Mobiliser Platform – Foundation

Introduction to the Spring Framework

Spring Framework

What it is and Why it is Needed?

Spring Framework – High-level Description

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Whilst neither of the following are exclusive use cases, the Spring Framework is most often used:

- For Java application development on the Java Enterprise Edition platform (Java EE).
- As an alternative to the Enterprise Java Bean (EJB) model

Spring Framework

Managing Java Objects

Spring Framework: Object Definition 1/2

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The POJO `Rectangle` implements the `Shape` interface

```
// A specific Rectangle object that implement the Shape interface
public class Rectangle implements Shape {
  private double length, width;

  // Constructors – Spring needs a zero argument constructor!
  public Rectangle() {}
  public Rectangle(double length, double width) {
    setLength(length);
    setWidth(width);
  }

 // Implement getter and setter methods
  public double getLength() { return length; }
  public double getWidth()  { return width; }
  public void setLength(double length) { this.length = length; }
  public void setWidth(double width)   { this.width  = width; }

  // Implement interface method
  public double getArea() { return length * width; }
}
```

Spring Framework: Object Definition 2/2

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Here is a simple interface that defines a basic Shape object.

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// A generic interface for all shapes
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}
```

The POJO Circle also implements the Shape interface

```java
// A specific Circle object that implement the Shape interface
public class Circle implements Shape {
  private double radius;

  // Constructors - Spring needs a zero argument constructor!
  public Circle() {}
  public Circle(double radius) {
    setRadius(radius);
  }

 // Implement getter and setter methods
  public double getRadius() { return radius; }
  public void setRadius(double radius) { this.radius = radius; }

  // Implement interface method
  public double getArea() { return Math.PI * radius * radius; }
}
```

Spring Framework: Object Declaration

The definitions of the `Rectangle` and `Circle` objects are declared to the Spring Framework in a bean definition file call `applicationContext.xml`

```
<?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.xsd">

    <bean id="shape1" class="Rectangle">
        <property name="length" value="10"/>
        <property name="width" value="20"/>
    </bean>

    <bean id="shape2" class=”Circle">
        <constructor-arg value="10"/>
    </bean>
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The `Rectangle` class will be identified as `shape1` and instantiated using the zero-argument constructor.
The `length` and `width` properties are set by calling the setter methods

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    <bean id="shape2" class=”Circle">
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</beans>
```

The `Circle` class will be identified as shape2 and instantiated by passing the radius to the single argument constructor.

Spring Framework: Object Management

The `Rectangle` and `Circle` objects are then instantiated by the Spring Framework using the following coding:

```
import org.springframework.context.*;
import org.springframework.context.support.*;

public class ShapeTest {
  public static void main(String[] args) {
    ApplicationContext context = new ClassPathXmlApplicationContext("/applicationContext.xml");

    Shape rect = (Shape)context.getBean("shape1");
    Shape circ = (Shape)context.getBean("shape2");

    printInfo(rect);
    printInfo(circ);
  }

  private static void printInfo(Shape shape) {
    System.out.printf("Area of %s is %.2f%n", shape.getClass().getSimpleName(), shape.getArea());
  }
}
```

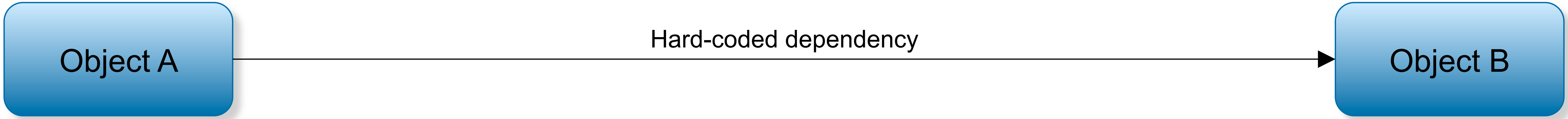
The `Rectangle` and `Circle` classes are instantiated using the identifiers declared in `applicationContext.xml`

Spring Framework

Dependency Injection and Inversion of Control

Dependency Injection

Dependency Injection is a software design pattern that allows you to remove hard-coded object dependencies from your application design.



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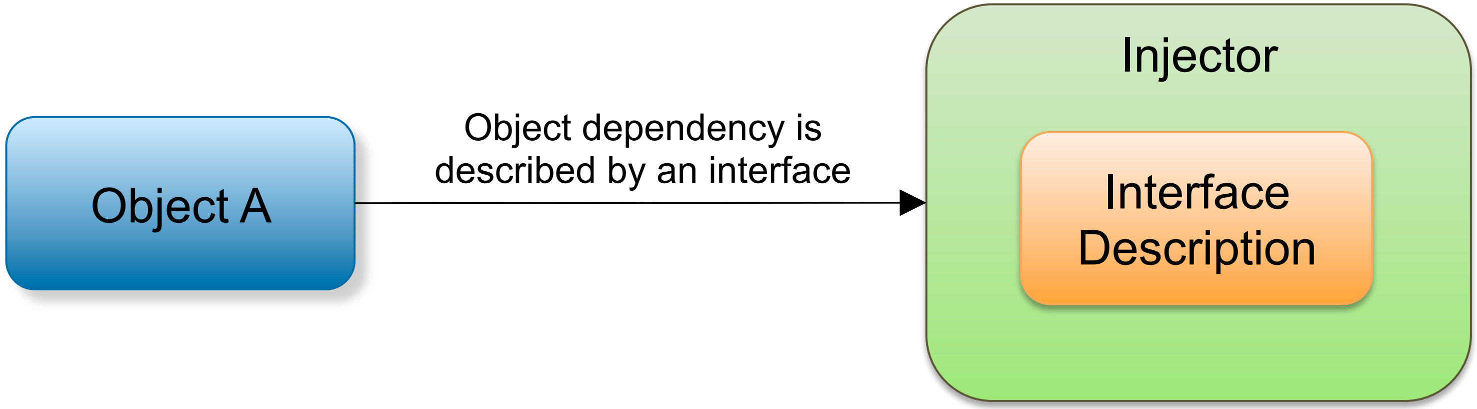

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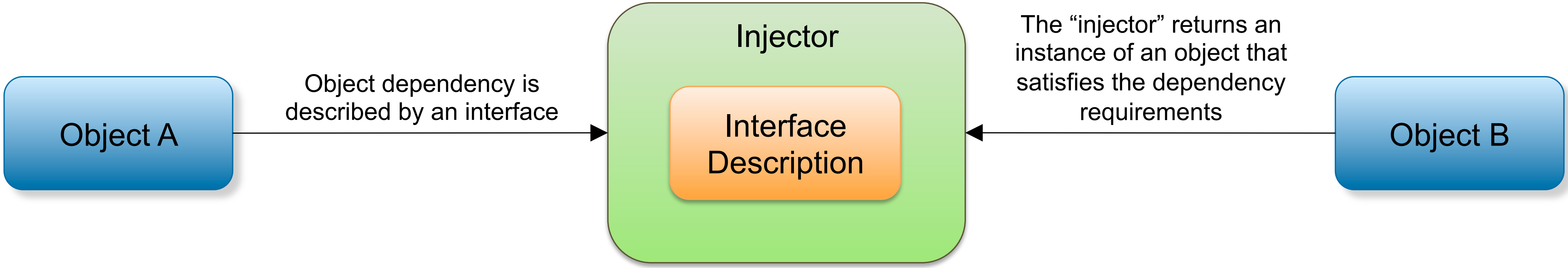
Object A
Object dependency is described by an interface
Injector
Interface Description
The “injector” returns an instance of an object that satisfies the dependency requirements
Object B

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Software frameworks that support dependency injection will provide an “Injector”.

The “Injector” performs dependency resolution and returns an instance of the correct object.

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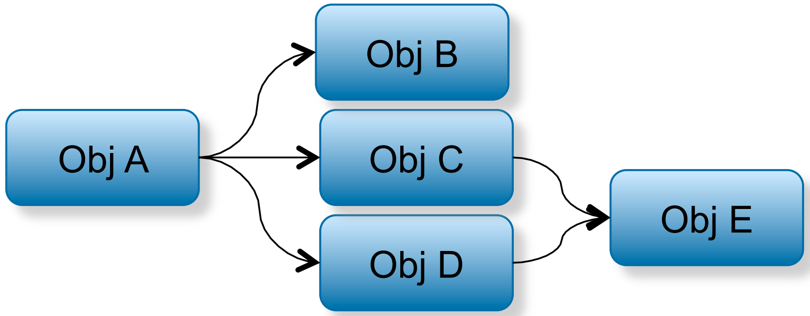

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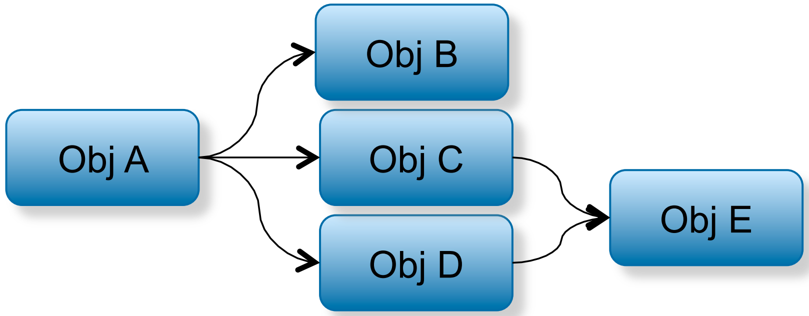

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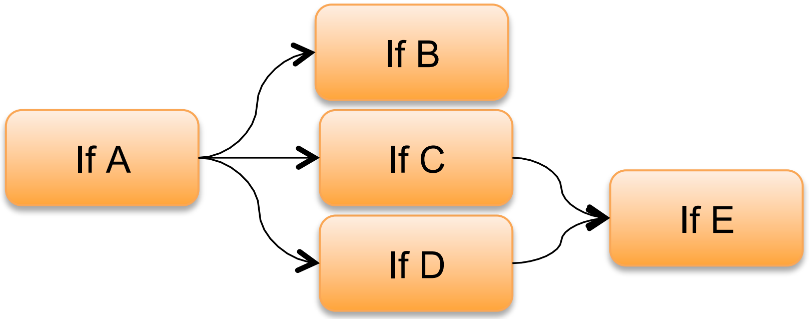

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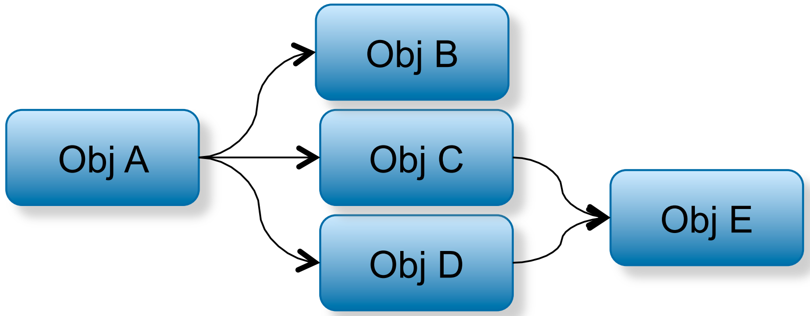
You are now said to have "inverted" the control and resolution of object dependencies, since using this dependency graph, any object that satisfies the stated interface requirements could be supplied as a runtime candidate.



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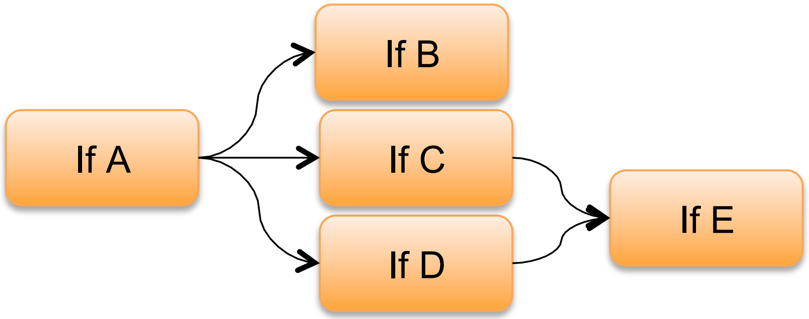

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Inversion of Control through Dependency Injection

Dependency Injection is the design pattern that abstracts the low level dependency between two units of code.

Inversion of Control is a programming paradigm that applies the Dependency Injection pattern to all the units of code in some large-scale unit such as an entire application.

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4. **Dynamic Module Replacement**

   If two modules both satisfy the same interface contract, then no side-effects are created by swapping one module for another at runtime. The dependent module is unaffected by such changes.

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- By means of the ***Dependency Injection*** pattern.

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Aspect Oriented Programming

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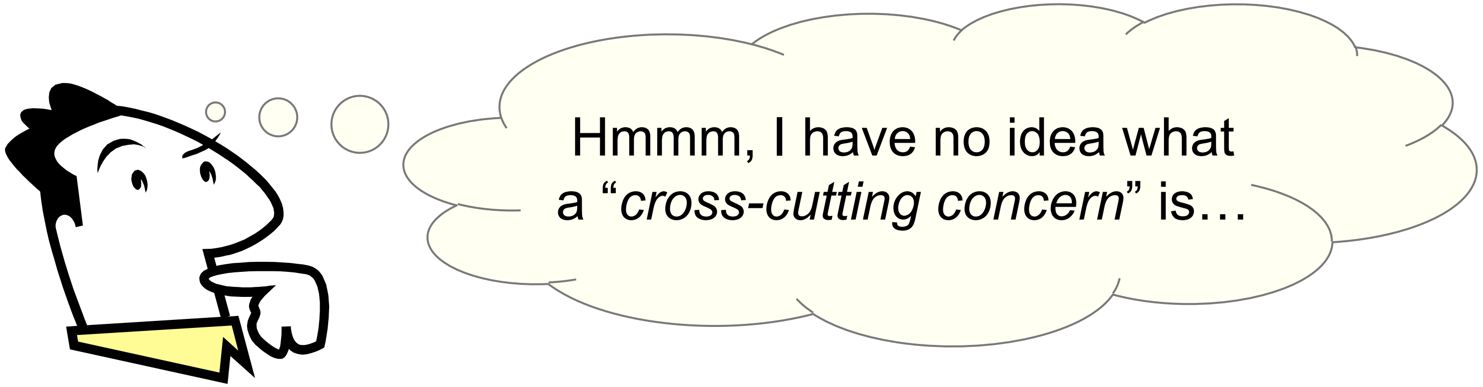

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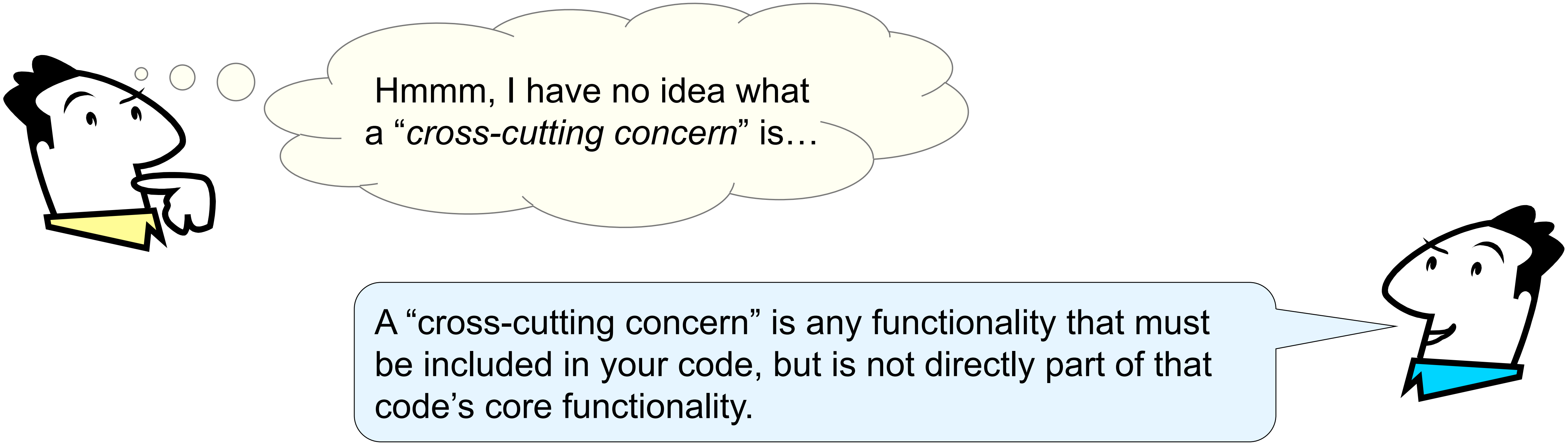
Hmmm, I have no idea what a "*cross-cutting concern*" is…
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Cross-Cutting Concerns: Examples

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However, from the larger perspective of managing a business application system, these tasks are all vitally necessary.

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Consequently, it is necessary to create a new programming paradigm in which cross-cutting code is separated into units known as ***Aspects***: hence the term Aspect Oriented Programming (AOP).

Cross-Cutting Concerns: Creating Aspects

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- ***Aspect***
  An "Aspect" is the union of an advice and a pointcut.

Spring Dynamic Modules

Managing OSGi bundles using the Spring Framework

Spring Dynamic Modules: Spring Framework + OSGi

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Therefore, if we use the Spring Framework to manage OSGi modules (a.k.a. bundles), then we arrive at a powerful set of tools for developing and managing OSGi bundles as if they were Java Beans.

Spring Dynamic Modules: Spring Framework + OSGi

Up until now, we have talked only about the Spring Framework as it is used to manage individual Java objects (known as Beans). However, Spring places no restrictions on what type of objects it can manage, or what type of programming model should be used.

Therefore, if we use the Spring Framework to manage OSGi modules (a.k.a. bundles), then we arrive at a powerful set of tools for developing and managing OSGi bundles as if they were Java Beans.

This is known as ***Spring Dynamic Modules*** *(or Spring DM)*.

See http://www.springsource.org/osgi for more details.

Spring Dynamic Module Overview 1/2

The combination of OSGi and the Spring Framework provides the following:

- Spring Framework JAR files as OSGi bundles
- Three additional Spring JAR files specific to OSGi
  - `org.springframework.osgi.bundle.extender`
  - `org.springframework.osgi.bundle.core`
  - `org.springframework.osgi.bundle.io`

Spring Dynamic Module Overview 2/2

When a Spring DM application starts, the following sequence of steps is performed:

Spring Dynamic Module Overview 2/2

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1. The `org.springframework.osgi.bundle.extender` queries all existing bundles in the `resolved` state to see which ones are “Spring-powered”. This means identifying which bundles contain either:
   - A line starting with `Spring-context` in `META-INF/MANIFEST.MF`
   - Any XML files in the JAR location `META-INF/spring`

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3. The `extender` checks to see if the bundle imports or exports any OSGi services. If so, exported services are published as Spring beans to the OSGi service registry and imported service dependencies are resolved.
4. The `extender` also registers a bundle listener to react should the bundle ever change back into the `resolved` state.

Summary

Spring Framework: Summary

The Spring Framework is an object factory that provides a runtime environment for the management of Java objects using Inversion of Control (implemented through Dependency Injection).

However, the Spring Framework is modular and provides additional functionality for:

- Aspect Oriented Programming
- Data Access (JDBC, Hibernate, JDO, Apache Cayenne etc.)
- Transaction Management
- Model-View-Controller
- Remote Access
- Authentication
- Messaging
- Remote Management
- Testing

Aspect Oriented Programming: Summary 1/2

Aspect Oriented Programming (AOP) is programming paradigm that separates cross-cutting concerns from core business functionality.

A cross-cutting concern is any type functionality needed for the successful running of an enterprise system, but in itself, is not the core business functionality performed by that system. For example:

- User authorization checks
- Logging
- Internationalization
- Memory Management
- Database Persistence

Aspect Oriented Programming: Summary 2/2

AOP focuses on identifying the "what" and the "when" of cross-cutting functionality. It then handles these units of code in a manner that integrates them with the core business functionality whilst at the same time, avoids them becoming tangled in it.

AOP Terminology

Advice: ***What*** needs to be done

Join Point: ***When*** it needs to be done

Pointcut: The set of join points related to a particular advice

Aspect: The combination of an Advice and a Pointcut

Spring Dynamic Modules: Summary

Spring Dynamic Modules (Spring DM) combines the object factory capabilities of the Spring Framework with the large scale bundles of business functionality defined in OSGi.

This allows us to develop and manage OSGi bundles as if they were Java Beans.

For a free eBook on Spring DM, visit http://it-ebooks.info/book/1907/

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