Exercise 1: Configuring a Basic Spring Application

**Step 1: Set Up a Spring Project**

**1.1** Create a Maven project named `LibraryManagement`

1. Open your IDE (e.g., IntelliJ IDEA, Eclipse) and create a new Maven project named

`LibraryManagement`.

1. Ensure your `pom.xml` file is set up to include the necessary Spring dependencies.

**1.2** Add Spring Core dependencies in the `pom.xml` file

Open the `pom.xml` file and add the following dependencies:

xml

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

xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](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>

<!-- Spring Core Dependency -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>  
<version>5.3.22</version>

</dependency>

</dependencies>

</project>

Step 2: Configure the Application Context

**2.1** Create an XML configuration file named `applicationContext.xml`

In the `src/main/resources` directory, create a file named `applicationContext.xml` and define the beans for `BookService` and `BookRepository`.

xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](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 -->

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

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

</bean>

</beans>  
  
  
Step 3: Define Service and Repository Classes

**3.1** Create `BookService` class

Create the package `com.library.service` and add a class named `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 manageBooks() {

System.out.println("Managing books in the library..."); bookRepository.displayBooks();

}

}  
**3.2** Create `BookRepository` class

Create the package `com.library.repository` and add a class named `BookRepository`.

java

package com.library.repository;

public class BookRepository {

public void displayBooks() {

System.out.println("Displaying books from the repository...");

}

}

Step 4: Run the Application

**4.1** Create a main class to load the Spring context and test the configuration

Create a main class `LibraryManagementApp` in the package `com.library`.

java

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args) {  
ApplicationContext context = new

ClassPathXmlApplicationContext("applicationContext.xml");

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

}

**Running the Application**

1. Right-click on `LibraryManagementApp` and select `Run`.
2. You should see the following output in the console:

Managing books in the library... Displaying books from the repository...

This output confirms that the Spring context has been successfully loaded and the beans have been correctly configured and injected.  
  
  
Exercise 2: Implementing Dependency Injection

Step 1: Modify the XML Configuration

Update `applicationContext.xml` to wire `BookRepository` into `BookService`.

Xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](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 -->

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

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

</bean>

</beans>

Step 2: Update the BookService Class

Ensure that the `BookService` class has a setter method for `BookRepository`.  
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 manageBooks() {

System.out.println("Managing books in the library..."); bookRepository.displayBooks();

}

}  
  
Step 3: Test the Configuration

Run the `LibraryManagementApp` main class to verify the dependency injection.

java

package com.library;  
import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args) { ApplicationContext context = new

ClassPathXmlApplicationContext("applicationContext.xml");

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

}  
}  
When you run `LibraryManagementApp`, you should see the following output:

Managing books in the library... Displaying books from the repository...

This confirms that the dependency injection is working correctly.

Exercise 3: Implementing Logging with Spring AOP

**Step 1: Add Spring AOP Dependency**

Update `pom.xml` to include the Spring AOP dependency.  
xml

<dependencies>

<!-- Spring Core Dependency -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>

<version>5.3.22</version>

</dependency>

<!-- Spring AOP Dependency -->  
<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-aop</artifactId>

<version>5.3.22</version>

</dependency>

<!-- AspectJ Dependency -->

<dependency>

<groupId>org.aspectj</groupId>

<artifactId>aspectjweaver</artifactId>

<version>1.9.7</version>

</dependency>

</dependencies>

Step 2: Create an Aspect for Logging

Create a package `com.library.aspect` and add a class `LoggingAspect` with a method to log execution times.  
java

package com.library.aspect;

import org.aspectj.lang.ProceedingJoinPoint;

import org.aspectj.lang.annotation.Around;

import org.aspectj.lang.annotation.Aspect;  
@Aspect

public class LoggingAspect {

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

public Object logExecutionTime(ProceedingJoinPoint joinPoint) throws Throwable

{ long start = System.currentTimeMillis();

Object proceed = joinPoint.proceed();

long executionTime = System.currentTimeMillis() - start;  
System.out.println(joinPoint.getSignature() + " executed in " + executionTime + "ms");

return proceed;

}

}

Step 3: Enable AspectJ Support

Update `applicationContext.xml` to enable AspectJ support and register the aspect.

xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](http://www.w3.org/2001/XMLSchema-instance) xmlns:aop="<http://www.springframework.org/schema/aop>"

xsi:schemaLocation="<http://www.springframework.org/schema/beans> <http://www.springframework.org/schema/beans/spring-beans.xsd>

<http://www.springframework.org/schema/aop> <http://www.springframework.org/schema/aop/spring-aop.xsd>">

<!-- Define BookRepository bean -->

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

<!-- Define BookService bean -->

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

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

</bean>

<!-- Enable AspectJ support -->

<aop:aspectj-autoproxy/>

<!-- Register LoggingAspect -->

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

</beans>

Step 4: Test the Aspect

Run the `LibraryManagementApp` main class and observe the console for log messages indicating method execution times.

java

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args)

{ ApplicationContext context = new

ClassPathXmlApplicationContext("applicationContext.xml");

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

}

}

When you run `LibraryManagementApp`, you should see output similar to the following:

Managing books in the library... Displaying books from the repository...

public void com.library.service.BookService.manageBooks() executed in [execution time]ms

public void com.library.repository.BookRepository.displayBooks() executed in [execution time]ms

This confirms that the logging aspect is working correctly and is tracking the method execution times.

Exercise 4: Creating and Configuring a Maven Project

Step 1: Create a New Maven Project

1. Open your IDE (e.g., IntelliJ IDEA, Eclipse) and create a new Maven project named

`LibraryManagement`.  
**Step 2**: Add Spring Dependencies in `pom.xml`

Update the `pom.xml` file to include dependencies for Spring Context, Spring AOP, and Spring WebMVC.

xml

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

xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](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>

<!-- Spring Context Dependency -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-context</artifactId>

<version>5.3.22</version>

</dependency>

<!-- Spring AOP Dependency -->

<dependency>

<groupId>org.springframework</groupId>

<artifactId>spring-aop</artifactId>

<version>5.3.22</version>

</dependency>

<!-- AspectJ Dependency -->

<dependency>

<groupId>org.aspectj</groupId>

<artifactId>aspectjweaver</artifactId>

<version>1.9.7</version>

</dependency>

</dependencies>

<build>

<plugins>

<plugin>

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

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

<version>3.8.1</version>

<configuration>

<source>1.8</source>

<target>1.8</target>

</configuration>

</plugin>

</plugins>

</build>

</project>

Exercise 5: Configuring the Spring IoC Container

Step 1: Create Spring Configuration File

Create an XML configuration file named `applicationContext.xml` in the `src/main/resources` directory and define beans for `BookService` and `BookRepository`.

xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](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 -->

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

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

</bean>

</beans>

Step 2: Update the BookService Class

Ensure that the `BookService` class has a setter method for `BookRepository`.

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 manageBooks() {

System.out.println("Managing books in the library...");

bookRepository.displayBooks();

}

}

Step 3: Run the Application

Create a main class to load the Spring context and test the configuration.

java

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args) { ApplicationContext context = new

ClassPathXmlApplicationContext("applicationContext.xml");

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

bookService.manageBooks();

}

}

Running the Application

1. Ensure your Maven project is set up correctly and all dependencies are resolved.
2. Run the `LibraryManagementApp` main class.

You should see the following output in the console:

Managing books in the library... Displaying books from the repository...

This confirms that the Spring IoC container is configured correctly, and the dependencies are injected properly.

Exercise 6: Configuring Beans with Annotations

Step 1: Enable Component Scanning

Update `applicationContext.xml` to include component scanning for the `com.library` package.

xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](http://www.w3.org/2001/XMLSchema-instance)

xmlns:context="[http://www.springframework.org/schema/context"](http://www.springframework.org/schema/context)

xsi:schemaLocation="<http://www.springframework.org/schema/beans> <http://www.springframework.org/schema/beans/spring-beans.xsd>

<http://www.springframework.org/schema/context> <http://www.springframework.org/schema/context/spring-context.xsd>">

<!-- Enable component scanning -->

<context:component-scan base-package="com.library"/>

</beans>

Step 2: Annotate Classes

Use `@Service` annotation for the `BookService` class and `@Repository` annotation for the

`BookRepository` class.

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 {

private BookRepository bookRepository;

@Autowired

public void setBookRepository(BookRepository bookRepository)

{ this.bookRepository = bookRepository;

}

public void manageBooks() {

System.out.println("Managing books in the library...");

bookRepository.displayBooks();

}

}

java

package com.library.repository;

import org.springframework.stereotype.Repository;

@Repository

public class BookRepository {

public void displayBooks() {

System.out.println("Displaying books from the repository...");

}

}

Step 3: Test the Configuration

Run the `LibraryManagementApp` main class to verify the annotation-based configuration.

java

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args)

{ ApplicationContext context = new

ClassPathXmlApplicationContext("applicationContext.xml");

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

}

}

When you run `LibraryManagementApp`, you should see the following output:

Managing books in the library... Displaying books from the repository...

This confirms that the annotation-based configuration is working correctly.

Exercise 7: Implementing Constructor and Setter Injection

Step 1: Configure Constructor Injection

Update `BookService` to use constructor injection and update `applicationContext.xml` to configure constructor injection.

**Update `BookService` Class**

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 {

private BookRepository bookRepository;

@Autowired

public BookService(BookRepository bookRepository)

{ this.bookRepository = bookRepository;

}

// Setter method for setter injection

public void setBookRepository(BookRepository bookRepository) { this.bookRepository = bookRepository;

}

public void manageBooks() {

System.out.println("Managing books in the library..."); bookRepository.displayBooks();

}

}

**Update `applicationContext.xml` for Constructor Injection**

xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](http://www.w3.org/2001/XMLSchema-instance)

xmlns:context="[http://www.springframework.org/schema/context"](http://www.springframework.org/schema/context)

xsi:schemaLocation="<http://www.springframework.org/schema/beans> <http://www.springframework.org/schema/beans/spring-beans.xsd>

<http://www.springframework.org/schema/context> <http://www.springframework.org/schema/context/spring-context.xsd>">

<!-- Enable component scanning -->

<context:component-scan base-package="com.library"/>

</beans>

Step 2: Ensure Setter Method for BookRepository

The `BookService` class already has a setter method for `BookRepository` from the previous step.

Step 3: Test the Injection

Run the `LibraryManagementApp` main class to verify both constructor and setter injection.

java

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args)

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

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

bookService.manageBooks();

}

}

When you run `LibraryManagementApp`, you should see the following output:

Managing books in the library...

Displaying books from the repository...

This confirms that both constructor and setter injections are working correctly. The Spring framework will use constructor injection by default, but the setter method is also available if needed.

Exercise 8: Implementing Basic AOP with Spring

Step 1: Define an Aspect

Create a package `com.library.aspect` and add a class `LoggingAspect`.

java

package com.library.aspect;

import org.aspectj.lang.annotation.After;

import org.aspectj.lang.annotation.Aspect;

import org.aspectj.lang.annotation.Before;

import org.springframework.stereotype.Component;

@Aspect @Component

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...");

}

}

Step 2: Create Advice Methods

The advice methods `logBefore` and `logAfter` in the `LoggingAspect` class handle logging before and after method execution.

Step 3: Configure the Aspect

Update `applicationContext.xml` to register the aspect and enable AspectJ auto-proxying.

xml

<?xml version="1.0" encoding="UTF-8"?>

<beans xmlns="[http://www.springframework.org/schema/beans"](http://www.springframework.org/schema/beans) xmlns:xsi="[http://www.w3.org/2001/XMLSchema-instance"](http://www.w3.org/2001/XMLSchema-instance)

xmlns:context="[http://www.springframework.org/schema/context"](http://www.springframework.org/schema/context)

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

xsi:schemaLocation="<http://www.springframework.org/schema/beans> <http://www.springframework.org/schema/beans/spring-beans.xsd>

<http://www.springframework.org/schema/context> <http://www.springframework.org/schema/context/spring-context.xsd>

<http://www.springframework.org/schema/aop> <http://www.springframework.org/schema/aop/spring-aop.xsd>">

<!-- Enable component scanning -->

<context:component-scan base-package="com.library"/>

<!-- Enable AspectJ auto-proxying -->

<aop:aspectj-autoproxy/>

<!-- Register LoggingAspect -->

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

</beans>

Step 4: Test the Aspect

Run the `LibraryManagementApp` main class to verify the AOP functionality.

java

package com.library;

import com.library.service.BookService;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class LibraryManagementApp {

public static void main(String[] args)

{

ApplicationContext context = new

ClassPathXmlApplicationContext("applicationContext.xml");

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

bookService.manageBooks();

}

}

When you run `LibraryManagementApp`, you should see output similar to the following:

Method execution started... Managing books in the library...

Displaying books from the repository... Method execution finished...

This confirms that the AOP functionality is working correctly.

Exercise 9: Creating a Spring Boot Application

Step 1: Create a Spring Boot Project

Use [Spring Initializr](https://start.spring.io/) to create a new Spring Boot project named

`LibraryManagement`.

* Project: Maven Project
* Language: Java
* Spring Boot: 2.7.6
* Group: com.library
* Artifact: LibraryManagement
* Name: LibraryManagement
* Dependencies: Spring Web, Spring Data JPA, H2 Database

Download the project and open it in your IDE.

Step 2: Add Dependencies

Ensure your `pom.xml` includes the dependencies for Spring Web, Spring Data JPA, and H2 Database.

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.h2database</groupId>

<artifactId>h2</artifactId>

<scope>runtime</scope>

</dependency>

<dependency>

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

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

<scope>test</scope>

</dependency>

</dependencies>

Step 3: Create Application Properties

Configure database connection properties in `src/main/resources/application.properties`.

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

Step 4: Define Entities and Repositories

Create `Book` entity and `BookRepository` interface.

Book Entity

java

package com.library.entity;

import javax.persistence.Entity;

import javax.persistence.GeneratedValue;

import javax.persistence.GenerationType;

import javax.persistence.Id;

@Entity

public class Book {

@Id

@GeneratedValue(strategy = GenerationType.IDENTITY)

private Long id;

private String title;

private String author;

// Getters and setters

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 getAuthor() { return author;

}

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

}

}

Book Repository Interface

java

package com.library.repository;

import com.library.entity.Book;

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

@Repository

public interface BookRepository extends JpaRepository<Book, Long> {

}

Step 5: Create a REST Controller

Create a `BookController` class to handle CRUD operations.

java

package com.library.controller;

import com.library.entity.Book;

import com.library.repository.BookRepository;

import org.springframework.beans.factory.annotation.Autowired; import org.springframework.web.bind.annotation.\*;

import java.util.List;

@RestController

@RequestMapping("/books") public class BookController {

@Autowired

private BookRepository bookRepository;

@GetMapping

public List<Book> getAllBooks() { return bookRepository.findAll();

}

@GetMapping("/{id}")

public Book getBookById(@PathVariable Long id) { return bookRepository.findById(id).orElse(null);

}

@PostMapping

public Book createBook(@RequestBody Book book) { return bookRepository.save(book);

}

@PutMapping("/{id}")

public Book updateBook(@PathVariable Long id, @RequestBody Book bookDetails)

{ Book book = bookRepository.findById(id).orElse(null);

if (book != null) {

book.setTitle(bookDetails.getTitle());

book.setAuthor(bookDetails.getAuthor());

return bookRepository.save(book);

}

return null;

}

@DeleteMapping("/{id}")

public void deleteBook(@PathVariable Long id)

{ bookRepository.deleteById(id);

}

}

Step 6: Run the Application

Run the Spring Boot application and test the REST endpoints.

1. In your IDE, run the `LibraryManagementApplication` main class.
2. Use a tool like Postman or curl to test the REST endpoints.

**Example REST Endpoints**

* Get all books: `GET http://localhost:8080/books`
* Get a book by ID:`GET http://localhost:8080/books/{id}`
* Create a book: `POST http://localhost:8080/books` (with JSON body)
* Update a book: `PUT http://localhost:8080/books/{id}` (with JSON body)
* Delete a book: `DELETE http://localhost:8080/books/{id}`

This confirms that the Spring Boot application is set up correctly and the REST endpoints are functional.