Bean definition contains the information called **configuration metadata**, which is needed for the container to know the following −

* How to create a bean
* Bean's lifecycle details
* Bean's dependencies

All the above configuration metadata translates into a set of the following properties that make up each bean definition.

|  |  |
| --- | --- |
| **Sr.No.** | **Properties & Description** |
| 1 | **class**  This attribute is mandatory and specifies the bean class to be used to create the bean. |
| 2 | **name**  This attribute specifies the bean identifier uniquely. In XMLbased configuration metadata, you use the id and/or name attributes to specify the bean identifier(s). |
| 3 | **scope**  This attribute specifies the scope of the objects created from a particular bean definition and it will be discussed in bean scopes chapter. |
| 4 | **constructor-arg**  This is used to inject the dependencies and will be discussed in subsequent chapters. |
| 5 | **properties**  This is used to inject the dependencies and will be discussed in subsequent chapters. |
| 6 | **autowiring mode**  This is used to inject the dependencies and will be discussed in subsequent chapters. |
| 7 | **lazy-initialization mode**  A lazy-initialized bean tells the IoC container to create a bean instance when it is first requested, rather than at the startup. |
| 8 | **initialization method**  A callback to be called just after all necessary properties on the bean have been set by the container. It will be discussed in bean life cycle chapter. |
| 9 | **destruction method**  A callback to be used when the container containing the bean is destroyed. It will be discussed in bean life cycle chapter. |

Spring Configuration Metadata

Spring IoC container is totally decoupled from the format in which this configuration metadata is actually written. Following are the three important methods to provide configuration metadata to the Spring Container −

* XML based configuration file.
* Annotation-based configuration
* Java-based configuration

When defining a <bean> you have the option of declaring a scope for that bean. For example, to force Spring to produce a new bean instance each time one is needed, you should declare the bean's scope attribute to be **prototype**. Similarly, if you want Spring to return the same bean instance each time one is needed, you should declare the bean's scope attribute to be **singleton**.

The Spring Framework supports the following five scopes, three of which are available only if you use a web-aware ApplicationContext.

|  |  |
| --- | --- |
| **Sr.No.** | **Scope & Description** |
| 1 | **singleton**  This scopes the bean definition to a single instance per Spring IoC container (default). |
| 2 | **prototype**  This scopes a single bean definition to have any number of object instances. |
| 3 | **request**  This scopes a bean definition to an HTTP request. Only valid in the context of a web-aware Spring ApplicationContext. |
| 4 | **session**  This scopes a bean definition to an HTTP session. Only valid in the context of a web-aware Spring ApplicationContext. |
| 5 | **global-session**  This scopes a bean definition to a global HTTP session. Only valid in the context of a web-aware Spring ApplicationContext. |

In this chapter, we will discuss about the first two scopes and the remaining three will be discussed when we discuss about web-aware Spring ApplicationContext.

## The singleton scope

If a scope is set to singleton, the Spring IoC container creates exactly one instance of the object defined by that bean definition. This single instance is stored in a cache of such singleton beans, and all subsequent requests and references for that named bean return the cached object.

The default scope is always singleton. However, when you need one and only one instance of a bean, you can set the **scope**property to **singleton** in the bean configuration file, as shown in the following code snippet −

<!-- A bean definition with singleton scope -->

<bean id = "..." class = "..." scope = "singleton">

<!-- collaborators and configuration for this bean go here -->

</bean>

### Example

Let us have a working Eclipse IDE in place and take the following steps to create a Spring application −

|  |  |
| --- | --- |
| **Steps** | **Description** |
| 1 | Create a project with a name *SpringExample* and create a package *com.tutorialspoint* under the **src** folder in the created project. |
| 2 | Add required Spring libraries using *Add External JARs* option as explained in the *Spring Hello World Example* chapter. |
| 3 | Create Java classes *HelloWorld* and *MainApp* under the *com.tutorialspoint* package. |
| 4 | Create Beans configuration file *Beans.xml* under the **src** folder. |
| 5 | The final step is to create the content of all the Java files and Bean Configuration file and run the application as explained below. |

Here is the content of **HelloWorld.java** file −

package com.tutorialspoint;

public class HelloWorld {

private String message;

public void setMessage(String message){

this.message = message;

}

public void getMessage(){

System.out.println("Your Message : " + message);

}

}

Following is the content of the **MainApp.java** file −

package com.tutorialspoint;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class MainApp {

public static void main(String[] args) {

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

HelloWorld objA = (HelloWorld) context.getBean("helloWorld");

objA.setMessage("I'm object A");

objA.getMessage();

HelloWorld objB = (HelloWorld) context.getBean("helloWorld");

objB.getMessage();

}

}

Following is the configuration file **Beans.xml** required for singleton scope −

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

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

xmlns:xsi = "http://www.w3.org/2001/XMLSchema-instance"

xsi:schemaLocation = "http://www.springframework.org/schema/beans

http://www.springframework.org/schema/beans/spring-beans-3.0.xsd">

<bean id = "helloWorld" class = "com.tutorialspoint.HelloWorld" scope = "singleton">

</bean>

</beans>

Once you are done creating the source and bean configuration files, let us run the application. If everything is fine with your application, it will print the following message −

Your Message : I'm object A

Your Message : I'm object A

## The prototype scope

If the scope is set to prototype, the Spring IoC container creates a new bean instance of the object every time a request for that specific bean is made. As a rule, use the prototype scope for all state-full beans and the singleton scope for stateless beans.

To define a prototype scope, you can set the **scope** property to **prototype** in the bean configuration file, as shown in the following code snippet −

<!-- A bean definition with prototype scope -->

<bean id = "..." class = "..." scope = "prototype">

<!-- collaborators and configuration for this bean go here -->

</bean>

### Example

Let us have working Eclipse IDE in place and follow the following steps to create a Spring application −

|  |  |
| --- | --- |
| **Steps** | **Description** |
| 1 | Create a project with a name *SpringExample* and create a package *com.tutorialspoint* under the **src** folder in the created project. |
| 2 | Add required Spring libraries using *Add External JARs* option as explained in the *Spring Hello World Example* chapter. |
| 3 | Create Java classes *HelloWorld* and *MainApp* under the *com.tutorialspoint* package. |
| 4 | Create Beans configuration file *Beans.xml* under the **src** folder. |
| 5 | The final step is to create the content of all the Java files and Bean Configuration file and run the application as explained below. |

Here is the content of **HelloWorld.java** file

package com.tutorialspoint;

public class HelloWorld {

private String message;

public void setMessage(String message){

this.message = message;

}

public void getMessage(){

System.out.println("Your Message : " + message);

}

}

Following is the content of the **MainApp.java** file −

package com.tutorialspoint;

import org.springframework.context.ApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class MainApp {

public static void main(String[] args) {

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

HelloWorld objA = (HelloWorld) context.getBean("helloWorld");

objA.setMessage("I'm object A");

objA.getMessage();

HelloWorld objB = (HelloWorld) context.getBean("helloWorld");

objB.getMessage();

}

}

Following is the configuration file **Beans.xml** required for prototype scope −

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

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

xmlns:xsi = "http://www.w3.org/2001/XMLSchema-instance"

xsi:schemaLocation = "http://www.springframework.org/schema/beans

http://www.springframework.org/schema/beans/spring-beans-3.0.xsd">

<bean id = "helloWorld" class = "com.tutorialspoint.HelloWorld" scope = "prototype">

</bean>

</beans>

Once you are done creating the source and bean configuration files, let us run the application. If everything is fine with your application, it will print the following message −

Your Message : I'm object A

Your Message : null

The life cycle of a Spring bean is easy to understand. When a bean is instantiated, it may be required to perform some initialization to get it into a usable state. Similarly, when the bean is no longer required and is removed from the container, some cleanup may be required.

Though, there are lists of the activities that take place behind the scene between the time of bean Instantiation and its destruction, this chapter will discuss only two important bean life cycle callback methods, which are required at the time of bean initialization and its destruction.

To define setup and teardown for a bean, we simply declare the <bean> with **initmethod** and/or **destroy-method** parameters. The init-method attribute specifies a method that is to be called on the bean immediately upon instantiation. Similarly, destroymethod specifies a method that is called just before a bean is removed from the container.

## Initialization callbacks

The org.springframework.beans.factory.InitializingBean interface specifies a single method −

void afterPropertiesSet() throws Exception;

Thus, you can simply implement the above interface and initialization work can be done inside afterPropertiesSet() method as follows −

public class ExampleBean implements InitializingBean {

public void afterPropertiesSet() {

// do some initialization work

}

}

In the case of XML-based configuration metadata, you can use the **init-method** attribute to specify the name of the method that has a void no-argument signature. For example −

<bean id = "exampleBean" class = "examples.ExampleBean" init-method = "init"/>

Following is the class definition −

public class ExampleBean {

public void init() {

// do some initialization work

}

}

## Destruction callbacks

The *org.springframework.beans.factory.DisposableBean* interface specifies a single method −

void destroy() throws Exception;

Thus, you can simply implement the above interface and finalization work can be done inside destroy() method as follows −

public class ExampleBean implements DisposableBean {

public void destroy() {

// do some destruction work

}

}

In the case of XML-based configuration metadata, you can use the **destroy-method** attribute to specify the name of the method that has a void no-argument signature. For example −

<bean id = "exampleBean" class = "examples.ExampleBean" destroy-method = "destroy"/>

Following is the class definition −

public class ExampleBean {

public void destroy() {

// do some destruction work

}

}

If you are using Spring's IoC container in a non-web application environment; for example, in a rich client desktop environment, you register a shutdown hook with the JVM. Doing so ensures a graceful shutdown and calls the relevant destroy methods on your singleton beans so that all resources are released.

It is recommended that you do not use the InitializingBean or DisposableBean callbacks, because XML configuration gives much flexibility in terms of naming your method.

### Example

Let us have a working Eclipse IDE in place and take the following steps to create a Spring application −

|  |  |
| --- | --- |
| **Steps** | **Description** |
| 1 | Create a project with a name *SpringExample* and create a package *com.tutorialspoint* under the **src** folder in the created project. |
| 2 | Add required Spring libraries using *Add External JARs* option as explained in the *Spring Hello World Example* chapter. |
| 3 | Create Java classes *HelloWorld* and *MainApp* under the *com.tutorialspoint* package. |
| 4 | Create Beans configuration file *Beans.xml* under the **src** folder. |
| 5 | The final step is to create the content of all the Java files and Bean Configuration file and run the application as explained below. |

Here is the content of **HelloWorld.java** file −

package com.tutorialspoint;

public class HelloWorld {

private String message;

public void setMessage(String message){

this.message = message;

}

public void getMessage(){

System.out.println("Your Message : " + message);

}

public void init(){

System.out.println("Bean is going through init.");

}

public void destroy() {

System.out.println("Bean will destroy now.");

}

}

Following is the content of the **MainApp.java** file. Here you need to register a shutdown hook **registerShutdownHook()** method that is declared on the AbstractApplicationContext class. This will ensure a graceful shutdown and call the relevant destroy methods.

package com.tutorialspoint;

import org.springframework.context.support.AbstractApplicationContext;

import org.springframework.context.support.ClassPathXmlApplicationContext;

public class MainApp {

public static void main(String[] args) {

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

HelloWorld obj = (HelloWorld) context.getBean("helloWorld");

obj.getMessage();

context.registerShutdownHook();

}

}

Following is the configuration file **Beans.xml** required for init and destroy methods −

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

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

xmlns:xsi = "http://www.w3.org/2001/XMLSchema-instance"

xsi:schemaLocation = "http://www.springframework.org/schema/beans

http://www.springframework.org/schema/beans/spring-beans-3.0.xsd">

<bean id = "helloWorld" class = "com.tutorialspoint.HelloWorld" init-method = "init"

destroy-method = "destroy">

<property name = "message" value = "Hello World!"/>

</bean>

</beans>

Once you are done creating the source and bean configuration files, let us run the application. If everything is fine with your application, it will print the following message −

Bean is going through init.

Your Message : Hello World!

Bean will destroy now.

## Default initialization and destroy methods

If you have too many beans having initialization and/or destroy methods with the same name, you don't need to declare **init-method** and **destroy-method** on each individual bean. Instead, the framework provides the flexibility to configure such situation using **default-init-method** and **default-destroy-method** attributes on the <beans> element as follows −

<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-3.0.xsd"

default-init-method = "init"

default-destroy-method = "destroy">

<bean id = "..." class = "...">

<!-- collaborators and configuration for this bean go here -->

</bean>

</beans>

The second method of injecting dependency is through **Setter Methods** of the TextEditor class where we will create a SpellChecker instance. This instance will be used to call setter methods to initialize TextEditor's properties.

Thus, DI exists in two major variants and the following two sub-chapters will cover both of them with examples −

|  |  |
| --- | --- |
| **Sr.No.** | **Dependency Injection Type & Description** |
| 1 | [Constructor-based dependency injection](https://www.tutorialspoint.com/spring/constructor_based_dependency_injection.htm)  Constructor-based DI is accomplished when the container invokes a class constructor with a number of arguments, each representing a dependency on the other class. |
| 2 | [Setter-based dependency injection](https://www.tutorialspoint.com/spring/setter_based_dependency_injection.htm)  Setter-based DI is accomplished by the container calling setter methods on your beans after invoking a no-argument constructor or no-argument static factory method to instantiate your bean. |

You can mix both, Constructor-based and Setter-based DI but it is a good rule of thumb to use constructor arguments for mandatory dependencies and setters for optional dependencies.

The code is cleaner with the DI principle and decoupling is more effective when objects are provided with their dependencies. The object does not look up its dependencies and does not know the location or class of the dependencies, rather everything is taken care by the Spring Framework.

Autowiring Modes

Following are the autowiring modes, which can be used to instruct the Spring container to use autowiring for dependency injection. You use the autowire attribute of the <bean/> element to specify **autowire** mode for a bean definition.

|  |  |
| --- | --- |
| **Sr.No** | **Mode & Description** |
| 1 | **no**  This is default setting which means no autowiring and you should use explicit bean reference for wiring. You have nothing to do special for this wiring. This is what you already have seen in Dependency Injection chapter. |
| 2 | [byName](https://www.tutorialspoint.com/spring/spring_autowiring_byname.htm)  Autowiring by property name. Spring container looks at the properties of the beans on which *autowire* attribute is set to *byName* in the XML configuration file. It then tries to match and wire its properties with the beans defined by the same names in the configuration file. |
| 3 | [byType](https://www.tutorialspoint.com/spring/spring_autowiring_bytype.htm)  Autowiring by property datatype. Spring container looks at the properties of the beans on which *autowire* attribute is set to *byType* in the XML configuration file. It then tries to match and wire a property if its **type** matches with exactly one of the beans name in configuration file. If more than one such beans exists, a fatal exception is thrown. |
| 4 | [constructor](https://www.tutorialspoint.com/spring/spring_autowiring_byconstructor.htm)  Similar to byType, but type applies to constructor arguments. If there is not exactly one bean of the constructor argument type in the container, a fatal error is raised. |
| 5 | **autodetect**  Spring first tries to wire using autowire by *constructor*, if it does not work, Spring tries to autowire by *byType*. |

You can use **byType** or **constructor** autowiring mode to wire arrays and other typed-collections.

Limitations with autowiring

Autowiring works best when it is used consistently across a project. If autowiring is not used in general, it might be confusing for developers to use it to wire only one or two bean definitions. Though, autowiring can significantly reduce the need to specify properties or constructor arguments but you should consider the limitations and disadvantages of autowiring before using them.

|  |  |
| --- | --- |
| **Sr.No.** | **Limitations & Description** |
| 1 | **Overriding possibility**  You can still specify dependencies using <constructor-arg> and <property> settings which will always override autowiring. |
| 2 | **Primitive data types**  You cannot autowire so-called simple properties such as primitives, Strings, and Classes. |
| 3 | **Confusing nature**  Autowiring is less exact than explicit wiring, so if possible prefer using explict wiring. |