**WEEK – 03**

**Spring Core and Maven - Spring Core\_Maven**

**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.

**Solution:**

**Dependencies added in 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 https://maven.apache.org/xsd/maven-4.0.0.xsd">

<modelVersion>4.0.0</modelVersion>

<groupId>com.library</groupId>

<artifactId>LibraryManagement</artifactId>

<version>0.0.1-SNAPSHOT</version>

<!-- 2. Spring dependencies -->

<dependencies>

<!-- Spring Core / Context -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>

<version>5.3.32</version>

</dependency>

<!-- Spring AOP -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-aop</artifactId>

<version>5.3.32</version>

</dependency>

<!-- Spring Web MVC -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-webmvc</artifactId>

<version>5.3.32</version>

</dependency>

</dependencies>

<!-- 3. Maven compiler plugin for Java 8 -->

<build>

<plugins>

<plugin>

<groupId>org.apache.maven.plugins</groupId>

<artifactId>maven-compiler-plugin</artifactId>

<version>3.11.0</version>

<configuration>

<source>1.8</source>

<target>1.8</target>

</configuration>

</plugin>

</plugins>

</build>

</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">

<!-- Repository bean -->

<bean id="bookRepository" class="com.library.repository.BookRepository" />

<!-- Service bean has a dependency on the repository -->

<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 save(String book) {

System.out.println("Saving book: " + book);

}

}

**BookService.java:**

package com.library.service;

import com.library.repository.BookRepository;

public class BookService {

private BookRepository bookRepository;

// Setter for dependency injection

public void setBookRepository(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

public void addBook(String book) {

bookRepository.save(book);

}

}

**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 ctx = new ClassPathXmlApplicationContext("applicationContext.xml");

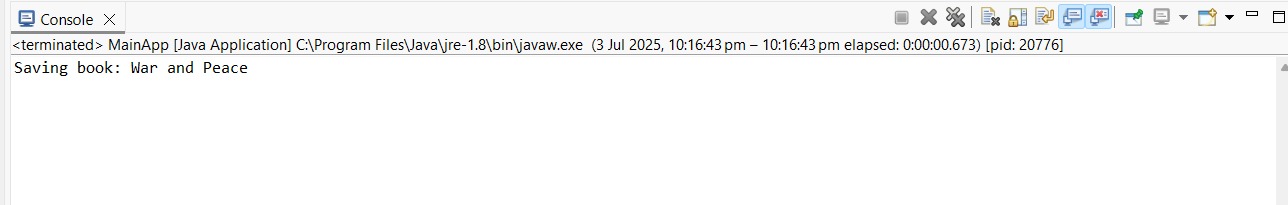
BookService service = ctx.getBean("bookService", BookService.class);

service.addBook("War and Peace");

}

}

**Output:**

****

**Explanation:**

* Basic Spring application was configured for a Library Management System using Spring Framework and Maven.
* A Maven project named *LibraryManagement* was created, and Spring Core dependencies were added in the pom.xml file.
* An XML-based Spring configuration file applicationContext.xml was created to define and manage beans for BookService and BookRepository.
* The service and repository classes were implemented under appropriate packages to follow a layered architecture.
* Finally, a main class was used to load the Spring ApplicationContext and test the proper wiring and functionality of the defined beans.

**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.

**Solution:**

**Dependencies added in 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 https://maven.apache.org/xsd/maven-4.0.0.xsd">

<modelVersion>4.0.0</modelVersion>

<groupId>com.library</groupId>

<artifactId>LibraryManagement</artifactId>

<version>0.0.1-SNAPSHOT</version>

<!-- 2. Spring dependencies -->

<dependencies>

<!-- Spring Core / Context -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>

<version>5.3.32</version>

</dependency>

<!-- Spring AOP -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-aop</artifactId>

<version>5.3.32</version>

</dependency>

<!-- Spring Web MVC -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-webmvc</artifactId>

<version>5.3.32</version>

</dependency>

</dependencies>

<!-- 3. Maven compiler plugin for Java 8 -->

<build>

<plugins>

<plugin>

<groupId>org.apache.maven.plugins</groupId>

<artifactId>maven-compiler-plugin</artifactId>

<version>3.11.0</version>

<configuration>

<source>1.8</source>

<target>1.8</target>

</configuration>

</plugin>

</plugins>

</build>

</project>

**applicationContext.xml:**

<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 save(String book) {

System.out.println("Saving book: " + book);

}

}

**BookService.java:**

public class BookService {

private BookRepository bookRepository;

public void setBookRepository(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

public void addBook(String book) {

bookRepository.save(book);

}

}

**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");

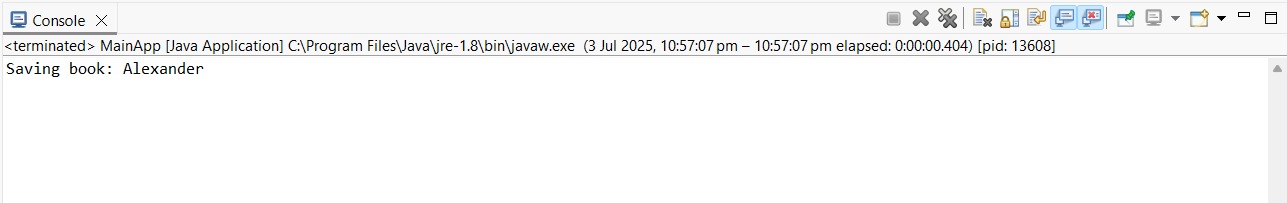
BookService bookService = context.getBean("bookService", BookService.class);

bookService.addBook("Alexander");

}

}

**Output:**



**Explanation:**

* Spring’s Inversion of Control (IoC) and Dependency Injection (DI) features were used to manage the relationship between BookService and BookRepository.
* The applicationContext.xml configuration file was updated to define both beans and wire them using setter injection.
* The BookService class was modified to include a setter method to accept the BookRepository dependency.
* Finally, the application was tested by running the MainApp class, which successfully demonstrated that Spring injected the repository into the service class and managed the dependencies effectively.

**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.

**Solution:**

**Dependencies added in 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 https://maven.apache.org/xsd/maven-4.0.0.xsd">

<modelVersion>4.0.0</modelVersion>

<groupId>com.library</groupId>

<artifactId>LibraryManagement</artifactId>

<version>0.0.1-SNAPSHOT</version>

<!-- 2. Spring dependencies -->

<dependencies>

<!-- Spring Core / Context -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>

<version>5.3.32</version>

</dependency>

<!-- Spring AOP -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-aop</artifactId>

<version>5.3.32</version>

</dependency>

<!-- Spring Web MVC -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-webmvc</artifactId>

<version>5.3.32</version>

</dependency>

</dependencies>

<!-- 3. Maven compiler plugin for Java 8 -->

<build>

<plugins>

<plugin>

<groupId>org.apache.maven.plugins</groupId>

<artifactId>maven-compiler-plugin</artifactId>

<version>3.11.0</version>

<configuration>

<source>1.8</source>

<target>1.8</target>

</configuration>

</plugin>

</plugins>

</build>

</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 save(String book) {

System.out.println("Saving book: " + book);

}

}

**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) {

bookRepository.save(title);

}

}

**LibraryManagementApplication.java:**

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApplication {

public static void main(String[] args) {

ApplicationContext ctx = new ClassPathXmlApplicationContext("applicationContext.xml");

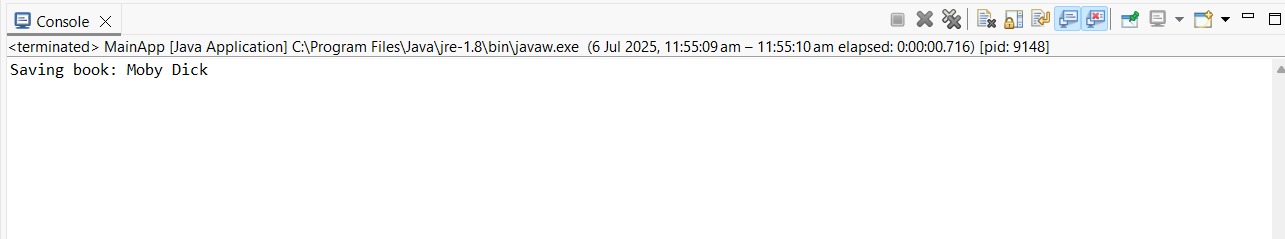
BookService service = ctx.getBean("bookService", BookService.class);

service.addBook("Moby Dick");

}

}

**Output:**



**Explanation:**

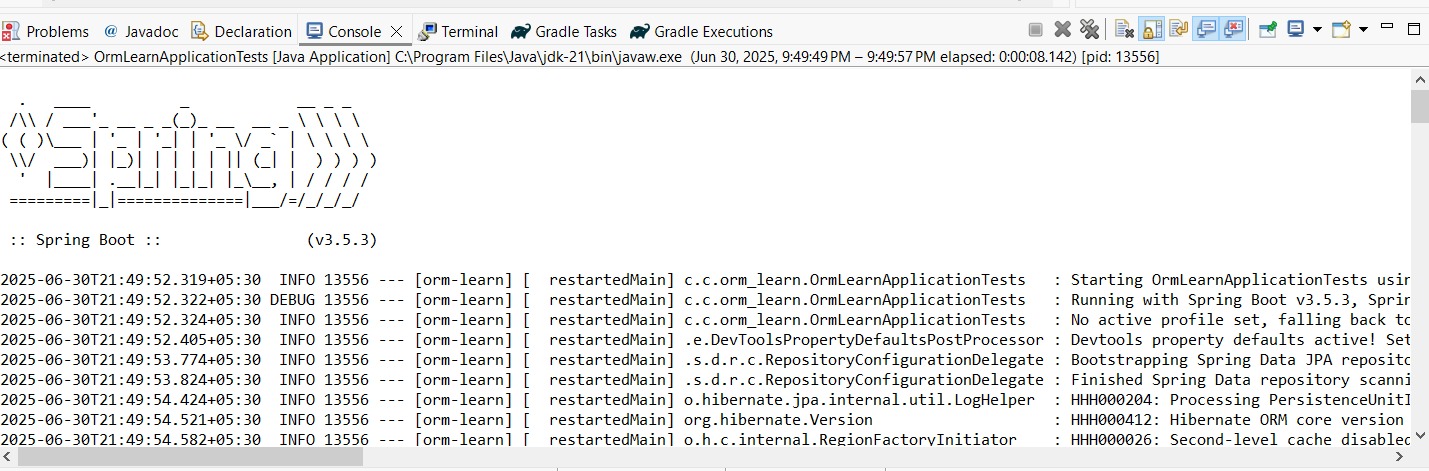
* Created a Maven project named LibraryManagement with Spring dependencies: spring-context, spring-aop, and spring-webmvc.
* The Maven Compiler Plugin was configured to use Java 1.8 for compatibility.
* In applicationContext.xml, I have defined two beans BookRepository and BookService and wired them using setter-based dependency injection.
* The BookService class includes an “addBook” method that calls “BookRepository.save”, representing a clean separation of logic. Running the main class initialized the Spring context and injected the dependencies.

**Spring Data JPA with Spring Boot, Hibernate**

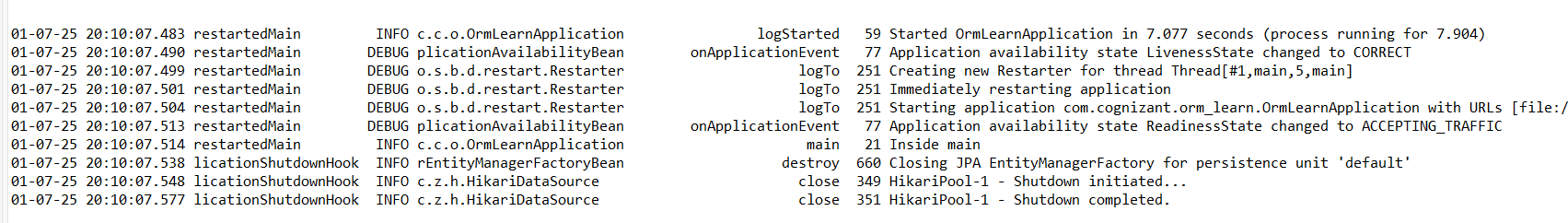
**Exercise 01: Spring Data JPA - Quick Example**

**Solution:**

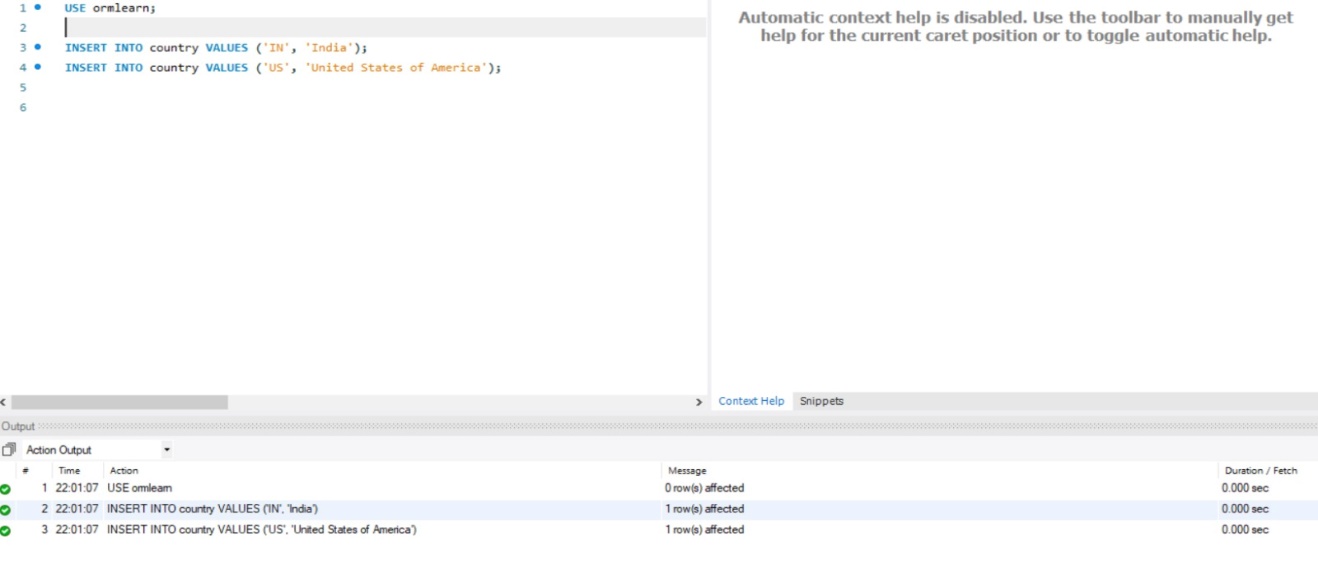
* Added the databases and log configuration in the application.properties file as per given.
* Included logs in the application and verified that the main() method is called. And the output is as follows:



……



* And I also created table named “country” and entered the couple of records into the table as per the table.



* The “Country.java” class is an entity that represents the country table in the database, with fields code and name mapped using JPA annotations.
* The “CountryRepository.java” interface extends JpaRepository to provide built-in CRUD operations for the Country entity without the need for boilerplate code.
* The “CountryService.java” class serves as the service layer, where business logic is implemented; it autowires the CountryRepository and provides methods like getAllCountries() to retrieve data from the database.
* Implemented code are as follows:

**Country.java:**

package com.cognizant.orm\_learn.model;

import jakarta.persistence.Column;

import jakarta.persistence.Entity;

import jakarta.persistence.Id;

import jakarta.persistence.Table;

@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.orm\_learn.repository;

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

import org.springframework.stereotype.Repository;

import com.cognizant.orm\_learn.model.Country;

@Repository

public interface CountryRepository extends JpaRepository<Country, String> {

}

**CountryService.java:**

package com.cognizant.orm\_learn.service;

import java.util.List;

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

import org.springframework.stereotype.Service;

import org.springframework.transaction.annotation.Transactional;

import com.cognizant.orm\_learn.model.Country;

import com.cognizant.orm\_learn.repository.CountryRepository;

@Service

public class CountryService {

@Autowired

private CountryRepository countryRepository;

@Transactional

public List<Country> getAllCountries() {

return countryRepository.findAll();

}

}

**OrmLearnApplication.java:**

package com.cognizant.orm\_learn;

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.orm\_learn.model.Country;

import com.cognizant.orm\_learn.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);

*testGetAllCountries*();

}

private static void testGetAllCountries() {

*LOGGER*.info("Start");

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

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

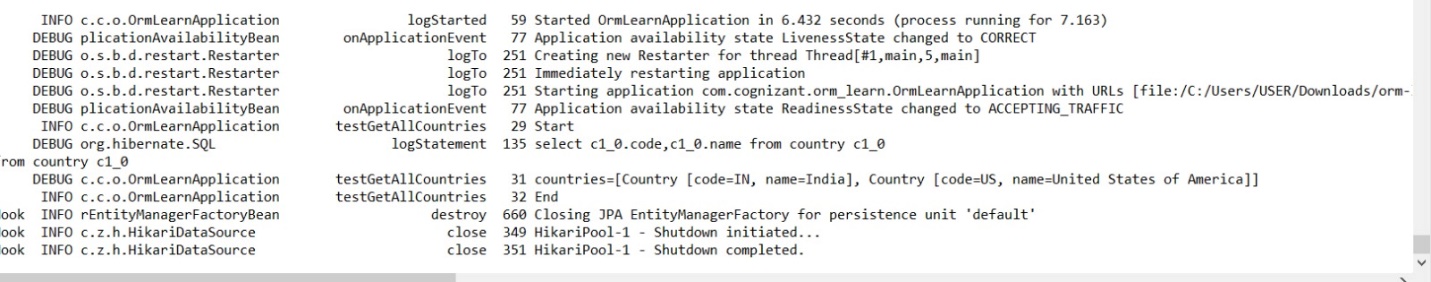
*LOGGER*.info("End");

}

}

**Output:**

****



**Exercise 3:   
Difference between JPA, Hibernate and Spring Data JPA**

**Solution:**

**JPA (Java Persistence API):**

* A specification (like a rulebook) for how to manage relational data in Java using objects.
* Part of Java EE (now Jakarta EE), defined under JSR 338.
* It defines interfaces and annotations but has no implementation.

**Hibernate:**

* A popular ORM (Object-Relational Mapping) tool.
* A concrete implementation of JPA.
* Handles:
  + - Connecting Java objects to DB tables
    - Generating SQL
    - Caching and lazy loading
    - Transaction management

**Spring Data JPA:**

* A Spring framework project that simplifies JPA-based data access.
* It does not implement JPA, but sits on top of JPA providers like Hibernate.
* Provides:
  + Auto CRUD operations (no need to write DAO classes)
  + Repository interfaces
  + Built-in pagination, sorting, query generation

**Code Comparison:**

**Hibernate (Approach):**

**Dependencies added in pom.xml:**

<dependencies>

<dependency>

<groupId>org.hibernate.orm</groupId>

<artifactId>hibernate-core</artifactId>

<version>6.4.4.Final</version>

</dependency>

<dependency>

<groupId>com.mysql</groupId>

<artifactId>mysql-connector-j</artifactId>

<version>8.0.33</version>

</dependency>

<dependency>

<groupId>jakarta.persistence</groupId>

<artifactId>jakarta.persistence-api</artifactId>

<version>3.1.0</version>

</dependency>

<dependency>

<groupId>org.jboss.logging</groupId>

<artifactId>jboss-logging</artifactId>

<version>3.5.3.Final</version>

</dependency>

</dependencies>

**hibernate.cfg.xml (File created in src/main/resources):**

<?xml version='1.0' encoding='utf-8'?>

<!DOCTYPE hibernate-configuration PUBLIC

"-//Hibernate/Hibernate Configuration DTD 3.0//EN"

"http://hibernate.sourceforge.net/hibernate-configuration-3.0.dtd">

<hibernate-configuration>

<session-factory>

<property name="hibernate.connection.driver\_class">com.mysql.cj.jdbc.Driver</property>

<property name="hibernate.connection.url">jdbc:mysql://localhost:3306/testdb</property>

<property name="hibernate.connection.username">root</property>

<property name="hibernate.connection.password">Divya@priya135</property>

<property name="hibernate.dialect">org.hibernate.dialect.MySQL8Dialect</property>

<property name="hibernate.hbm2ddl.auto">update</property>

<property name="hibernate.show\_sql">true</property>

<mapping class="com.example.Employee"/>

</session-factory>

</hibernate-configuration>

**Employee.java:**

package com.example;

import jakarta.persistence.\*;

@Entity

@Table(name = "employee")

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.*IDENTITY*)

private int id;

private String name;

private String department;

// Getters & Setters

public int getId() { return id; }

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

public String getName() { return name; }

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

public String getDepartment() { return department; }

public void setDepartment(String department) { this.department = department; }

}

**HibernateUtil.java:**

package com.example;

import org.hibernate.SessionFactory;

import org.hibernate.cfg.Configuration;

public class HibernateUtil {

private static final SessionFactory sessionFactory;

static {

try {

sessionFactory = new Configuration()

.configure("hibernate.cfg.xml")

.buildSessionFactory();

} catch (Throwable ex) {

throw new ExceptionInInitializerError(ex);

}

}

public static SessionFactory getSessionFactory() {

return sessionFactory;

}

}

**Main.java:**

package com.example;

import org.hibernate.Session;

import org.hibernate.Transaction;

public class Main {

public static void main(String[] args) {

Employee emp = new Employee();

emp.setName("Divya");

emp.setDepartment("HR");

emp.setName("Divya");

emp.setDepartment("HR");

emp.setName("Divya");

emp.setDepartment("HR");

Session session = HibernateUtil.getSessionFactory().openSession();

Transaction tx = null;

try {

tx = session.beginTransaction();

session.save(emp); // persist employee object

tx.commit();

} catch (Exception e) {

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

e.printStackTrace();

} finally {

session.close();

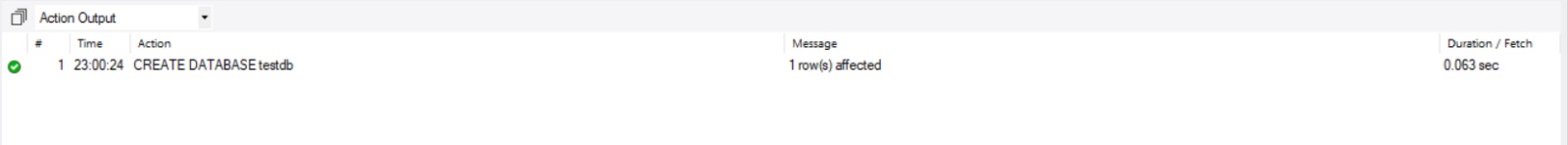
}

}

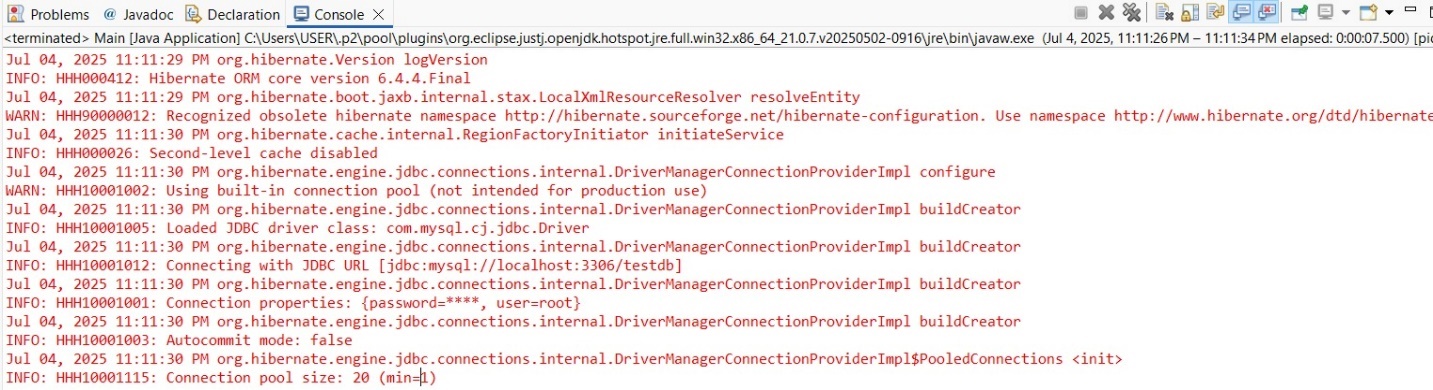
}

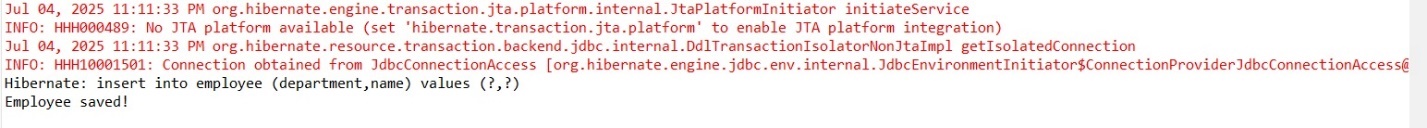
**Output:**

**Successfully created database testbase:**

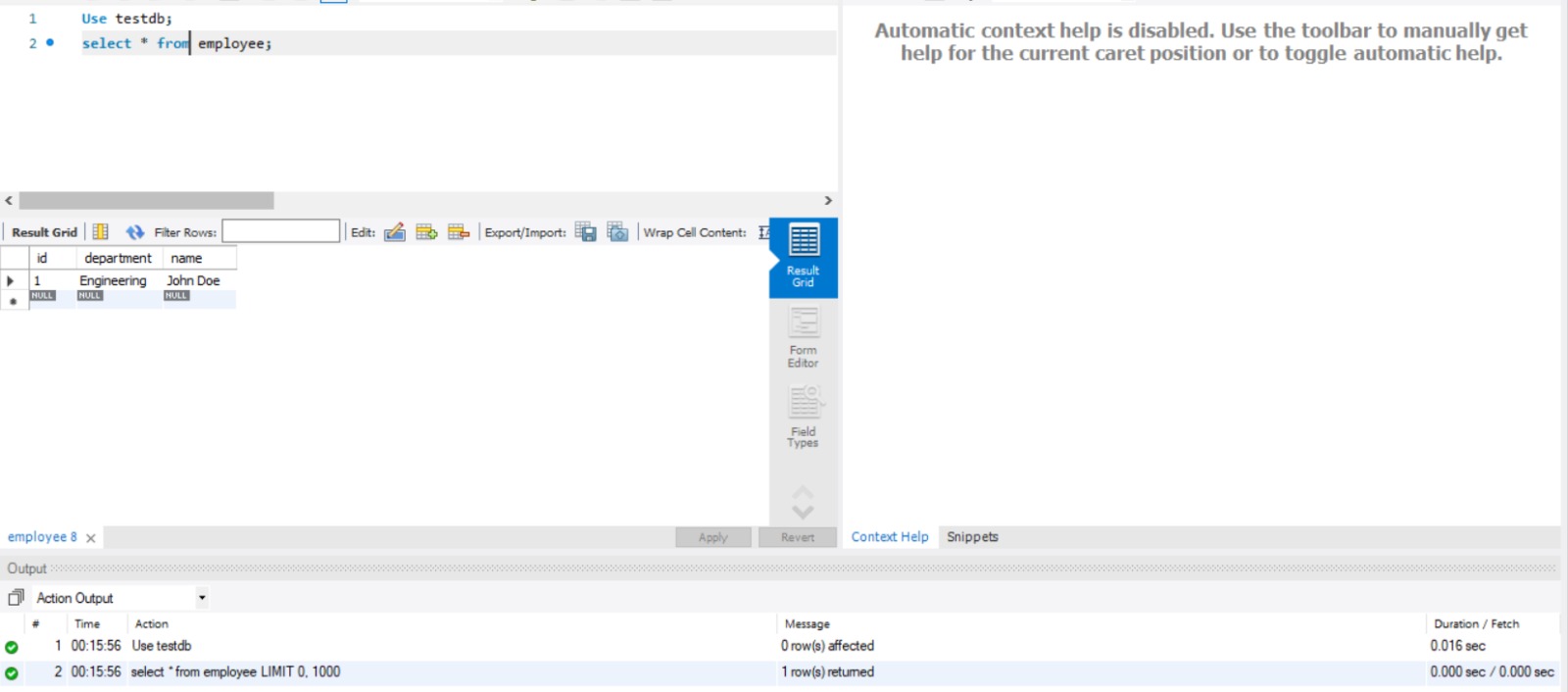


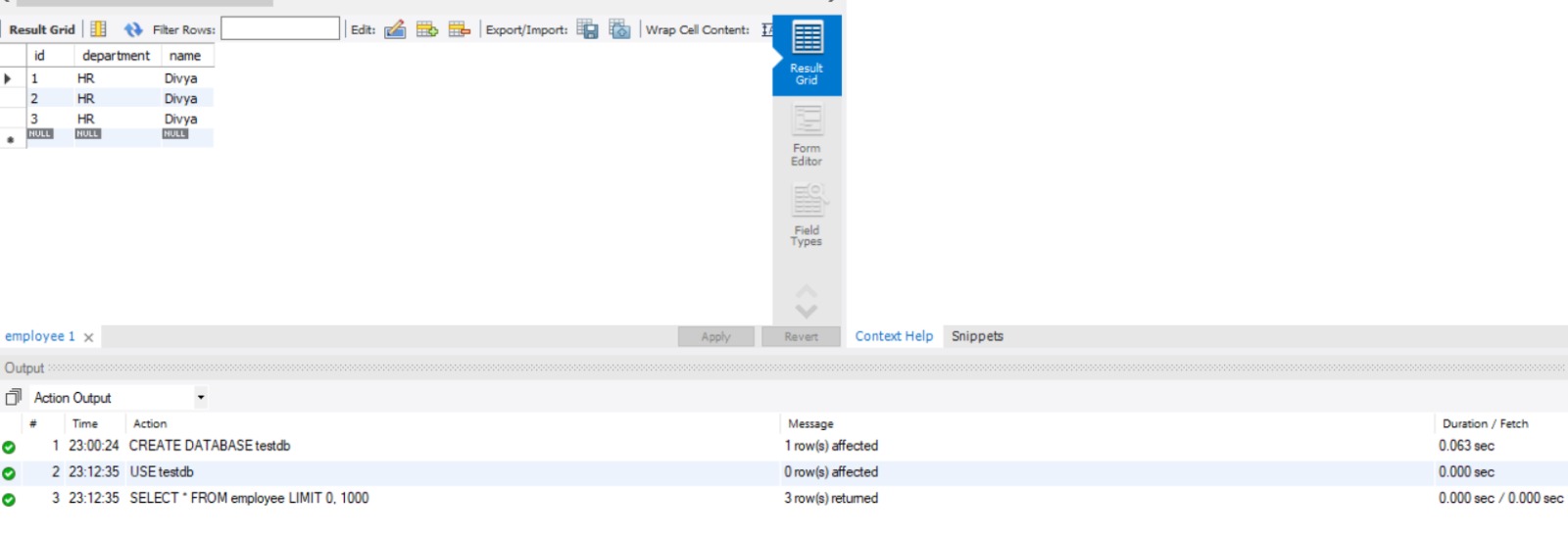
**Console Output After Running Eclipse Code:**





**Verified in MYSQL workbench:**





**Explanation:**

* Hibernate config (hibernate.cfg.xml) is loaded.
* SessionFactory(Database Factory) is created once, used throughout the app.
* A new Session(Database session) is opened to talk to the DB.
* A Transaction is started and committed to save data.
* On exception, transaction is rolled back.

**Spring Data JPA (Approach):**

**Dependencies added in pom.xml:**

<dependencies>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-data-jpa</artifactId>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-web</artifactId>

</dependency>

<dependency>

<groupId>com.mysql</groupId>

<artifactId>mysql-connector-j</artifactId>

<version>8.0.33</version>

</dependency>

<dependency>

<groupId>jakarta.persistence</groupId>

<artifactId>jakarta.persistence-api</artifactId>

<version>3.1.0</version>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-data-jpa</artifactId>

</dependency>

<dependency>

<groupId>org.springframework.boot</groupId>

<artifactId>spring-boot-starter-web</artifactId>

</dependency>

<dependency>

<groupId>com.mysql</groupId>

<artifactId>mysql-connector-j</artifactId>

<version>8.0.33</version>

</dependency>

</dependencies>

**application.properties (File created in src/main/resources):**

# Database connection

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

spring.datasource.username=root

spring.datasource.password=\*\*\*\*\*\*\* # “ \*\*\*\*\*\*\*\*” is the password for my sql

spring.jpa.hibernate.ddl-auto=update

spring.jpa.show-sql=true

spring.jpa.properties.hibernate.dialect=org.hibernate.dialect.MySQL8Dialect

logging.level.org.hibernate.SQL=DEBUG

**Employee.java:**

package com.example.entity;

import jakarta.persistence.Entity;

import jakarta.persistence.Id;

import jakarta.persistence.GeneratedValue;

import jakarta.persistence.GenerationType;

@Entity

public class Employee {

@Id

@GeneratedValue(strategy = GenerationType.*IDENTITY*)

private Integer id;

private String name;

private String department;

public void setName(String name) {

this.name = name;

}

public void setDepartment(String department) {

this.department = department;

}

// Optional: Add getters as well

public Integer getId() {

return id;

}

public String getName() {

return name;

}

public String getDepartment() {

return department;

}

}

**EmployeeRepository.java:**

package com.example.repository;

import com.example.entity.Employee;

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

public interface EmployeeRepository extends JpaRepository<Employee, Integer> {

}

**EmployeeService.java:**

package com.example.service;

import com.example.entity.Employee;

import com.example.repository.EmployeeRepository;

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

import org.springframework.stereotype.Service;

@Service

public class EmployeeService {

@Autowired

private EmployeeRepository repository;

public void saveEmployee(Employee employee) {

repository.save(employee);

System.*out*.println("Employee saved!");

}

}

**SpringDataJpaDemoApplication.java:**

package com.example;

import com.example.entity.Employee;

import com.example.repository.EmployeeRepository;

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

import org.springframework.boot.CommandLineRunner;

import org.springframework.boot.SpringApplication;

import org.springframework.boot.autoconfigure.SpringBootApplication;

@SpringBootApplication

public class SpringDataJpaDemoApplication implements CommandLineRunner {

@Autowired

private EmployeeRepository employeeRepository;

public static void main(String[] args) {

SpringApplication.*run*(SpringDataJpaDemoApplication.class, args);

}

@Override

public void run(String... args) throws Exception {

Employee emp = new Employee();

emp.setName("John Doe");

emp.setDepartment("Engineering");

employeeRepository.save(emp);

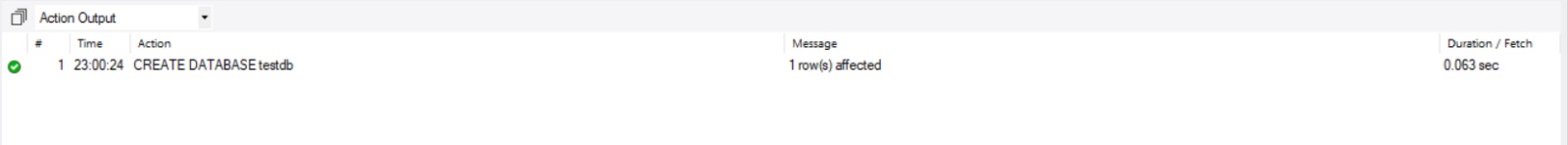
System.*out*.println("Employee Saved!");

}

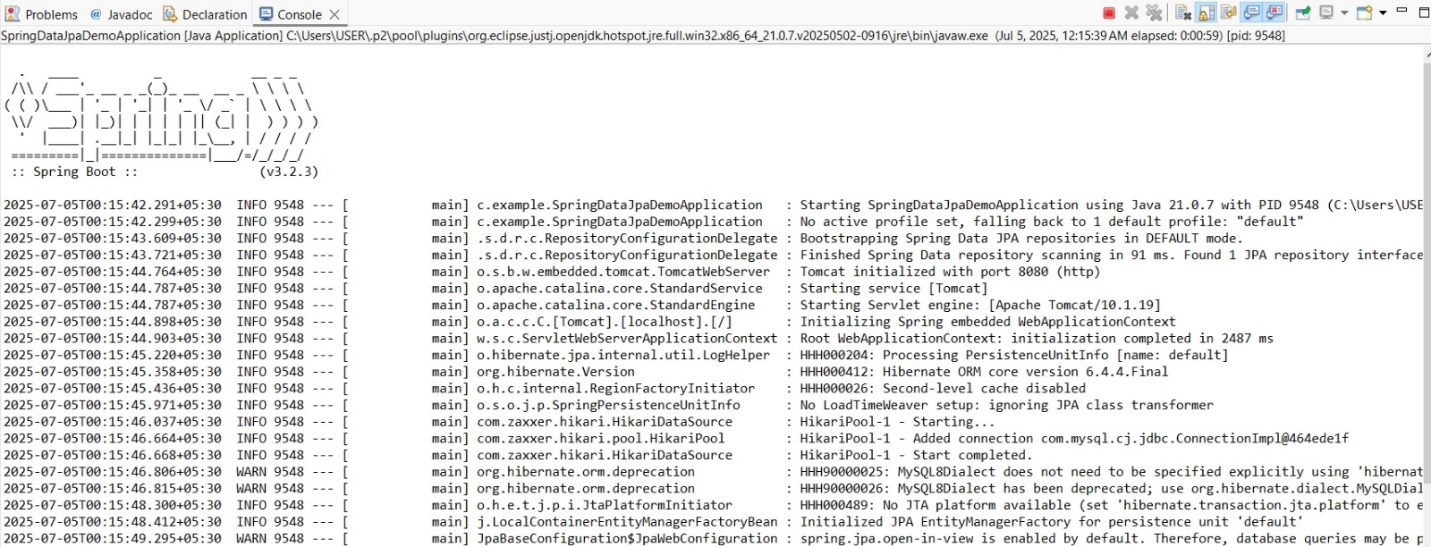
}

**Output:**

**Created database testdb:**

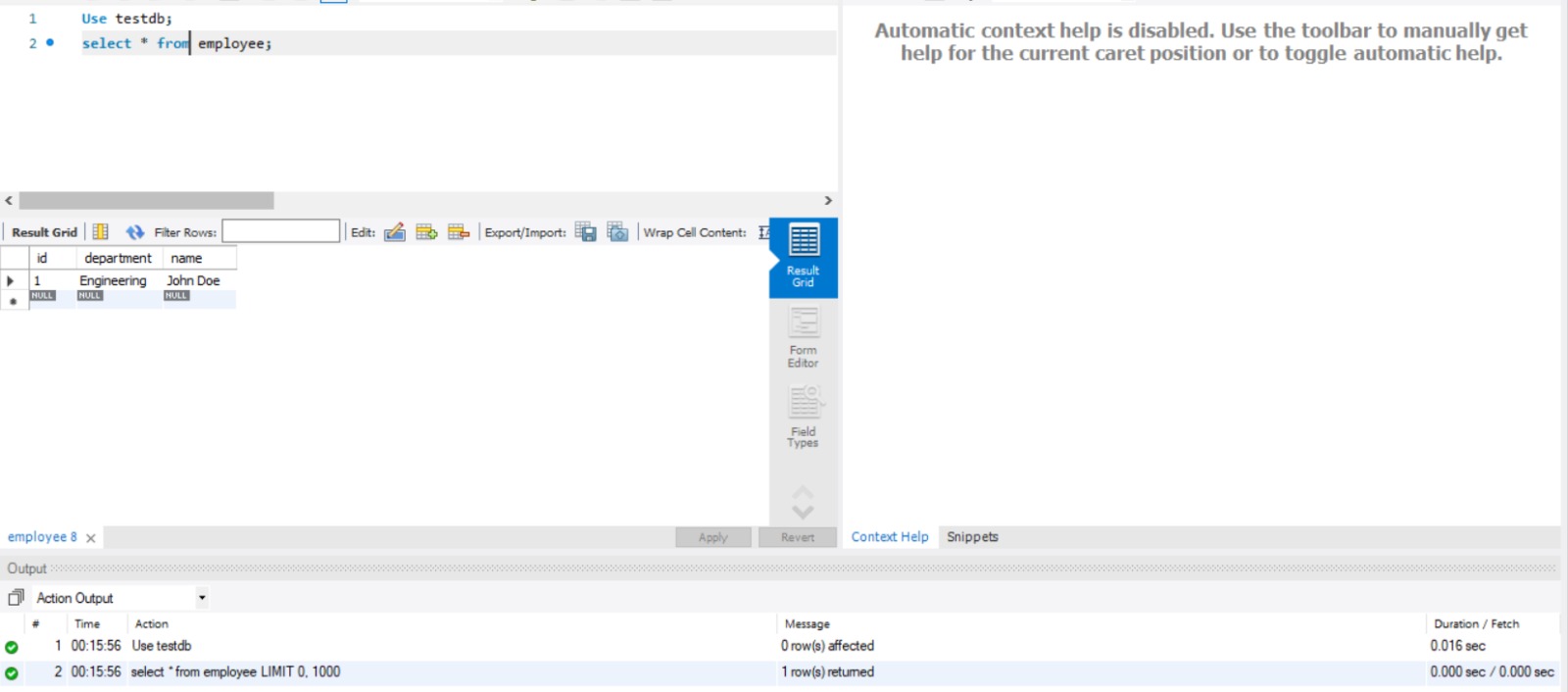


**Console output after running SpringDataJpaDemoApplication as Java Application:**





**Verified in MYSQL workbench:**



**Explanation:**

* Spring Data JPA simplifies data access in Java by providing an abstraction over JPA and Hibernate.
* Unlike traditional Hibernate code, it eliminates boilerplate by using built-in repository interfaces for CRUD operations.
* Implemented a basic Spring Data JPA project using Eclipse and Maven, configured the application with application.properties, created entity and repository classes,
* And it also verified successful data insertion into MySQL.