Spring基于注解驱动开发的事务控制配置，只需要把 xml 配置部分改为注解实现。只是需要一个注解替换掉xml配置文件中的 `<tx:annotation-driven transaction-manager="transactionManager"/>` 配置。

在 Spring 的配置类上添加 @EnableTransactionManagement 注解即可

```
@EnableTransactionManagement//开启spring注解事务的支持
public class SpringConfiguration {
}
```

第七部分 Spring AOP源码深度剖析

第1节 代理对象创建

1.1 AOP基础用例准备

Bean定义

```
@Component
public class LagouBean {

    public void tech(){
        System.out.println("java learning......");
    }
}
```

Aspect定义

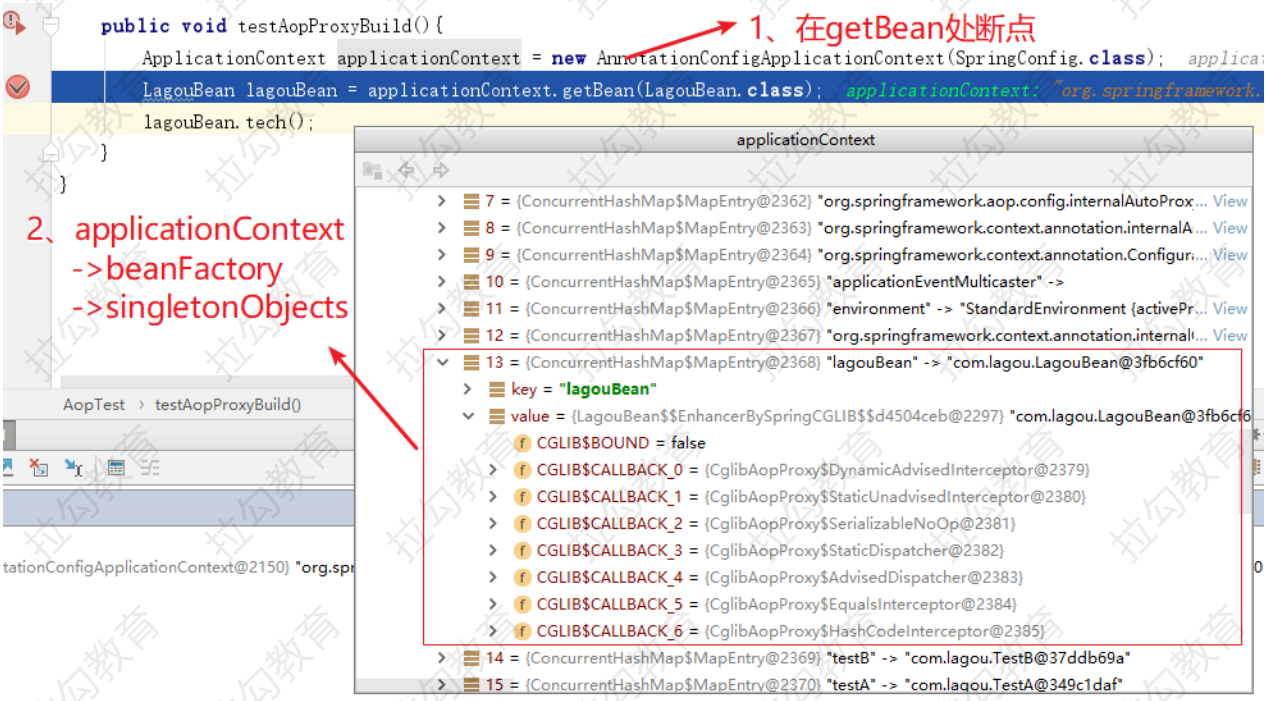
```
package com.lagou;

import org.aspectj.lang.annotation.Aspect;
import org.aspectj.lang.annotation.Before;
import org.aspectj.lang.annotation.Pointcut;
import org.springframework.stereotype.Component;

@Component
@Aspect
public class LagouAspect {
    @Pointcut("execution(* com.lagou.*.*(..))")
    public void pointcut(){
    }

    @Before("pointcut()")
    public void before() {
        System.out.println("before method ......");
    }
```

```
}
```

测试用例

```
/**
 *  测试用例：Aop 代理对象创建
 */
@Test
public void testAopProxyBuild(){
    ApplicationContext applicationContext = new
AnnotationConfigApplicationContext(SpringConfig.class);
    LagouBean lagouBean = applicationContext.getBean(LagouBean.class);
    lagouBean.tech();
}
```

1.2 时机点分析



我们发现在 getBean 之前，LagouBean对象已经产生（即在第一行初始化代码中完成），而且该对象是一个代理对象（Cglib代理对象），我们断定，容器初始化过程中目标Ban已经完成了代理，返回了代理对象。

1.3 代理对象创建流程

AbstractAutowireCapableBeanFactory#initializeBean(java.lang.String, java.lang.Object, org.springframework.beans.factory.support.RootBeanDefinition)

```
/**
    *
    * 初始化Bean
        包括Bean后置处理器初始化
        Bean的一些初始化方法的执行init-method
```

```
        Bean的实现的声明周期相关接口的属性注入
    */
protected Object initializeBean(final String beanName, final Object bean,
@Nullable RootBeanDefinition mbd) {
    // 执行所有的AwareMethods
    if (System.getSecurityManager() != null) {
        AccessController.doPrivileged((PrivilegedAction<Object>) () -> {
            invokeAwareMethods(beanName, bean);
            return null;
        }, getAccessControlContext());
    }
    else {
        invokeAwareMethods(beanName, bean);
    }

    Object wrappedBean = bean;
    if (mbd == null || !mbd.isSynthetic()) {
        // 执行所有的BeanPostProcessor#postProcessBeforeInitialization  初始化之前
的处理器方法
        wrappedBean = applyBeanPostProcessorsBeforeInitialization(wrappedBean,
beanName);
    }

    try {
        // 这里就开始执行afterPropertiesSet（实现了InitializingBean接口）方法和
initMethod
        invokeInitMethods(beanName, wrappedBean, mbd);
    }
    catch (Throwable ex) {
        throw new BeanCreationException(
            (mbd != null ? mbd.getResourceDescription() : null),
            beanName, "Invocation of init method failed", ex);
    }
    if (mbd == null || !mbd.isSynthetic()) {
        // 整个Bean初始化完成，执行后置处理器方法
        wrappedBean = applyBeanPostProcessorsAfterInitialization(wrappedBean,
beanName);
    }

    return wrappedBean;
}
```

AbstractAutowireCapableBeanFactory#applyBeanPostProcessorsAfterInitialization

```
@Override
  public Object applyBeanPostProcessorsAfterInitialization(Object
existingBean, String beanName)
      throws BeansException {
```

```
    Object result = existingBean;
        // 循环执行后置处理器
    for (BeanPostProcessor processor : getBeanPostProcessors()) {
      Object current = processor.postProcessAfterInitialization(result,
beanName);
      if (current == null) {
        return result;
      }
      result = current;
    }
    return result;
  }
```

创建代理对象的后置处理器AbstractAutoProxyCreator#postProcessAfterInitialization

```
/**
   * Create a proxy with the configured interceptors if the bean is
   * identified as one to proxy by the subclass.
   * @see #getAdvicesAndAdvisorsForBean
   */
  @Override
public Object postProcessAfterInitialization(@Nullable Object bean, String
beanName) {
    if (bean != null) {
            // 检查下该类是否已经暴露过了（可能已经创建了，比如A依赖B时，创建A时候，就会先
去创建B。
            // 当真正需要创建B时，就没必要再代理一次已经代理过的对象），避免重复创建
      Object cacheKey = getCacheKey(bean.getClass(), beanName);
      if (this.earlyProxyReferences.remove(cacheKey) != bean) {
        return wrapIfNecessary(bean, beanName, cacheKey);
      }
    }
    return bean;
  }
```

AbstractAutoProxyCreator#wrapIfNecessary

```
/**
```

```
   * Wrap the given bean if necessary, i.e. if it is eligible for being
proxied.
   * @param bean the raw bean instance
   * @param beanName the name of the bean
   * @param cacheKey the cache key for metadata access
   * @return a proxy wrapping the bean, or the raw bean instance as-is
   */
  protected Object wrapIfNecessary(Object bean, String beanName, Object
cacheKey) {
    // targetSourcedBeans包含，说明前面创建过
        if (StringUtils.hasLength(beanName) &&
this.targetSourcedBeans.contains(beanName)) {
      return bean;
    }
    if (Boolean.FALSE.equals(this.advisedBeans.get(cacheKey))) {
      return bean;
    }
    if (isInfrastructureClass(bean.getClass()) || shouldSkip(bean.getClass(),
beanName)) {
      this.advisedBeans.put(cacheKey, Boolean.FALSE);
      return bean;
    }

    // Create proxy if we have advice.
        // 得到所有候选Advisor，对Advisors和bean的方法双层遍历匹配，最终得到一个
List<Advisor>，即specificInterceptors
    Object[] specificInterceptors =
getAdvicesAndAdvisorsForBean(bean.getClass(), beanName, null);
    if (specificInterceptors != DO_NOT_PROXY) {
      this.advisedBeans.put(cacheKey, Boolean.TRUE);
            // 重点，创建代理对象
      Object proxy = createProxy(
          bean.getClass(), beanName, specificInterceptors, new
SingletonTargetSource(bean));
      this.proxyTypes.put(cacheKey, proxy.getClass());
      return proxy;
    }

    this.advisedBeans.put(cacheKey, Boolean.FALSE);
    return bean;
  }
```

AbstractAutoProxyCreator#createProxy

```
/**
   * Create an AOP proxy for the given bean.
   * 为指定 bean 创建代理对象
   */
  protected Object createProxy(Class<?> beanClass, @Nullable String beanName,
```

```
      @Nullable Object[] specificInterceptors, TargetSource targetSource) {

    if (this.beanFactory instanceof ConfigurableListableBeanFactory) {
      AutoProxyUtils.exposeTargetClass((ConfigurableListableBeanFactory)
this.beanFactory, beanName, beanClass);
    }
    // 创建代理的工作交给ProxyFactory
    ProxyFactory proxyFactory = new ProxyFactory();
    proxyFactory.copyFrom(this);

      // 根据一些情况判断是否要设置proxyTargetClass=true
    if (!proxyFactory.isProxyTargetClass()) {
      if (shouldProxyTargetClass(beanClass, beanName)) {
        proxyFactory.setProxyTargetClass(true);
      }
      else {
        evaluateProxyInterfaces(beanClass, proxyFactory);
      }
    }

      // 把指定和通用拦截对象合并, 并都适配成Advisor
    Advisor[] advisors = buildAdvisors(beanName, specificInterceptors);
    proxyFactory.addAdvisors(advisors);
    // 设置参数
      proxyFactory.setTargetSource(targetSource);
    customizeProxyFactory(proxyFactory);

    proxyFactory.setFrozen(this.freezeProxy);
    if (advisorsPreFiltered()) {
      proxyFactory.setPreFiltered(true);
    }
    // 上面准备做完就开始创建代理
    return proxyFactory.getProxy(getProxyClassLoader());
  }
```

接着跟进到ProxyFactory中

```
public class ProxyFactory extends ProxyCreatorSupport {

  public Object getProxy(ClassLoader classLoader) {
    // 用ProxyFactory创建AopProxy, 然后用AopProxy创建Proxy, 所以这里重要的是看获取的
AopProxy
    // 对象是什么,
    // 然后进去看怎么创建动态代理, 提供了两种: jdk proxy, cglib
    return createAopProxy().getProxy(classLoader);
  }
}
```

```
public class ProxyCreatorSupport extends AdvisedSupport {
  private AopProxyFactory aopProxyFactory;

  public ProxyCreatorSupport() {
    this.aopProxyFactory = new DefaultAopProxyFactory();
  }

  protected final synchronized AopProxy createAopProxy() {
    if (!this.active) {
      activate();
    }
    //先获取创建AopProxy的工厂，再由此创建AopProxy
    return getAopProxyFactory().createAopProxy(this);
  }

  public AopProxyFactory getAopProxyFactory() {
    return this.aopProxyFactory;
  }
}
```

流程就是用AopProxyFactory创建AopProxy, 再用AopProxy创建代理对象，这里的AopProxyFactory默认是DefaultAopProxyFactory，看他的createAopProxy方法

```
public class DefaultAopProxyFactory implements AopProxyFactory, Serializable {

  @Override
  public AopProxy createAopProxy(AdvisedSupport config) throws
AopConfigException {
    if (config.isOptimize() || config.isProxyTargetClass() ||
hasNoUserSuppliedProxyInterfaces(config)) {
      Class<?> targetClass = config.getTargetClass();
      if (targetClass == null) {
        throw new AopConfigException("TargetSource cannot determine target
class: "
            + "Either an interface or a target is required for proxy
creation.");
      }
      if (targetClass.isInterface()) {
        return new JdkDynamicAopProxy(config);
      }
      return new ObjenesisCglibAopProxy(config);
    } else {
      return new JdkDynamicAopProxy(config);
    }
  }

  /**
   * Determine whether the supplied {@link AdvisedSupport} has only the
   * {@link org.springframework.aop.SpringProxy} interface specified (or no
```

```
     * proxy interfaces specified at all).
     */
    private boolean hasNoUserSuppliedProxyInterfaces(AdvisedSupport config) {
      Class<?>[] interfaces = config.getProxiedInterfaces();
      return (interfaces.length == 0 || (interfaces.length == 1 &&
SpringProxy.class.equals(interfaces[0])));
    }
}
```

这里决定创建代理对象是用JDK Proxy，还是用 Cglib 了，最简单的从使用方面使用来说：设置 proxyTargetClass=true强制使用Cglib 代理，什么参数都不设并且对象类实现了接口则默认用JDK 代理，如果没有实现接口则也必须用Cglib

ProxyFactory#getProxy(java.lang.ClassLoader)

------ CglibAopProxy#getProxy(java.lang.ClassLoader)

```
@Override
    public Object getProxy(@Nullable ClassLoader classLoader) {
      if (logger.isTraceEnabled()) {
        logger.trace("Creating CGLIB proxy: " + this.advised.getTargetSource());
      }

      try {
        Class<?> rootClass = this.advised.getTargetClass();
        Assert.state(rootClass != null, "Target class must be available for
creating a CGLIB proxy");

        Class<?> proxySuperClass = rootClass;
        if (ClassUtils.isCglibProxyClass(rootClass)) {
          proxySuperClass = rootClass.getSuperclass();
          Class<?>[] additionalInterfaces = rootClass.getInterfaces();
          for (Class<?> additionalInterface : additionalInterfaces) {
            this.advised.addInterface(additionalInterface);
          }
        }

        // Validate the class, writing log messages as necessary.
        validateClassIfNecessary(proxySuperClass, classLoader);

        // 配置 Cglib 增强
        Enhancer enhancer = createEnhancer();
        if (classLoader != null) {
          enhancer.setClassLoader(classLoader);
          if (classLoader instanceof SmartClassLoader &&
              ((SmartClassLoader)
classLoader).isClassReloadable(proxySuperClass)) {
            enhancer.setUseCache(false);
          }
```

```
        }
        enhancer.setSuperclass(proxySuperClass);

enhancer.setInterfaces(AopProxyUtils.completeProxiedInterfaces(this.advised));
        enhancer.setNamingPolicy(SpringNamingPolicy.INSTANCE);
        enhancer.setStrategy(new
ClassLoaderAwareUndeclaredThrowableStrategy(classLoader));

        Callback[] callbacks = getCallbacks(rootClass);
        Class<?>[] types = new Class<?>[callbacks.length];
        for (int x = 0; x < types.length; x++) {
          types[x] = callbacks[x].getClass();
        }
        // fixedInterceptorMap only populated at this point, after getCallbacks
call above
        enhancer.setCallbackFilter(new ProxyCallbackFilter(
            this.advised.getConfigurationOnlyCopy(), this.fixedInterceptorMap,
this.fixedInterceptorOffset));
        enhancer.setCallbackTypes(types);

        // 生成代理类，并且创建一个代理类的实例
        return createProxyClassAndInstance(enhancer, callbacks);
      }
      catch (CodeGenerationException | IllegalArgumentException ex) {
        throw new AopConfigException("Could not generate CGLIB subclass of " +
this.advised.getTargetClass() +
            ": Common causes of this problem include using a final class or a
non-visible class",
            ex);
      }
      catch (Throwable ex) {
        // TargetSource.getTarget() failed
        throw new AopConfigException("Unexpected AOP exception", ex);
      }
    }
```

AOP源码分析类方法调用关系课堂讲解过程中记录

```
org.springframework.beans.factory.support.AbstractAutowireCapableBeanFactory#i
nitializeBean

调用

org.springframework.beans.factory.support.AbstractAutowireCapableBeanFactory#a
pplyBeanPostProcessorsAfterInitialization

调用
```

```
org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#postProcessAfterInitialization（后置处理器AbstractAutoProxyCreator完成bean代理对象创建）

调用

org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#wrapIfNecessary

调用

org.springframework.aop.framework.autoproxy.AbstractAutoProxyCreator#createProxy （在这一步把委托对象的aop增强和通用拦截进行合并，最终给代理对象）

调用

org.springframework.aop.framework.DefaultAopProxyFactory#createAopProxy

调用

org.springframework.aop.framework.CglibAopProxy#getProxy(java.lang.ClassLoader)
```

第2节 Spring声明式事务控制

声明式事务很方便，尤其纯注解模式，仅仅几个注解就能控制事务了

思考：这些注解都做了什么？好神奇！

@EnableTransactionManagement @Transactional

2.1 @EnableTransactionManagement

```
@Target(ElementType.TYPE)
@Retention(RetentionPolicy.RUNTIME)
@Documented
@Import(TransactionManagementConfigurationSelector.class)
public @interface EnableTransactionManagement {
```

@EnableTransactionManagement 注解使用 @Import 标签引入了TransactionManagementConfigurationSelector类，这个类又向容器中导入了两个重要的组件

```
@Override
protected String[] selectImports(AdviceMode adviceMode) {
    switch (adviceMode) {
        case PROXY:
            return new String[] {AutoProxyRegistrar.class.getName(),
                    ProxyTransactionManagementConfiguration.class.getName()};
        case ASPECTJ:
            return new String[] {determineTransactionAspectClass()};
        default:
            return null;
    }
}
```

2.2 加载事务控制组件

- AutoProxyRegistrar

  AutoProxyRegistrar 类的 registerBeanDefinitions 方法中又注册了一个组件

```
candidateFound = true;
if (mode == AdviceMode.PROXY) {
    AopConfigUtils.registerAutoProxyCreatorIfNecessary(registry);
    if ((Boolean) proxyTargetClass) {
        AopConfigUtils.forceAutoProxyCreatorToUseClassProxying(registry);
        return;
    }
}
```

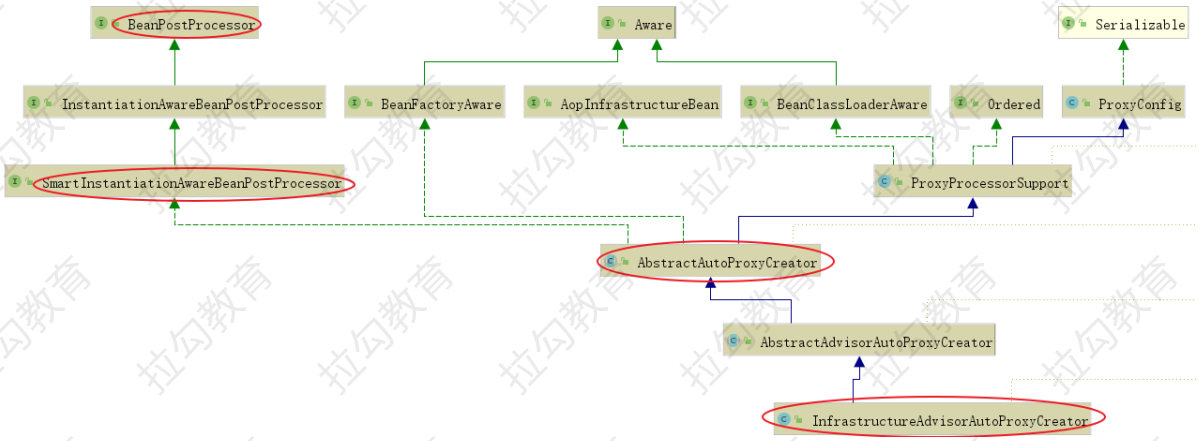
  进入 AopConfigUtils.registerAutoProxyCreatorIfNecessary 方法

```
@Nullable
public static BeanDefinition registerAutoProxyCreatorIfNecessary(BeanDefinitionRegistry registry) {
    return registerAutoProxyCreatorIfNecessary(registry, source: null);
}

@Nullable
public static BeanDefinition registerAutoProxyCreatorIfNecessary(
        BeanDefinitionRegistry registry, @Nullable Object source) {

    return registerOrEscalateApcAsRequired(InfrastructureAdvisorAutoProxyCreator.class, registry, source);
}
```

  发现最终，注册了一个叫做 InfrastructureAdvisorAutoProxyCreator 的 Bean，而这个类是 AbstractAutoProxyCreator 的子类，实现了 SmartInstantiationAwareBeanPostProcessor 接口

```
public class InfrastructureAdvisorAutoProxyCreator extends
AbstractAdvisorAutoProxyCreator

public abstract class AbstractAdvisorAutoProxyCreator extends
AbstractAutoProxyCreator

public abstract class AbstractAutoProxyCreator extends
ProxyProcessorSupport
    implements SmartInstantiationAwareBeanPostProcessor, BeanFactoryAware
```

继承体系结构图如下



它实现了SmartInstantiationAwareBeanPostProcessor，说明这是一个后置处理器，而且跟 spring AOP 开启@EnableAspectJAutoProxy 时注册的 AnnotationAwareAspectJProxyCreator实现的是同一个接口，所以说，声明式事务是 springAOP 思想的一种应用

- ProxyTransactionManagementConfiguration 组件

```
/*
 * Copyright 2002-2017 the original author or authors.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *      https://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or
implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

package org.springframework.transaction.annotation;

import org.springframework.beans.factory.config.BeanDefinition;
```

```
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;
import org.springframework.context.annotation.Role;
import
org.springframework.transaction.config.TransactionManagementConfigUtils;
import
org.springframework.transaction.interceptor.BeanFactoryTransactionAttribut
eSourceAdvisor;
import
org.springframework.transaction.interceptor.TransactionAttributeSource;
import org.springframework.transaction.interceptor.TransactionInterceptor;

/**
 * {@code @Configuration} class that registers the Spring infrastructure
beans
 * necessary to enable proxy-based annotation-driven transaction
management.
 *
 * @author Chris Beams
 * @since 3.1
 * @see EnableTransactionManagement
 * @see TransactionManagementConfigurationSelector
 */
@Configuration
public class ProxyTransactionManagementConfiguration extends
AbstractTransactionManagementConfiguration {

  @Bean(name =
TransactionManagementConfigUtils.TRANSACTION_ADVISOR_BEAN_NAME)
  @Role(BeanDefinition.ROLE_INFRASTRUCTURE)
  public BeanFactoryTransactionAttributeSourceAdvisor transactionAdvisor()
{
    // 事务增强器
    BeanFactoryTransactionAttributeSourceAdvisor advisor = new
BeanFactoryTransactionAttributeSourceAdvisor();
    // 向事务增强器中注入 属性解析器 transactionAttributeSource
  advisor.setTransactionAttributeSource(transactionAttributeSource());
    // 向事务增强器中注入 事务拦截器 transactionInterceptor
    advisor.setAdvice(transactionInterceptor());
    if (this.enableTx != null) {
      advisor.setOrder(this.enableTx.<Integer>getNumber("order"));
    }
    return advisor;
  }

  @Bean
  @Role(BeanDefinition.ROLE_INFRASTRUCTURE)
  // 属性解析器 transactionAttributeSource
  public TransactionAttributeSource transactionAttributeSource() {
```

```
    return new AnnotationTransactionAttributeSource();
  }

  @Bean
  @Role(BeanDefinition.ROLE_INFRASTRUCTURE)
  // 事务拦截器 transactionInterceptor
  public TransactionInterceptor transactionInterceptor() {
    TransactionInterceptor interceptor = new TransactionInterceptor();
interceptor.setTransactionAttributeSource(transactionAttributeSource());
    if (this.txManager != null) {
      interceptor.setTransactionManager(this.txManager);
    }
    return interceptor;
  }

}
```

ProxyTransactionManagementConfiguration是一个容器配置类，注册了一个组件transactionAdvisor，称为事务增强器，然后在这个事务增强器中又注入了两个属性：transactionAttributeSource，即属性解析器transactionAttributeSource 和 事务拦截器transactionInterceptor

- 属性解析器 AnnotationTransactionAttributeSource 部分源码如下

```
public class AnnotationTransactionAttributeSource extends AbstractFallbackTransactionAttributeSource
      implements Serializable {

  private static final boolean jta12Present;

  private static final boolean ejb3Present;

  static {
    ClassLoader classLoader = AnnotationTransactionAttributeSource.class.getClassLoader();
    jta12Present = ClassUtils.isPresent( className: "javax.transaction.Transactional", classLoader);
    ejb3Present = ClassUtils.isPresent( className: "javax.ejb.TransactionAttribute", classLoader);
  }

  private final boolean publicMethodsOnly;

  // 注解解析器集合
  private final Set<TransactionAnnotationParser> annotationParsers;
```

属性解析器有一个成员变量是annotationParsers，是一个集合，可以添加多种注解解析器(TransactionAnnotationParser)，我们关注 Spring 的注解解析器，部分源码如下

```
protected TransactionAttribute parseTransactionAnnotation(AnnotationAttributes attributes) {
    RuleBasedTransactionAttribute rbta = new RuleBasedTransactionAttribute();

    Propagation propagation = attributes.getEnum( attributeName: "propagation");
    rbta.setPropagationBehavior(propagation.value());
    Isolation isolation = attributes.getEnum( attributeName: "isolation");
    rbta.setIsolationLevel(isolation.value());
    rbta.setTimeout(attributes.getNumber( attributeName: "timeout").intValue());
    rbta.setReadOnly(attributes.getBoolean( attributeName: "readOnly"));
    rbta.setQualifier(attributes.getString( attributeName: "value"));

    List<RollbackRuleAttribute> rollbackRules = new ArrayList<>();
    for (Class<?> rbRule : attributes.getClassArray( attributeName: "rollbackFor")) {
        rollbackRules.add(new RollbackRuleAttribute(rbRule));
    }
    for (String rbRule : attributes.getStringArray( attributeName: "rollbackForClassName")) {
        rollbackRules.add(new RollbackRuleAttribute(rbRule));
    }
```

对应@Transactional的属性

属性解析器的作用之一就是用来解析@Transaction注解

- TransactionInterceptor 事务拦截器，部分源码如下

```
public TransactionInterceptor(PlatformTransactionManager ptm, Properties attributes) {
    setTransactionManager(ptm);
    setTransactionAttributes(attributes);
}
```

构造方法传入

```
@Override
@Nullable
public Object invoke(MethodInvocation invocation) throws Throwable {
    // Work out the target class: may be {@code null}.
    // The TransactionAttributeSource should be passed the target class
    // as well as the method, which may be from an interface.
    Class<?> targetClass = (invocation.getThis() != null ? AopUtils.getTargetClass(invocation.getThis()) : null);

    // Adapt to TransactionAspectSupport's invokeWithinTransaction...
    return invokeWithinTransaction(invocation.getMethod(), targetClass, invocation::proceed);
}
```

添加事务支持

- 上述组件如何关联起来的?
  - 事务拦截器实现了MethodInterceptor接口，追溯一下上面提到的InfrastructureAdvisorAutoProxyCreator后置处理器，它会在代理对象执行目标方法的时候获取其拦截器链，而拦截器链就是这个TransactionInterceptor，这就把这两个组件联系起来；
  - 构造方法传入PlatformTransactionManager(事务管理器)、TransactionAttributeSource(属性解析器)，但是追溯一下上面贴的ProxyTransactionManagementConfiguration的源码，在注册事务拦截器的时候并没有调用这个带参构造方法，而是调用的无参构造方法，然后再调用set方法注入这两个属性，效果一样。
- invokeWithinTransaction 方法，部分源码如下（关注1、2、3、4 标注处）

```
protected Object invokeWithinTransaction(Method method, @Nullable Class<?> targetClass,
        final InvocationCallback invocation) throws Throwable {

    // If the transaction attribute is null, the method is non-transactional.
    // 获取属性解析器，即在ProxyTransactionManagementConfiguration容器配置类中注册事务拦截器时注入的
    TransactionAttributeSource tas = getTransactionAttributeSource();
    final TransactionAttribute txAttr = (tas != null ? tas.getTransactionAttribute(method, targetClass) : null);
    // 获取事务管理器
    final PlatformTransactionManager tm = determineTransactionManager(txAttr);
    final String joinpointIdentification = methodIdentification(method, targetClass, txAttr);

    try {
        // This is an around advice: Invoke the next interceptor in the chain.
        // This will normally result in a target object being invoked.
        retVal = invocation.proceedWithInvocation();
    }
    catch (Throwable ex) {
        // target invocation exception
        // 如果目标方法抛异常，会执行completeTransactionAfterThrowing（获取事务管理器，执行回滚操作）
        completeTransactionAfterThrowing(txInfo, ex);
        throw ex;
    }
    finally {
        cleanupTransactionInfo(txInfo);
    }
    // 如果目标方法正常运行，则会执行commitTransactionAfterReturning（获取事务管理器，执行提交事务操作）
    commitTransactionAfterReturning(txInfo);
    return retVal;
```

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声明式事务分析课堂讲解过程中记录

@EnableTransactionManagement 注解
1)通过@import引入了TransactionManagementConfigurationSelector类
它的selectImports方法导入了另外两个类：AutoProxyRegistrar和

ProxyTransactionManagementConfiguration
2）AutoProxyRegistrar类分析
方法registerBeanDefinitions中，引入了其他类，通过
AopConfigUtils.registerAutoProxyCreatorIfNecessary(registry)引入

InfrastructureAdvisorAutoProxyCreator，
它继承了AbstractAutoProxyCreator，是一个后置处理器类
3）ProxyTransactionManagementConfiguration 是一个添加了@Configuration注解的配置类（注册bean）
注册事务增强器（注入属性解析器、事务拦截器）
属性解析器：AnnotationTransactionAttributeSource，内部持有了一个解析器集合
Set<TransactionAnnotationParser> annotationParsers;
具体使用的是SpringTransactionAnnotationParser解析器，用来解析@Transactional的事务属性
事务拦截器：TransactionInterceptor实现了MethodInterceptor接口，该通用拦截会在产生代理对象之前和aop增强合并，最终一起影响到代理对象
TransactionInterceptor的invoke方法中invokeWithinTransaction会触发原有业务逻辑调用（增强事务）