SPRING *with* BOOT

[Spring Core, Spring-Jdbc, Spring-Hibernate, Profiling, Spring-Txs, Spring-MVC, Spring BOOT, Design Patterns, N-Tier Architecture]

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1.INTRODUCTION

What is Spring?

Spring is an Integration Framework for developing Enterprise Applications easily. Spring is an open-source framework, developed by Rod Johnson.

Spring's Pledge

J2EE should be Easy to use.

Spring framework simplifies (addresses) complexity of enterprise applications because it uses Java beans to implement enterprise applications that were previously possible only with enterprise beans.

Spring Features

- Dependency Injection (DI) / Inversion Of Control (IOC)
- AOP (Aspect Oriented Programming)
- Lightweight Container

Dependency Injection (DI) / Inversion Of Control (IOC)

All dependent objects are automatically instantiated and injected to bean class instead of creating and looking for dependent objects. Hence, Inversion Of Control is also called as Dependency Injection. The responsibility is transferred away from the bean class and towards its dependencies.
The Advantage with DI is promoting **loose coupling**.

Aspect Oriented Programming (AOP)

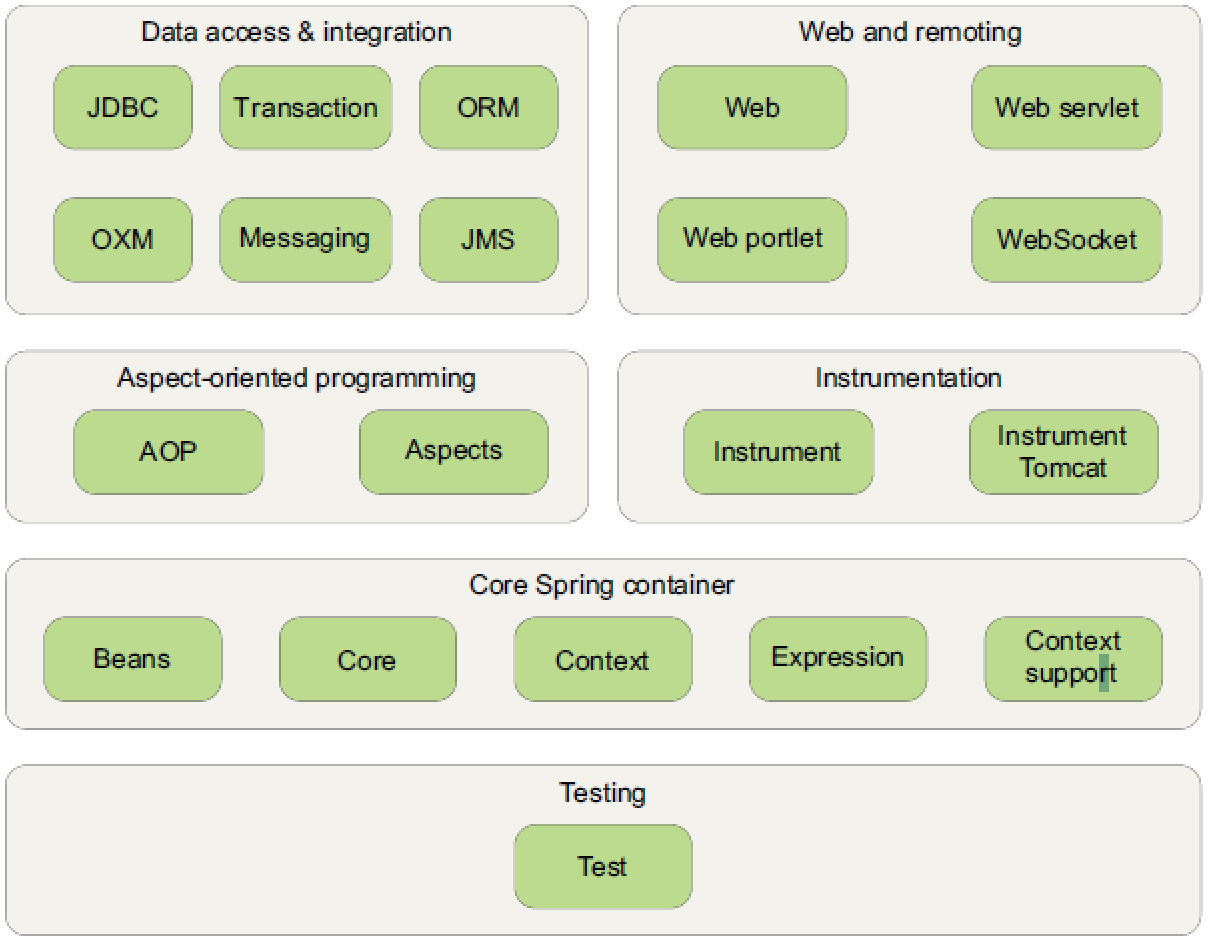
Separating application business logic from system services such as logging, transaction management, persistence, connection pooling, etc.

Lightweight Container

Spring is a lightweight container. The entire spring framework can be distributed in a JAR file. The spring container manages the bean lifecycle. Spring Dependency Injection is also resolved by the container.

Spring Modules

The spring framework consisting of **six** well-defined means main modules. We can selectively choose required modules rather than all for application implementation. The spring modules are built on top of the core container, which defines how beans are created, configured, and managed.



The Spring Framework is made up of six well-defined module categories.

1. **Core Spring container**
   The core container provides the fundamental functionality of the spring framework. The primary component in this module is BeanFactory and ApplicationContext, an implementation of the FactoryPattern with IOC. Also, this module supplies many enterprise services such as email, JNDI, EJB integration, and scheduling.

2. **Spring AOP Module**
   Spring AOP separates business logic from system services such as Logging, Transaction management, Persistence, Application Resources (eg: connection pooling).

3. **Data Access and Integration**
   The Template based approach in Spring JDBC API avoids the repetitive code like getting connection, creates a Statement, process ResultSet, and then close the connection.

Spring does not have its own ORM framework, instead it will integrate with several popular ORM frameworks such as Hibernate, iBATIS, TopLink, JDO, OJB, etc. Spring transaction management supports each of these ORM frameworks as well as JDBC.

4. **Web and Remoting**
   The web context module builds on the application context module, providing a web context that is required for web based applications. As a result, the spring framework supports third party MVC frameworks like Struts, Webwork, Portlet, Tapestry, etc.
   Spring comes with a full-featured Model/View/Controller (MVC) framework for building web applications. Spring's MVC framework uses IoC to provide for a clean separation of controller logic from business objects (POJOs). It also allows us to declaratively bind request parameters to our POJOs. Spring MVC encourages different view technologies like JSPs, Velocity, XSLT, Freemarker, etc.
   Spring integrates with several popular MVC frameworks such as STRUTS, JSF, Web Work, and Tapastry.
   Spring Remoting capabilities include RMI, Hessian, Burlap, JAX-WS, Spring's own HTTP invoker, REST.

5. **Instrumentation**

6. **Testing**
   Spring provides a module to test spring application.

New Features in Spring 2.5

1. Annotation driven development greatly reduces XML-based configuration. Also, supports JSR-250 annotations.
2. Auto-detection of spring component that are annotated with @Component annotation.
3. Annotation driven Spring MVC programming model that greatly simplifies Spring Web development.
4. Full Java 6 and EE 5 support including JDBC 4.0, JAX-WS 2.0, etc.
5. Test framework based on JUnit4 and annotations.

New Features in Spring 3.0

1. Full-scale REST support in Spring MVC, including Spring MVC controllers that respond to REST-style URLs with XML, JSON, etc.
2. New Spring Expression Language (SpEL) is a powerful way of wiring values into a bean's properties or constructor arguments using expressions that are evaluated at runtime.
3. Support for declarative validation with JSR-303 annotations.
4. Java based (using annotations) configuration model that allows for nearly XML-free spring configuration.

New Features in Spring 4.0

1. Spring Boot

2. Spring DATA
3. Leverages Java 8 features such as Lambda expresssions, etc
4. @RestController newly added
5. @GetMapping and @PostMapping, etc
6. @ConditionalOnClass newly added
7. …

Spring Hello

This example explains how spring container manages the bean lifecycle and echos greeting message on console. The following files are required:

1. Interface
2. Implementation of bean class
3. Spring Configuration [XML Config | Java Config]
4. Client Code

//GreetingService.java

```
Package edu.aspire.beans;
public interface GreetingService {
        public void sayGreeting();
}
```

// GreetingServiceImpl.java

```
Package edu.aspire.beans;
public class GreetingServiceImpl implements GreetingService {
        private String greeting;
        public GreetingServiceImpl() { } //no-arg constructor
        public GreetingServiceImpl(String greeting) { // Initialize through constructor
                this.greeting = greeting;
        }
        public void setGreeting(String greeting) { // Initialize through setter method.
                this.greeting = greeting;
        }
        public void sayGreeting() {
                System.out.println("Hai " + greeting);
        }
}
```

XML Based Configuration

//applicationContext.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<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-4.2.xsd">
        <bean id="gs1" class="edu.aspire.beans.GreetingServiceImpl" scope="singleton"  lazy-init="default">
                <!--  Setter based IOC-- >
                <property name="greeting">
                        <value>Good Morning</value>
                </property>
        </bean>
        <bean id="gs2" class="edu.aspire.beans.GreetingServiceImpl">
                <!--  Constructor based IOC -- >
                <constructor-arg>
                        <value>Good Evening</value>
                </constructor-arg>
        </bean>
</beans>
```

// HelloApp.java

```
package edu.aspire.test;
import org.springframework.beans.factory.BeanFactory;
import org.springframework.beans.factory.xml.XmlBeanFactory;
import org.springframework.context.ApplicationContext;
import org.springframework.context.support.ClassPathXmlApplicationContext;
import org.springframework.core.io.FileSystemResource;
import edu.aspire.beans.GreetingService;
public class HelloClient {
        public static void main(String[] args) {
                // Spring Container
                BeanFactory factory = new XmlBeanFactory(new
                                FileSystemResource("spring_hello/applicationContext.xml"));

                //Spring Framework
                //ApplicationContext factory = new ClassPathXmlApplicationContext("applicationContext.xml");

                GreetingService gs1 = (GreetingService) factory.getBean("gs1");
                GreetingService gs2 = (GreetingService) factory.getBean("gs2");
        gs1.sayGreeting();
        gs2.sayGreeting();
    }
}
```

Java Based Configuration

In Spring 3, Java Based Configuration is included in core Spring module, it allows developer to move bean definition and Spring configuration out of XML file and into Java class.
But, we are still allowed to use the classic XML way to define beans and configuration, the Java Based Configuration is just another alternative solution.
Java based configuration option enables us to write most of our Spring configuration without XML but with the help of few Java-based annotations such as @Configuration, @Bean, etc.
@Configuration: Indicates that the class can be used by the Spring IoC container as a source of bean definitions.
@Bean: Annotation tells Spring that a method annotated with @Bean will return an object that should be registered as a bean in the Spring application context.

```
package edu.aspire.config;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;
import org.springframework.context.annotation.Scope;
import edu.aspire.beans.GreetingService;
import edu.aspire.beans.GreetingServiceImpl;

@Configuration
public class AppConfig {
    @Bean(name = "gs1")
    @Scope(value = "singleton")
    public GreetingService getGs1() {
        GreetingServiceImpl gs = new GreetingServiceImpl();
        gs.setGreeting("Good Morning");
        return gs;
    }

    @Bean(name = "gs2")
    public GreetingService getGs2() {
        GreetingServiceImpl gs = new GreetingServiceImpl("Good Evening");
        return gs;
    }
}
```

```
public class HelloClient {
	public static void main(String[] args) {
		ApplicationContext factory = new AnnotationConfigApplicationContext(AppConfig.class);

		GreetingService gs1 = (GreetingService) factory.getBean("gs1");
		GreetingService gs2 = (GreetingService) factory.getBean("gs2");

		gs1.sayGreeting();
		gs2.sayGreeting();
	}
}
```

Maven Build

#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>edu.aspire</groupId>
	<artifactId>SpringHello</artifactId>
	<version>1</version>
	<packaging>jar</packaging>
	<name>SpringHello</name>
	<url>http://maven.apache.org</url>

	<dependencies>
		<dependency>
			<groupId>org.springframework</groupId>
			<artifactId>spring-beans</artifactId>
			<version>4.3.9.RELEASE</version>
		</dependency>
		<dependency>
			<groupId>org.springframework</groupId>
			<artifactId>spring-context</artifactId>
			<version>4.3.9.RELEASE</version>
		</dependency>
	</dependencies>

	<!--Build configuration -->
	<build>
```

```
                <plugins>
                        <!-- using Java 8 -->
                        <plugin>
                                <groupId>org.apache.maven.plugins</groupId>
                                <artifactId>maven-compiler-plugin</artifactId>
                                <configuration>
                                        <source>1.8</source>
                                        <target>1.8</target>
                                </configuration>
                        </plugin>
                </plugins>
        </build>
</project>
```

2. DEPENDENCY INJECTION

We can reduce spring configuration file size by using different types of wirings or injections such as:

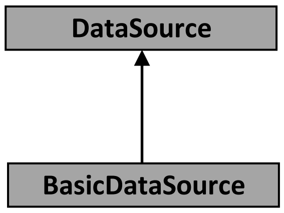
1. Explicit wiring
2. Auto wiring (spring 2.0)
3. Annotation based wiring (Newly added in Spring 2.5)
4. Autodiscovery (Newly added in Spring 2.5)

Explicit Wiring

In case of explicit wiring, the dependencies are explicitly injected / wired using <property> or <constructor-arg> elements to bean class.

Example:

```
package edu.aspire.daos;
public class AccountDaoImpl{
        private DataSource dataSource;
        Public AccountDaoImpl(){} //no-arg constructor
        Public AccountDaoImpl(DataSource ds){ this.dataSource = ds;}
        Public void setDataSource(DataSource ds){ this.dataSource = ds;}
        Public DataSource getDataSource(){ return dataSource;}
}
```



Following is the spring configuration file snippet:

```
<beans …>
        <bean id="dataSource" class="org.apache.commons.dbcp.BasicDataSource">
                …
        </bean>
        <bean id="accdao" class="edu.aspire.daos.AccountDaoImpl" autowire="no">
                <property name="dataSource">
                        <ref bean="dataSource"/>
                </property>
        </bean>
</beans>
```

Auto Wiring

The autowiring eliminate the need for <property> or <constructor-arg> elements by letting spring automatically figure out how to wire bean dependencies.

There are **4** modes of autowirings, they are explained using below bean class:

Below table summarizes four modes of autowiring:

Mode	Description	Example
No	No autowiring means explicit wiring is required	<bean id=" accdao" class=" edu.aspire.daos

	using either <property> or <constructor-arg> elements.	.AccountDaoImpl" **autowire="no"**> <property name="dataSource"> <ref bean="dataSource"/> </property> </bean>
Byname	The container automatically wired if the property name in bean class matches with 'id' attribute of <bean> element in config file. Unmatched property names will remain unwired.	<bean id=" accdao" class="AccountDaoImpl" **autowire="byName"**/>
byType	Automatically wired if the bean types are assignable to the property data types. Unmatched property types remains unwired. **Note**: The 'id' or 'name' attribute of injecting <bean> element is not required.	<bean id=" accdao" class="AccountDaoImpl" **autowire="byType"**/>
constructor	Automatically wired if the bean types are assignable to the constructor parameter types.	<bean id=" accdao" class="AccountDaoImpl" **autowire="constructor"**/>

The explicit wiring using <property> and <constructor-arg> elements always have more priority than autowiring.

Default autowiring

If all or majority of the <bean> elements uses same autowire, then we can add '**default-autowire**' attribute to the root <beans> element.

<beans… default-autowire="byName">…</beans>

We can still override the default on bean-by-bean basis using the 'autowire' attribute of <bean> element.

Mixing auto with explicit wiring

We can mix autowiring as well as explicit wiring. Explicit wiring takes precedence of autowiring.

Annnotation Based Wiring

From Spring 2.5, bean dependencies are wired using annotations. Annotation based autowiring is almost same as 'autowire' attribute, but it additionally gives fine-grained autowiring, where we can selectively annotate certain properties for autowiring. **In this case, the 'autowire' attribute of <bean> element is not required in spring configuration file**. Also, the setter and getter methods not required in Java class.

By default, annotation based wiring is turned off in the spring container. Hence, to enable, we have to add **<context:annotation-config/>** element from spring's context namespace:

Example:

```
<beans xmlns="http://www.springframework.org/schema/beans"
        xmlns:context="http://www.springframework.org/schema/context"
        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-4.2.xsd
                              http://www.springframework.org/schema/context
                              http://www.springframework.org/schema/context/spring-context-4.2.xsd">
     <context:annotation-config/>
     <bean id="dataSource" class="org.apache.commons.dbcp.BasicDataSource">
          …
     </bean>
     <bean id="accdao" class="edu.aspire.daos.AccountDaoImpl"/>
</beans>
```

The **<context:annotation-config>** tells spring that we intend to use annotation-based wiring.
The Spring2.5 supports following annotations for autowiring, which should be added to bean class:

@Autowired (Spring's own)
@Inject (From JSR-330)
@Resource (From JSR-250)

@Autowired

The @Autowired annotation can be added on top of property or constructor or methods (any method) but preferably added on top of property. **The @Autowired annotation will try to perform 'byType' autowiring**.

Example #1: Use @Autowired with property

```
Public class AccountDaoImpl implements AccountDao{
     @Autowired
     Private DataSource dataSource;
}
```

Example #2: Use @Autowired with setter method.

```
Public class AccountDaoImpl implements AccountDao{
     Private DataSource dataSource;
     @Autowired
     Public void setDataSource(DataSource ds){}
}
```

Example #3: Use @Autowired with constructor.

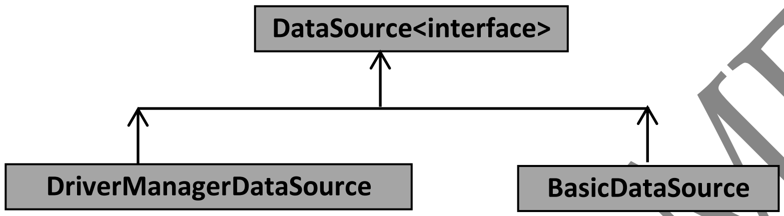
```
Public class AccountDaoImpl implements AccountDao{
     Private DataSource dataSource;
     @Autowired
     Public AccountDaoImpl(DataSource ds){}
}
```

Qualifying Ambiguous Dependencies

Sometimes more than one bean element may be equally qualified for wiring.

Example:

```
public class AccountDaoImpl{
     @Autowired
```

```
        Private DataSource dataSource;
}
```
#applicationContext.xml
```
<beans>
        <context:annotation-config/>
        <bean id="ds" class="org.springframework.jdbc.datasource.DriverManagerDataSource">...</>
        <bean id="bds" class="org.apache.commons.dbcp.BasicDataSource">...</>
        <bean id="daoimpl" class="AccountDaoImpl" />
</beans>
```


O/P:
org.springframework.beans.factory.NoUniqueBeanDefinitionException: No qualifying bean of type [javax.sql.DataSource] is defined: expected single matching bean but found 2: ds,bds

The **@Qualifier** is used to resolve ambiguous dependencies i.e., it helps @Autowired annotation to choose one of the dependency.

Example:
```
Import org.springframework.bean.factory.annotation.Autowired;
Import org.springframework.bean.factory.annotation.Qualifier;
Public class AccountDaoImpl implements AccountDao{
        @Autowired
        @Qualifier("bds")
        private DataSource dataSource;
}
```
The @Qualifier annotation will try to wire in a bean whose ID matches **bds**.
Conclusion: The @Qualifier is really about **narrowing** the selection of autowire candidate beans.

In addition to narrowing by a bean's ID, it is also possible to narrow by a qualifier that's is applied to bean itself.
Example:
```
Public class AccountDaoImpl implements AccountDao{
        @Autowired
        @Qualifier("aspire")
        Private DataSource dataSource;
}
<bean id="ds" class="org.springframework.jdbc.datasource.DriverManagerDataSource">
```

```
<bean id="bds" class="org.apache.commons.dbcp.BasicDataSource">
        <qualifier value="aspire"/>
        …
</bean>
```

@Inject

In an effort to unify the programming model among various dependency injection frameworks, sun published dependency injection for java specification (JSR-330). Spring3 supports JSR-330 (also called as Inject model). Instead of using spring-specific @Autowired annotation, we recommended to use @Inject annotation, which is part of JSR-330. The @Inject is a complete replacement for spring specific @Autowired annotation.
Just like @Autowired, the @Inject annotation can be used to autowire properties, methods, and constructors.
We have to download and add **javax.inject.jar** file into the classpath.

```
Import javax.inject.Inject;
Public class AccountDaoImpl implements AccountDao{
        @Inject
        Private DataSource dataSource;
        …
}
```

Add **<context:annotation-config/>** in spring configuration file.
The @Inject's answer to the @Qualifier annotation is the **@Named** annotation to resolve ambiguous dependencies.
Example:

```
Import javax.inject.Inject;
Import javax.inject.Named;
Public class AccountDaoImpl implements AccountDao{
        @Inject
        @Named("bds")
        Private DataSource dataSource;
        …
}
```

Where "**bds**" is bean ID in spring configuration file.

Autodiscovery

Even though <context:annotation-config/> can eliminate <property> and <constructor-arg> elements from spring configuration, we still must explicitly configure beans using<bean> element.
The autodiscovery eliminates <bean> element from spring configuration file.
To configure spring for autodiscovery, use **<context:component-scan/>** instead of <context:annotation-config/>.
The <context:component-scan/> element does everything that <context:annotation-config/> does, plus it automatically discovers beans without adding <bean> element in configuration file.
How does <context:component-scan/> element knows which classes to register as a spring bean?

By default, the <context:component-scan/> looks for classes that are annotated with one of the following stereotype annotations:

1. @Component – Indicates the class is a spring component.
2. @Repository – Indicates class represents data repository. It is used in model layer.
3. @Service – Indicates a service class means business class. It is used in Service layer.
4. @Controller – Indicates Spring MVC controller. It is used in controller layer to handle http requests.

Example:

```
Package edu.aspire.daos;
Import org.springframework.stereotype.Component;
Import org.springframework.bean.factory.annotation.Autowired;
//@Component("accdao")
@Repository("accdao")
Public class AccountDaoImpl implements AccountDao{
        @Autowired
        Private DataSource dataSource;
        …
}
```

Where "accdao" automatically becomes bean ID.

Add **<context:component-scan base-package="edu.aspire.daos"/>** element in the configuration file, which scans package and all of its subpackages.

Note:

1. The '**autowire**' attribute eliminates both <property> as well as <constructor-arg> elements, but still needs <bean> element.
2. The **annotation based wiring** additionally eliminates 'autowire' attribute, but still needs <bean> element.
3. The **autodiscovery** eliminates <bean> element itself.

Different Types Of Configurations

Spring framework provides flexibility to configure beans in multiple ways such as:

1) XML Based Configuration
2) Java Based Configuration
3) Annotation Based Configuration

Xml Based Configuration	Explicit configuration in XML Ex: applicationContext.xml	<beans>, <bean>, <property>
Java Based Configuration	Explicit configuration in Java Ex: AppConfig.java	@Configuration, @Bean, @Scope
Annotation Based Configuration	Implicit bean discovery and automatic	@Component, @Repository,

	wiring. Directly added to source code such as dao, service, controller classes, etc.	@Service, @Controller

Note: Spring's configuration styles are mix-and-match, so we could choose XML to wire up some beans, use Spring's Java-based configuration (JavaConfig) for other beans, and let remaining beans be automatically discovered by Spring.

3.SPRING-DAO

This application is intended to perform Data Access Object (DAO) operations using pure JDBC API.
This example includes all types of wirings such as Explicit Wiring, Auto Wiring Annotaton Based Wiring and Autodiscovery. All these wirings will be explained in both Xml Based Configuration and Java Based Configuration.

*/*create table account(ACC_NO NUMBER(4)PRIMARY KEY, ACC_NAME VARCHAR2(20), ACC_TYPE VARCHAR2(20), BAL NUMBER(10,2));*/*

//Account.java

```
package edu.aspire.model;
public class Account{
        private int accno;
        private String accName;
        private String accType;
        private double bal;
        public Account() {}
        public int getAccno() {return accno;}
        public void setAccno(int accno) {this.accno = accno;}
        public String getAccName() {return accName;}
        public void setAccName(String accName) {this.accName = accName;}
        public String getAccType() {return accType;}
        public void setAccType(String accType) {this.accType = accType; }
        public double getBal() {  return bal;}
        public void setBal(double bal) {this.bal = bal;}
}
```

//AccountDao.java

```
package edu.aspire.dao;
import edu.aspire.model.Account;
public interface AccountDao {
        public void save(Account account);
        public void update(Account accout);
        public void remove(int accno);
        public Account get(int accno);
}
```

// AccountDaoImpl.java

```
package edu.aspire.dao;
import java.sql.Connection;
import java.sql.PreparedStatement;
import java.sql.ResultSet;
import java.sql.SQLException;
import java.sql.Statement;
import javax.sql.DataSource;
import edu.aspire.model.Account;
import org.springframework.beans.factory.annotation.Required;

public class AccountDaoImpl implements AccountDao {
        private DataSource dataSource;

        @Required
        public void setDataSource(DataSource dataSource) {this.dataSource = dataSource;}

        @Override
        public void save(Account account) {
                // Declare resources
                Connection con = null;
                PreparedStatement pstmt = null;
                try {
                        // Get connection
                        con = dataSource.getConnection();
                        //Prepare query
                        String query = "INSERT INTO account VALUES(?,?,?,?)";
                        // Create JDBC statement
                        pstmt = con.prepareStatement(query);
                        // Set data
                        pstmt.setInt(1, account.getAccno());
                        pstmt.setString(2, account.getAccName());
                        pstmt.setString(3, account.getAccType());
                        pstmt.setDouble(4, account.getBal());
                        // Execute statement
                        pstmt.execute();
                } catch (Exception e) { //Handle Exceptions
                        e.printStackTrace();
                } finally {  //Clean up resources to avoid memory leaks problems.
                        try {
                                pstmt.close();
                                con.close();
                        } catch (SQLException e) {
                                e.printStackTrace();
                        }
```

```
		}
	}

	@Override
	public Account get(int accno) {
		// Declare resources
		Connection con = null;
		Statement stmt = null;
		ResultSet rs = null;
		Account avo = null;
		try {
			// Get connection.
			con = dataSource.getConnection();
			// Prepare query.
			String query = "SELECT * FROM account WHERE ACC_NO=" + accno;
			// Create statement object.
			stmt = con.createStatement();
			// Execute query and Process ResultSet
			rs = stmt.executeQuery(query);
			if (rs.next()) {
				avo = new Account();
				avo.setAccno(rs.getInt(1));
				avo.setAccName(rs.getString(2));
				avo.setAccType(rs.getString(3));
				avo.setBal(rs.getDouble(4));
			}
		} catch (Exception e) { //Handle exceptions
			e.printStackTrace();
		} finally { //Release resources to avoid memory leaks
			try {
				rs.close();
				stmt.close();
				con.close();
			} catch (SQLException e) {
				e.printStackTrace();
			}
		}
		return avo;
	}
	@Override
```

```
        public void remove(int accno) {
                // TODO Auto-generated method stub
        }
        @Override
        public void update(Account accout) {
                // TODO Auto-generated method stub
        }
}
```

# applicationContext_Dao.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<beans xmlns="http://www.springframework.org/schema/beans"
        xmlns:context="http://www.springframework.org/schema/context"
        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-4.2.xsd
         http://www.springframework.org/schema/context
         http://www.springframework.org/schema/context/spring-context-4.2.xsd">
        <!—Not required from Spring 4.0 -- >
        ~~<context:annotation-config />~~

        <bean id="dataSource" class="org.springframework.jdbc.datasource.DriverManagerDataSource">
                <property name="driverClassName">
                        <value>oracle.jdbc.driver.OracleDriver</value>
                </property>
                <property name="url">
                        <value>jdbc:oracle:thin:@localhost:1521:xe</value>
                </property>
                <property name="username">
                        <value>system</value>
                </property>
                <property name="password">
                        <value>manager</value>
                </property>
        </bean>

        <bean id="accdao" class="edu.aspire.dao.AccountDaoImpl" autowire="no">
                <property name="dataSource">
                        <ref bean="dataSource"/>
                </property>
```

```
	</bean>

	<!-- <bean id="accdao" class="edu.aspire.dao.AccountDaoImpl" autowire="byName"/> -->
</beans>

package edu.aspire.test;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.context.ApplicationContext;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import edu.aspire.model.Account;
import edu.aspire.dao.AccountDao;

@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration("/applicationContext_dao.xml")
public class SpringDaoTest {
	@Autowired
	ApplicationContext context;

	@Test
	public void testSpringDao() {
		AccountDao accDao = (AccountDao)context.getBean("accdao");
		Account account = new Account();
		account.setAccno(1);
		account.setAccName("Aspire");
		account.setAccType("Current");
		account.setBal(1000.00);

		accDao.save(account);
	}
}

// SpringDaoConfig.java
package edu.aspire.config;
import javax.sql.DataSource;
import org.springframework.beans.factory.annotation.Autowire;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;
import org.springframework.jdbc.datasource.DriverManagerDataSource;
import edu.aspire.dao.AccountDao;
import edu.aspire.dao.AccountDaoImpl;

@Configuration
public class SpringDaoConfig {
	@Bean
	public DataSource dataSource() {
		DriverManagerDataSource ds = new DriverManagerDataSource();
		ds.setDriverClassName("oracle.jdbc.driver.OracleDriver");
		ds.setUrl("jdbc:oracle:thin:@localhost:1521:xe");
		ds.setUsername("system");
		ds.setPassword("manager");
		return ds;
	}

	@Bean(name = "accdao", autowire=Autowire.NO)
	public AccountDao getAccDao(DataSource ds) {
		AccountDaoImpl adao = new AccountDaoImpl();
		adao.setDataSource(ds);
		return adao;
	}
}
```

```
#pom.xml
	…
	<dependencies>
		<dependency>
			<groupId>org.springframework</groupId>
			<artifactId>spring-context</artifactId>
			<version>4.3.9.RELEASE</version>
		</dependency>
		<dependency>
			<groupId>org.springframework</groupId>
			<artifactId>spring-jdbc</artifactId>
			<version>4.3.9.RELEASE</version>
		</dependency>
		<dependency>
			<groupId>org.springframework</groupId>
			<artifactId>spring-test</artifactId>
			<version>4.3.9.RELEASE</version>
		</dependency>
		<dependency>
			<groupId>junit</groupId>
			<artifactId>junit</artifactId>
			<version>4.12</version>
		</dependency>
		<dependency>
			<groupId>oracle</groupId>
			<artifactId>oracle-jdbc</artifactId>
			<version>11</version>
		</dependency>
	</dependencies>
```

4.SPRING-JDBC

This application is intended to perform database operations using JdbcTemplate.
This application also includes “Annotation Based Wiring”.
Note: SimpleJdbcTemplate deprecated from Spring 3.1

/* create table employee(eno number(4)primary key, ename varchar2(100), desig varchar2(100), sal number(6,2)); */

```
package edu.aspire.model;
public class Employee{
        private int eno;
        private String ename;
        private String desig;
        private double sal;
        public Employee() { }
        public int getEno() { return eno; }
        public void setEno(int eno) { this.eno = eno; }
        public String getEname() { return ename; }
        public void setEname(String ename) { this.ename = ename; }
        public String getDesig() { return desig; }
        public void setDesig(String desig) { this.desig = desig; }
        public double getSal() { return sal; }
        public void setSal(double sal) { this.sal = sal; }
}
```

//EmployeeDao.java

```
Package edu.aspire.daos;
import edu.aspire.model.Employee;
public interface EmployeeDao {
        public void save(Employee e);
        public void update(Employee e);
        public void delete(int eno);
        public Employee get(int eno);
}
```

//EmployeeDaoImpl.java

```
package edu.aspire.daos;
import java.sql.Connection;
import java.sql.PreparedStatement;
import java.sql.SQLException;
import org.springframework.beans.factory.annotation.Autowired;
import edu.aspire.model.Employee;
import org.springframework.jdbc.core.JdbcTemplate;
import org.springframework.jdbc.core.PreparedStatementCreator;

public class EmployeeDaoImpl implements EmployeeDao {
	//Default value is true. In case of 'true', the attribute is injected forcefully to bean in Spring Configuration file
	//In case of false, spring will leave the reference null if no qualifying bean is found.
	@Autowired(required=true)
	private JdbcTemplate jdbcTemplate;

	@Override
	public void save(final Employee emp) {
		//Anonymous approach
		jdbcTemplate.update(new PreparedStatementCreator() {
			public PreparedStatement createPreparedStatement(Connection con)
					throws SQLException {
				String query = "INSERT INTO employee(eno, ename, desig, sal) VALUES (?,?,?,?)";
				PreparedStatement pstmt =con.prepareStatement(query);
				pstmt.setInt(1, emp.getEno());
				pstmt.setString(2, emp.getEname());
				pstmt.setString(3, emp.getDesig());
				pstmt.setDouble(4, emp.getSal());
				return pstmt;
			}
		});

		//Short cut approach
		/*String query = "INSERT INTO employee(eno, ename, desig, sal) VALUES (?,?,?,?)";
		Object[] data = {emp.getEno(), emp.getEname(), emp.getDesig(), emp.getSal()};
		jdbcTemplate.update(query, data);*/
	}
	@Override
	public Employee get(int eno) {
		String query = "SELECT * FROM EMPLOYEE WHERE ENO=?";
		Employee emp = jdbcTemplate.queryForObject(query, new EmployeeRowMapper(), eno);
		return emp;
	}
	@Override
	public void delete(int eno) {
		// TODO Auto-generated method stub
	}
	@Override
	public void update(Employee e) {
		// TODO Auto-generated method stub
	}
}
```

//**SpringJdbcConfig.java**

```
@Configuration
@ComponentScan(basePackages="edu.aspire.daos")
public class SpringJdbcConfig {
	@Bean
	public DataSource dataSource() {  //explicit wiring
		BasicDataSource bds = new BasicDataSource();
		bds.setDriverClassName("oracle.jdbc.driver.OracleDriver");
		bds.setUrl("jdbc:oracle:thin:@localhost:1521:xe");
		bds.setUsername("system");
		bds.setPassword("manager");
		bds.setInitialSize(10);
		bds.setMaxActive(15);
		return bds;
	}

	@Bean(autowire = Autowire.BY_TYPE)
	public JdbcTemplate jdbcTemplate() { //autowiring
		return new JdbcTemplate();
	}

	@Bean(name = "empdao" )
	public EmployeeDao empDao(){ //annotation based wiring
		return new EmployeeDaoImpl();
	}
}
```

//SpringJdbcTestjava

```
package edu.aspire.test;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.context.ApplicationContext;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import edu.aspire.daos.EmployeeDao;
import edu.aspire.model.Employee;
@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration(classes={SpringJdbcConfig.class})
public class SpringJdbcTest {
	@Autowired
	ApplicationContext context;
	@Test
	public void testSpringJdbc() {
		EmployeeDao empdao = (EmployeeDao)context.getBean("empdao");

		Employee e = new Employee();
		e.setEno(1);
		e.setEname("Ramesh");
		e.setDesig("Director");
		e.setSal(1000.0);
		empdao.save(e);
		System.out.println("Record inserted successfully...");
	}
}
```

#pom.xml

```
	…
	<dependencies>
		…
		<dependency>
			<groupId>commons-dbcp</groupId>
			<artifactId>commons-dbcp</artifactId>
			<version>1.4</version>
		</dependency>
	</dependencies>
```

5.SPRING-HIBERNATE

This application is intended to integrate Spring with Hibernate Framework.
This application also includes “Autodiscovery” and “Externalizing the configuration”.

```
/* CREATE TABLE CUSTOMER(CNO NUMBER(5)PRIMARY KEY, CNAME VARCHAR2(20), ADDRESS VARCHAR2(100),
PHONE NUMBER(15));*/
package edu.aspire.pojos;
import java.io.Serializable;
public class Customer implements Serializable {
        private int cno;
        private String cname;
        private String address;
        private long phone;
        public Customer() {   }

        public int getCno() { return cno; }
        public void setCno(int cno) { this.cno = cno; }
        public String getCname() { return cname; }
        public void setCname(String cname) { this.cname = cname; }
        public String getAddress() { return address; }
        public void setAddress(String address) { this.address = address; }
        public long getPhone() { return phone; }
        public void setPhone(long phone) { this.phone = phone; }
}
```

#Customer.hbm.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE hibernate-mapping PUBLIC "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
"http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">
<hibernate-mapping>
        <class name="edu.aspire.pojos.Customer" table="CUSTOMER">
                <id name="cno" column="CNO" type="integer" >
                        <generator class="assigned"/>
                </id>
                <property name="cname" column="CNAME" type="string" length="20"/>
                <property name="address" column="ADDRESS" type="string" length="100"/>
                <property name="phone" column="PHONE" type="long"/>
        </class>
</hibernate-mapping>
```

//CustomerDao.java

```
package edu.aspire.daos;
import edu.aspire.pojos.Customer;
public interface CustomerDao {
        public void save(Customer e);
        public void update(Customer e);
        public void delete(int eno);
        public Customer get(int eno);
}
```

//CustomerDaoImpl.java

```
package edu.aspire.daos;
import java.sql.SQLException;
import org.hibernate.HibernateException;
import org.hibernate.Session;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.orm.hibernate3.HibernateCallback;
import org.springframework.orm.hibernate3.HibernateTemplate;
//import org.springframework.stereotype.Component;
import org.springframework.stereotype.Repository;
import edu.aspire.pojos.Customer;

//@Component("custdao")
@Repository("custdao")
public class CustomerDaoImpl implements CustomerDao {
        @Autowired
        private HibernateTemplate hibernateTemplate;

        public CustomerDaoImpl() {}
        @Override
        public void save(final Customer c) {
                //anonymous approach
                hibernateTemplate.execute(new HibernateCallback() {
                        @Override
                        public Object doInHibernate(Session session)
                                        throws HibernateException, SQLException {
                                Integer iRef = (Integer) session.save(c);
                                return iRef;
                        }
                });

                //short cut approach
                //hibernateTemplate.save(c);
        }

        @Override
        public void delete(int eno) {
        }

        @Override
        public Customer get(int eno) {
                return null;
        }

        @Override
        public void update(Customer e) {
        }
}
```

#connection.properties

```
jdbc.driverClass=oracle.jdbc.driver.OracleDriver
jdbc.url=jdbc:oracle:thin:@localhost:1521:xe
jdbc.username=system
jdbc.password=manager
jdbc.initPoolSize=5
jdbc.maxPoolSize=10
```

```
@Configuration
@ComponentScan(basePackages = { "edu.aspire.daos" })
@PropertySource(value = { "classpath:connection.properties" })
@EnableTransactionManagement
public class SpringHibernateConfig {
        @Bean
        public PropertySourcesPlaceholderConfigurer placeHolderConfigurer() {
                return new PropertySourcesPlaceholderConfigurer();
        }

        @Bean
        public DataSource dataSource(@Value("${jdbc.driverClass}") String driverClass,
                        @Value("${jdbc.url}") String url,
                        @Value("${jdbc.username}") String username,
                        @Value("${jdbc.password}") String password,
                        @Value("${jdbc.initPoolSize}") int initPoolSize,
                        @Value("${jdbc.maxPoolSize}") int maxPoolSize) {
                BasicDataSource bds = new BasicDataSource();
                bds.setDriverClassName(driverClass);
                bds.setUrl(url);
                bds.setUsername(username);
                bds.setPassword(password);
                bds.setInitialSize(initPoolSize);
                bds.setMaxActive(maxPoolSize);
                return bds;
        }

        /* @Autowired
         Environment env;
         @Bean public DataSource dataSource() {
                BasicDataSource bds = new BasicDataSource();
                 bds.setDriverClassName(env.getProperty("jdbc.driverClass"));
                 bds.setUrl(env.getProperty("jdbc.url"));
                 bds.setUsername(env.getProperty("jdbc.username"));
                 bds.setPassword(env.getProperty("jdbc.password"));
                 //bds.setInitialSize(Integer.parseInt(env.getProperty("jdbc.initPoolSize")));
                 bds.setInitialSize(env.getProperty("jdbc.initPoolSize", Integer.class));
                 bds.setMaxActive(env.getProperty("jdbc.maxPoolSize", Integer.class));
                 return bds;
        } */

        @Bean
        public LocalSessionFactoryBean sessionFactory(DataSource ds) {
                LocalSessionFactoryBean lsfb = new LocalSessionFactoryBean();
                lsfb.setDataSource(ds);

                Properties props = new Properties();
                props.put("hibernate.show_sql", "true");
                props.put("hibernate.format_sql", "true");
                props.put("hibernate.use_sql_comments", "true");
                props.put("hibernate.hbm2ddl.auto", "create");
                props.put("hibernate.transaction.factory_class", "org.hibernate.transaction.JDBCTransactionFactory");
```

```
                lsfb.setHibernateProperties(props);

                lsfb.setMappingResources(new String[] { "Customer.hbm.xml" });

                return lsfb;
        }

        @Bean(autowire = Autowire.BY_TYPE)
        public HibernateTemplate hibernateTemplate() {
                return new HibernateTemplate();
        }

        @Bean(autowire = Autowire.BY_TYPE)
        public PlatformTransactionManager transactionManager() {
                return new HibernateTransactionManager();
        }
}
```

//SpringHibernateTest.java

```
package edu.aspire.test;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.context.ApplicationContext;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import edu.aspire.daos.CustomerDao;
import edu.aspire.pojos.Customer;

@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration (classes={SpringHibernateConfig.class})
public class SpringHibernateTest {
        @Autowired
        ApplicationContext context;

        @Test
        public void testSpringHibernate() {
                CustomerDao custDao = (CustomerDao) context.getBean("custdao");
                Customer c = new Customer();
                c.setCno(1);
```

```
			c.setCname("ramesh");
			c.setAddress("Ameerpet");
			c.setPhone(7799108899L);
			custDao.save(c);
			System.out.println("Record inserted successfully...");
		}
}
```

#pomo.xml

```
	<dependencies>
		<dependency>
			<groupId>org.springframework</groupId>
			<artifactId>spring-orm</artifactId>
			<version>4.3.9.RELEASE</version>
		</dependency>
		<dependency>
			<groupId>org.hibernate</groupId>
			<artifactId>hibernate-core</artifactId>
			<version>5.4.5.Final</version>
		</dependency>
		…
	</dependencies>
```

6.PROFILES *and* EMBEDDED DATABASES

One of the most challenging things about developing software is **transitioning** an application from one environment to another. Certain environment-specific choices made for development aren't appropriate or won't work when the application transitions from development to production. Database configuration, encryption algorithms, etc are likely to vary across deployment environments.
Consider database configuration, in a development environment, we're likely to use an **embedded database** preloaded with test data.
Generally EmbeddedDatabaseBuilder created DataSource is perfect for development but not for production.
Generally production uses either third-party data sources or JNDI datasources.
Profiles are used to decide appropriate bean for appropriate environment at runtime.
Example:

```
// SpringProfilesConfig.java
package edu.aspire.config;
import java.util.Properties;
import javax.sql.DataSource;
import org.apache.commons.dbcp.BasicDataSource;
import org.springframework.beans.factory.annotation.Autowire;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.ComponentScan;
import org.springframework.context.annotation.Configuration;
import org.springframework.context.annotation.Profile;
import org.springframework.jdbc.datasource.embedded.EmbeddedDatabaseBuilder;
import org.springframework.jdbc.datasource.embedded.EmbeddedDatabaseType;
import org.springframework.orm.hibernate5.HibernateTemplate;
import org.springframework.orm.hibernate5.HibernateTransactionManager;
import org.springframework.orm.hibernate5.LocalSessionFactoryBean;
import org.springframework.transaction.PlatformTransactionManager;
import org.springframework.transaction.annotation.EnableTransactionManagement;

@Configuration
@ComponentScan(basePackages = { "edu.aspire.profiles.daos" })
@EnableTransactionManagement
public class SpringProfilesConfig {
        @Bean
        @Profile("dev")
        public DataSource dataSourceDev(){
                return new EmbeddedDatabaseBuilder()
                                .setType(EmbeddedDatabaseType.H2)
                                .addScript("classpath:schema.sql")
                                .ignoreFailedDrops(true)
                                .build();
}

@Bean
@Profile("prod")
public DataSource dataSourceProd(){
          BasicDataSource bds = new BasicDataSource();
          bds.setDriverClassName("oracle.jdbc.driver.OracleDriver");
          bds.setUrl("jdbc:oracle:thin:@localhost:1521:xe");
          bds.setUsername("system");
          bds.setPassword("manager");
          bds.setInitialSize(10);
          bds.setMaxActive(15);
          return bds;
}

@Bean
public LocalSessionFactoryBean sessionFactory(DataSource ds) {
          LocalSessionFactoryBean lsfb = new LocalSessionFactoryBean();
          lsfb.setDataSource(ds);

          Properties props = new Properties();
          props.put("hibernate.show_sql", "true");
          props.put("hibernate.format_sql", "true");
          props.put("hibernate.use_sql_comments", "true");
          props.put("hibernate.transaction.factory_class", "org.hibernate.transaction.JDBCTransactionFactory");

          lsfb.setHibernateProperties(props);
          lsfb.setMappingResources(new String[] { "Customer2.hbm.xml" });

          return lsfb;
}

@Bean(autowire=Autowire.BY_TYPE)
public HibernateTemplate hibernateTemplate() {
          return new HibernateTemplate();
}

@Bean(autowire = Autowire.BY_TYPE)
public PlatformTransactionManager transactionManager() {
```

```
                return new HibernateTransactionManager();
        }
}

package edu.aspire.test;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.context.ApplicationContext;
import org.springframework.test.context.ActiveProfiles;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import edu.aspire.config.SpringProfilesConfig;
import edu.aspire.pojos.Customer2;
import edu.aspire.profiles.daos.CustomerDao;

@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration(classes = { SpringProfilesConfig.class })
@ActiveProfiles(profiles = {"dev"})
public class SpringProfilesTest {
        @Autowired
        ApplicationContext context;

        @Test
        public void testSpringHibernate() {
                CustomerDao custDao = (CustomerDao) context.getBean("custdao");
                Customer2 c = new Customer2();
                c.setCno(1);
                c.setCname("ramesh");
                c.setAddress("Ameerpet");
                c.setPhone(7799108899L);
                custDao.save(c);
                System.out.println("Record inserted successfully...");
        }
}
```

The beans which are annotated with @Profile will only be created if the prescribed profile is active but the beans that aren’t annotated with @Profile will be always created regardless of which profile is active.
Spring offers the **@ActiveProfiles** annotation to let’s specify which profile should be active when a test is run.

We can use **EmbeddedDatabaseBuilder** to construct embedded databases such as **H2, HSQL** and **DERBY**.

```
@Bean
public DataSource dataSource() {
        return new EmbeddedDatabaseBuilder()
                .setType(EmbeddedDatabaseType.H2)
                .addScript("classpath:schema.sql")
                .addScript("classpath:test-data.sql")
                .build();
}
```

Spring Boot Profiles

Write different property files for different environments to define environment specific properties as shown below.

```
#application-dev.properties
spring.datasource.driver-class-name=org.h2.Driver
spring.datasource.url=jdbc:h2:mem:dataSource;DB_CLOSE_DELAY=-1;DB_CLOSE_ON_EXIT=FALSE
spring.datasource.username=sa
spring.datasource.password=

#application-prod.properties
spring.datasource.driver-class-name=oracle.jdbc.driver.OracleDriver
spring.datasource.url=jdbc:oracle:thin:@localhost:1521:xe
spring.datasource.username=system
spring.datasource.password=manager
```

Activate one of the profiles in application.properties file. Also define common properties across all environments in application.properties file.

```
#application.properties
spring.profiles.active=prod

#Below are common properties across all environments.
spring.datasource.tomcat.initialSize=20
spring.datasource.tomcat.max-active=25
debug=true
```

7.SPRING TRANSACTION MANAGEMENT

The Spring framework supports both Programmatic and Declarative transactions.
In case of Programmatic transactions, the business component contains both database operations as well as transactional statements.
In case of Declarative transactions, the business component contains only database operations without transactional statements. The transactional statements are implemented as transaction advice and merged using AOP.

Difference between Programmatic and Declarative transactions:

Programmatic Transactions	Declarative Transactions
Business component contains both database operations as well as transactional statements.	Business component contains only database operations without transactional statements.
Give fine grained control since single method may have multiple transactions.	Convenient to use because of AOP.

Propagation Behavior (or Transaction Attributes)

Method1 begins a transaction and invokes method2. When method2 executes, does it run within the method1 transaction or does it execute in a new transaction? The answer depends on the transaction attribute of method2.
A transaction attribute may have one of the following values:

- Required
- RequiresNew
- Supports
- NotSupported
- Mandatory
- Never
- Nested

Required
If the method1 is running within a transaction and invokes the method2, the method2 executes within the method1 transaction. If the method1 is not associated with a transaction, the container starts a new transaction before running the method2.

RequiresNew
If the method1 is running within a transaction and invokes the method2, the container does following steps:

1. Suspends the method1 transaction
2. Starts a new transaction
3. Delegates the call to the method2
4. Resumes the method1 transaction after the method2 completes.

If the method1 is not associated with a transaction, the container starts a new transaction before running the method2.
You should use the RequiresNew attribute when you want to ensure that the method2 always runs within a new transaction.

Mandatory
If the method1 is running within a transaction and invokes the method2, the method2 executes within the method1 transaction. If the method1 is not associated with a transaction, the container throws the TransactionRequiredException.
Use the Mandatory attribute if the method2 must use the transaction of the method1.

NotSupported
If the method1 is running within a transaction and invokes the method2, the container suspends the method1 transaction before invoking the method2. After the method2 has completed, the container resumes the method1 transaction.
If the method1 is not associated with a transaction, the container does not start a new transaction before running the method2.
Use the NotSupported attribute for methods that don't need transactions.

Supports
If the method1 is running within a transaction and invokes the method2, the method2 executes within the method1 transaction. If the method1 is not associated with a transaction, the container does not start a new transaction before running the method2.

Nested
Indicates that the method should be run within a nested transaction if an existing transaction is in progress. The nested transaction can be committed and rollback individually from the enclosing transction.

Never
If the method1 is running within a transaction and invokes the method2, the container throws a RemoteException. If the method1 is not associated with a transaction, the container does not start a new transaction for method2.

The above Propagation Behavior is set using txTemplate.setPropagationBehavior(TransactionDefinition.PROPAGATION_REQUIRES_NEW) method.

Isolation Level
The spring framework supports following Isolation levels, these are from TransactionDefinition interface:
1) ISOLATION_READ_UNCOMMITTED
2) ISOLATION_READ_COMMITTED

3) ISOLATION_REPEATABLE_READ
4) ISOLATION_SERIALIZABLE
5) ISOLATION_DEFAULT

The above Isolation levels are set using txTemplate.setIsolationLevel(TransactionDefinition.ISOLATION_DEFAULT) method.

Programatic Transactions

This application is intended to perform programmatic transactions using spring framework.

```
create  table withdraw(accno number(3)primary key, name varchar2(100), amount number(5));
create  table deposit(accno number(3)primary key, name varchar2(100), amount number(5));
insert into withdraw values(1, 'Ramesh', 1000);
insert into deposit  values(1, 'Balaji', 2000);
commit;
```

```
//Withdraw.java
package edu.aspire.pojos;
import java.io.Serializable;
public class Withdraw implements Serializable {
        private int accno;
        private String name;
        private int amount;
        public Withdraw() { }
        public int getAccno() {  return accno; }
        public void setAccno(int accno) { this.accno = accno; }
        public String getName() { return name; }
        public void setName(String name) { this.name = name; }
        public int getAmount() { return amount; }
        public void setAmount(int amount) { this.amount = amount; }
}
```

```
//Deposit.java
package edu.aspire.pojos;
import java.io.Serializable;
public class Deposit implements Serializable {
        private int accno;
        private String name;
        private int amount;
        public Deposit() {  }
        public int getAccno() { return accno; }
        public void setAccno(int accno) { this.accno = accno; }
        public String getName() { return name; }
        public void setName(String name) { this.name = name; }
        public int getAmount() { return amount; }
        public void setAmount(int amount) { this.amount = amount; }
}
```

#**Withdraw.hbm.xml**

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
"http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">
<hibernate-mapping>
        <class name="edu.aspire.pojos.Withdraw" table="WITHDRAW">
                <id name="accno" column="ACCNO" type="integer">
                        <generator class="assigned" />
                </id>
                <property name="name" column="NAME" type="string" />
                <property name="amount" column="AMOUNT" type="integer" />
        </class>
</hibernate-mapping>
```

#**Deposit.hbm.xml**

```
<?xml version="1.0"?>
<!DOCTYPE hibernate-mapping PUBLIC "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
"http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">
<hibernate-mapping>
        <class name="edu.aspire.pojos.Deposit" table="DEPOSIT">
                <id name="accno" column="ACCNO" type="integer">
                        <generator class="assigned"/>
                </id>
                <property name="name" column="NAME" type="string"/>
                <property name="amount" column="AMOUNT" type="integer"/>
        </class>
</hibernate-mapping>
```

//**WithdrawDaoImpl.java**

```
package edu.aspire.prog.daos;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.orm.hibernate3.HibernateTemplate;
import org.springframework.stereotype.Repository;
import edu.aspire.pojos.Withdraw;

@Repository
public class WithdrawDaoImpl {
	@Autowired
	private HibernateTemplate hibernateTemplate;
	public Withdraw read(int id) {
		return (Withdraw) hibernateTemplate.get(Withdraw.class, new Integer(id));
	}
	public void update(Withdraw w){
		hibernateTemplate.update(w);
	}
}
```

//DepositDaoImpl.java

```
package edu.aspire.prog.daos;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.orm.hibernate3.HibernateTemplate;
import org.springframework.stereotype.Repository;
import edu.aspire.pojos.Deposit;

@Repository
public class DepositDaoImpl {
	@Autowired
	private HibernateTemplate hibernateTemplate;
	public Deposit read(int id) {
		return (Deposit) hibernateTemplate.get(Deposit.class, new Integer(id));
	}
	public void update(Deposit w) {
		hibernateTemplate.update(w);
	}
}
```

//ITransferMoney.java

```
package edu.aspire.tx.programmatic;
public interface ITransferMoney {
	public void transfer(final int fromAccNo, final int toAccNo);
}
```

//TransferMoney.java

```
package edu.aspire.tx.programmatic;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Service;
import org.springframework.transaction.TransactionStatus;
import org.springframework.transaction.support.TransactionCallback;
import org.springframework.transaction.support.TransactionTemplate;
import edu.aspire.pojos.Deposit;
import edu.aspire.pojos.Withdraw;
import edu.aspire.prog.daos.DepositDaoImpl;
import edu.aspire.prog.daos.WithdrawDaoImpl;

@Service("transferMoney")
public class TransferMoney implements ITransferMoney {
        @Autowired
        private TransactionTemplate txTemplate;
        @Autowired
        private WithdrawDaoImpl withdradao;
        @Autowired
        private DepositDaoImpl depositdao;

        public void transfer(final int fromAccNo, final int toAccNo) {
                // txTemplate.setPropagationBehavior(TransactionDefinition.PROPAGATION_REQUIRES_NEW);
                // txTemplate.setIsolationLevel(TransactionDefinition.ISOLATION_DEFAULT);
                txTemplate.execute(new TransactionCallback() {
                        public Object doInTransaction(TransactionStatus arg0) {
                                try {
                                        Withdraw w = withdradao.read(fromAccNo);     //SELECT
                                        w.setAmount(w.getAmount() - 100);
                                        withdradao.update(w);                        //UPDATE

                                        //if(true) throw new Exception();

                                        Deposit d = depositdao.read(toAccNo);        //SELECT
                                        d.setAmount(d.getAmount() + 100);
                                        depositdao.update(d);                        //UPDATE
                                } catch (Exception e) {
                                        e.printStackTrace();
                                        arg0.setRollbackOnly();
                                }
                                return null;
```

```
                    }
                });
        }
}
```

//**SpringProgTxsConfig.java**

```
@Configuration
@ComponentScan(basePackages = { "edu.aspire.tx.programmatic", "edu.aspire.prog.daos" })
public class SpringProgTxsConfig {
        @Bean
        public DataSource dataSource() {
                BasicDataSource bds = new BasicDataSource();
                bds.setDriverClassName("oracle.jdbc.driver.OracleDriver");
                bds.setUrl("jdbc:oracle:thin:@localhost:1521:xe");
                bds.setUsername("system");
                bds.setPassword("manager");
                bds.setInitialSize(10);
                bds.setMaxActive(15);
                return bds;
        }

        @Bean
        public LocalSessionFactoryBean sessionFactory(DataSource ds) {
                LocalSessionFactoryBean lsfb = new LocalSessionFactoryBean();
                lsfb.setDataSource(ds);

                Properties props = new Properties();
                props.put("hibernate.show_sql", "true");
                props.put("hibernate.format_sql", "true");
                props.put("hibernate.use_sql_comments", "true");
                props.put("hibernate.transaction.factory_class", "org.hibernate.transaction.JDBCTransactionFactory");

                lsfb.setHibernateProperties(props);
                lsfb.setMappingResources(new String[] { "Withdraw.hbm.xml", "Deposit.hbm.xml" });

                return lsfb;
        }

        @Bean(autowire = Autowire.BY_TYPE)
        public HibernateTemplate hibTemplate() {
```

```
			return new HibernateTemplate();
		}

		@Bean(autowire = Autowire.BY_TYPE)
		public PlatformTransactionManager transactionManager() {
			return new HibernateTransactionManager();
		}

		@Bean(autowire = Autowire.BY_TYPE)
		public TransactionTemplate trnsactionTemplate() {
			return new TransactionTemplate();
		}
}
```

// **SpringProgTxsTest.java**

```
package edu.aspire.test;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.context.ApplicationContext;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import edu.aspire.tx.programmatic.ITransferMoney;
import edu.aspire.config.SpringProgTxsConfig;
@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration(classes={SpringProgTxsConfig.class})
public class SpringProgTxsTest {
		@Autowired
		ApplicationContext context;

		@Test
		public void testSpringProgTxs() {
			ITransferMoney transMoney = (ITransferMoney)context.getBean("transferMoney");
			transMoney.transfer(1, 1);
			System.out.println("successfully transferred...");
		}
}
```

Note: pom.xml file is same as before.

Declarative Transactions

Implementing Declarative transactions using Annotation based AOP.

The declarative transactions are implemented using AOP.

The declarative transactions are managed using annotations (From Spring 2.5). Add following element from http://www.springframework.org/schema/tx namespace:

<tx:annotation-driven transaction-manager="transactionManager" proxy-target-class="true"/>

The <tx:annotation-driven/> element tells spring to examine all beans in the context and to look for beans that are annotated with **@Transactional**, either at class-level or at the method level.

For every bean that is annotated with **@Transactional**, the <tx:annotation-driven/> will automatically advise it with transaction advice.

The transaction attributes of the advice will be defined by parameters of the @Transactional annotation.

Please note that the following files are Identical as before:

- ✓ **Withdraw.java**
- ✓ **Deposit.java**
- ✓ **Withdraw.hbm.xml**
- ✓ **Deposit.hbm.xml**
- ✓ **WithdrawDaoImpl.java**
- ✓ **DepositDaoImpl.java**
- ✓ **ITransferMoney.java**

```
// TransferMoney.java
package edu.aspire.tx.declarative;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Service;
import org.springframework.transaction.annotation.Propagation;
import org.springframework.transaction.annotation.Transactional;
import edu.aspire.decl.daos.DepositDaoImpl;
import edu.aspire.decl.daos.WithdrawDaoImpl;
import edu.aspire.decl.pojos.Deposit;
import edu.aspire.decl.pojos.Withdraw;

@Service("transfermoney")
@Transactional(propagation = Propagation.REQUIRED)
public class TransferMoney implements ITransferMoney {
	@Autowired
	private WithdrawDaoImpl withdrawdao;
```

```
        @Autowired
        private DepositDaoImpl depositdao;

        public void transfer(final int fromAccNo, final int toAccNo) {
                Withdraw w = withdrawdao.read(fromAccNo);   // SELECT
                w.setAmount(w.getAmount() - 100);
                withdrawdao.update(w);                      // UPDATE

                Deposit d = depositdao.read(toAccNo);       // SELECT
                d.setAmount(d.getAmount() + 100);           // UPDATE
                depositdao.update(d);
        }
}
```

// **SpringDeclTxsConfig.java**

```
@Configuration
@ComponentScan(basePackages = { "edu.aspire.tx.declarative", "edu.aspire.decl.daos" })
@EnableTransactionManagement
public class SpringDeclTxsConfig {
        @Bean
        public DataSource dataSource() {
                BasicDataSource bds = new BasicDataSource();
                bds.setDriverClassName("oracle.jdbc.driver.OracleDriver");
                bds.setUrl("jdbc:oracle:thin:@localhost:1521:xe");
                bds.setUsername("system");
                bds.setPassword("manager");
                bds.setInitialSize(10);
                bds.setMaxActive(15);
                return bds;
        }

        @Bean
        public LocalSessionFactoryBean sessionFactory(DataSource ds) {
                LocalSessionFactoryBean lsfb = new LocalSessionFactoryBean();
                lsfb.setDataSource(ds);

                Properties props = new Properties();
                props.put("hibernate.show_sql", "true");
                props.put("hibernate.format_sql", "true");
                props.put("hibernate.use_sql_comments", "true");
        props.put("hibernate.transaction.factory_class", "org.hibernate.transaction.JDBCTransactionFactory");

        lsfb.setHibernateProperties(props);
        lsfb.setMappingResources(new String[] { "Withdraw_decl.hbm.xml", "Deposit_decl.hbm.xml" });

        return lsfb;
    }

    @Bean(autowire = Autowire.BY_TYPE)
    public HibernateTemplate hibTemplate() {
        return new HibernateTemplate();
    }

    @Bean(autowire = Autowire.BY_TYPE)
    public PlatformTransactionManager transactionManager() {
        return new HibernateTransactionManager();
    }
}
```

// **SpringDeclTxsTest.java**

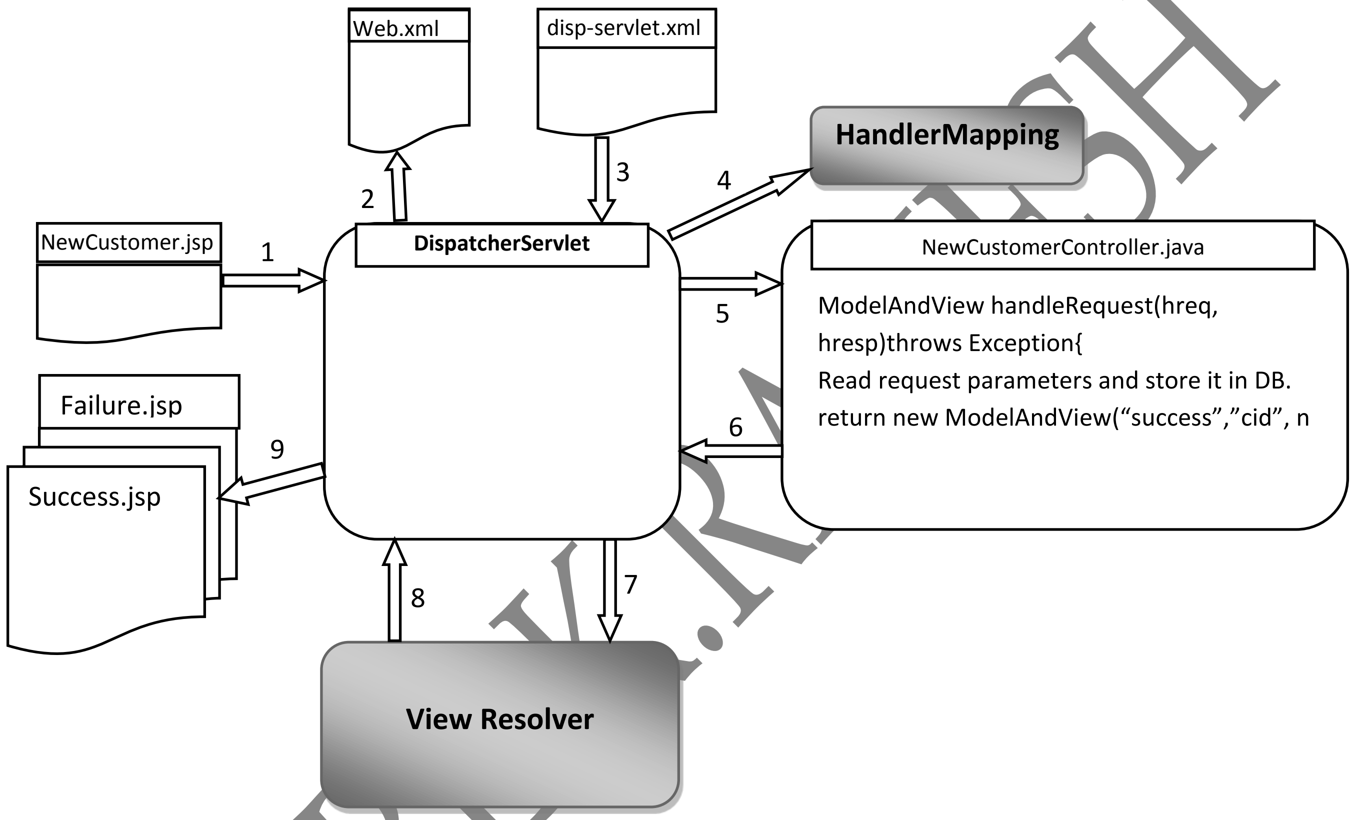
```
package edu.aspire.test;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.context.ApplicationContext;
import org.springframework.test.context.ContextConfiguration;
import org.springframework.test.context.junit4.SpringJUnit4ClassRunner;
import edu.aspire.tx.declarative.ITransferMoney;

@RunWith(SpringJUnit4ClassRunner.class)
@ContextConfiguration(classes = { SpringDeclTxsConfig.class })
public class SpringDeclTxsTest {
    @Autowired
    ApplicationContext context;

    @Test
    public void testSpringDeclTxs() {
        ITransferMoney transMoney = (ITransferMoney) context.getBean("transfermoney");
        transMoney.transfer(1, 1);
        System.out.println("successfully transferred...");
        }
}
```

Note: The pom.xml file is same as before.

8.SPRING MVC

The Spring MVC helps us to build **web applications** that are **flexible** and **loosely coupled**.

Architecture



Web.xml
disp-servlet.xml
HandlerMapping
NewCustomer.jsp
DispatcherServlet
NewCustomerController.java
ModelAndView handleRequest(hreq, hresp)throws Exception{
Read request parameters and store it in DB.
return new ModelAndView("success","cid", n
Failure.jsp
Success.jsp
View Resolver
1
2
3
4
5
6
7
8
9

Conclusion: The Spring moves requests around between a dispatcher servlet, handler mappings, controllers, and view resolvers.

Whenever Spring MVC application is deployed into servlet container, then the container will parse web.xml file.

#WEB-INF\web.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<web-app>
        <servlet>
                <servlet-name>disp</servlet-name>
                <servlet-class>org.springframework.web.servlet.DispatcherServlet</servlet-class>
                <load-on-startup>1</load-on-startup>
        </servlet>
        <servlet-mapping>
                <servlet-name>disp</servlet-name>
                <url-pattern>*.htm</url-pattern>
        </servlet-mapping>
</web-app>
```

In Spring MVC, the spring configuration file name format is: **<servlet-name>-servlet.xml**.
From Servlet 3 specification and in Spring 3.1, we can configure DispatcherServlet in Java file instead of web.xml file.

DispatcherServlet

It is a **front controller** servlet which **delegates** request to controller (business component).
The DispatcherServlet consults HandlerMapping to decide controller class to delegate.
The DispatcherServlet will consult a ViewResolver to map the logical view name to a specific physical response page.

Handler Mappings

It is used to decide one controller among many controllers using urlpath.
The spring api contains following handler mapping implementations:

Handler Mapping Implementation	Description
BeanNameUrlHandlerMapping	Maps controllers to URLs that are based on controllers' bean name in spring configuration file.
ControllerBeanNameHandlerMapping	Same as above except the bean names aren't required to follow URL conventions.
ControllerClassNameHandlerMapping	Maps controllers to URLs by using the controllers' class name as the basis for their URLs.
DefaultAnnotationHandlerMapping	Maps request to controller and controller methods that are annotated with @RequestMapping.
SimpleUrlHandlerMapping	Maps controllers to URLs using a property collection defined in the spring application context.

By default, the DispatcherServlet creates and uses BeanNameUrlHandlerMapping and DefaultAnnotationHandlerMapping. However, we can explicitly configure handler mapping class as below:

```
        <bean class="org.springframework.web.servlet.handler.BeanNameUrlHandlerMapping"/>
```

Controller classes

It is used to provide or invoke **business logic**. Actually, a well-designed controller performs little or no business processing itself and instead delegates responsibility for the business logic to one or more service objects.
It sends back model data along with logical view name to DispatcherServlet.

ViewResolver

The DispatcherServlet consults a view resolver to exchange the logical view name returned by a controller for an actual view that should render the results.
In reality, view resolver job is to map logical view name to some implementation of org.springframework.web.servlet.View.
Spring comes with several view resolver implementations to choose from, as described in below table:

View Resolver	Description

BeanNameViewResolver	Finds an implementation of View that's registered as a <bean> whose ID is same as logical view name. Supports InternalResourceView, VelocityView, FreeMarkerView.
InternalResourceViewResolver	Resolves view name by taking the logical view and surrounding it with a prefix and a suffix. Supports InternalResourceView, and JstlView.
UrlBasedViewResolver	It is a base class for other view resolver classes. Support InternalResourceView, VelocityView, FreeMarkerView.
TilesViewResolver	Looks in tiles definition file (xml file). The definition name and logical view name should be same. Supports TilesView.
ResourceBundleViewResolver	Uses bean defitions in a ResourceBundle (.properties file). Supports InternalResourceView, VelocityView, FreeMarkerView.

The InternalResourceViewResolver takes logical view name and surrounding it with prefix and suffix to resolve response view name including its location.

Example:

<bean class="org.springframework.web.servlet.view.**InternalResourceViewResolver**">
<property name="prefix" value="/WEB-INF/views/"/>
<property name="suffix" value=".jsp"/>
~~<property name="viewClass" value="org.springframework.web.servlet.view.InternalResourceView"/>~~
</bean>

When controller class returns 'success' as a logical view name, then InternalResourceViewResolver prefixes it with '/WEB-INF/views' and suffixes it with '.jsp' and ended up with path as "**/WEB-INF/views/success.jsp**".

Note: It's good practice to put JSP files that just serve as views under WEB-INF, to hide them from direct access (e.g. via a manually entered URL). Only controllers will be able to access them.

Spring MVC Flow

1) Spring MVC flow starts when user submits request from the browser.
2) The **request** comes to DispatcherServlet via web.xml. It automatically loads the spring configuration file whose name format is <servlet-name>-servlet.xml, where <servlet-name> is configured in web.xml file.
3) The DispatcherServlet **consults** Handler Mapping to decide controller class to delegate.
4) The Handler Mapping **decides** one controller among many controllers based on URL path (/nc.html) specified in request page (NewCustomer.jsp).
5) The DispatcherServlet **delegates** request to the corresponding Controller (CustomerController.java).
6) The controller returns ModelAndView, which contains **logical view** and **model data**, back to DispatcherServlet.
7) The DispatcherServlet **consults** viewresolver to resolve response view name including its location.
8) The viewresolver **returns** physical response view page name.

9) Finally, the DispatcherServlet does view **navigation** to response page (success.jsp).

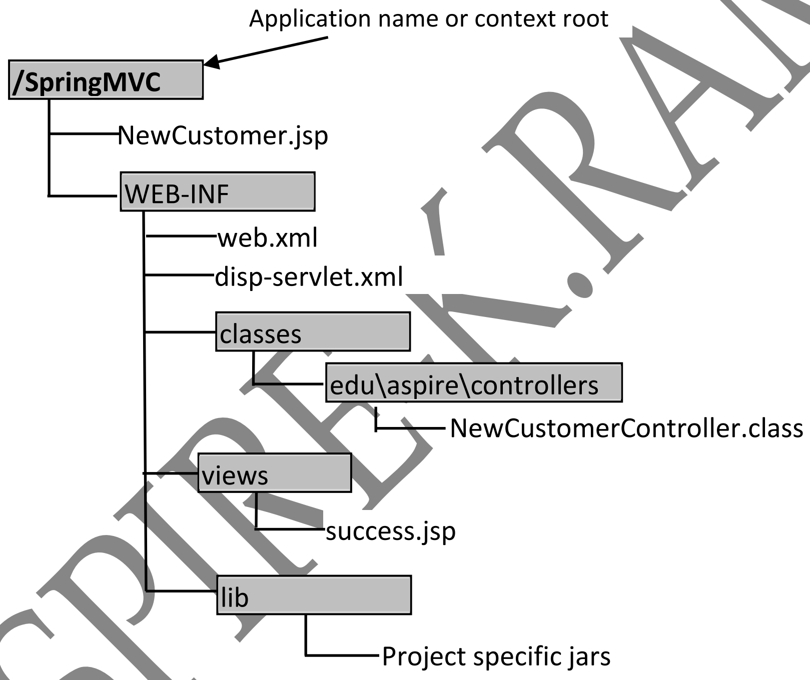
The Spring MVC flow is almost same as Struts MVC webflow. The minor differences between spring and struts mvc flows are:

	Spring	Struts
Front-controller	DispatcherServlet	ActionServlet
Business Logic Class	Subclass of Controller Interface.	Subclass of Action class.
Return type	ModelAndView	ActionForward
Method Name	handleRequest()	execute()
FormBeans	No separate formbean	Have separate formbean

Spring–MVC Application

This application is intended to use Spring-MVC module.
Also, the JNDI DataSource is configured to connect with database.

Directory Structure



Note: The following content should be added to **%TOMCAT_HOME%/conf/context.xml**

```
<?xml version='1.0' encoding='utf-8'?>
<Context path="">
<Resource name="mypool" type="javax.sql.DataSource" auth="Container" description=""
maxTotal="15" maxIdle="10" maxWaitMillis="10000" username="system" password="manager"
factory="org.apache.tomcat.dbcp.dbcp2.BasicDataSourceFactory"
driverClassName="oracle.jdbc.driver.OracleDriver" url="jdbc:oracle:thin:@localhost:1521:xe"/>
</Context>
```

#NewCustomer.jsp

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1" pageEncoding="ISO-8859-1"%>
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"  http://www.w3.org/TR/html4/loose.dtd">
<html><body><pre>
<form action="nc.htm" method="post">
        Name <INPUT type="text" name="cname" />
        Email <INPUT type="text" name="email" />
        Mobile <INPUT type="text" name="mobile" />
        <INPUT type="submit" name="submit" value="Insert" />
</FORM>
</pre></body></html>
```

```
//CREATE TABLE CUSTOMER(CID NUMBER(3)PRIMARY KEY, CNAME VARCHAR2(100), EMAIL VARCHAR2(100),
MOBILE VARCHAR2(20));
//CREATE SEQUENCE CUSTOMER_SEQ;
package edu.aspire.domains;
public class Customer {  //POJO class
        private int cid;
        private String cname;
        private String email;
        private long mobile;
        public int getCid() { return cid; }
        public void setCid(int cid) { this.cid = cid; }
        public String getCname() { return cname; }
        public void setCname(String cname) { this.cname = cname; }
        public String getEmail() { return email; }
        public void setEmail(String email) { this.email = email; }
        public long getMobile() { return mobile; }
        public void setMobile(long mobile) { this.mobile = mobile; }
}
```

#Customer.hbm.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE hibernate-mapping PUBLIC "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
"http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">
<hibernate-mapping>
        <class name="edu.aspire.domains.Customer" table="CUSTOMER">
                <id name="cid" column="CID" type="integer">
                        <generator class="sequence">
                                <param name="sequence_name">CUSTOMER_SEQ</param>
                        </generator>
                </id>
                <property name="cname" column="CNAME" type="string" length="20" />
                <property name="email" column="email" type="string" length="100" />
                <property name="mobile" column="mobile" type="long" />
        </class>
</hibernate-mapping>
```

//**CustomerDao.java**

```
package edu.aspire.model;
import edu.aspire.domains.Customer;
public interface CustomerDao {
        public int save(Customer e);
        public void update(Customer e);
        public void delete(int eno);
        public Customer get(int eno);
}
```

//**CustomerDaoImpl.java**

```
package edu.aspire.model;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.orm.hibernate3.HibernateTemplate;
import org.springframework.stereotype.Repository;
import edu.aspire.domains.Customer;
@Repository
public class CustomerDaoImpl implements CustomerDao {
        @Autowired(required = true)
        private HibernateTemplate hibernateTemplate;
        public CustomerDaoImpl() { }
        public int save(Customer c) { return (Integer) hibernateTemplate.save(c); }
        public void delete(int eno) { }
        public Customer get(int eno) { return null; }
        public void update(Customer e) { }
}
```

//**NewCustomerController.java**

```
package edu.aspire.controllers;
import javax.servlet.http.HttpServletRequest;
import javax.servlet.http.HttpServletResponse;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.servlet.ModelAndView;
import org.springframework.web.servlet.mvc.Controller;
import edu.aspire.domains.Customer;
import edu.aspire.model.CustomerDao;
public class NewCustomerController implements Controller { //controller class
        @Autowired
        private CustomerDao customerDao;

        @Override
        public ModelAndView handleRequest(HttpServletRequest req, HttpServletResponse resp) throws Exception {
                String cname = req.getParameter("cname").trim();
                String email = req.getParameter("email").trim();
                String mobile = req.getParameter("mobile").trim();

                Customer cust = new Customer();
                cust.setCname(cname);
                cust.setEmail(email);
                cust.setMobile(Long.parseLong(mobile));

                Integer cno = (Integer)customerDao.save(cust);
                return new ModelAndView("success", "cid", cno);
        }
}

//AspireWebRootConfig.java
@Configuration
@EnableTransactionManagement
public class AspireWebRootConfig {
  @Bean
  public DataSource dataSource() {
    JndiObjectFactoryBean dataSource = new JndiObjectFactoryBean();
    dataSource.setJndiName("java:comp/env/mypool");
    try {
      dataSource.afterPropertiesSet(); //Look up the JNDI object and store it.
    } catch (IllegalArgumentException | NamingException e) {
      throw new RuntimeException(e);
    }
    return (DataSource)dataSource.getObject();
  }
```

```
@Bean
public LocalSessionFactoryBean sessionFactory(DataSource ds) {
        LocalSessionFactoryBean lsfb = new LocalSessionFactoryBean();
        lsfb.setDataSource(ds);

        Properties props = new Properties();
        props.put("hibernate.show_sql", "true");
        props.put("hibernate.format_sql", "true");
        props.put("hibernate.use_sql_comments", "true");
        props.put("hibernate.transaction.factory_class", "org.hibernate.transaction.JDBCTransactionFactory");

        lsfb.setHibernateProperties(props);
        lsfb.setMappingResources(new String[] { "Customer.hbm.xml" });

        return lsfb;
}

@Bean(autowire=Autowire.BY_TYPE)
public HibernateTemplate hibernateTemplate() {
        return new HibernateTemplate();
}

@Bean(name="/nc.htm")
public NewCustomerController customerController(){
        return new NewCustomerController();
}

@Bean
public BeanNameUrlHandlerMapping handlerMapping(){
        return new BeanNameUrlHandlerMapping();
}

@Bean
public ViewResolver viewResolver() {
        InternalResourceViewResolver resolver = new InternalResourceViewResolver();
        resolver.setPrefix("/WEB-INF/views/");
        resolver.setSuffix(".jsp");
        resolver.setViewClass(InternalResourceView.class);
        return resolver;
}
```

```
	@Bean(autowire = Autowire.BY_TYPE)
	public PlatformTransactionManager transactionManager() {
		return new HibernateTransactionManager();
	}
}
```

#WEB-INF\views\success.jsp

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1" pageEncoding="ISO-8859-1"%>
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" http://www.w3.org/TR/html4/loose.dtd">
<html><body>
	Customer ID is: <%=((Integer)request.getAttribute("cid")).intValue()%>
</body> </html>
```

Web Initializer is a java based configuration alternative for web.xml file.

```
package edu.aspire.config;
import javax.servlet.ServletContext;
import javax.servlet.ServletException;
import javax.servlet.ServletRegistration;
import org.springframework.web.WebApplicationInitializer;
import org.springframework.web.context.support.XmlWebApplicationContext;
import org.springframework.web.servlet.DispatcherServlet;
import org.springframework.web.servlet.support.AbstractAnnotationConfigDispatcherServletInitializer;
public class AspireWebInitializer extends AbstractAnnotationConfigDispatcherServletInitializer {
	@Override
	protected String[] getServletMappings() {
		return new String[] { "*.htm" };
	}

	@Override
	protected Class<?>[] getServletConfigClasses() {
		return new Class<?>[] { AppWebRootConfig.class };
	}

	@Override
	protected Class<?>[] getRootConfigClasses() {
		return null;
	}
}
```

#pom.xml

```
…
<dependencies>
                    <dependency>
                              <groupId>org.springframework</groupId>
                              <artifactId>spring-webmvc</artifactId>
                              <version>4.3.9.RELEASE</version>
                    </dependency>
                    <dependency>
                              <groupId>org.springframework</groupId>
                              <artifactId>spring-orm</artifactId>
                              <version>4.3.9.RELEASE</version>
                    </dependency>
                    <dependency>
                              <groupId>org.springframework</groupId>
                              <artifactId>spring-context</artifactId>
                              <version>4.3.9.RELEASE</version>
                    </dependency>
                    <dependency>
                              <groupId>org.hibernate</groupId>
                              <artifactId>hibernate-core</artifactId>
                              <version>5.0.12.Final</version>
                    </dependency>
                    <dependency>
                              <groupId>javax.servlet</groupId>
                              <artifactId>servlet-api</artifactId>
                              <version>2.5</version>
                              <scope>provided</scope>
                    </dependency>
                    <dependency>
                              <groupId>commons-dbcp</groupId>
                              <artifactId>commons-dbcp</artifactId>
                              <version>1.4</version>
                    </dependency>
                    <dependency>
                              <groupId>oracle</groupId>
                              <artifactId>oracle-jdbc</artifactId>
                              <version>11</version>
                    </dependency>
          </dependencies>
```

9. CASE STUDY

In this case study, we use Annotation Based Controllers.
This is new feature added in Spring 2.5.
The class is annotated with **@Controller** annotation indicates that this class is controller. Hence, the controller subclass no need to implements Controller interface. The methods annotated with **@RequestMapping** makes method as **request-handling** method. The signature of a **request-handling method can include almost anything as parameter such as HttpServletRequest, HttpServletResponse, Map<String, Object>, Value Object, or any type**.
For Example, as a request-handling method, it takes Map<String, Object> as a parameter, which represents the model – the data that's passed between the controller and a response view page. **The DispatcherServlet will copy all entries of map into request scope with the same name**.
The request-handling method returns logical name of the response view page.
The @Controller annotation is a specialization of the @Component annotation, which means that <context:component-scan/> will pick up and register @Controller annotated classes as beans. To enable autodiscovery, we need to add **<context:component-scan/>** in spring configuration file.
In case of annotation driven controllers, the DispatcherServlet creates and uses **DefaultAnnotationHandlerMapping** from org.springframework.web.servlet.mvc.annotation package. This is good enough for mapping requests to controller methods that are annotated with @RequestMapping.
But we also use other annotations to bind request parameters to handler method parameters, perform validations and perform message conversion. Therefore, the DefaultAnnotationHandlerMapping is not enough.
Add **<mvc:annotation-driven/>** element in spring configuration file which registers several features including JSR-303 validation support, message conversion, and support for field formatting.

Form Processing

Working with forms in web applications involve two operations: **displaying the form** and **processing the form submission**. Therefore, in order to register a new Customer in our application, two request-handling methods in CustomerController class are needed to handle each of the operations.

Displaying the registration form

When the form is displayed, it'll need a Customer object to bind to the form fields. The following createCustomerProfile() handler method will create an empty customer object and place it in the model.

```
@Controller
@RequestMapping("/customers")
Public class CustomerController{  //controller class
        //@RequestMapping(value="/registration/form", method = RequestMethod.GET)
        @GetMapping(value="/registration/form")
        public String displayRegistrationForm(Map<String, Object> m){ //endpoint
                m.put("customer", new Customer());
                return "NewCustomer"; //logical name mapped to "/WEB-INF/views/NewCustomer.jsp" page
        }
}
```

The **endpoint url** to access above controller method is **http://localhost:9090/FormProcessing/customers/registration/form**

Rendering a form to capture user registration information

The following jsp page uses **Spring's form binding library** %SPRING_HOME%\projects\org.springframework.web.servlet\src\main\resources\META-INF\spring-forms.tld.

```
<%@ taglib uri="http://www.springframework.org/tags/form" prefix="sf"%>
<sf:form action="/FormProcessing/customers/create" method="POST" modelAttribute="customer">
        Full Name: <sf:input path="cname" size="15" />
        E-Mail: <sf:input path="email" size="50"/>
        Mobile: <sf:input path="mobile" size="50"/>
        <input type="submit" value="submit"/>
</sf:form>
```

The <sf:form> tag binds the customer object (identified by the **modelAttribute** attribute) that createCustomerProfile() placed into the model to the various fields in the form. The <sf:input> tags each have a '**path'** attribute that references the property of the Customer object that the form is bound to. When the form is submitted, whatever values these fields contain will be placed into a Customer object and submitted to the server for processing.

Processing form Input

```
@Controller
@RequestMapping("/customers")
Public class CustomerController{
        //@RequestMapping(value="/registration/form", method = RequestMethod.GET)
        @GetMapping(value="/registration/form")
        public String displayRegistrationForm(Map<String, Object> m){  //endpoint
        }

        //@RequestMapping(value="/create", method=RequestMethod.POST)
        @PostMapping(value="/create")
        public String insertCustomer(Customer customer) throws Exception{  // endpoint
                //Read I/P data from vo object
        }
}
```

Validations

The **@Valid** annotation is used to trace faulty form input. The @Valid is actually a part of the JavaBean validation specification (JSR-303). The **Spring 3** includes support for JSR-303, and we're using @Valid here to tell Spring that the Customer object should be validated as it is bound to the form input.

The following jars need to be added to classpath:

1) validation-api-1.0.0.GA.jar
2) hibernate-validator-4.3.0.Final.jar
3) jboss-logging-3.0.0.GA.jar

The JSR-303 defines **annotations** that can be **placed on properties** to specify validation rules. The following shows the properties of the Customer class that are annotated with validation annotations.

```
package edu.aspire.view.vo;
import javax.validation.constraints.Pattern;
import javax.validation.constraints.Size;
public class Customer {
	private int cid;

	@Size(min = 3, max = 20, message = "Customer Name must be between 3 and 20 characters long.")
	@Pattern(regexp = "^[a-zA-Z  ]+$", message = "Customer Name must be alphabetic")
	private String cname;

	@Pattern(regexp = "^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\\.[A-Za-z]{2,4}$", message = "Invalid Email Format")
	private String email;

	@Pattern(regexp="^\\d{10}$", message="Mobile number must be 10-digits numeric number")
	private String mobile;
	…
}
```

Note:

1) ^ shows beginning of string.
2) $ is used for ending the string.
3) \d{10} shows any digit 0-9 having 10 places.

The method signature of handler method is:

```
import javax.validation.Valid;
import org.springframework.validation.Errors;
@PostMapping(value="/create")
public String insertCustomer(@Valid Customer customer, Errors errors) throws Exception{
	if(errors.hasErrors()){ //In case of validation errors
		return "NewCustomer"; //redirect back to request page
```

```
        }
        //Business logic
}
```

If the **hasErrors()** method in Errors class returns true, that means that validation failed. In that case, the method will return logical name of request page (NewCustomer.jsp) as the view name to display the form again so that the user can re-enter and re-submit the form.

Displaying Validation Errors

Use **<sf:errors/>** element from Spring's form binding JSP tag library to render (display) field validation errors.

```
<%@ taglib uri="http://www.springframework.org/tags/form" prefix="sf"%>
<sf:form action="/FormProcessing/customers/create" method="POST" modelAttribute="customer">
        Full Name: <sf:input path="cname" size="15" /><font color="red"><sf:errors path="cname"/></font>
        E-Mail: <sf:input path="email" size="50"/><font color="red"><sf:errors path="email"/></font>
        Mobile: <sf:input path="mobile" size="50"/><font color="red"><sf:errors path="mobile"/></font>
        <input type="submit" value="submit"/>
</sf:form>
```

The <sf:errors> tag's '**path**' attribute specifies the form field for which errors should be displayed. If there are multiple errors for a single field, they'll all be displayed, separated by an HTML <br/> tag. If you'd rather have them separated some other way, then you can use the delimiter attribute.
We can display all of the errors in one place by using single <sf:errors **path="*"**/>

This Case Study includes:

a) Annotation driven Controller (@Controller)
b) Spring's form binding library
c) Form Processing
d) Spring's MVC namespace
e) Validations (JSR-303)
f) N-Tier Architecture
g) Http Endpoints
h) Multiple Spring Configuration files

#WEB-INF\views\NewCustomer.jsp

```
<%@ taglib uri="http://www.springframework.org/tags/form" prefix="sf"%>
<html> <body>
<sf:form action="/FormProcessing/customers/create" method="POST" modelAttribute="customer">
        <fieldset><table cellspacing="0">
                <tr>
                        <th><label for="user_full_name">Full Name:</label></th>
                        <td><sf:input path="cname" size="15" id="user_full_name" />
                            <font color="red"><sf:errors path="cname" delimiter=", "/></font>
                        </td>
                </tr> <tr>
                        <th><label for="user_email">E-Mail:</label></th>
                        <td><sf:input path="email" size="50" id="user_email" />
                            <font color="red"><sf:errors path="email"/></font>
                    </td></tr>
                <tr>
                        <th><label for="user_mobile">Mobile:</label></th>
                        <td><sf:input path="mobile" size="50" id="user_mobile" />
                            <font color="red"><sf:errors path="mobile"/></font>
                        </td>
                </tr><tr>
                        <th></th>
                        <td><input type="submit" value="submit"/></td>
                </tr>
        </table></fieldset>
</sf:form>
</body></html>
```

#Customer.hbm.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE hibernate-mapping PUBLIC "-//Hibernate/Hibernate Mapping DTD 3.0//EN"
"http://hibernate.sourceforge.net/hibernate-mapping-3.0.dtd">
<hibernate-mapping>
        <class name="edu.aspire.view.vo.Customer" table="CUSTOMER">
                <id name="cid" column="CID" type="integer">
                        <generator class="sequence">
                                <param name="sequence_name">CUSTOMER_SEQ</param>
                        </generator>
                </id>
                <property name="cname" column="CNAME" type="string" length="20" />
                <property name="email" column="email" type="string" length="100" />
                <property name="mobile" column="mobile" type="string" />
        </class>
</hibernate-mapping>
```

// **CustomerDao.java**

```
package edu.aspire.model;
import edu.aspire.view.vo.Customer;
```

```
public interface CustomerDao {
            public int save(Customer e);
            public void update(Customer e);
            public void delete(int eno);
            public Customer get(int eno);
}
```

// **CustomerDaoImpl.java**

```
package edu.aspire.model;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.orm.hibernate3.HibernateTemplate;
import org.springframework.stereotype.Repository;
import edu.aspire.view.vo.Customer;
//CREATE TABLE CUSTOMER(CID NUMBER(3)PRIMARY KEY, CNAME VARCHAR2(100), EMAIL VARCHAR2(100),
MOBILE VARCHAR2(20));
//CREATE SEQUENCE CUSTOMER_SEQ;
@Repository
public class CustomerDaoImpl implements CustomerDao {
            @Autowired(required = true)
            private HibernateTemplate hibernateTemplate;
            public CustomerDaoImpl() { }
            public int save(Customer c) {  return (Integer) hibernateTemplate.save(c); }
            public void delete(int eno) {  }
            public Customer get(int eno) {  return null; }
            public void update(Customer e) { }
}
```

// **CustomerService.java**

```
package edu.aspire.services;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Service;
import edu.aspire.model.CustomerDao;
import edu.aspire.view.vo.Customer;
@Service
public class CustomerService { //business class
            @Autowired
            private CustomerDao customerDao;
            public int processCustomer(Customer c){
                        return customerDao.save(c);
            }
}

//CustomerController.java
package edu.aspire.controllers;
import java.util.Map;
import javax.validation.Valid;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.stereotype.Controller;
import org.springframework.validation.Errors;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RequestMethod;
import edu.aspire.services.CustomerService;
import edu.aspire.view.vo.Customer;
@Controller
@RequestMapping("/customers")
public class CustomerController{ //Generally controller class handles HTTP requests
	@Autowired
	private CustomerService custService;

	//@RequestMapping(value=”/registration/form”, method=RequestMethod.GET)
	@GetMapping(value=”/registration/form”)
	public String displayRegistrationForm (Map<String, Object> m){ //endpoint
		m.put("customer", new Customer());
		return "NewCustomer";
	}

	//@RequestMapping(value=”/create”, method=RequestMethod.POST)
	@PostMapping(value=”/create”)
	public String insertCustomer(@Valid Customer customer, Errors errors) throws Exception { //endpoint
		if(errors.hasErrors()){ //In case of validation errors
			return "NewCustomer"; //redirected back to request page
		}
		Integer cid = custService.processCustomer(customer);
		customer.setCid(cid);
		return "success";
	}
}

//POJO class / VO class
package edu.aspire.view.vo;
```

```
import javax.validation.constraints.Pattern;
import javax.validation.constraints.Size;
public class Customer {
        private int cid;
        @Size(min = 3, max = 20, message = "Customer Name must be between 3 and 20 characters long.")
        @Pattern(regexp = "^[a-zA-Z ]+$", message = "Customer Name must be Alphabetic")
        private String cname;
        @Pattern(regexp = "^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\\.[A-Za-z]{2,4}$", message = "Invalid Email Format")
        private String email;
        @Pattern(regexp="^\\d{10}$", message="Mobile number must be 10-digits numeric number")
        private String mobile;
        public Customer() { }
        public int getCid() { return cid; }
        public void setCid(int cid) { this.cid = cid; }
        public String getCname() { return cname; }
        public void setCname(String cname) { this.cname = cname; }
        public String getEmail() { return email; }
        public void setEmail(String email) {  this.email = email; }
        public String getMobile() { return mobile; }
        public void setMobile(String mobile) { this.mobile = mobile; }
}
```

#WEB-INF\views\success.jsp

```
<%@page import="edu.aspire.data.Customer"%>
<html><body>
<%
        Customer cust = (Customer) request.getAttribute("customer");
        out.println("Customer ID is:"+cust.getCid());
%>
</body> </html>
```

Multiple Spring Configuration Files

The below class is used to load beans containing web components such as controllers, view resolvers, and handler mappings. The DispatcherServlet is expected to load these beans.

@EanbleWebMvc enables Annotation Based Spring MVC configuration which is same as <mvc:annotation-driven>.

// **AspireWebConfig.java**

```
package edu.aspire.config;
@Configuration
@EnableWebMvc
```

```
@ComponentScan(basePackages = {"edu.aspire.controllers"})
public class AspireWebConfig {
        @Bean
        public HandlerMapping handlerMapping(){
                return new DefaultAnnotationHandlerMapping();
        }

        @Bean
        public ViewResolver viewResolver(){
                InternalResourceViewResolver resolver = new InternalResourceViewResolver();
                resolver.setPrefix("/WEB-INF/views/");
                resolver.setSuffix(".jsp");
                resolver.setViewClass(InternalResourceView.class);
                return resolver;
        }
}
```

The below configuration class to load the other beans which are typically the middle-tier and data-tier components that drive the back end of the application. The ContextLoaderListener is expected to load these beans.

// **AspireRootConfig.java**

```
package edu.aspire.config;
@Configuration
@ComponentScan(basePackages = {"edu.aspire.model", "edu.aspire.services" })
@EnableTransactionManagement
public class AspireRootConfig {
          @Bean
          public DataSource dataSource() {
            JndiObjectFactoryBean dataSource = new JndiObjectFactoryBean();
            dataSource.setJndiName("java:comp/env/mypool");
            try {
              dataSource.afterPropertiesSet(); //Look up the JNDI object and store it.
            } catch (IllegalArgumentException | NamingException e) {
              throw new RuntimeException(e);
            }
            return (DataSource)dataSource.getObject();
          }

        @Bean
        public LocalSessionFactoryBean sessionFactory(DataSource ds) {
```

```
		LocalSessionFactoryBean lsfb = new LocalSessionFactoryBean();
		lsfb.setDataSource(ds);

		Properties props = new Properties();
		props.put("hibernate.show_sql", "true");
		props.put("hibernate.format_sql", "true");
		props.put("hibernate.use_sql_comments", "true");
		props.put("hibernate.transaction.factory_class", "org.hibernate.transaction.JDBCTransactionFactory");

		lsfb.setHibernateProperties(props);
		lsfb.setMappingResources(new String[] { "Customer.hbm.xml" });

		return lsfb;
	}

	@Bean(autowire=Autowire.BY_TYPE)
	public HibernateTemplate hibernateTemplate() {
		return new HibernateTemplate();
	}

	@Bean(autowire = Autowire.BY_TYPE)
	public PlatformTransactionManager transactionManager() {
		return new HibernateTransactionManager();
	}
}
```

// **AspireWebInitializer.java**

```
package edu.aspire.config;
import org.springframework.web.servlet.support.AbstractAnnotationConfigDispatcherServletInitializer;
public class AspireWebInitializer extends AbstractAnnotationConfigDispatcherServletInitializer{
	@Override
	protected Class<?>[] getRootConfigClasses() {
		return new Class[]{ AspireRootConfig.class };
	}
	@Override
	protected Class<?>[] getServletConfigClasses() {
		return new Class[]{ AspireWebConfig.class };
	}
	@Override
	protected String[] getServletMappings() {
			return new String[]{"/"};
		}
}
```

URL: http://localhost:9090/FormProcessing/customers/registration/form

Any class that extends **AbstractAnnotationConfigDispatcherServletInitializer** will automatically configures DispatcherServlet and ContextLoaderListener i.e., it creates both a DispatcherServlet and a ContextLoaderListener. It will be automatically discovered when deployed in a Servlet 3.0 container.
The **getServletMappings()** identifies one or more paths that DispatcherServlet will be mapped to. The / indicating that it will be the application's default servlet which is DispatherServlet.
The DispatcherServlet is expected to load beans containing web components such as controllers, view resolvers, and handler mappings, but ContextLoaderListener is expected to load the other beans in our application. These beans are typically the middle-tier and data-tier components that drive the back end of the application. Hence in Spring web applications, there's often another application context. This other application context is created by ContextLoaderListener.
The @Configuration classes returned from getServletConfigClasses() will define beans for DispatcherServlet's application context.
The @Configuration class's returned from getRootConfigClasses() will be used to configure the application context created by ContextLoaderListener.

#pom.xml

```
	…
	<!-- The below plug-in used to process form validations -->
	<dependency>
		<groupId>org.hibernate</groupId>
		<artifactId>hibernate-validator</artifactId>
		<version>5.3.6.Final</version>
	</dependency>
```

Deploy, start server and try '**http://localhost:9090/FormProcessing/customers/registration/form**'
The above url should display customer registration form.