**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.

**JAVA CODE**

<!-- src/main/resources/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>

// com.library.repository.BookRepository.java

package com.library.repository;

public class BookRepository {

public void saveBook() {

System.out.println("Book saved to repository.");

}

}

// com.library.service.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() {

bookRepository.saveBook();

}

}

// LibraryManagementApplication.java

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

import com.library.service.BookService;

public class LibraryManagementApplication {

public static void main(String[] args) {

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

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

bookService.addBook();

}

}

**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.

**JAVA CODE**

<!-- 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>

package com.library.repository;

public class BookRepository {

public void saveBook() {

System.out.println("BookRepository: Book saved successfully.");

}

}

package com.library.service;

import com.library.repository.BookRepository;

public class BookService {

private BookRepository bookRepository;

// Setter Injection

public void setBookRepository(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

public void addBook() {

System.out.println("BookService: Delegating save to repository...");

bookRepository.saveBook();

}

}

package com.library;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

import com.library.service.BookService;

public class LibraryManagementApplication {

public static void main(String[] args) {

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

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

bookService.addBook(); // Test if dependency injection is working

}

}

**Exercise 3: Implementing Logging with Spring AOP**

**Scenario:**

The library management application requires logging capabilities to track method execution times.

**Steps:**

1. **Add Spring AOP Dependency:**
   * Update **pom.xml** to include Spring AOP dependency.
2. **Create an Aspect for Logging:**
   * Create a package **com.library.aspect** and add a class **LoggingAspect** with a method to log execution times.
3. **Enable AspectJ Support:**
   * Update **applicationContext.xml** to enable **AspectJ** support and register the aspect.
4. **Test the Aspect:**
   * Run the **LibraryManagementApplication** main class and observe the console for log messages indicating method execution times.

**JAVA CODE**

<!-- applicationContext.xml additions -->

<aop:aspectj-autoproxy xmlns:aop="http://www.springframework.org/schema/aop"/>

<bean id="loggingAspect" class="com.library.aspect.LoggingAspect"/>

// com.library.aspect.LoggingAspect.java

package com.library.aspect;

import org.aspectj.lang.ProceedingJoinPoint;

import org.aspectj.lang.annotation.\*;

@Aspect

public class LoggingAspect {

@Around("execution(\* com.library.service.\*.\*(..))")

public Object logExecutionTime(ProceedingJoinPoint joinPoint) throws Throwable {

long start = System.currentTimeMillis();

Object result = joinPoint.proceed();

long time = System.currentTimeMillis() - start;

System.out.println(joinPoint.getSignature() + " executed in " + time + "ms");

return result;

}

}

**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.

**JAVA CODE**

<!-- pom.xml -->

<project xmlns="http://maven.apache.org/POM/4.0.0" ...>

<modelVersion>4.0.0</modelVersion>

<groupId>com.library</groupId>

<artifactId>LibraryManagement</artifactId>

<version>1.0</version>

<dependencies>

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>

<version>5.3.20</version>

</dependency>

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-aop</artifactId>

<version>5.3.20</version>

</dependency>

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-webmvc</artifactId>

<version>5.3.20</version>

</dependency>

</dependencies>

<build>

<plugins>

<plugin>

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

<version>3.8.0</version>

<configuration>

<source>1.8</source>

<target>1.8</target>

</configuration>

</plugin>

</plugins>

</build>

</project>

**Exercise 5: Configuring the Spring IoC Container**

**Scenario:**

The library management application requires a central configuration for beans and dependencies.

**Steps:**

1. **Create Spring Configuration File:**
   * Create an XML configuration file named **applicationContext.xml** in the **src/main/resources** directory.
   * Define beans for **BookService** and **BookRepository** in the XML file.
2. **Update the BookService Class:**
   * Ensure that the **BookService** class has a setter method for **BookRepository**.
3. **Run the Application:**
   * Create a main class to load the Spring context and test the configuration.

**JAVA CODE**

<!-- 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">

<!-- Define BookRepository bean -->

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

<!-- Define BookService bean and inject BookRepository using setter -->

<bean id="bookService" class="com.library.service.BookService">

<property name="bookRepository" ref="bookRepository"/>

</bean>

</beans>

package com.library.repository;

public class BookRepository {

public void saveBook() {

System.out.println("BookRepository: Book saved to the database.");

}

}

package com.library.service;

import com.library.repository.BookRepository;

public class BookService {

private BookRepository bookRepository;

// Setter injection method

public void setBookRepository(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

public void addBook() {

System.out.println("BookService: Calling repository to save book...");

bookRepository.saveBook();

}

}

package com.library;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

import com.library.service.BookService;

public class LibraryManagementApplication {

public static void main(String[] args) {

// Load Spring IoC container from applicationContext.xml

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

// Retrieve BookService bean

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

// Test the configuration

bookService.addBook();

}

}

**Exercise 6: Configuring Beans with Annotations**

**Scenario:**

You need to simplify the configuration of beans in the library management application using annotations.

**Steps:**

1. **Enable Component Scanning:**
   * Update **applicationContext.xml** to include component scanning for the **com.library** package.
2. **Annotate Classes:**
   * Use **@Service** annotation for the **BookService** class.
   * Use **@Repository** annotation for the **BookRepository** class.
3. **Test the Configuration:**
   * Run the **LibraryManagementApplication** main class to verify the annotation-based configuration.

**JAVA CODE**

<!-- applicationContext.xml -->

<context:component-scan base-package="com.library" xmlns:context="http://www.springframework.org/schema/context"/>

// com.library.service.BookService.java

package com.library.service;

import com.library.repository.BookRepository;

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

import org.springframework.stereotype.Service;

@Service

public class BookService {

@Autowired

private BookRepository bookRepository;

public void addBook() {

bookRepository.saveBook();

}

}

// com.library.repository.BookRepository.java

package com.library.repository;

import org.springframework.stereotype.Repository;

@Repository

public class BookRepository {

public void saveBook() {

System.out.println("Book saved.");

}

}

**Exercise 7: Implementing Constructor and Setter Injection**

**Scenario:**

The library management application requires both constructor and setter injection for better control over bean initialization.

**Steps:**

1. **Configure Constructor Injection:**
   * Update applicationContext.**xml** to configure constructor injection for **BookService**.
2. **Configure Setter Injection:**
   * Ensure that the **BookService** class has a setter method for **BookRepository** and configure it in **applicationContext.xml**.
3. **Test the Injection:**
   * Run the **LibraryManagementApplication** main class to verify both constructor and setter injection.

**JAVA CODE**

<!-- applicationContext.xml -->

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

<bean id="bookService" class="com.library.service.BookService">

<constructor-arg ref="bookRepository"/>

<property name="bookRepository" ref="bookRepository"/>

</bean>  
// com.library.service.BookService.java

package com.library.service;

import com.library.repository.BookRepository;

public class BookService {

private BookRepository bookRepository;

public BookService(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

public void setBookRepository(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

public void addBook() {

bookRepository.saveBook();

}

}

**Exercise 8: Implementing Basic AOP with Spring**

**Scenario:**

The library management application requires basic AOP functionality to separate cross-cutting concerns like logging and transaction management.

**Steps:**

1. **Define an Aspect:**
   * Create a package **com.library.aspect** and add a class **LoggingAspect**.
2. **Create Advice Methods:**
   * Define advice methods in **LoggingAspect** for logging before and after method execution.
3. **Configure the Aspect:**
   * Update **applicationContext.xml** to register the aspect and enable **AspectJ** auto-proxying.
4. **Test the Aspect:**
   * Run the **LibraryManagementApplication** main class to verify the AOP functionality.

**JAVA CODE**

// com.library.aspect.LoggingAspect.java

package com.library.aspect;

import org.aspectj.lang.annotation.\*;

@Aspect

public class LoggingAspect {

@Before("execution(\* com.library.service.\*.\*(..))")

public void logBefore() {

System.out.println("Method execution started...");

}

@After("execution(\* com.library.service.\*.\*(..))")

public void logAfter() {

System.out.println("Method execution finished.");

}

}

<!-- applicationContext.xml additions -->

<aop:aspectj-autoproxy xmlns:aop="http://www.springframework.org/schema/aop"/>

<bean id="loggingAspect" class="com.library.aspect.LoggingAspect"/>

**Exercise 9: Creating a Spring Boot Application**

**Scenario:**

You need to create a Spring Boot application for the library management system to simplify configuration and deployment.

**Steps:**

1. **Create a Spring Boot Project:**
   * Use **Spring Initializr** to create a new Spring Boot project named **LibraryManagement**.
2. **Add Dependencies:**
   * Include dependencies for **Spring Web, Spring Data JPA, and H2 Database**.
3. **Create Application Properties:**
   * Configure database connection properties in **application.properties**.
4. **Define Entities and Repositories:**
   * Create **Book** entity and **BookRepository** interface.
5. **Create a REST Controller:**
   * Create a **BookController** class to handle CRUD operations.
6. **Run the Application:**
   * Run the Spring Boot application and test the REST endpoints.

**JAVA CODE**

// LibraryManagementApplication.java

package com.library;

import org.springframework.boot.SpringApplication;

import org.springframework.boot.autoconfigure.SpringBootApplication;

@SpringBootApplication

public class LibraryManagementApplication {

public static void main(String[] args) {

SpringApplication.run(LibraryManagementApplication.class, args);

}

}

// com.library.model.Book.java

package com.library.model;

import jakarta.persistence.\*;

@Entity

public class Book {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String title;

}

// com.library.repository.BookRepository.java

package com.library.repository;

import com.library.model.Book;

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

public interface BookRepository extends JpaRepository<Book, Long> {}

// com.library.controller.BookController.java

package com.library.controller;

import com.library.model.Book;

import com.library.repository.BookRepository;

import org.springframework.web.bind.annotation.\*;

import java.util.List;

@RestController

@RequestMapping("/books")

public class BookController {

private final BookRepository bookRepository;

public BookController(BookRepository bookRepository) {

this.bookRepository = bookRepository;

}

@PostMapping

public Book addBook(@RequestBody Book book) {

return bookRepository.save(book);

}

@GetMapping

public List<Book> getAllBooks() {

return bookRepository.findAll();

}

}

# application.properties

spring.datasource.url=jdbc:h2:mem:testdb

spring.datasource.driverClassName=org.h2.Driver

spring.datasource.username=sa

spring.datasource.password=

spring.jpa.database-platform=org.hibernate.dialect.H2Dialect

spring.h2.console.enabled=true