Spring Core
Spring AOP

LUXOFT TRAINING

LXFT LISTED NYSE

AOP :: Example

- Look at the method to get user by id:

```
public class UserService {
  public UserDTO getUser(Integer id) {
     return userDAO.getUser(id);
  }
}
```

AOP :: Example

- Look at the method to get user by id:

```
public class UserService {
   public UserDTO getUser(Integer id) {
       return userDAO.getUser(id);
   }
}
```

- Add logging:

```
public UserDTO getUser(Integer id) {
   log.debug("Call method getUser with id " + id);
   UserDTO user = userDAO.getUser(id);
   log.debug("User info is: " + user.toString());
   return user;
}
```

AOP :: Example

- Add exception handling:

```
public UserDTO getUser(Integer id) throws ServiceException{
   log.debug("Call method getUser with id " + id);
   UserDTO user = null;
   UserDTO user = userDAO.getUser(id);
   try {
       user = userDAO.getUser(id);
   } catch(SQLException e) {
       throw new ServiceException(e);
   }

   log.debug("User info is: " + user.toString());
   return user;
}
```

AOP :: Example

- Add user rights check:

```
public UserDTO getUser(Integer id) throws ServiceException, AuthException{
   if (!SecurityContext.getUser().hasRight("getUser")) {
        throw new AuthException("Permission Denied");
   }

   log.debug("Call method getUser with id " + id);
   UserDTO user = null;
   UserDTO user = userDAO.getUser(id);

   try {
       user = userDAO.getUser(id);
   } catch(SQLException e) {
       throw new ServiceException(e);
   }

   log.debug("User info is: " + user.toString());
   return user;
}
```

AOP :: Example

- Add results caching:

```
public UserDTO getUser(Integer id) throws ServiceException, AuthException {
    …
    try {
        if (cache.contains(cacheKey)) {
            user = (UserDTO) cache.get(cacheKey);
        } else {
            user = userDAO.getUser(id);
            cache.put(cacheKey, user);
        }
    } catch(SQLException e) {
        throw new ServiceException(e);
    }
    log.debug("User info is: " + user.toString());
    return user;
}
```

AOP :: Example

- **What we get:**
  - Large amount of the service code
  - 16 lines instead of one, and the code continues to grow…

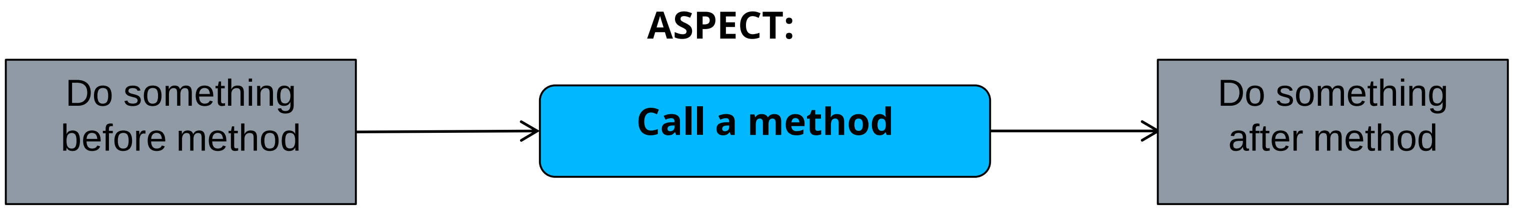
- **Types of orthogonal functionality:**
  - Logging
  - Exception handling
  - Transactions
  - Caching
  - User rights check
  - And many others...

- **Disadvantages of the service code inside the main code:**
  - The code size is growing
  - It’s more difficult to support
  - Code duplication

- **Solution:** use aspects

  ⇒ Take of the orthogonal functionality to the separate classes - aspects

How aspects work



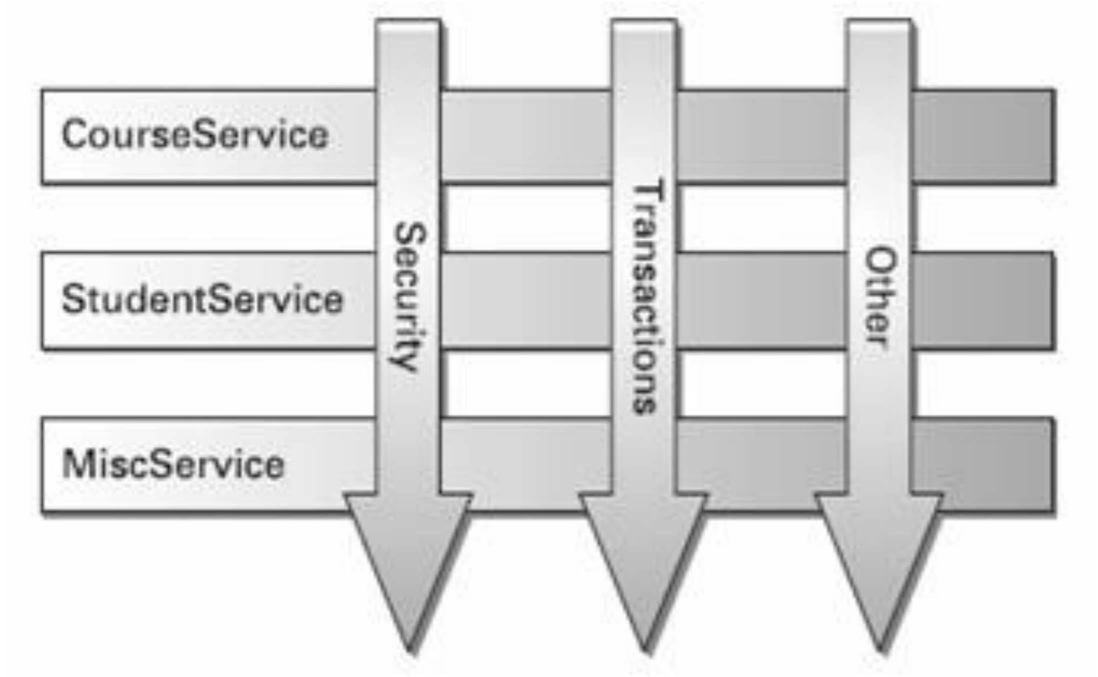
Add logging:

```
public UserDTO getUser(Integer id) {
   log.debug("Call method getUser with id " + id);  →  @Before advice
   UserDTO user = userDAO.getUser(id);
   log.debug("User info is: " + user.toString());  →  @After advice
   return user;
}
```

Logging aspect

AOP :: Introduction

- Aspect Oriented Programming (AOP)
- AOP gives means for implementing orthogonal (crosscutting) functionality



AOP :: Introduction

- How can we implement crosscutting logic in RDBMS?

AOP :: Introduction

- Example of crosscutting logging based on RDBMS triggers:

```
/* Table level triggers */
 CREATE OR REPLACE TRIGGER DistrictUpdatedTrigger
 AFTER UPDATE ON district
 BEGIN
  INSERT INTO info VALUES ('table "district" has changed');
 END;
```

AOP :: Logging advice example

```
@Aspect
public class LoggingAspect {
   private Logger logger = Logger.getLogger(LoggingAspect.class.getName());

  @Around("execution(* *.*User(..))")
  public Object log (ProceedingJoinPoint thisJoinPoint) throws Throwable {
         String methodName = thisJoinPoint.getSignature().getName();
         Object[] methodArgs = thisJoinPoint.getArgs();
         logger.info("Call method " + methodName + " with args " + methodArgs);
         Object result = thisJoinPoint.proceed();
         logger.info("Method " + methodName + " returns " + result);
         return result;
  }

}
```

AOP :: Logging advice example

```
<beans xmlns="http://www.springframework.org/schema/beans"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:aop="http://www.springframework.org/schema/aop"
    xsi:schemaLocation="http://www.springframework.org/schema/beans
       http://www.springframework.org/schema/beans/spring-beans-3.0.xsd
       http://www.springframework.org/schema/aop
       http://www.springframework.org/schema/aop/spring-aop-3.0.xsd">

   <aop:aspectj-autoproxy/>

   <bean id="userDao" class="UserDaoImpl"/>
   <bean id="loggingAspect" class = "LoggingAspect"/>
</beans>
```

AOP :: Logging advice example

```java
public interface UserDao {
  UserDTO getUser(int id);
}


public class UserDaoImpl implements UserDao {

   public UserDTO getUser(int id) {
       if (null != userDaoMap.get(id)) {
        return userDaoMap.get(id);
       }

       UserDTO user = new UserDTO(id);
       userDaoMap.put(id, user);
       return user;
   }

}
```

With the use of aspects we can automatically add:
- Logging
- Exception handling
- Transactions
- Caching
- User rights check
- And a lot more...

ex.1

AOP :: Example

```
@Aspect
public class LoggingAspect {
  @Pointcut("execution(* *.*User(..))")
  public void userMethod() { }

  @Around("userMethod() ")
 public Object log (
     ProceedingJoinPoint thisJoinPoint) {
     String methodName =
        thisJoinPoint.getSignature().getName();
     Object[] methodArgs =
        thisJoinPoint.getArgs();
     logger.debug("Call method " + methodName
               + " with args " + methodArgs);

     Object result = thisJoinPoint.proceed();
     logger.debug("Method " + methodName
               + " returns " + result);
     return result;
  }
```

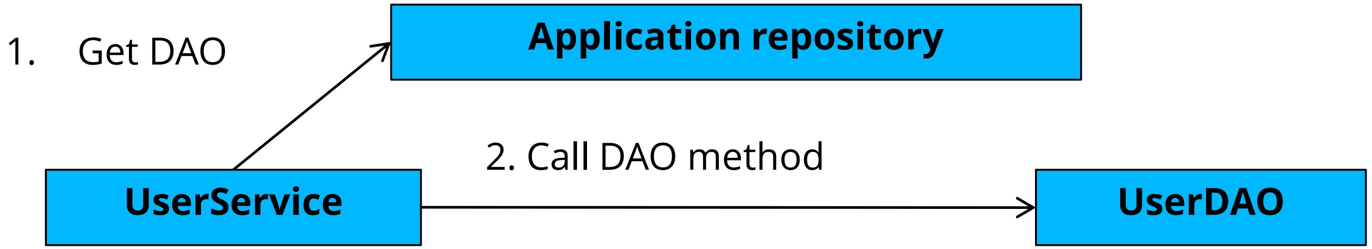
```
class UserDaoProxy implements UserDao {

  public UserDTO getUser(final Integer id)
  {
     Aspect logger = new LoggingAspect();
     ProceedingJoinPoint joinpoint =
              new ProceedingJoinPoint() {
       Object proceed() {
              return userDao.getUser(id);
       }
     };
     return logger.log(joinpoint);
  }
}
```

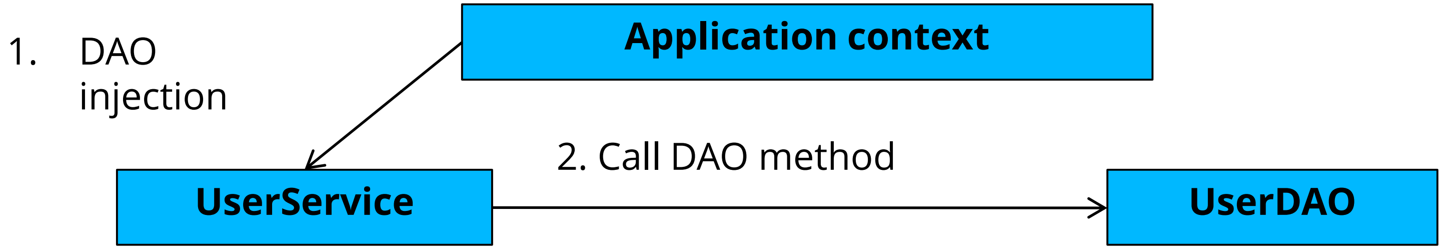
```
class UserDaoImpl implements UserDao {
  public UserDTO getUser(Integer id) {
     return userDAO.getUser(id);
  }
}
```

AOP :: Introduction

Working with DAO without IoC and AOP

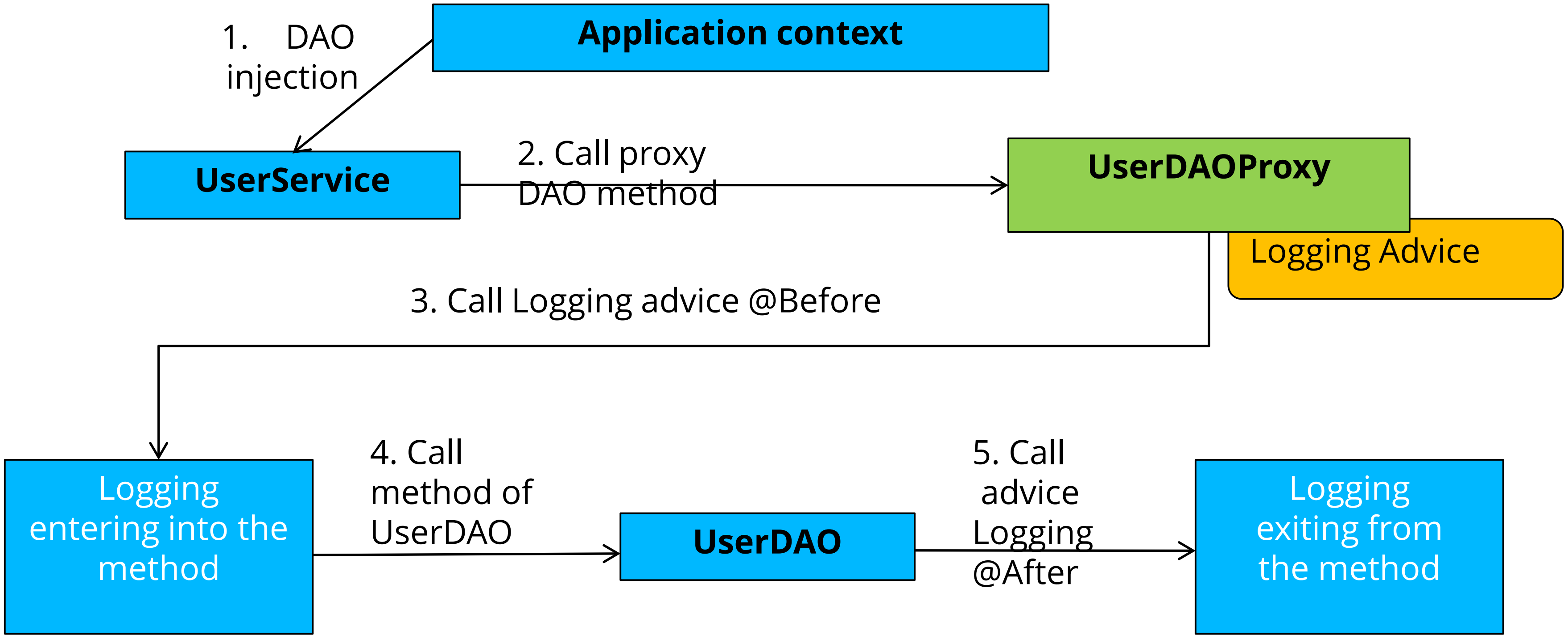


Working with DAO with IoC, but without AOP



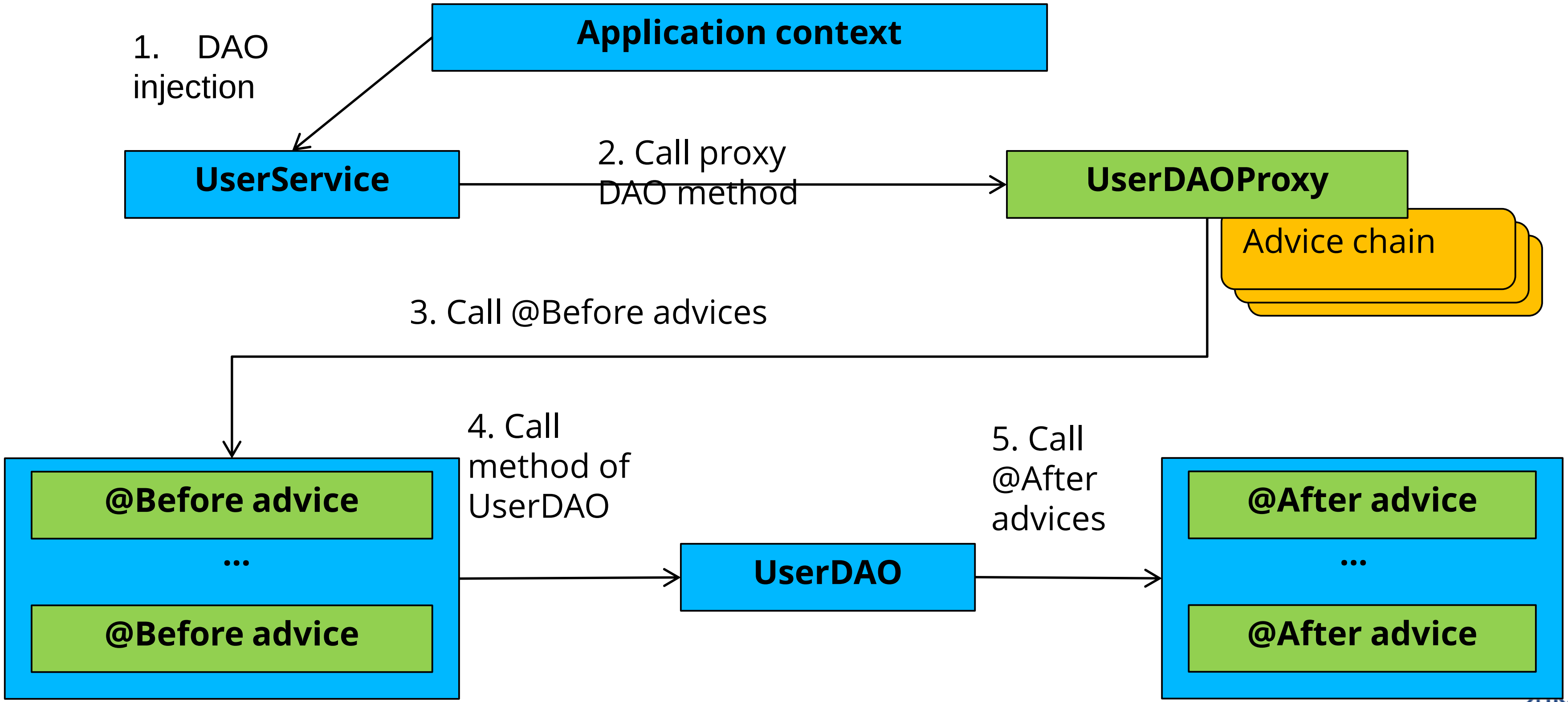
AOP :: Introduction

Working with DAO with IoC and AOP


Application context
1. DAO injection
UserService
2. Call proxy DAO method
UserDAOProxy
Logging Advice
3. Call Logging advice @Before
Logging entering into the method
4. Call method of UserDAO
UserDAO
5. Call advice Logging @After
Logging exiting from the method

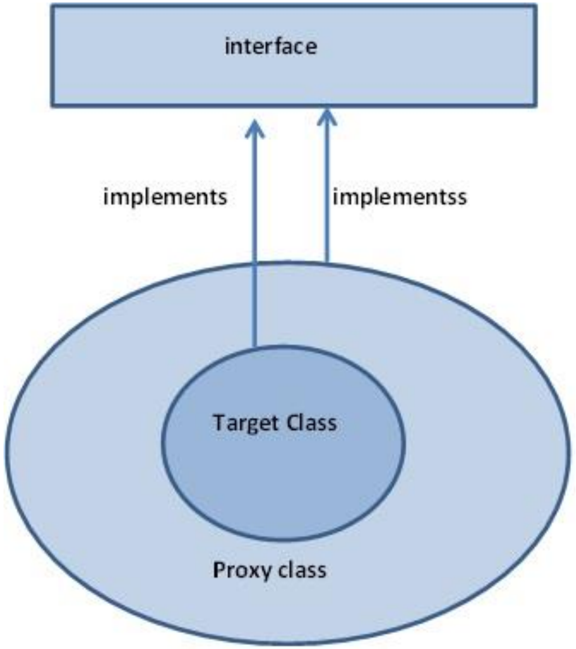
AOP :: Introduction

Working with DAO with IoC and AOP

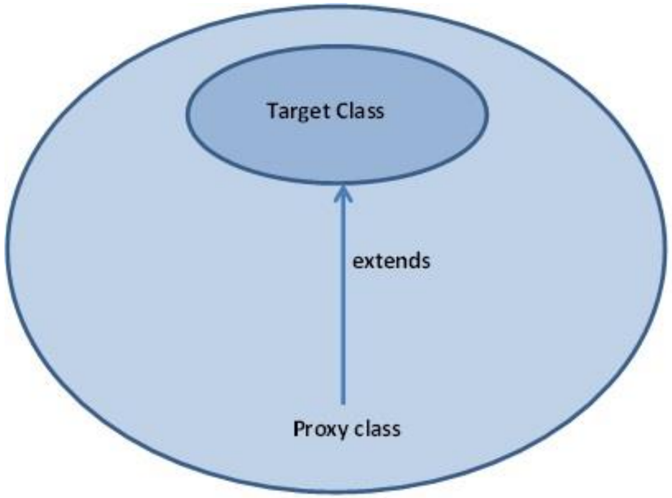


AOP :: Introduction

In Spring Framework AOP is implemented by creating proxy object for your service.

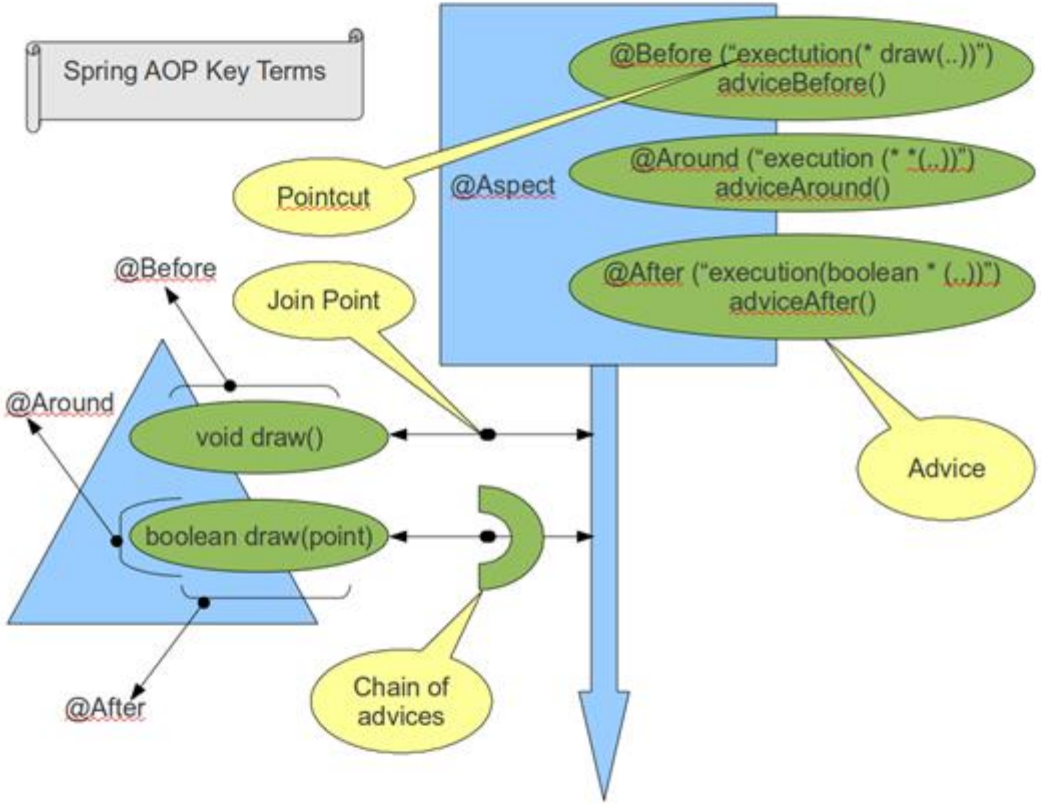


Standard mechanism of proxy creation from JSE (JDK dynamic proxy)



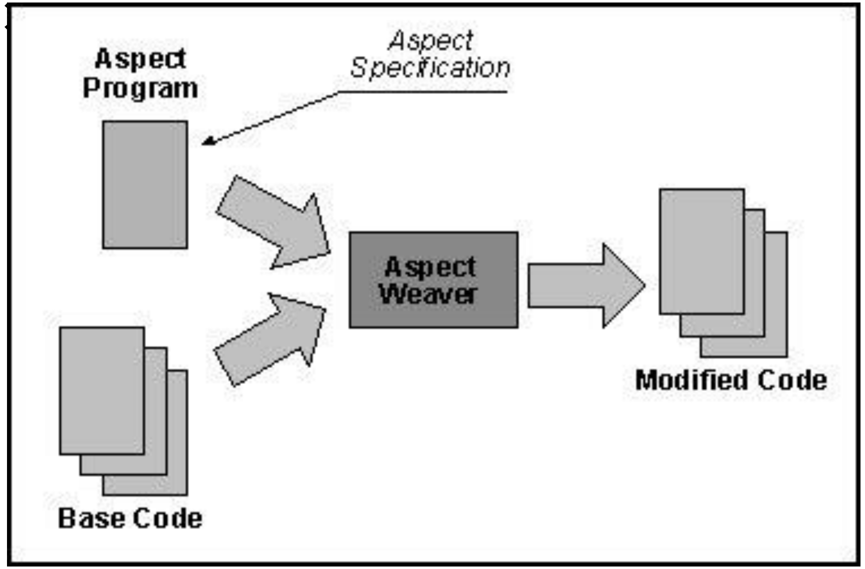
CGLIB proxy

AOP :: Key terms



AOP activation

- Weaving: applying the aspect to target object to create new proxy object;
- There are 2 additional dependencies to perform weaving:
  - aspectjrt.jar
  - aspectjweaver.jar
- Also you need to initiate the creation of dynamic proxies in the configuration file: `<aop:aspectj-autoproxy /`



AOP :: Pointcut language

execution – defines the pointcut on the base of method signature

execution(@CustomAnnotation? modifiers-pattern? **ret-type-pattern**

declaring-type-pattern?.**name-pattern(param-pattern)** throws-pattern?)

? – optional parameter

declaring-type-pattern - template for the method and class name

Examples:

- **execution (* *(..))** – pointcut attaches to any method with any signature;
- **execution (int *(..))** – pointcut attaches to any method returning int;
- **execution(* com.package.subpackage.Classname.*(..))** – attaches to every method of com.package.subpackage.Classname class;

AOP :: Pointcut language

- **execution (void Test.foo(int, String))** – pointcut attaches to foo() method of Test class, taking int and String as the parameters;
- **execution (* foo.bar.*.dao.*.update*(..))** – pointcut attaches to any method starting from «update» in package starting from foo.bar and ending on dao;

- **bean** – attach join points to some Spring bean (or set of beans)
  - **bean("*Bean")** – defines the jointpoint for all beans with id ending "Bean"
- **within** – attach join point to every method of some class
  - **within(com.package.subpackage.*)** – any join point (method execution only in Spring AOP) within the package com.package.subpackage
- **this** – matches the join points (the execution of methods when using Spring AOP) where the bean reference (Spring AOP proxy) is an instance of the given type

AOP :: Pointcut

- **this(com.package.InterfaceName)** – define join points to all methods in classes which implement the interface com.package.InterfaceName

- **target** – matches the join points (the execution of methods when using Spring AOP) where the target object (application object being proxied) is an instance of the given type
  - **target(com.package.InterfaceName)** – defines all mathods of the object which target object implements com.package.InterfaceName
- **args** – match the join points where the arguments are instances of the given types
  - **args(String)** – define methods with the single argument of String type
- **@annotation** - matching the join points where the subject of the join point (method being executed in Spring AOP) has the given annotation
  - **@annotation(com.package.annotation.Annotation) –** all the methods marked by annotation @Annotation
  - **@annotation(org.springframework.stereotype.Repository) –** all methods in repository

AOP :: Advice types

- @Around advice – surrounds the joinpoint
- Most powerful of all advices

```
@Around("@annotation(com.luxoft.springaop.example2.Log)")
public Object log (ProceedingJoinPoint thisJoinPoint) throws Throwable {
        String methodName = thisJoinPoint.getSignature().getName();
        Object[] methodArgs = thisJoinPoint.getArgs();
        logger.info("Call method " + methodName + " with args " +
                    methodArgs);
        Object result = thisJoinPoint.proceed();
        logger.info("Method " + methodName + " returns " + result);
        return result;
}
```

ex.2

AOP use cases

- Logging-related
- Security checks
- Transaction management
- Exception handling
- User-rights check
- Profiling

AOP :: Aspects grouping

```java
@Aspect
public class SystemArchitecture {

   @Pointcut("within(com.xyz.someapp.web..*)")
   public void inWebLayer() {}

   @Pointcut("within(com.xyz.someapp.service..*)")
   public void inServiceLayer() {}

   @Pointcut("within(com.xyz.someapp.dao..*)")
   public void inDataAccessLayer() {}

   @Pointcut("execution(* com.xyz.someapp.dao.*.*(..))")
   public void dataAccessOperation() {}

}
```

AOP :: Pointcut combining

Combining pointcut expressions:

```
@Pointcut("execution(public * *(..))")
private void anyPublicOperation() {}

@Pointcut("within(com.xyz.someapp.trading..*")
private void inTrading() {}

@Pointcut("anyPublicOperation() && inTrading()")
private void tradingOperation() {}
```

AOP :: Advice types

- Can decide, should we execute joinpoint or return its own result:

```
@Around("com.luxoft.example.SystemArchitecture.businessService()")
public Object accessRightsCheck(ProceedingJoinPoint pjp) throws Throwable
{

  if (currentUser.hasRights()) {
      return pjp.proceed();
  } else {
      throw new AuthorizationException();
  }

  return null;

}
```

AOP :: Use of @AfterThrowing

```
@Aspect
public class AfterThrowingExample {

    @AfterThrowing(
        pointcut="com.luxoft.example.SystemArchitecture.dataAccessOperation()",
        throwing="ex")
   public void doRecoveryActions(DataAccessException ex) {
   // ...
   }
}
```

- There is no way to return to the calling method or continue processing on the subsequent line
- If you handle the exception here, it won't prevent it to bubble up the chain

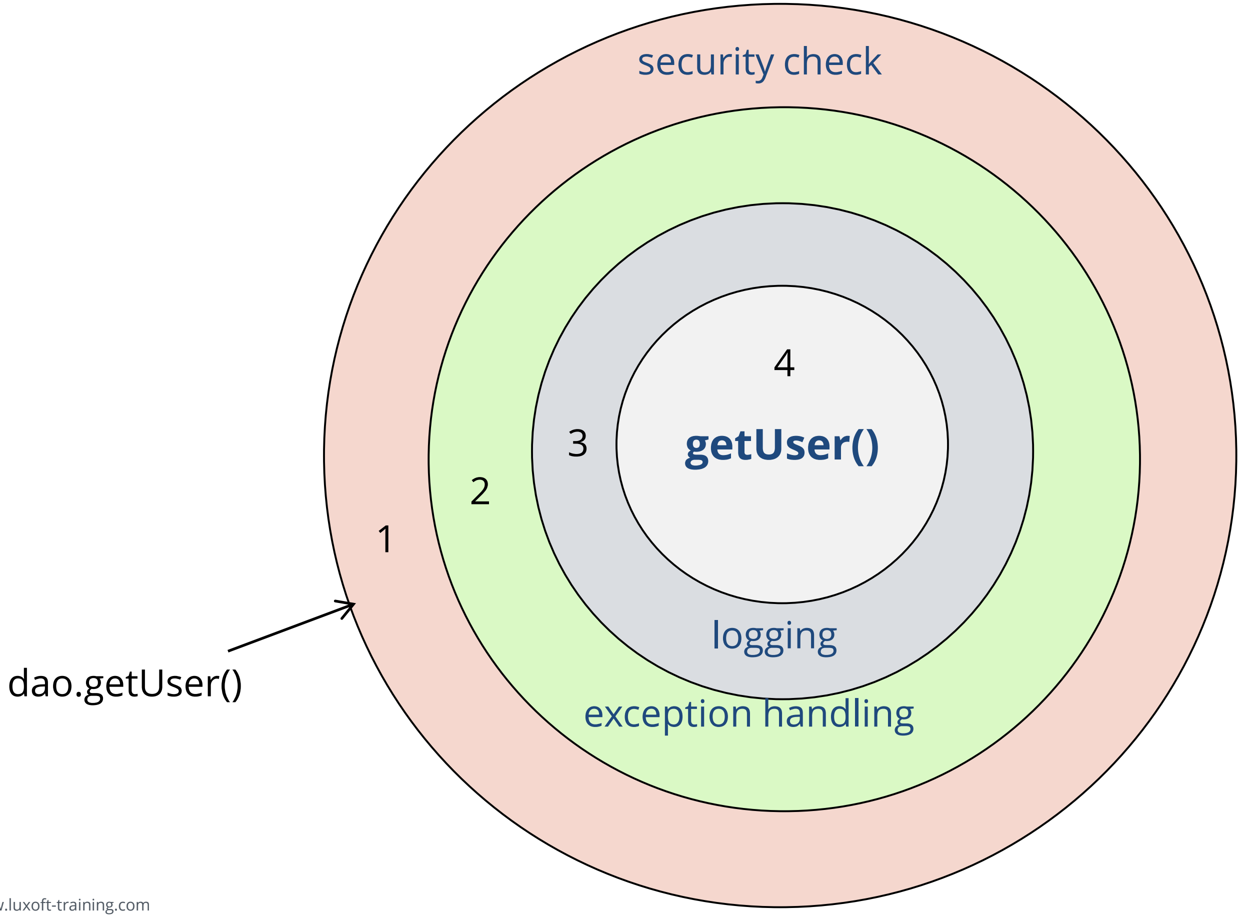
ex.3

AOP :: Advice types summary

@Before – executed before joinpoint
There’s no possibility not to execute joinpoint, except for throw an exception
@Around – executed before and after joinpoint

@AfterReturning – after success joinpoint execution – method is finished without exception
@AfterThrowing – in case of exception in joinpoint
@After – executed after the joinpoint

AOP :: Aspects chaining



Matryoshka doll

AOP :: @Order

The order of aspects execution can be defined with use of `@Order` annotation:

```
@Aspect
@Order(1)
public class AspectA
{
  @Before("............")
  public void doIt() {}
}

@Aspect
@Order(2)
public class AspectB
{
  @Before(".............")
  public void doIt() {}
}
```

The order of advices in the aspect are defined by its order in the aspect source code. ex.4

Exercise

Lab guide:

- Exercise 4