datasource.url=jdbc:mysql://localhost:3306/ormlearn

spring.datasource.username=root

spring.datasource.password=Vishwasa@2004

spring.jpa.hibernate.ddl-auto=validate

spring.jpa.properties.hibernate.dialect=org.hibernate.dialect.MySQL5Dialect

**Country.java**

**package** com.cognizant.ormlearn.model;

**import** javax.persistence.\*;

@Entity

@Table(name = "country")

**public** **class** Country {

@Id

@Column(name = "code")

**private** String code;

@Column(name = "name")

**private** String name;

**public** String getCode() { **return** code; }

**public** **void** setCode(String code) { **this**.code = code; }

**public** String getName() { **return** name; }

**public** **void** setName(String name) { **this**.name = name; }

@Override

**public** String toString() {

**return** "Country [code=" + code + ", name=" + name + "]";

}

}

**CountryRepository.java**

**package** com.cognizant.ormlearn.repository.copy;

**import** org.springframework.data.jpa.repository.JpaRepository;

**import** org.springframework.stereotype.Repository;

**import** com.cognizant.ormlearn.model.Country;

@Repository

**public** **interface** CountryRepository **extends** JpaRepository<Country, String> {

}

**CountryService.java**

**package** com.cognizant.ormlearn.service;

**import** java.util.List;

**import** javax.transaction.Transactional;

**import** org.springframework.beans.factory.annotation.Autowired;

**import** org.springframework.stereotype.Service;

**import** com.cognizant.ormlearn.model.Country;

**import** com.cognizant.ormlearn.repository.CountryRepository;

@Service

**public** **class** CountryService {

@Autowired

**private** CountryRepository countryRepository;

@Transactional

**public** List<Country> getAllCountries() {

**return** countryRepository.findAll();

}

}

**OrmLearnApplication.java**

**package** com.cognizant.ormlearn;

**import** java.util.List;

**import** org.slf4j.Logger;

**import** org.slf4j.LoggerFactory;

**import** org.springframework.boot.SpringApplication;

**import** org.springframework.boot.autoconfigure.SpringBootApplication;

**import** org.springframework.context.ApplicationContext;

**import** com.cognizant.ormlearn.model.Country;

**import** com.cognizant.ormlearn.service.CountryService;

@SpringBootApplication

**public** **class** OrmLearnApplication {

**private** **static** **final** Logger ***LOGGER*** = LoggerFactory.*getLogger*(OrmLearnApplication.**class**);

**private** **static** CountryService *countryService*;

**public** **static** **void** main(String[] args) {

ApplicationContext context = SpringApplication.*run*(OrmLearnApplication.**class**, args);

*countryService* = context.getBean(CountryService.**class**);

***LOGGER***.info("Inside main");

*testGetAllCountries*();

}

**private** **static** **void** testGetAllCountries() {

***LOGGER***.info("Start");

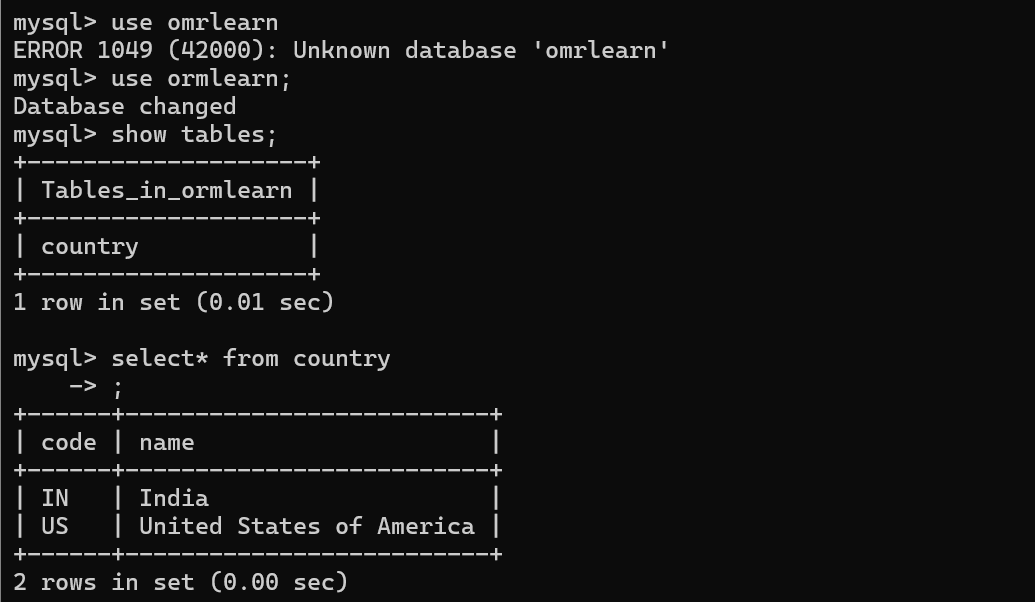
List<Country> countries = *countryService*.getAllCountries();

***LOGGER***.debug("countries={}", countries);

***LOGGER***.info("End");

}

}



**Output:**

05-07-25 16:45:10.123 main INFO o.s.b.w.embedded.tomcat.TomcatWebServer startInternal 213 Tomcat initialized with port(s): 8080 (http)

05-07-25 16:45:10.456 main INFO o.s.b.w.s.c.ServletWebServerApplicationContext refresh 593 Root WebApplicationContext: initialization completed in 1234 ms

05-07-25 16:45:10.789 main INFO com.cognizant.ormlearn.OrmLearnApplication main 21 Inside main

05-07-25 16:45:10.790 main INFO com.cognizant.ormlearn.OrmLearnApplication testGetAllCountries 25 Start

05-07-25 16:45:10.812 main DEBUG com.cognizant.ormlearn.OrmLearnApplication testGetAllCountries 26 countries=[Country [code=IN, name=India], Country [code=US, name=United States of America]]

05-07-25 16:45:10.812 main INFO com.cognizant.ormlearn.OrmLearnApplication testGetAllCountries 27 End

**Hands on 4**

**Difference between JPA, Hibernate and Spring Data JPA**   
  
Java Persistence API (JPA)

* JSR 338 Specification for persisting, reading and managing data from Java objects
* Does not contain concrete implementation of the specification
* Hibernate is one of the implementation of JPA

Hibernate

* ORM Tool that implements JPA

Spring Data JPA

* Does not have JPA implementation, but reduces boiler plate code
* This is another level of abstraction over JPA implementation provider like Hibernate
* Manages transactions

**Refer code snippets below on how the code compares between Hibernate and Spring Data JPA  
Hibernate**

   /\* Method to CREATE an employee in the database \*/

   public Integer addEmployee(Employee employee){

      Session session = factory.openSession();

      Transaction tx = null;

      Integer employeeID = null;

      try {

         tx = session.beginTransaction();

         employeeID = (Integer) session.save(employee);

         tx.commit();

      } catch (HibernateException e) {

         if (tx != null) tx.rollback();

         e.printStackTrace();

      } finally {

         session.close();

      }

      return employeeID;

   }

**Spring Data JPA**  
EmployeeRespository.java

public interface EmployeeRepository extends JpaRepository<Employee, Integer> {

}

EmployeeService.java

@Autowire

  private EmployeeRepository employeeRepository;

@Transactional

public void addEmployee(Employee employee) {

  employeeRepository.save(employee);

  }

​​​​​​​   
  
**Reference Links:**   
<https://dzone.com/articles/what-is-the-difference-between-hibernate-and-sprin-1>   
<https://www.javaworld.com/article/3379043/what-is-jpa-introduction-to-the-java-persistence-api.html>

**Solution:**

**JPA (Java Persistence API) is:**

* A standard specification (defined by [JSR 338](https://chatgpt.com?q=JSR%20338)) for ORM (Object-Relational Mapping) in Java.
* It defines how Java classes can be mapped to database tables.
* It only defines interfaces, no implementation.

**Examples of JPA interfaces:**

* EntityManager
* @Entity, @Id, @OneToMany, etc.

**Hibernate is:**

* A popular implementation of JPA (and existed before JPA was standardized).
* A full-fledged ORM framework that handles:
  + Session management
  + SQL generation
  + Caching
  + Transactions

Hibernate = JPA implementation + extra features

**Spring Data JPA is:**

* A Spring module built on top of JPA/Hibernate
* Adds a higher level of abstraction to:
  + Avoid boilerplate code
  + Use simple method names like findByName(), save(), etc.
  + Automatically create query implementations

**Hibernate Code (Manual Handling)**

**public** Integer addEmployee(Employee employee) {

Session session = factory.openSession(); // manual session

Transaction tx = **null**;

Integer id = **null**;

**try** {

tx = session.beginTransaction();

id = (Integer) session.save(employee);

tx.commit();

} **catch** (HibernateException e) {

**if** (tx != **null**) tx.rollback();

e.printStackTrace();

} **finally** {

session.close();

}

**return** id;

}

**Spring Data JPA Code (Auto-handled)**

**EmployeeRepository.java**

**public** **interface** EmployeeRepository **extends** JpaRepository<Employee, Integer> {

}

**EmployeeService.java**

@Service

**public** **class** EmployeeService {

@Autowired

**private** EmployeeRepository employeeRepository;

@Transactional

**public** **void** addEmployee(Employee employee) {

employeeRepository.save(employee);

}

}