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Introduction to Java Spring

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(420-JD5-AB) Programming III

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Agenda

- What is Spring Framework
- Intro to Spring
- What are Beans?
- Big Picture of Spring
- Two Key Components of Spring(AOP&DI)
- Spring Framework Architecture
  - Core Container Modules
  - Data Access/Integration Layer Modules
  - Web Layer Modules
- Dependency Injection(DI) Types
- Constructor-based Dependency Injection
- Setter-based Dependency Injection

What is Spring Framework?

- Spring Framework was created by Rod Johnson(2003) and released under Apache 2.0 license.
- The most popular application development framework for enterprise Java
- An Open source Java platform
- Provides to create high performing, easily testable and reusable code.
- is organized in a modular fashion
- simplifies java development

Intro to Spring-1

Spring Framework

- enables Plain Old Java Object (POJO) based programming model
- with POJO you don’t need EJB container product
- utilizes existing technologies like
  - ORM frameworks
  - logging frameworks
  - JEE
  - Quartz
  - JDK timers

Intro to Spring-2

Spring Framework

- is a well-designed web model-view-controller (MVC) framework(a great alternative to Struts)
- provides a coherent transaction management interface that be applicable to a local transactions() local transactions or global transactions(JTA)
- provides a suitable API for translating technology-specific exceptions (for instance, thrown by JDBC, Hibernate, or JDO,) into consistent, unchecked exceptions.
- The Inversion of Control (IoC) containers are lightweight, especially when compared to EJB containers. Being lightweight is beneficial for developing and deploying applications on computers with limited resources (RAM&CPU).
- Testing is simple because environment-dependent code is moved into this framework.

What are Beans?

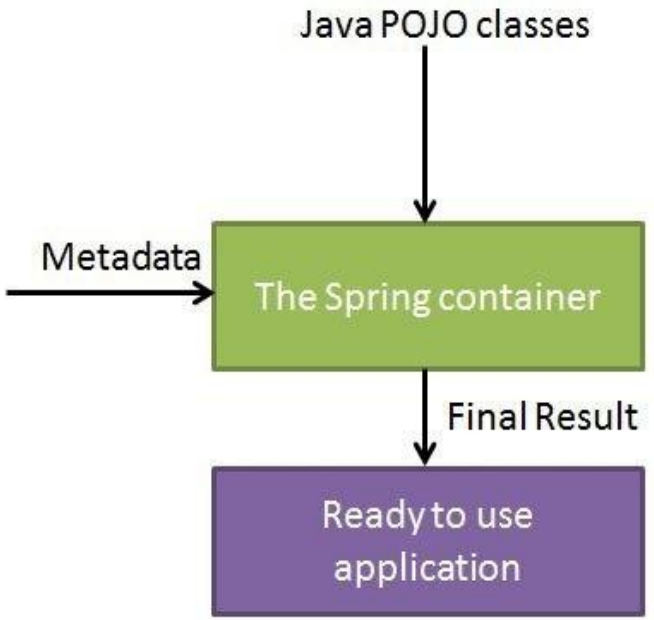
- In Spring, POJO's (plain old java object) are called 'beans' and those objects instantiated, managed, created by Spring IoC container.
- Beans are created with the configuration metadata (XML file) that we supply to the container.
- Bean definition contains configuration metadata. With this information container knows how to create bean, beans lifecycle, beans dependencies
- After specifying objects of an application, instances of those objects will be reached by getBean() method.
- Spring supports given scope types for beans:
  - Singleton (a single instance per Spring IoC container (default))
  - Prototype
  - Request
  - Session
  - Global-session

Scope of Beans

- Spring supports given scope types for beans:
  - Singleton (a single instance per Spring IoC container (default))
  - Prototype
  - Request
  - Session
  - Global-session

```
<!-- A bean definition with singleton scope -->
<bean id="..." class="..." scope="singleton">
    <!-- collaborators and configuration for this bean go here -->
</bean>
```

Big Picture of Spring (High-level view)

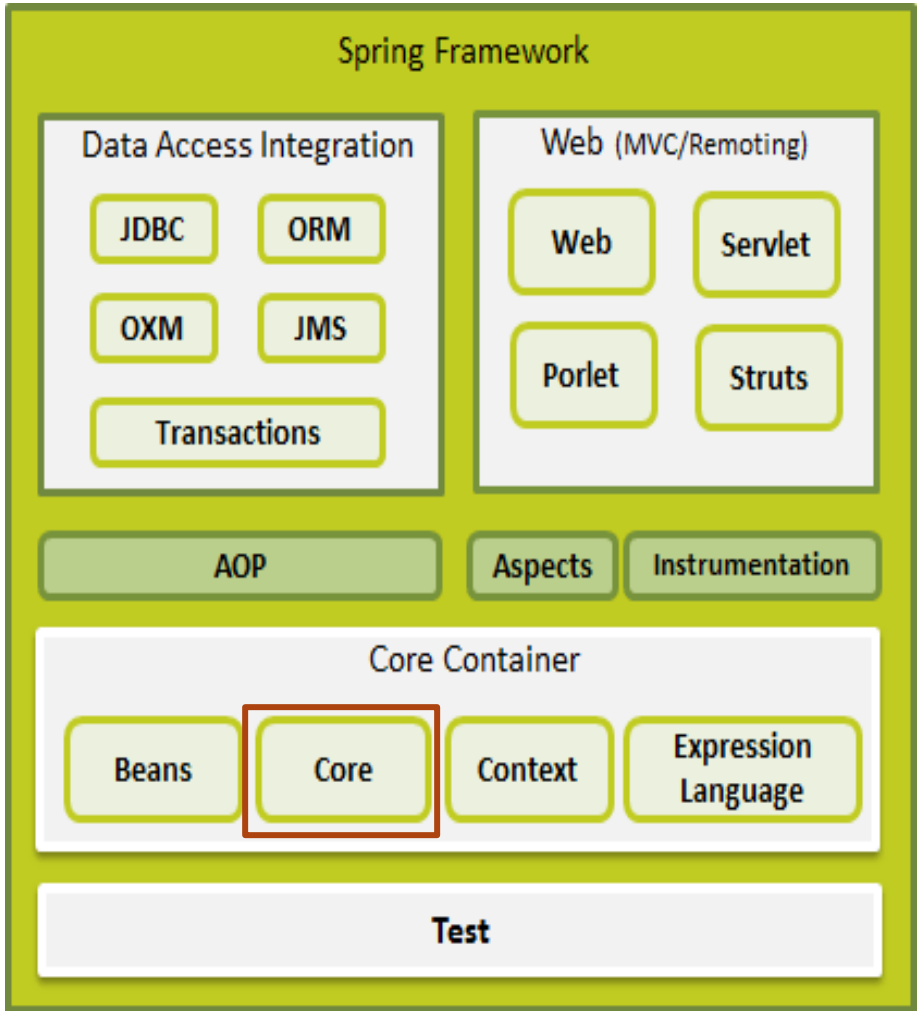


The Spring IoC container makes use of Java POJO classes and configuration metadata to produce a fully configured and executable system or application.

Two Key Components of Spring

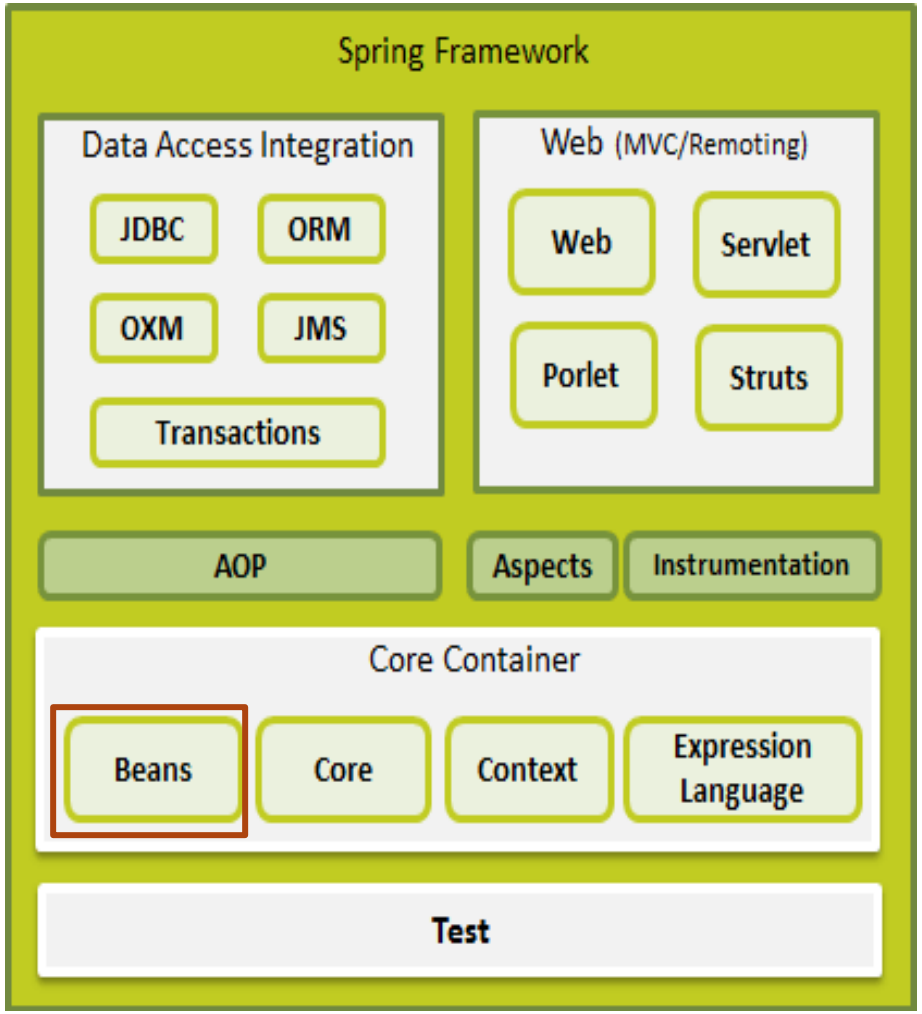
- **Dependency Injection (DI)** helps you decouple your ***application objects*** from each other
- **Aspect Oriented Programming (AOP)**
  - The key unit of modularity is the ***aspect*** in AOP (***class*** in OOP)
  - **Cross-cutting concerns** are the functions that span multiple points of an application.
  - Cross-cutting concerns are conceptually separate from the application's business logic.
  - AOP helps you decouple ***cross-cutting concerns from the objects*** that they affect Examples (logging, declarative transactions, security, and caching)

Spring Framework Architecture



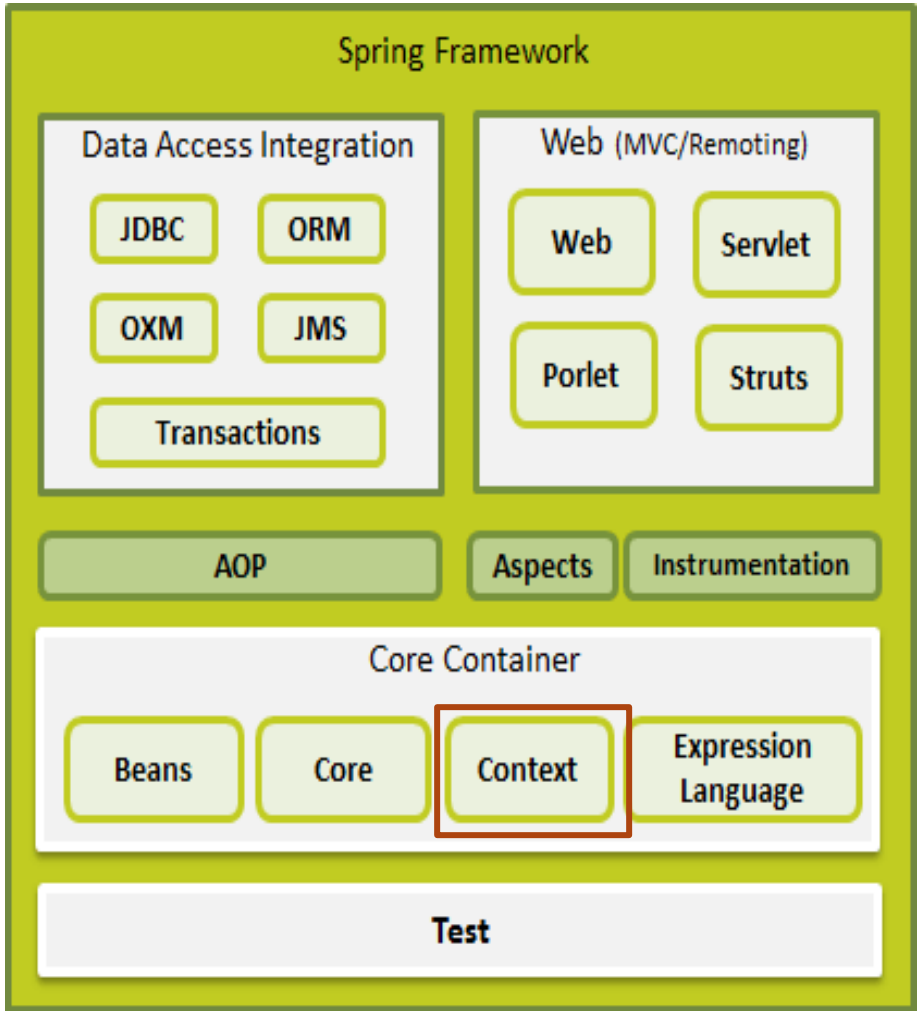
- **Core Module** : The Spring container is at the core module.
  - The Spring container is responsible to create objects, wire them together an manage them form creation until destruction.
  - The Spring container utilizes Dependency Injection to manage objects that make up an application.

Spring Framework Architecture



- **Beans Module** provides BeanFactory,(preferred when the resources are limited such as mobile devices or applet based applications)

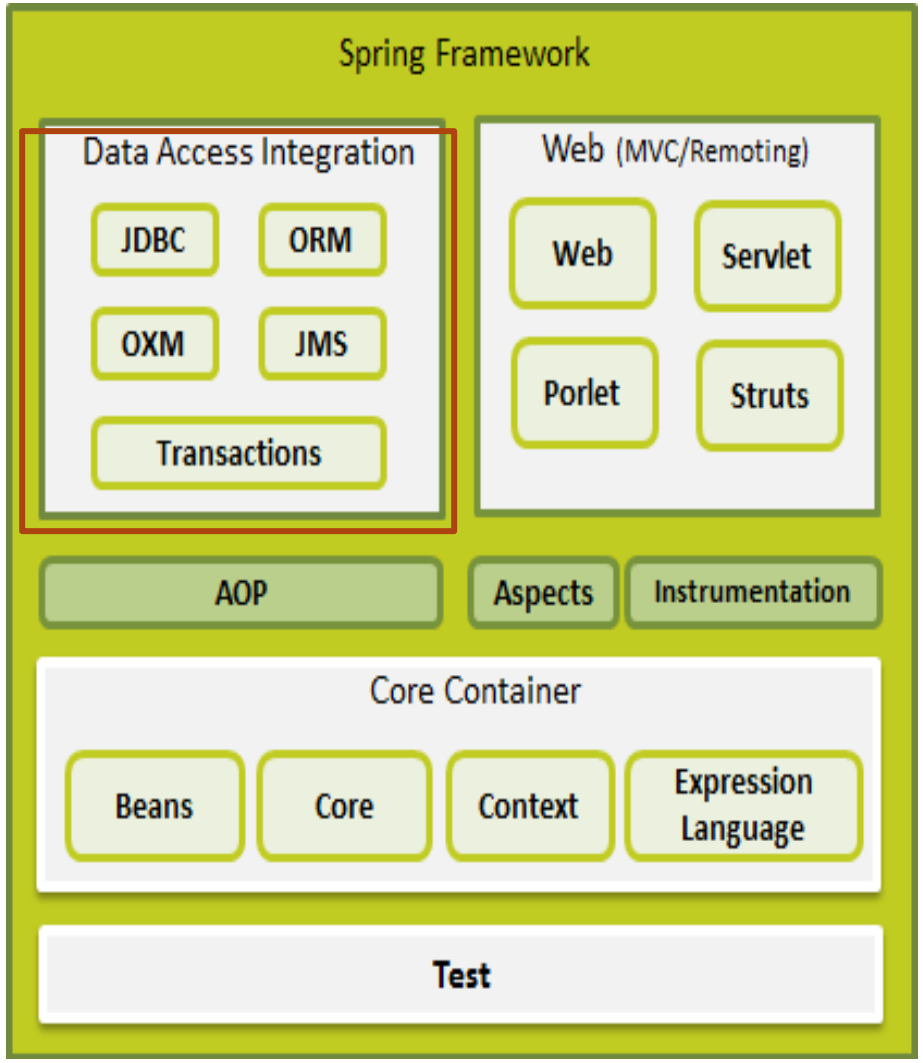
Spring Framework Architecture



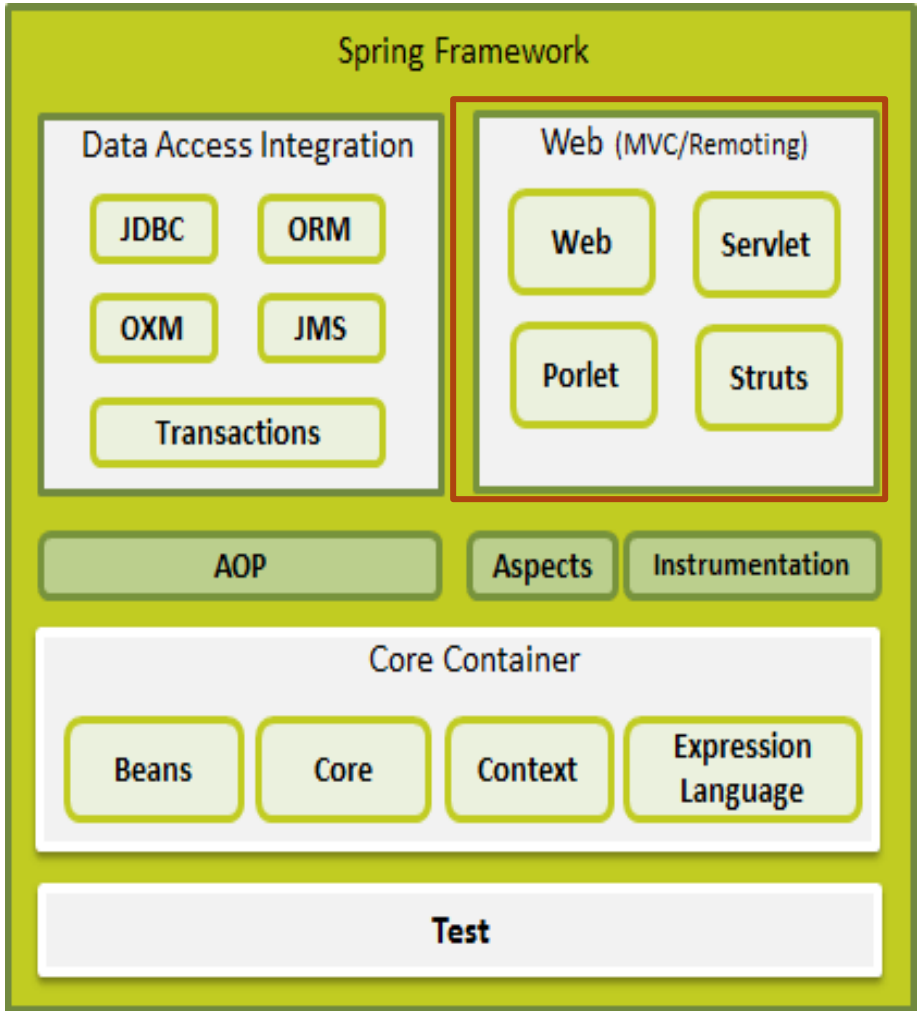
- **Context Module** builds on the solid base provided by the Core and Beans modules and it (medium to access any objects defined and configured)
  - ApplicationContext Container (Spring's more advanced container). This includes all functionality of BeanFactory. The most commonly used implementations are:
    - ***FileSystemXmlApplicationContext*** (loads definitions of the beans from an XML file. Need to provide full path of xml file)
    - ***ClassPathXmlApplicationContext*** loads definitions of the beans from an XML file. Does not need to provide the full path it will work with the xml file in the Classpath)
    - ***WebXmlApplicationContext***(loads the XML file with definitions of all beans from within a web application.)

Spring Framework Architecture

- The JDBC (provides a JDBC-abstraction layer that removes the need to JDBC related coding)
- The ORM (provides integration layers for popular object-relational mapping APIs, including JPA, JDO, Hibernate, and iBatis)
- The OXM provides an abstraction layer that supports Object/XML mapping implementations for JAXB, Castor, XMLBeans, JiBX and XStream.
- The Java Messaging Service (features for producing and consuming messages.)
- The Transaction module supports programmatic and declarative transaction management for classes that implement special interfaces and for all your POJOs.



Spring Framework Architecture



- The Web module provides
  - Basic web-oriented integration features (ie multipart file-upload functionality and the initialization of the IoC container using servlet listeners and a web-oriented application context.
- The Web-Servlet module contains Spring's MVC implementation for web applications.
- The Web-Struts module contains the support classes for integrating a classic Struts web tier within a Spring application.
- The Web-Portlet module provides the MVC implementation to be used in a portlet environment and mirrors the functionality of Web-Servlet module.

Dependency Injection (DI)

- Spring is most identified with **Dependency Injection (DI)** technology.
- DI is only one concrete example of Inversion of Control.
- In a complex Java application, classes should be loosely coupled. This feature provides code reuse and independently testing classes.
- DI helps in gluing loosely coupled classes together and at the same time keeping them independent.
- Using dependency injection helps to see easily what the component dependencies are.
- DI is preferable because it makes testing easier

Dependency Injection Types

- DI will be accomplished by given two ways:
  - *passing parameters* to the constructor (***used for mandatory dependencies***) or
  - using *setter methods*(***used for optional depenedencies***).

Constructor-based DI

- Constructor based DI occurs when the container invokes a class constructor with a number of arguments, each representing a dependency on other class.

Constructor-based DI (Plane.java)

```java
public class Plane {

    private RouteFinder routeChecker;


    public Plane (RouteFinder routeChecker) {
        System.out.println("Inside Plane Constructor" );
        this.routeChecker = routeChecker;
    }

    public void routeCheck() {
        routeChecker.findRoute();
    }

}
```

Constructor-based DI(RouteFinder.java)

```java

public class RouteFinder {

    public RouteFinder(){
        System.out.println("Inside RouteFinder's constructor");
    }

    public void findRoute() {
        System.out.println("Inside findRoute method in RouteFinder ");
    }
}
```

Constructor-based DI (RouteTest.java)

```java

import org.springframework.context.ApplicationContext;
import org.springframework.context.support.ClassPathXmlApplicationContext;

public class RouteTest {

    public static void main(String[] args) {

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

        Plane rc = (Plane) context.getBean("plane");

        rc.routeCheck();

    }

}
```

```
INFO: Pre-instantiating singletons in org.springframew
Inside RouteFinder's constructor
Inside Plane Constructor
Inside findRoute method in RouteFinder
```

Constructor-based DI(Beans.xml)

```
1
2  <?xml version="1.0" encoding="UTF-8"?>
3
4  <beans
5      xmlns="http://www.springframework.org/schema/beans"
6      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
7      xsi:schemaLocation="http://www.springframework.org/schema
8      /beans http://www.springframework.org/schema/beans/spring-beans-3.0.xsd">
9
10
11     <bean id="plane" class="Plane">
12           <constructor-arg ref="route"/>
13     </bean>
14
15
16     <bean id="route" class="RouteFinder"> </bean>
17
18   </beans>
19
```

Setter-based DI (Plane.java)

```java

public class Plane {

    private RouteFinder routeChecker;

    // a setter method to inject the dependency.
    public void setRoute(RouteFinder routeChecker) {
        System.out.println("Inside setRoute methon in Plane" );
        this.routeChecker = routeChecker;
    }

    // a getter method to return routeChecker
    public RouteFinder getRoute() {
        return routeChecker;
    }

    public void routeCheck() {
        routeChecker.findRoute();
    }
}
```

Setter-based DI(RouteFinder.java)

```
1
2  public class RouteFinder {
3
4      public RouteFinder(){
5          System.out.println("Inside RouteFinder's constructor");
6      }
7
8      public void findRoute() {
9          System.out.println("Inside findRoute method in RouteFinder ");
10     }
11 }
```

Setter-based DI (RouteTest.java)

```
1
2  import org.springframework.context.ApplicationContext;
3  import org.springframework.context.support.ClassPathXmlApplicationContext;
4
5  public class RouteTest {
6
7      public static void main(String[] args) {
8
9          ApplicationContext context =new ClassPathXmlApplicationContext("Beans.xml");
10
11         Plane rc = (Plane) context.getBean("plane");
12
13         rc.routeCheck();
14
15     }
16
17 }
```

```
Nov 16, 2012 12:20:36 AM org.springframev
INFO: Refreshing org.springframework.cont
Nov 16, 2012 12:20:36 AM org.springframev
INFO: Loading XML bean definitions from c
Nov 16, 2012 12:20:36 AM org.springframev
INFO: Pre-instantiating singletons in org
Inside RouteFinder's constructor
Inside setRoute methon in Plane
Inside findRoute method in RouteFinder
```

Setter-based DI(Beans.xml)

```
1
2  <?xml version="1.0" encoding="UTF-8"?>
3
4  <beans
5      xmlns="http://www.springframework.org/schema/beans"
6      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
7      xsi:schemaLocation="http://www.springframework.org/schema/beans
8      http://www.springframework.org/schema/beans/spring-beans-3.0.xsd">
9
10
11     <bean id="plane" class="Plane">
12           <property name="route" ref="route"/>
13     </bean>
14
15
16     <bean id="route" class="RouteFinder"> </bean>
17
18   </beans>
```

Conclusion

- The most popular application development framework for enterprise Java
- Spring Framework (Architecture) is modular and allows you to pick and choose modules that are applicable to your application.
- POJO's (plain old java object) are called 'beans' and those objects instantiated, managed, created by Spring IoC container.
- The Spring IoC container makes use of Java POJO classes and configuration metadata to produce a fully configured and executable system or application.
- DI helps in gluing loosely coupled classes together and at the same time keeping them independent.

Questions/Discussions

Q & A