

# Aspect-Oriented Programming

- 1. Getting started with AOP
- 2. Simple AOP example
- 3. More AOP syntax

# 1. Getting Started with AOP

- What is AOP?
- How to utilize AOP
- AOP technologies
- Essential AOP concepts



#### What is AOP?

- AOP allows you to modularize cross-cutting concerns, such as:
  - Logging and tracing
  - Transaction management
  - Security
  - Error handling
- AOP allows you to define cross-cutting logic in one place...
  - Avoids code tangling
    - E.g. mixing security checks in with your real application logic
  - Avoids code scattering
    - E.g. security checks in every method



#### How to Utilize AOP

- 1 Implement your mainstream application logic
  - Focus on business rules, algorithms, etc.
- 2 Write aspects to implement cross-cutting concerns
  - Spring provides many predefined aspects
- 3 Weave the aspects into your application
  - Add the cross-cutting behaviours to the appropriate places



#### **AOP Technologies**

- AspectJ
  - The original AOP technology (first appeared in 1995)
  - Full-blown AOP language
  - Uses Java byte-code modification for aspect weaving
- Spring AOP (aka @AspectJ)
  - Annotation-based AOP framework for Spring
  - This is what you'll probably use when you use AOP in Spring apps
  - Uses subset of AspectJ expression syntax
  - Can use dynamic proxies for aspect weaving



#### **Essential AOP Concepts**

- Join point
  - A point in the execution of an application, e.g. a method call
- Pointcut
  - An (AspectJ) expression that selects one or more join points
- Advice
  - Code to execute at a join point that's selected by a pointcut
- Aspect
  - A class that encapsulates pointcuts and advice



## 2. Simple AOP Example

- Configuring Maven dependencies
- Defining a simple aspect
- Using named pointcuts
- Enabling @AspectJ support
- Accessing context information



#### Configuring Maven Dependencies

 Add the "Spring Boot Starter for AOP" dependency to your POM file:

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-aop</artifactId>
</dependency>
pom.xml
```



# Defining a Simple Aspect (1 of 2)

- Problem statement:
  - Log a message every time a property is about to change
  - Here's a sample class with some properties that might change...

```
public class MySampleClass implements MySampleInterface {
    public void setPropertyA(String value) {...}
    public void setPropertyB(int value) {...}
    ...
}

MySampleClass.java
```

- How can we define an aspect that runs before these methods are executed?
  - See following slide...



# Defining a Simple Aspect (2 of 2)

 Here's an aspect that runs before the "setter" methods in MySampleClass are executed

```
@Aspect
@Component
public class PropertySetTracker {

    @Before("execution(void MySampleClass.set*(*))")
    public void logPropertyChange() {
        System.out.println("A property is about to be set...");
    }
}

PropertySetTracker.java
```

- This is before advice
  - You can also define *after* advice and *around* advice see later



#### **Using Named Pointcuts**

 It's generally good practice to define named pointcuts, and apply them by name in join point(s)...

```
@Aspect
@Component
public class PropertySetTrackerV2 {

    @Pointcut("execution(void MySampleClass.set*(*))")
    public void setterMethodExecuted() {}

    @Before("setterMethodExecuted()")
    public void logPropertyChange() {
        System.out.println("A property is about to be set...");
    }
}

    PropertySetTrackerV2.java
```



## Enabling @AspectJ Support

You must enable @AspectJ support in your application

```
@SpringBootApplication
@EnableAspectJAutoProxy
public class Application {
    ...
}
Application.java
```



## Accessing Context Info (1 of 2)

- Advice methods can access context info
  - Declare JoinPoint param in advice method, and call getters...

JoinPoint getter	Description
getThis()	The currently executing object that has been intercepted (i.e. Spring dynamic proxy)
getTarget()	The target of the execution (typically your object)
getSignature()	The signature of the join point
getArgs()	The method arguments passed to the join point



## Accessing Context Info (2 of 2)

#### • Example:

```
@Aspect
@Component
public class AnotherPropertySetTracker {
   @Pointcut("execution(void MySampleClass.set*(*))")
   public void setterMethodExecuted() {}
   @Before("setterMethodExecuted()")
   public void logPropertyChange(JoinPoint jp) {
      System.out.println("Target: " + jp.getTarget() +
                         " Method: " + jp.getSignature().getName() +
                         " value: " + jp.getArgs()[0]);
```

AnotherPropertySetTracker.java



# 3. More AOP Syntax

- Separating pointcuts from aspects
- Formal syntax for execution pointcuts
- Combining pointcuts



#### Separating Pointcuts from Aspects

```
@Aspect @Component
public class MyAspect {

    @Before("MyPointcuts.callToMyBean()")
    public void logCallToBean() {
        System.out.println("***Call to bean");
    }

    @Before("MyPointcuts.withinMyBean()")
    public void logWithinBean() {
        System.out.println("***Within bean");
    }
}

    MyAspect.java
```

## Formal Syntax for Execution Pointcuts (1 of 2)

#### Formal syntax:

[Modifiers] ReturnType [ClassType] MethodName ([Args]) [throws ExcType]

#### Wildcards:

- \* Any return type, method name fragment, class name fragment, param
- . . Zero or more sub-packages, zero or more additional parameters



#### Formal Syntax for Execution Pointcuts (2 of 2)

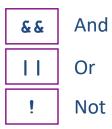
#### Discuss \(\frac{\text{\ti}\}\etx{\text{\tetx{\text{\text{\text{\text{\text{\text{\text{\text{\text{\text{\ti}\}\tittt{\text{\text{\text{\text{\text{\texi}\text{\text{\tex{\text{\texi}\text{\text{\texi}\text{\text{\texi}\titt{\text{\texi}\titt{\text{\texi}\tittt{\texitit}\\\ \tittt{\texittt{\text{\t

```
1) execution(void com.osl.MyBean.* (int))
2) execution(* send*(int))
3) execution(void send(*))
4) execution(void send(Date, ..))
5) execution(* com.osl..*.*(..))
6) execution(public * *(..))
7) execution(@org.spingframework.transaction.annotation.Transactional void *(..))
8) execution((@myannotationspackage.MyAnnotation *) *(..))
```



## **Combining Pointcut Expressions**

You can combine pointcut expressions using these operators:



#### • Example:



#### Summary

- Getting started with AOP
- Simple AOP example
- More AOP syntax

