【Spring Cloud OpenFeign】

1.说在前面

上一节我们讲到 Ribbon 做了负载均衡，用 Eureka-Client 来做服务发现，通过 RestTemplate 来完成服务调用，但是这都不是我们的终极方案，终极方案是使用 **OpenFeign**

2.OpenFeign 简介

https://docs.spring.io/spring-cloud-openfeign/docs/2.2.4.RELEASE/reference/html/#spring-cloud-feign

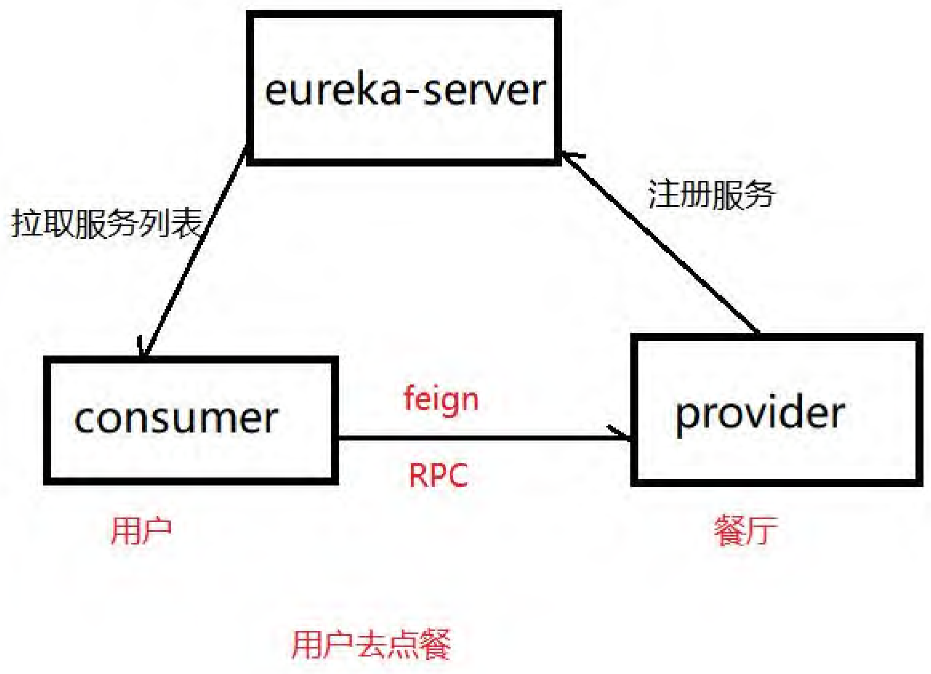
Feign 是**声明性(注解)**Web 服务**客户端**。它使编写 Web 服务客户端更加容易。**要使用 Feign，请创建一个接口并对其进行注解**。它具有可插入注解支持，包括 Feign 注解和 JAX-RS 注解。Feign 还支持可插拔编码器和解码器。**Spring Cloud 添加了对 Spring MVC 注解的支持**，并支持使用 HttpMessageConverters，Spring Web 中默认使用的注解。Spring Cloud 集成了 Ribbon 和 Eureka 以及 Spring Cloud LoadBalancer，以**在使用 Feign 时提供负载平衡的 http 客户端**。

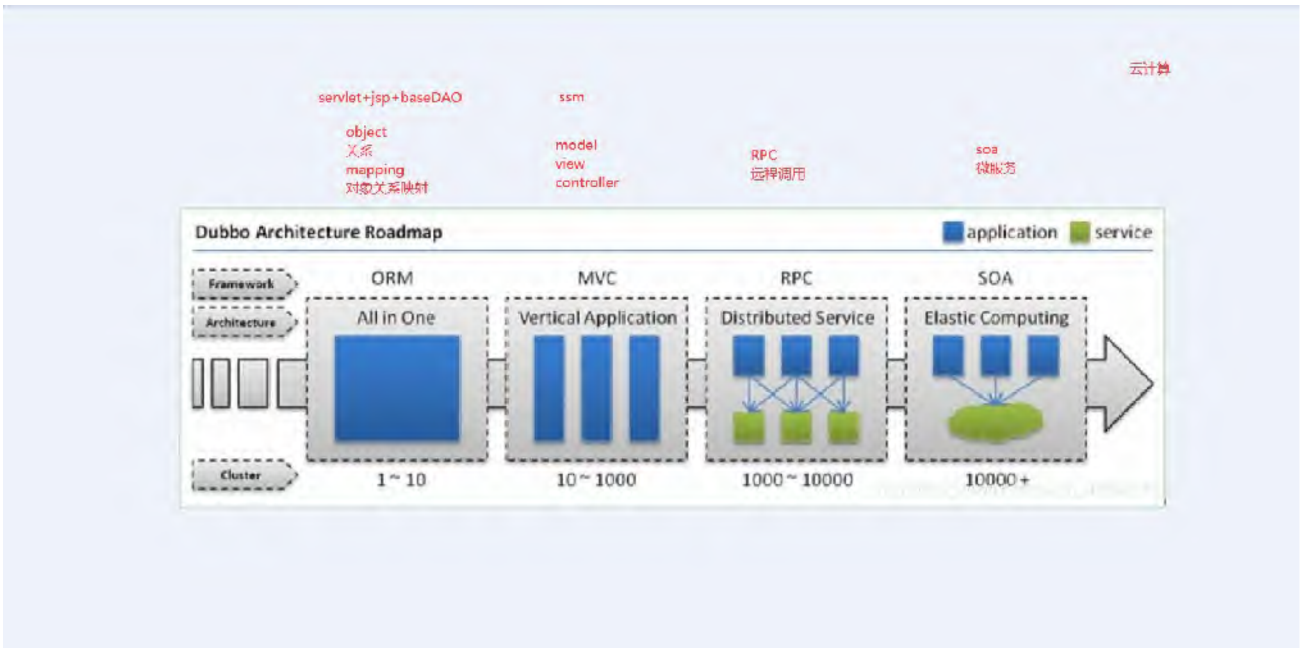
Feign 是一个**远程调用**的组件（接口，注解）http 调用的

Feign 集成了 ribbon　　ribbon 里面集成了 eureka

3.OpenFeign 快速入门

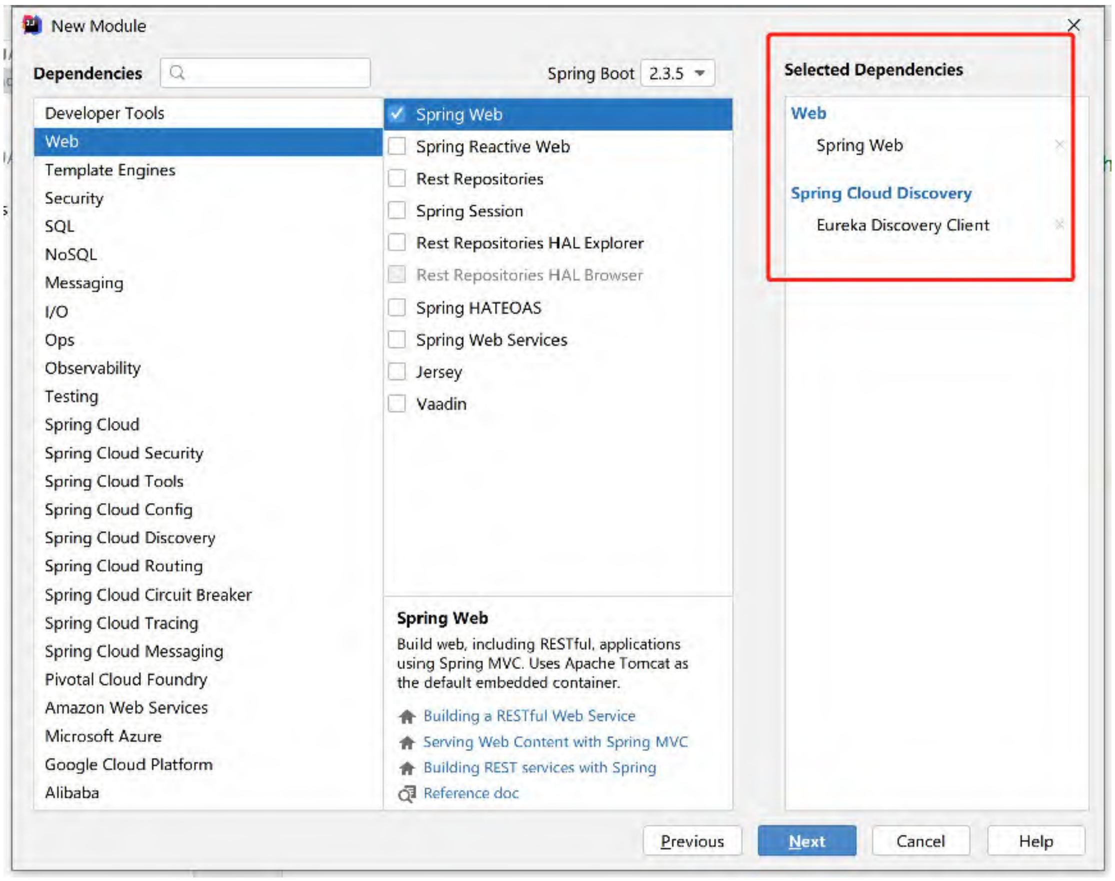
3.1 本次调用的设计图





3.2 启动一个 eureka-server 服务，这里不重复演示，参考 eureka 文档

3.3 先创建 provider-order-service，选择依赖



Spring Web ✓

Spring Web
Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

Selected Dependencies
Web
Spring Web
Spring Cloud Discovery
Eureka Discovery Client

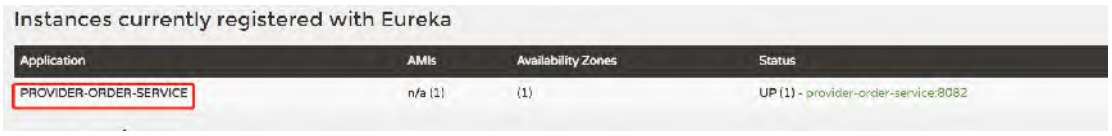
3.4 provider-order-service 修改配置文件

```yaml
server:
    port: 8081
spring:
    application:
        name: consumer-user-service
eureka:
    client:
        service-url:
            defaultZone: http://localhost:8761/eureka
    instance:
        instance-id: ${spring.application.name}:${server.port}
        prefer-ip-address: true
```

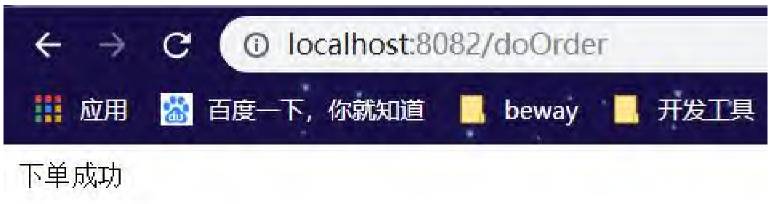
3.5 provider-order-service 修改启动类增加一个访问接口

```
package com.bjpowernode.controller;

import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;

/**
 * @Author: 动力节点
 */
@RestController
public class OrderController {

    /**

     * 订单服务下单接口

     *

     * @return
     */
    @GetMapping("doOrder")
    public String doOrder() {

        System.out.println("有用户来下单了");

        return "下单成功";

    }
}
```

3.6 provider-order-service 启动测试访问

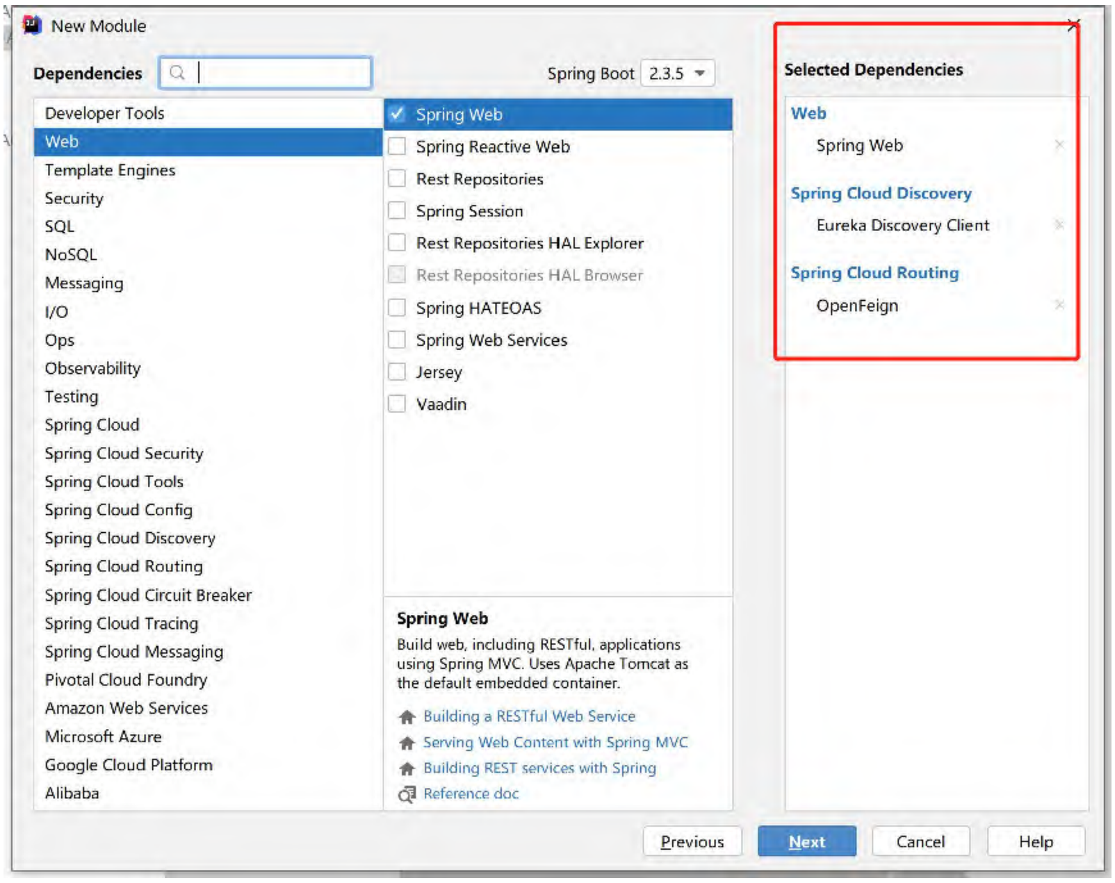

Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
PROVIDER-ORDER-SERVICE	n/a (1)	(1)	UP (1) - provider-order-service:8082


localhost:8082/doOrder

下单成功

3.7 再创建 consumer-user-service，选择依赖


New Module

Dependencies: Spring Boot 2.3.5

Selected Dependencies:
- Web
  - Spring Web
- Spring Cloud Discovery
  - Eureka Discovery Client
- Spring Cloud Routing
  - OpenFeign

3.8 consumer-user-service 修改配置文件

```
server:
    port: 8081
spring:
    application:
        name: consumer-user-service
eureka:
    client:
        service-url:
            defaultZone: http://localhost:8761/eureka
    instance:
        instance-id: ${spring.application.name}:${server.port}
        prefer-ip-address: true
```

3.9 consumer-user-service 创建一个接口（重点）

```
package com.bjpowernode.feign;

import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.web.bind.annotation.GetMapping;

/**
 * @Author: 动力节点
 *
 * @FeignClient 声明是 feign 的调用
 * value = "provider-order-service" value 后面的值必须和提供者的服
务名一致
 */
@FeignClient(value = "provider-order-service")
public interface UserOrderFeign {

    /**
     * 描述: 下单的方法 这里的路径必须和提供者的路径一致
     *
     * @param :
     * @return java.lang.String
     */
    @GetMapping("doOrder")
    String doOrder();

}
```

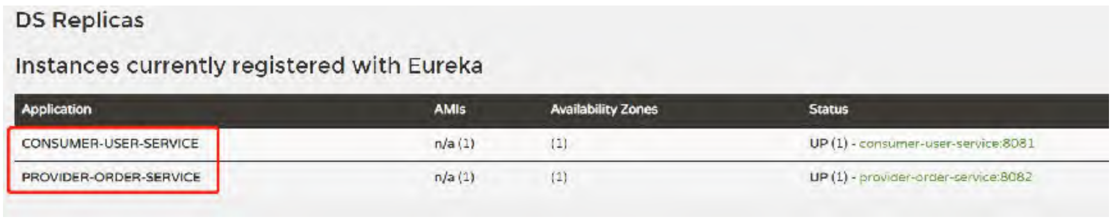
3.10 consumer-user-service 创建 controller

```java
package com.bjpowernode.controller;

import com.bjpowernode.feign.UserOrderFeign;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;

/**
 * @Author: 动力节点
 */
@RestController
public class UserController {

    @Autowired
    private UserOrderFeign userOrderFeign;

    /**
     * 用户远程调用下单的接口
     *
     * @return
     */
    @GetMapping("userDoOrder")
    public String userDoOrder() {
        String result = userOrderFeign.doOrder();
        System.out.println(result);
        return result;
    }
}
```

3.11 consumer-user-service 修改启动类

```java
package com.bjpowernode;

import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.cloud.netflix.eureka.EnableEurekaClient;
import org.springframework.cloud.openfeign.EnableFeignClients;

@SpringBootApplication
@EnableEurekaClient

@EnableFeignClients  //标记feign 的客户端

public class ConsumerUserServiceApplication {

    public static void main(String[] args) {
        SpringApplication.run(ConsumerUserServiceApplication.class, args);
    }
}
```

3.12 启动调用测试

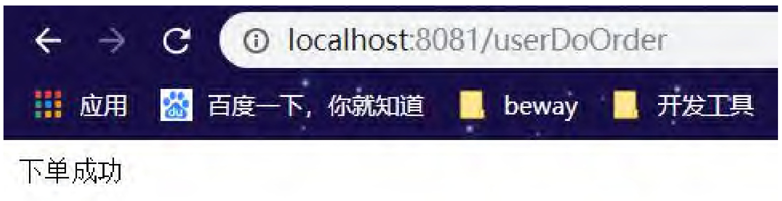


DS Replicas

Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
CONSUMER-USER-SERVICE	n/a (1)	(1)	UP (1) - consumer-user-service:8081
PROVIDER-ORDER-SERVICE	n/a (1)	(1)	UP (1) - provider-order-service:8082

访问：http://localhost:8081/userDoOrder



下单成功

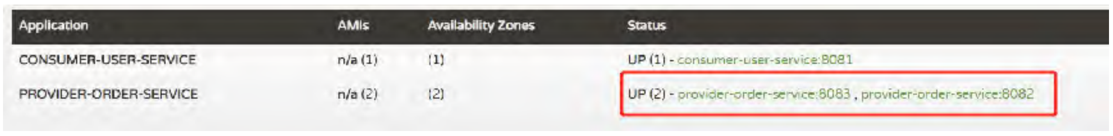
3.13 本次调用总结

consumer-user-service---》 /userDoOrder ---》通过 feign 调用 /doOrder ---》

provider-order-service 下单成功

3.14 测试 feign 调用的负载均衡

启动多台 provider-order-service:



Application	AMIs	Availability Zones	Status
CONSUMER-USER-SERVICE	n/a (1)	(1)	UP (1) - consumer-user-service:8081
PROVIDER-ORDER-SERVICE	n/a (2)	(2)	UP (2) - provider-order-service:8083 , provider-order-service:8082

测试访问:

```
下单成功
下单成功222
下单成功
下单成功222
下单成功
下单成功222
下单成功
下单成功222
下单成功
下单成功222
下单成功
下单成功222
```

3.15 调用超时设置

因为 ribbon 默认调用超时时长为 1s，可以修改，超时调整 可以查看 DefaultClientConfigImpl

```
ribbon: #feign 默认调用 1s 超时

    ReadTimeout: 5000    #修改调用时长为 5s

    ConnectTimeout: 5000    #修改连接时长为 5s
```

4.OpenFeign 调用参数处理（开发重点）

4.1 说在前面

Feign 传参确保消费者和提供者的参数列表一致 包括返回值 方法签名要一致

1. 通过 URL 传参数，GET 请求，参数列表使用@PathVariable（“”）

2. 如果是 GET 请求，每个基本参数必须加@RequestParam（“”）

3. 如果是 POST 请求，而且是对象集合等参数，必须加@Requestbody 或者@RequestParam

4.2 修改 provider-order-service

4.2.1 创建 BaseResult 类

```java
public class BaseResult implements Serializable {

    private Integer code;
    private String msg;
    private Object data;

    public static BaseResult success(Integer code, String msg, Object data) {
        BaseResult baseResult = new BaseResult();
        baseResult.setCode(code);
        baseResult.setData(data);
        baseResult.setMsg(msg);
        return baseResult;
    }
}
```

4.2.2 创建 Order 类

```java
public class Order implements Serializable {

    private String orderSn;
    private String orderName;
    private String orderDetail;
    private Date orderTime;
    private String userId;
}
```

4.2.3 创建 TestParamController 类

```
package com.bjpowernode.controller;

import com.bjpowernode.domain.Order;
import com.bjpowernode.model.BaseResult;
import org.springframework.web.bind.annotation.*;

@RestController
public class TestParamController {

    /**
     * 测试单个参数
     *
     * @param name
     * @return
     */
    @GetMapping("testOneParam")
    public BaseResult oneParam(@RequestParam("name") String name) {
        System.out.println(name);
        return BaseResult.success(200, "成功", "ok");
    }

    /**
     * 测试两个参数
     *
     * @param name
     * @param age
     * @return
     */
    @PostMapping("testTwoParam")
    public BaseResult twoParam(@RequestParam("name") String name,
@RequestParam("age") Integer age) {
        System.out.println(name + ":" + age);
        return BaseResult.success(200, "ok", "ok");
    }

    /**

     * 测试一个对象的传参

     *
     * @param order
     * @return
     */
    @PostMapping("testObjectParam")
    public BaseResult objectParam(@RequestBody Order order) {
        System.out.println(order);
        return BaseResult.success(200, "ok", order);
    }

    /**

     * 测试一个对象 一个参数

     *
     * @param order
     * @param name
     * @return
     */
    @PostMapping("testOneObjectOneParam")
    public BaseResult oneObjectOneParam(@RequestBody Order order,
@RequestParam String name) {
        System.out.println(order);
        System.out.println(name);
        return BaseResult.success(200, "ok", order);
    }

    /**

     * 测试url 传参

     *
     * @param id
     * @return
     */
    @GetMapping("testUrlParam/{id}")
    public BaseResult testUrlParam(@PathVariable("id") Integer id) {
        System.out.println(id);
        return BaseResult.success(200, "ok", id);
    }
}
```

4.3 修改 consumer-user-service

4.3.1 将 Order 类和 BaseResult 类拷贝过来，后面会抽到公共模块里

4.3.2 修改 UserOrderFeign 接口

```
package com.bjpowernode.feign;

import com.bjpowernode.domain.Order;
import com.bjpowernode.model.BaseResult;
import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.web.bind.annotation.*;

/**
 * @Author: 动力节点
 *

 * @FeignClient 声明是 feign 的调用

 * value = "provider-order-service" value 后面的值必须和提供者的服务名一致

 */
@FeignClient(value = "provider-order-service")
public interface UserOrderFeign {

    /**

     * 远程调用下单的方法

     *
     * @return
     */
    @RequestMapping("doOrder")
    String doOrder();

    /**

     * 测试单个参数

     *
     * @param name
     * @return
     */
    @GetMapping("testOneParam")
    public BaseResult oneParam(@RequestParam("name") String name);


    /**

     * 测试两个参数

     *
     * @param name
     * @param age
     * @return
     */
    @PostMapping("testTwoParam")
    public BaseResult twoParam(@RequestParam("name") String name,
@RequestParam("age") Integer age);

    /**

     * 测试一个对象的传参

     *
     * @param order
     * @return
     */
    @PostMapping("testObjectParam")
    public BaseResult objectParam(@RequestBody Order order);
    /**
     * 测试一个对象 一个参数
     *
     * @param order
     * @param name
     * @return
     */
    @PostMapping("testOneObjectOneParam")
    public BaseResult oneObjectOneParam(@RequestBody Order order,
@RequestParam String name);

    /**
     * 测试url 传参
     *
     * @param id
     * @return
     */
    @GetMapping("testUrlParam/{id}")
    public BaseResult testUrlParam(@PathVariable("id") Integer id);
}
```

4.3.3 创建 TestController 类

```
package com.bjpowernode.controller;

import com.bjpowernode.domain.Order;
import com.bjpowernode.feign.UserOrderFeign;
import com.bjpowernode.model.BaseResult;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.web.bind.annotation.RequestMapping;
import org.springframework.web.bind.annotation.RestController;

import java.util.Date;

@RestController
public class TestController {
    @Autowired
    private UserOrderFeign userOrderFeign;

    @RequestMapping("testFeignParam")
    public String testFeignParam() {
        //测试一个参数
        BaseResult result1 = userOrderFeign.oneParam("bjpowernode");
        System.out.println(result1);
        System.out.println("---------------------------------------------------");
        //测试多个参数
        BaseResult result2 = userOrderFeign.twoParam("bjpowernode", 666);
        System.out.println(result2);
        System.out.println("---------------------------------------------------");
        //测试一个对象
        Order order = new Order("111", "牛排", "一份牛排 256g", new Date(), "159357");
        BaseResult result3 = userOrderFeign.objectParam(order);
        System.out.println(result3);
        System.out.println("---------------------------------------------------");
        //测试 url 传参
        BaseResult result4 = userOrderFeign.testUrlParam(999);
        System.out.println(result4);
        System.out.println("---------------------------------------------------");
        //测试一个对象 一个参数
        BaseResult result5 = userOrderFeign.oneObjectOneParam(order,
"bjpowernodebjpowernode");
        System.out.println(result5);
        System.out.println("---------------------------------------------------");
        return "ok";
    }
}
```

4.3.4 测试调用

访问： http://localhost:8081/testFeignParam

4.3.5 时间日期参数问题

使用 feign 远程调用时，传递 Date 类型，接收方的时间会相差 14 个小时，是因为时区造成的

处理方案：

1.使用字符串传递参数，接收方转换成时间类型（推荐使用）不要单独传递时间

2.使用 JDK8 的 LocalDate(日期) 或 LocalDateTime(日期和时间，接收方只有秒，没有毫秒)

3.自定义转换方法

传参总结：

get 请求只用来传递基本参数 而且加注解@RequestParam

post 请求用来传递对象参数 并且加注解@RequestBody

5.OpenFeign 源码分析

（学习别人的思想，可以找 bug，优化你的代码，提高代码的健壮性）

看源码之前要先大致猜想一下 他是怎么实现的？ （先使用在分析）

5.1 OpenFeign 的原理是什么?

根据上面的案例，我们知道 feign 是接口调用，接口如果想做事，必须要有实现类

可是我们并没有写实现类，只是加了一个@FeignClient(value=”xxx-service”)的注解

所以我们猜测 feign 帮我们创建了代理对象，然后完成真实的调用。

动态代理 1jdk （invoke） 2cglib 子类继承的

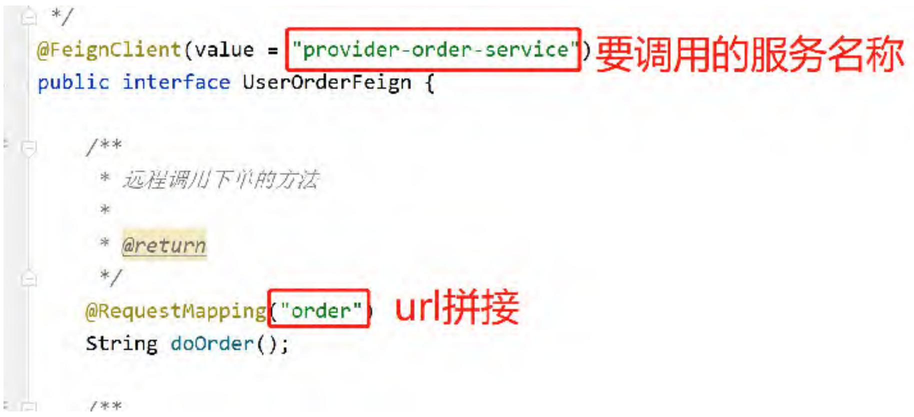
1. 给接口创建代理对象（启动扫描）

2. 代理对象执行进入 invoke 方法

3. 在 invoke 方法里面做远程调用

具体我们这次的流程：

A. 扫描注解得到要调用的服务名称和 url



```
 */
@FeignClient(value = "provider-order-service")
public interface UserOrderFeign {

    /**
     * 远程调用下单的方法
     *
     * @return
     */
    @RequestMapping("order")
    String doOrder();

    /**
```

B. 拿到 provider-order-service/doOrder，通过 ribbon 的负载均衡拿到一个服务，

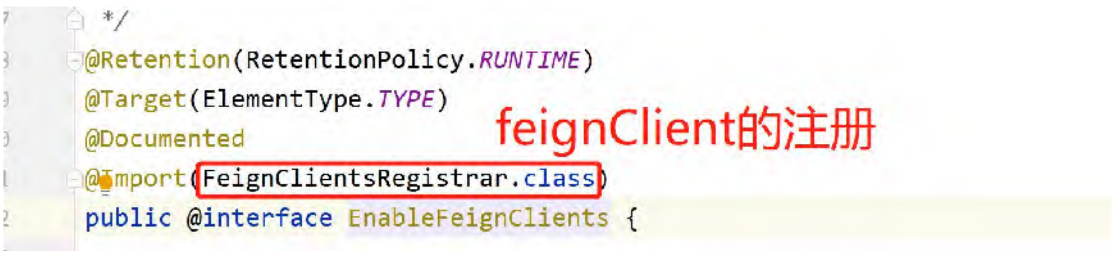
provider-order-service/doOrder---》http://ip:port/doOrder

C. 发起请求，远程调用

5.2 看看 OpenFeign 的内部是如何实现这些的

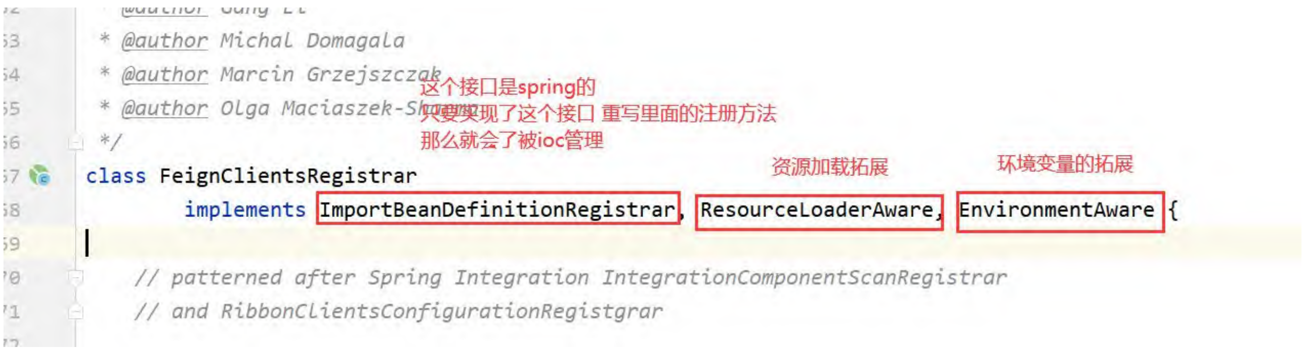
5.2.1 如何扫描注解@FeignClient

查看启动类的@EnableFeignClients

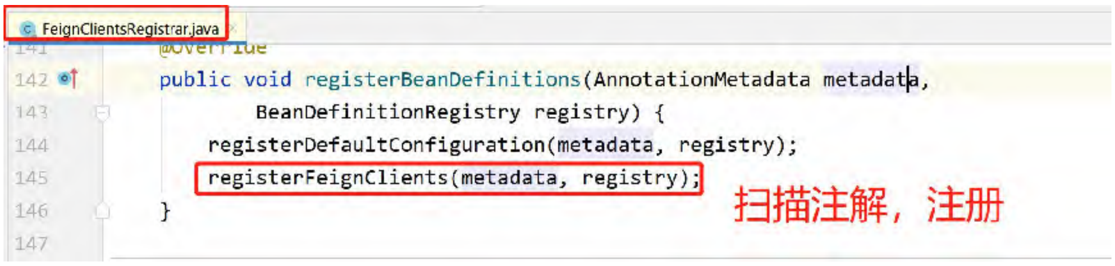


```
 */
@Retention(RetentionPolicy.RUNTIME)
@Target(ElementType.TYPE)
@Documented
@Import(FeignClientsRegistrar.class)
public @interface EnableFeignClients {
```

进入 FeignClientsRegistrar 这个类 去查看里面的东西

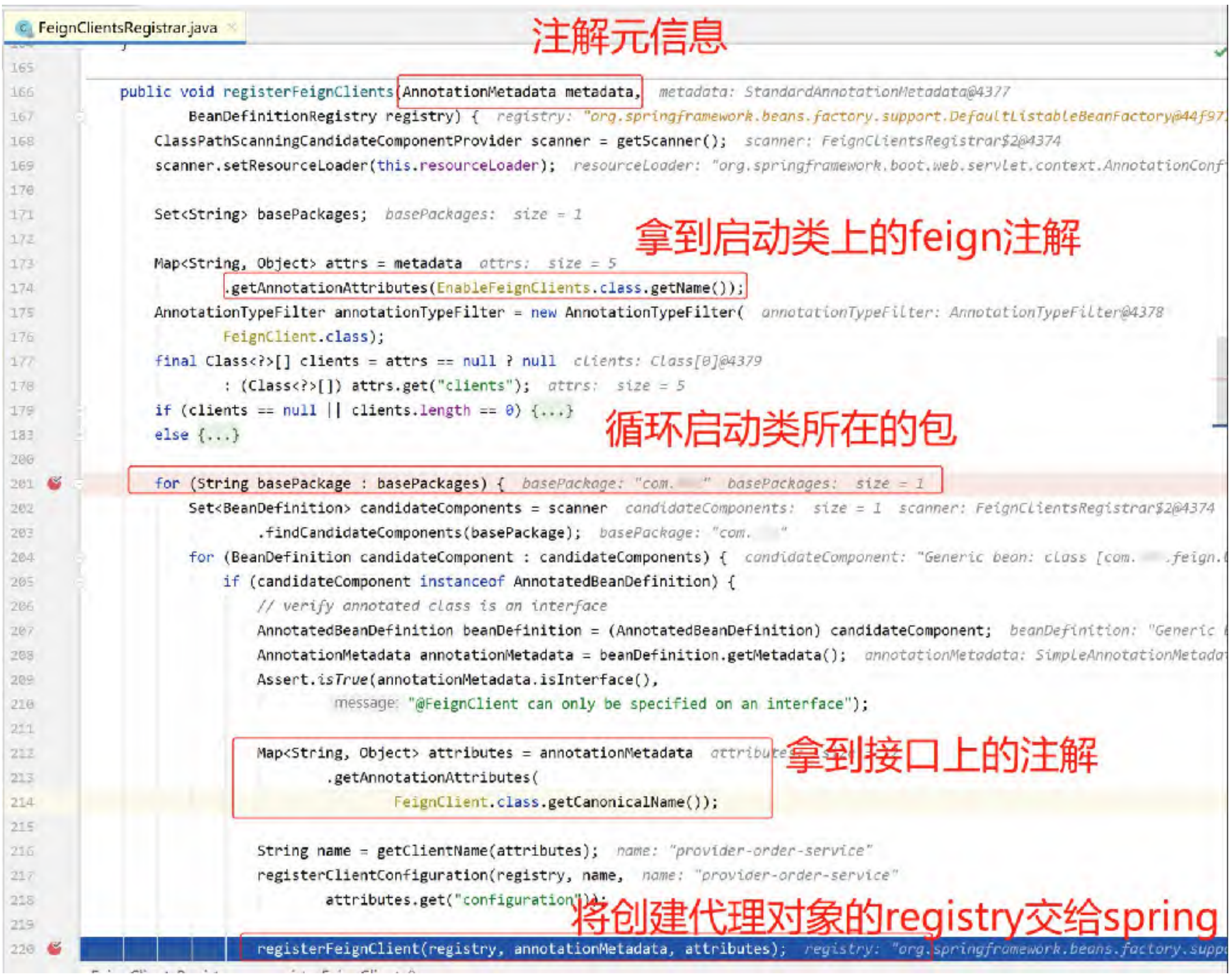


```
 * @author Michal Domagala
 * @author Marcin Grzejszczak
 * @author Olga Maciaszek-Sharma
 */
class FeignClientsRegistrar
        implements ImportBeanDefinitionRegistrar, ResourceLoaderAware, EnvironmentAware {

    // patterned after Spring Integration IntegrationComponentScanRegistrar
    // and RibbonClientsConfigurationRegistgrar
```



```
FeignClientsRegistrar.java
    @Override
    public void registerBeanDefinitions(AnnotationMetadata metadata,
            BeanDefinitionRegistry registry) {
        registerDefaultConfiguration(metadata, registry);
        registerFeignClients(metadata, registry);
    }
```

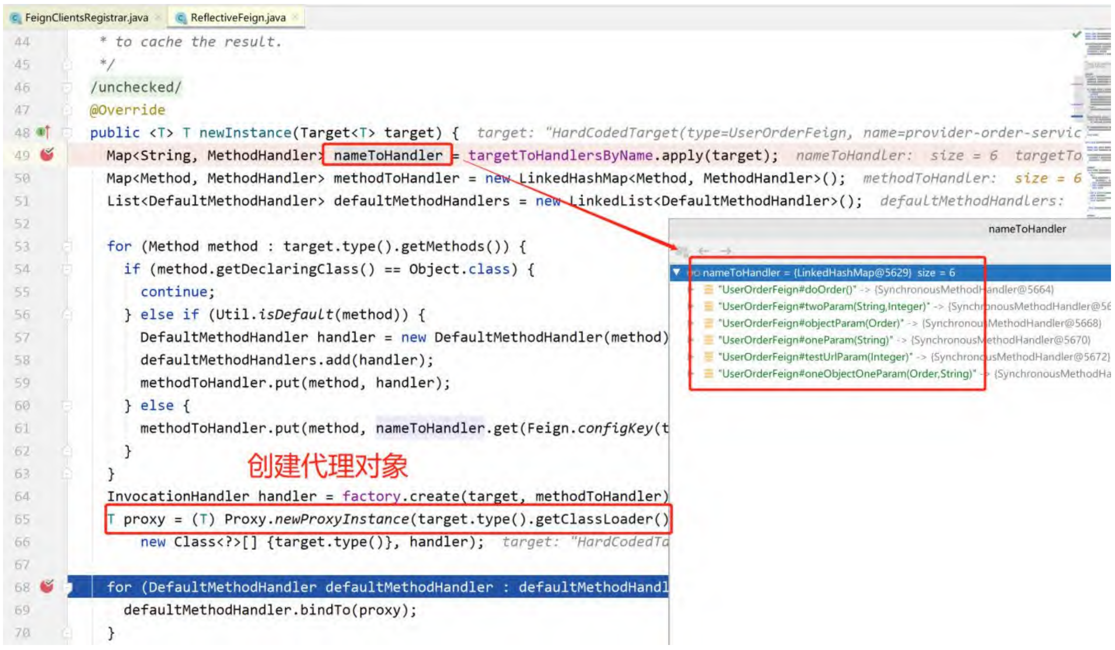
真正的扫描拿到注解和服务名称



```java
    public void registerFeignClients(AnnotationMetadata metadata,
            BeanDefinitionRegistry registry) {
        ClassPathScanningCandidateComponentProvider scanner = getScanner();
        scanner.setResourceLoader(this.resourceLoader);

        Set<String> basePackages;

        Map<String, Object> attrs = metadata
                .getAnnotationAttributes(EnableFeignClients.class.getName());
        AnnotationTypeFilter annotationTypeFilter = new AnnotationTypeFilter(
                FeignClient.class);
        final Class<?>[] clients = attrs == null ? null
                : (Class<?>[]) attrs.get("clients");
        if (clients == null || clients.length == 0) {...}
        else {...}

        for (String basePackage : basePackages) {
            Set<BeanDefinition> candidateComponents = scanner
                    .findCandidateComponents(basePackage);
            for (BeanDefinition candidateComponent : candidateComponents) {
                if (candidateComponent instanceof AnnotatedBeanDefinition) {
                    // verify annotated class is an interface
                    AnnotatedBeanDefinition beanDefinition = (AnnotatedBeanDefinition) candidateComponent;
                    AnnotationMetadata annotationMetadata = beanDefinition.getMetadata();
                    Assert.isTrue(annotationMetadata.isInterface(),
                            message: "@FeignClient can only be specified on an interface");

                    Map<String, Object> attributes = annotationMetadata
                            .getAnnotationAttributes(
                                    FeignClient.class.getCanonicalName());

                    String name = getClientName(attributes);
                    registerClientConfiguration(registry, name,
                            attributes.get("configuration"));

                    registerFeignClient(registry, annotationMetadata, attributes);
```

5.2.2 如何创建代理对象去执行调用?

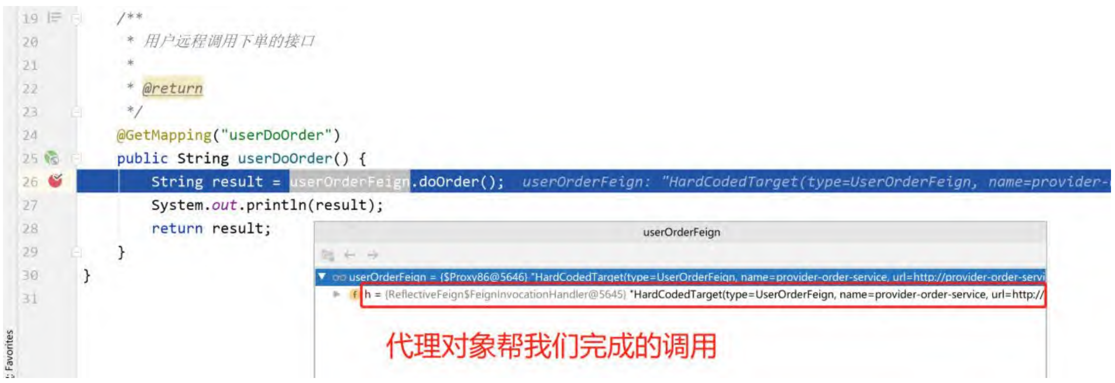
当我们启动时，在 ReflectiveFeign 类的 newInstance 方法，给接口创建了代理对象



```
   * to cache the result.
   */
  /unchecked/
  @Override
  public <T> T newInstance(Target<T> target) {  target: "HardCodedTarget(type=UserOrderFeign, name=provider-order-servic
    Map<String, MethodHandler> nameToHandler = targetToHandlersByName.apply(target);  nameToHandler:  size = 6  targetTo
    Map<Method, MethodHandler> methodToHandler = new LinkedHashMap<Method, MethodHandler>();  methodToHandler:  size = 6
    List<DefaultMethodHandler> defaultMethodHandlers = new LinkedList<DefaultMethodHandler>();  defaultMethodHandlers:

    for (Method method : target.type().getMethods()) {
      if (method.getDeclaringClass() == Object.class) {
        continue;
      } else if (Util.isDefault(method)) {
        DefaultMethodHandler handler = new DefaultMethodHandler(method)
        defaultMethodHandlers.add(handler);
        methodToHandler.put(method, handler);
      } else {
        methodToHandler.put(method, nameToHandler.get(Feign.configKey(t
      }
    }
    InvocationHandler handler = factory.create(target, methodToHandler)
    T proxy = (T) Proxy.newProxyInstance(target.type().getClassLoader()
        new Class<?>[] {target.type()}, handler);  target: "HardCodedTa

    for (DefaultMethodHandler defaultMethodHandler : defaultMethodHandl
      defaultMethodHandler.bindTo(proxy);
    }
```

```
nameToHandler = {LinkedHashMap@5629}  size = 6
    "UserOrderFeign#doOrder()" -> {SynchronousMethodHandler@5664}
    "UserOrderFeign#twoParam(String,Integer)" -> {SynchronousMethodHandler@56
    "UserOrderFeign#objectParam(Order)" -> {SynchronousMethodHandler@5668}
    "UserOrderFeign#oneParam(String)" -> {SynchronousMethodHandler@5670}
    "UserOrderFeign#testUrlParam(Integer)" -> {SynchronousMethodHandler@5672}
    "UserOrderFeign#oneObjectOneParam(Order,String)" -> {SynchronousMethodHa
```

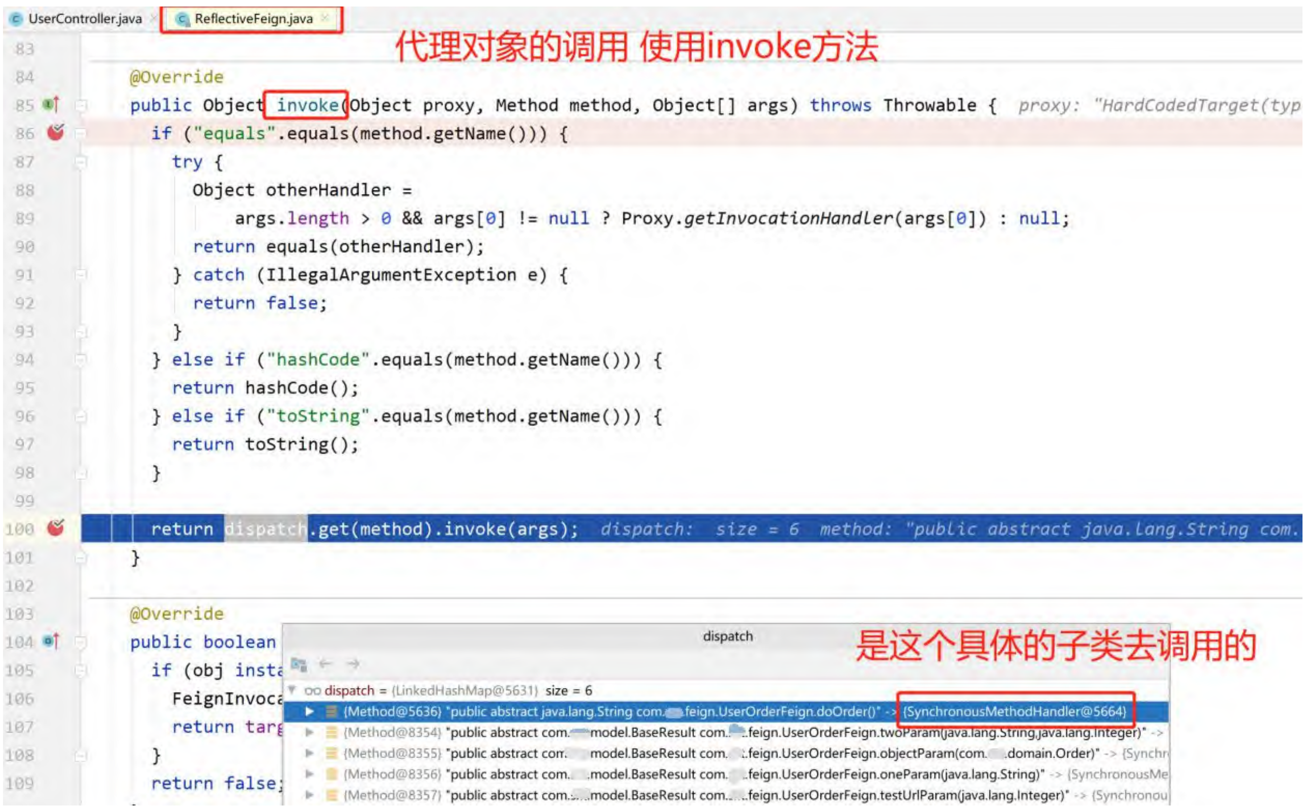
当我们执行调用的时候，打个断点去查看



```
    /**
     * 用户远程调用下单的接口
     *
     * @return
     */
    @GetMapping("userDoOrder")
    public String userDoOrder() {
        String result = userOrderFeign.doOrder();  userOrderFeign: "HardCodedTarget(type=UserOrderFeign, name=provider-
        System.out.println(result);
        return result;
    }
}
```

```
userOrderFeign = {$Proxy86@5646} "HardCodedTarget(type=UserOrderFeign, name=provider-order-service, url=http://provider-order-servi
    h = {ReflectiveFeign$FeignInvocationHandler@5645} "HardCodedTarget(type=UserOrderFeign, name=provider-order-service, url=http://
```

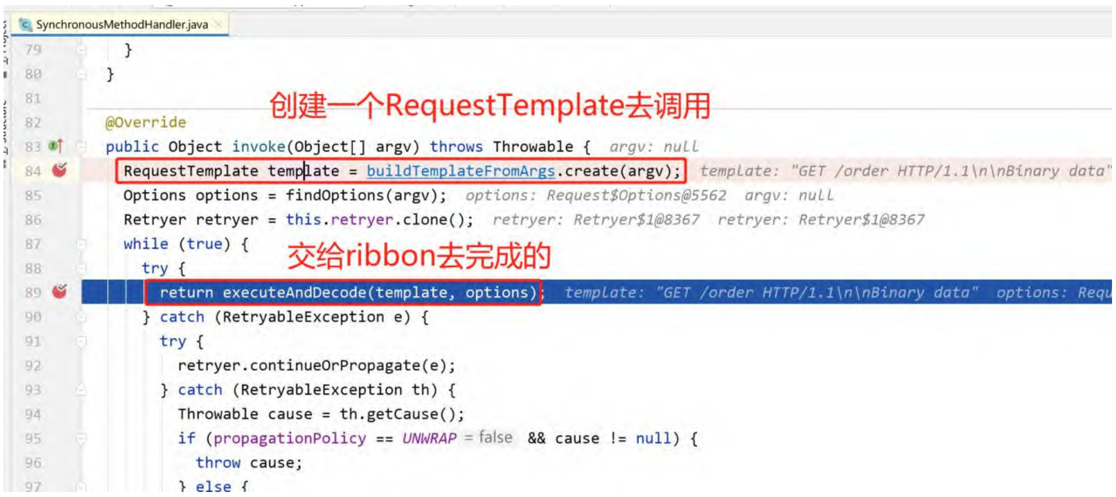
ReflectiveFeign 类中的 invoke 方法帮我们完成调用



```java
@Override
public Object invoke(Object proxy, Method method, Object[] args) throws Throwable {   proxy: "HardCodedTarget(typ
  if ("equals".equals(method.getName())) {
    try {
      Object otherHandler =
          args.length > 0 && args[0] != null ? Proxy.getInvocationHandler(args[0]) : null;
      return equals(otherHandler);
    } catch (IllegalArgumentException e) {
      return false;
    }
  } else if ("hashCode".equals(method.getName())) {
    return hashCode();
  } else if ("toString".equals(method.getName())) {
    return toString();
  }

  return dispatch.get(method).invoke(args);   dispatch:  size = 6   method: "public abstract java.lang.String com.
}

@Override
public boolean
  if (obj insta
    FeignInvoca
    return targ
  }
  return false;
```

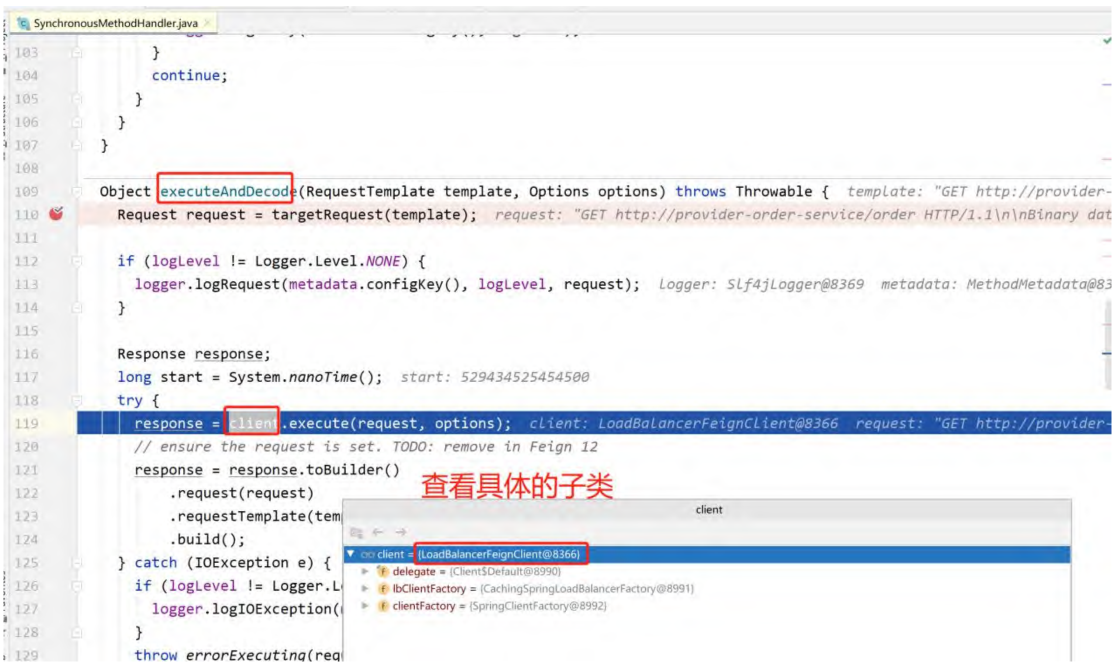
```
oo dispatch = {LinkedHashMap@5631}  size = 6
 ▶ {Method@5636} "public abstract java.lang.String com.feign.UserOrderFeign.doOrder()" -> {SynchronousMethodHandler@5664}
 ▶ {Method@8354} "public abstract com.model.BaseResult com..feign.UserOrderFeign.twoParam(java.lang.String,java.lang.Integer)" ->
 ▶ {Method@8355} "public abstract com.model.BaseResult com..feign.UserOrderFeign.objectParam(com..domain.Order)" -> {Synchr
 ▶ {Method@8356} "public abstract com..model.BaseResult com..feign.UserOrderFeign.oneParam(java.lang.String)" -> {SynchronousMe
 ▶ {Method@8357} "public abstract com....model.BaseResult com....feign.UserOrderFeign.testUrlParam(java.lang.Integer)" -> {Synchronou
```

SynchronousMethodHandler 的 invoke 中给每一个请求创建了一个 requestTemplate 对象，去执行请求



```java
    }
  }

  @Override
  public Object invoke(Object[] argv) throws Throwable {   argv: null
    RequestTemplate template = buildTemplateFromArgs.create(argv);   template: "GET /order HTTP/1.1\n\nBinary data"
    Options options = findOptions(argv);   options: Request$Options@5562   argv: null
    Retryer retryer = this.retryer.clone();   retryer: Retryer$1@8367   retryer: Retryer$1@8367
    while (true) {
      try {
        return executeAndDecode(template, options);   template: "GET /order HTTP/1.1\n\nBinary data"   options: Requ
      } catch (RetryableException e) {
        try {
          retryer.continueOrPropagate(e);
        } catch (RetryableException th) {
          Throwable cause = th.getCause();
          if (propagationPolicy == UNWRAP = false  && cause != null) {
            throw cause;
          } else {
```

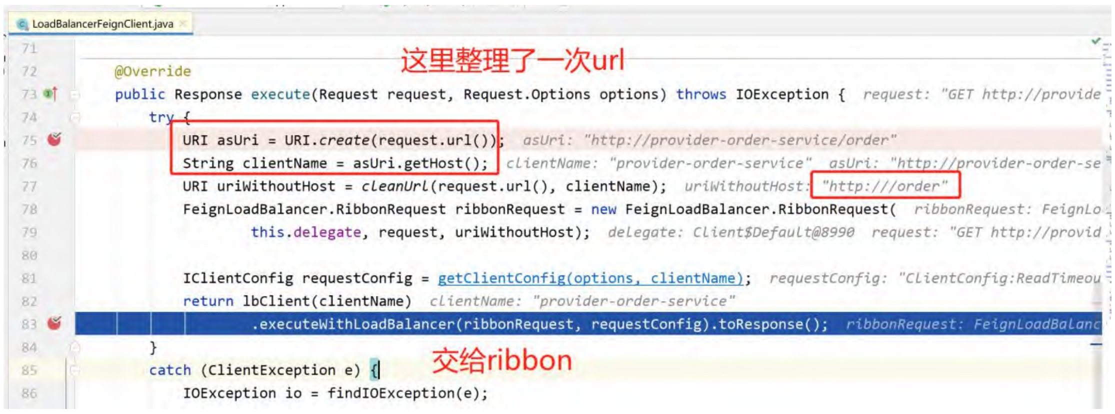
executeAndDecode



```
        }
        continue;
      }
    }
  }

  Object executeAndDecode(RequestTemplate template, Options options) throws Throwable {  template: "GET http://provider-
    Request request = targetRequest(template);  request: "GET http://provider-order-service/order HTTP/1.1\n\nBinary dat

    if (logLevel != Logger.Level.NONE) {
      logger.logRequest(metadata.configKey(), logLevel, request);  logger: Slf4jLogger@8369  metadata: MethodMetadata@83
    }

    Response response;
    long start = System.nanoTime();  start: 529434525454500
    try {
      response = client.execute(request, options);  client: LoadBalancerFeignClient@8366  request: "GET http://provider-
      // ensure the request is set. TODO: remove in Feign 12
      response = response.toBuilder()
          .request(request)
          .requestTemplate(tem
          .build();
    } catch (IOException e) {
      if (logLevel != Logger.L
        logger.logIOException(
      }
      throw errorExecuting(req
```

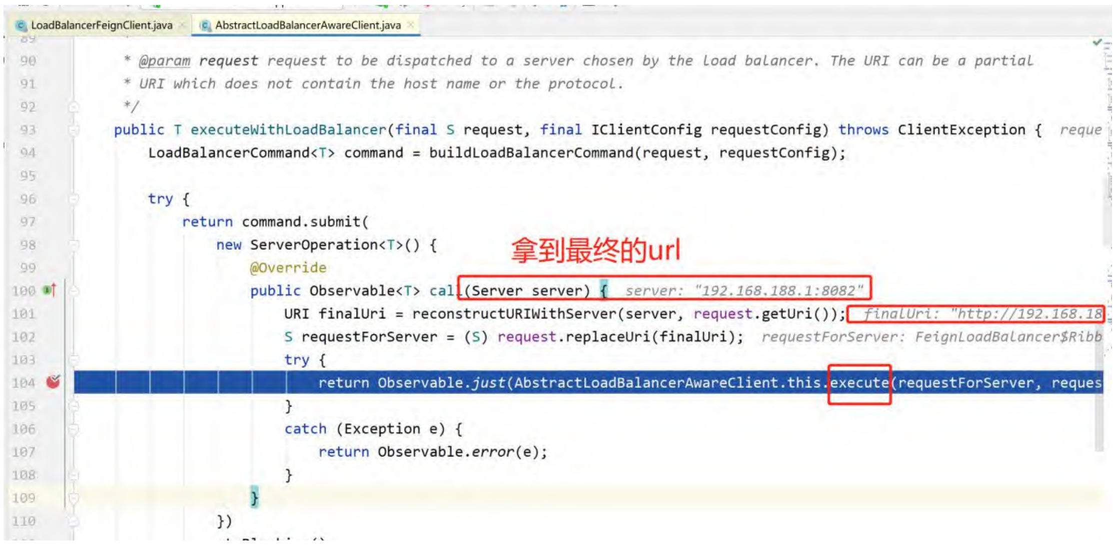
```
▼ client = {LoadBalancerFeignClient@8366}
  ▶ delegate = {Client$Default@8990}
  ▶ lbClientFactory = {CachingSpringLoadBalancerFactory@8991}
  ▶ clientFactory = {SpringClientFactory@8992}
```

我们去看 LoadBalancerFeignClient 的 execute 方法

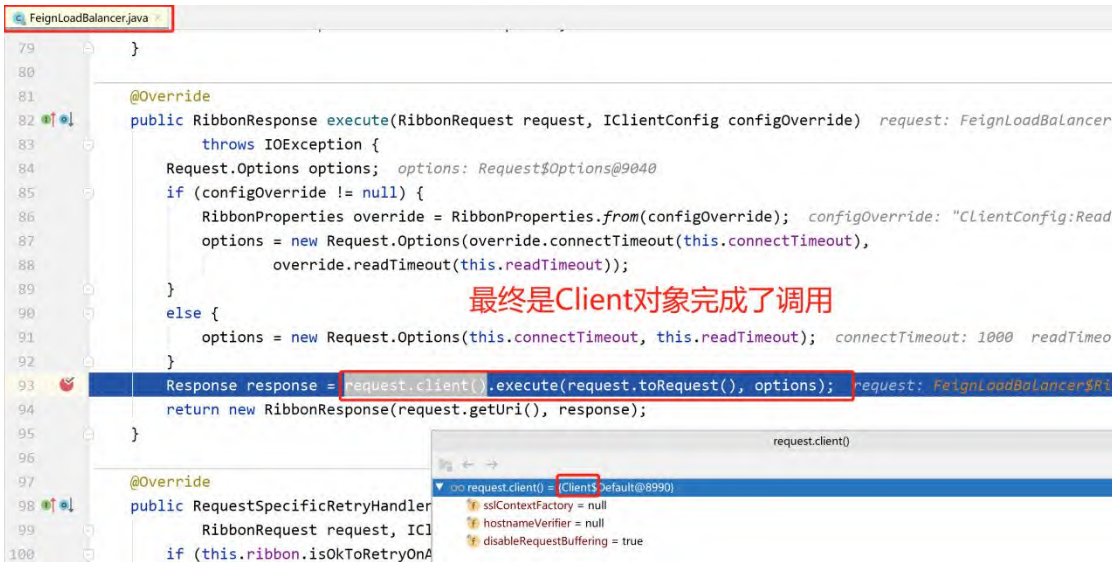


```
    @Override
    public Response execute(Request request, Request.Options options) throws IOException {  request: "GET http://provide
        try {
            URI asUri = URI.create(request.url());  asUri: "http://provider-order-service/order"
            String clientName = asUri.getHost();  clientName: "provider-order-service"  asUri: "http://provider-order-se
            URI uriWithoutHost = cleanUrl(request.url(), clientName);  uriWithoutHost: "http:///order"
            FeignLoadBalancer.RibbonRequest ribbonRequest = new FeignLoadBalancer.RibbonRequest(  ribbonRequest: FeignLo
                    this.delegate, request, uriWithoutHost);  delegate: Client$Default@8990  request: "GET http://provid

            IClientConfig requestConfig = getClientConfig(options, clientName);  requestConfig: "ClientConfig:ReadTimeou
            return lbClient(clientName)  clientName: "provider-order-service"
                    .executeWithLoadBalancer(ribbonRequest, requestConfig).toResponse();  ribbonRequest: FeignLoadBalanc
        }
        catch (ClientException e) {
            IOException io = findIOException(e);
```

executeWithLoadBalancer 继续往下看

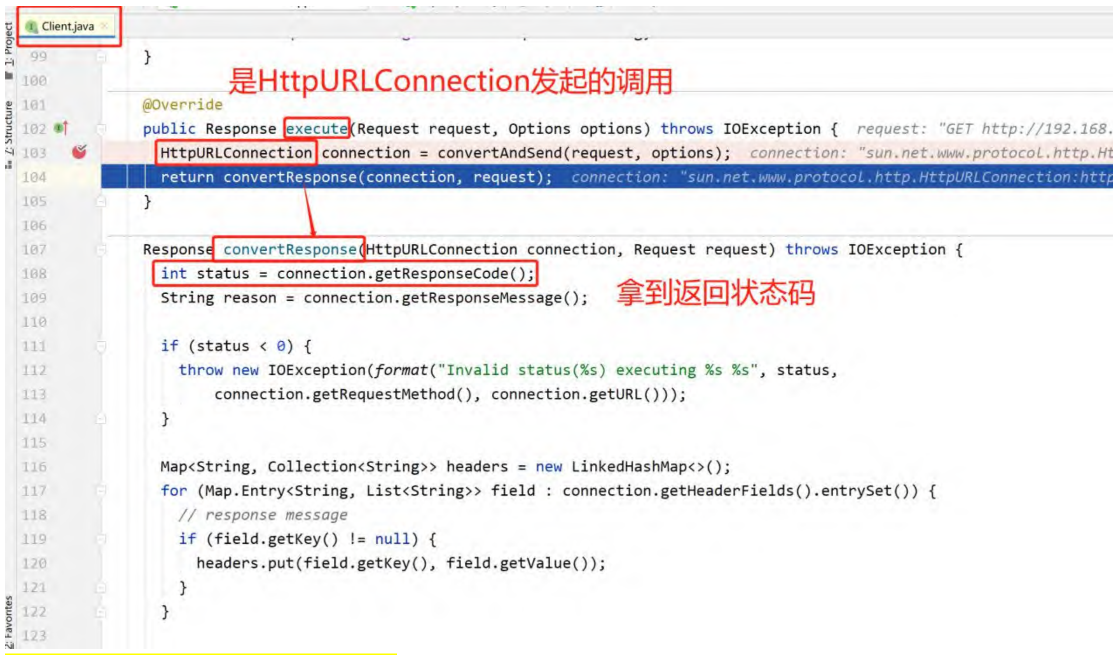

LoadBalancerFeignClient.java
AbstractLoadBalancerAwareClient.java
拿到最终的url

```
     * @param request request to be dispatched to a server chosen by the load balancer. The URI can be a partial
     * URI which does not contain the host name or the protocol.
     */
    public T executeWithLoadBalancer(final S request, final IClientConfig requestConfig) throws ClientException {  reque
        LoadBalancerCommand<T> command = buildLoadBalancerCommand(request, requestConfig);

        try {
            return command.submit(
                new ServerOperation<T>() {
                    @Override
                    public Observable<T> call(Server server) {  server: "192.168.188.1:8082"
                        URI finalUri = reconstructURIWithServer(server, request.getUri());  finalUri: "http://192.168.18
                        S requestForServer = (S) request.replaceUri(finalUri);  requestForServer: FeignLoadBalancer$Ribb
                        try {
                            return Observable.just(AbstractLoadBalancerAwareClient.this.execute(requestForServer, reques
                        }
                        catch (Exception e) {
                            return Observable.error(e);
                        }
                    }
                })
```



```
    }

    @Override
    public RibbonResponse execute(RibbonRequest request, IClientConfig configOverride)  request: FeignLoadBalancer
            throws IOException {
        Request.Options options;  options: Request$Options@9040
        if (configOverride != null) {
            RibbonProperties override = RibbonProperties.from(configOverride);  configOverride: "ClientConfig:Read
            options = new Request.Options(override.connectTimeout(this.connectTimeout),
                    override.readTimeout(this.readTimeout));
        }
        else {
            options = new Request.Options(this.connectTimeout, this.readTimeout);  connectTimeout: 1000  readTimeo
        }
        Response response = request.client().execute(request.toRequest(), options);  request: FeignLoadBalancer$Ri
        return new RibbonResponse(request.getUri(), response);
    }

    @Override
    public RequestSpecificRetryHandler
            RibbonRequest request, ICl
        if (this.ribbon.isOkToRetryOnA
```

```
▼ oo request.client() = {Client$Default@8990}
      f sslContextFactory = null
      f hostnameVerifier = null
      f disableRequestBuffering = true
```



```
  }

  @Override
  public Response execute(Request request, Options options) throws IOException {   request: "GET http://192.168.
    HttpURLConnection connection = convertAndSend(request, options);   connection: "sun.net.www.protocol.http.Ht
    return convertResponse(connection, request);   connection: "sun.net.www.protocol.http.HttpURLConnection:http
  }

  Response convertResponse(HttpURLConnection connection, Request request) throws IOException {
    int status = connection.getResponseCode();
    String reason = connection.getResponseMessage();

    if (status < 0) {
      throw new IOException(format("Invalid status(%s) executing %s %s", status,
          connection.getRequestMethod(), connection.getURL()));
    }

    Map<String, Collection<String>> headers = new LinkedHashMap<>();
    for (Map.Entry<String, List<String>> field : connection.getHeaderFields().entrySet()) {
      // response message
      if (field.getKey() != null) {
        headers.put(field.getKey(), field.getValue());
      }
    }
```

只要是 feign 调用出了问题

看 feign 包下面的 Client 接口下面的 108 行

200 成功

400 请求参数错误

401 没有权限

403 权限不够

404 路径不匹配

405 方法不允许

500 提供者报错了

302 资源重定向

6.OpenFeign 总结

OpenFeign 主要基于接口和注解实现了远程调用

源码总结：面试

1. OpenFeign 用过吗？它是如何运作的?

在主启动类上加上@EnableFeignClients 注解后，启动会进行包扫描，把所有加了@FeignClient(value=”xxx-service”)注解的接口进行创建代理对象通过代理对象，使用ribbon 做了负载均衡和远程调用

2. 如何创建的代理对象?

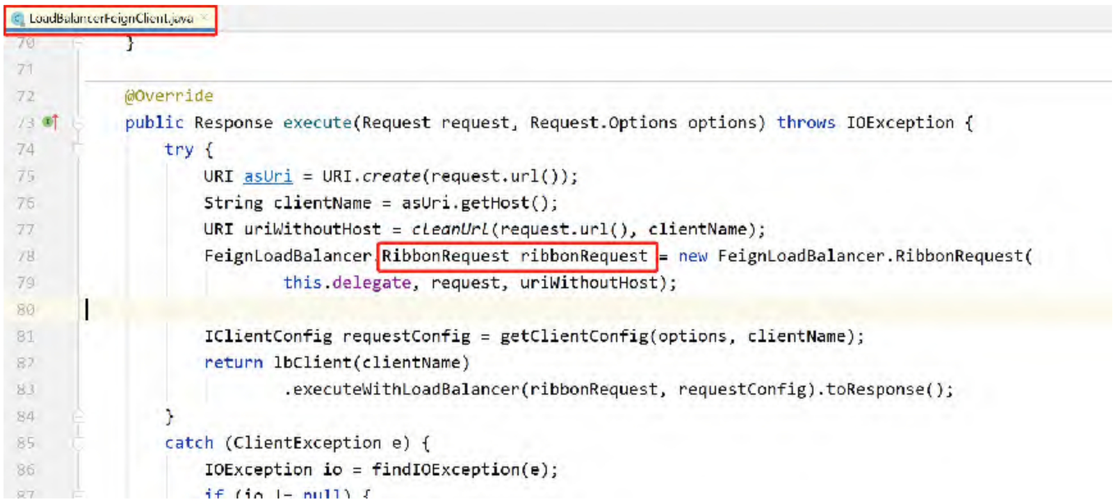
当项目在启动时，先扫描，然后拿到标记了@FeignClient 注解的接口信息，由ReflectiveFeign 类的 newInstance 方法创建了代理对象 JDK 代理

3. OpenFeign 到底是用什么做的远程调用?

使用的是 HttpURLConnection （java.net)

4. OpenFeign 怎么和 ribbon 整合的?

在代理对象执行调用的时候



LoadBalancerFeignClient.java

```
    }

    @Override
    public Response execute(Request request, Request.Options options) throws IOException {
        try {
            URI asUri = URI.create(request.url());
            String clientName = asUri.getHost();
            URI uriWithoutHost = cleanUrl(request.url(), clientName);
            FeignLoadBalancer.RibbonRequest ribbonRequest = new FeignLoadBalancer.RibbonRequest(
                    this.delegate, request, uriWithoutHost);

            IClientConfig requestConfig = getClientConfig(options, clientName);
            return lbClient(clientName)
                    .executeWithLoadBalancer(ribbonRequest, requestConfig).toResponse();
        }
        catch (ClientException e) {
            IOException io = findIOException(e);
            if (io != null) {
```

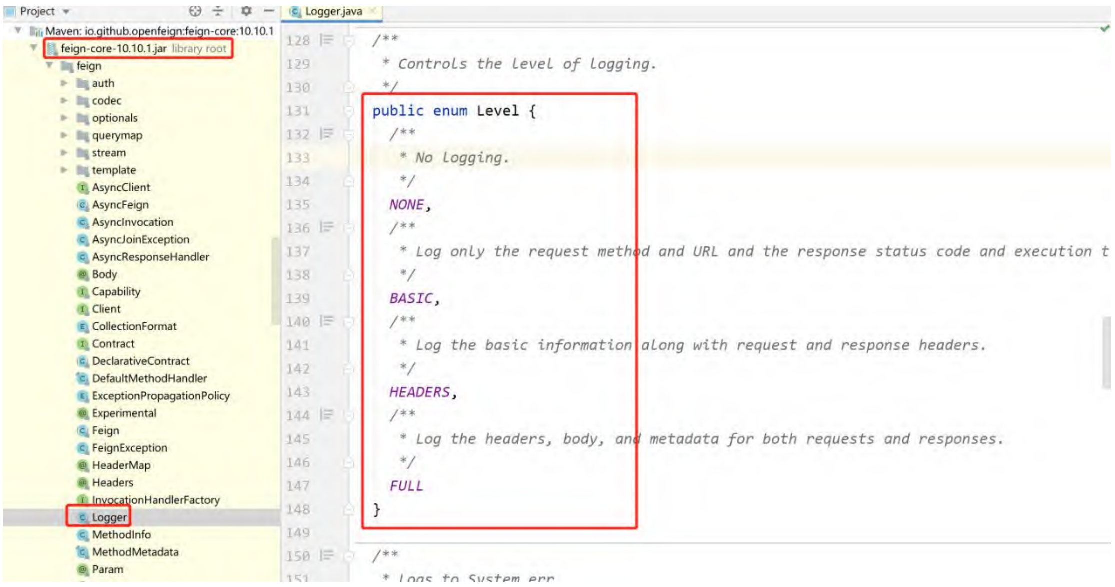
7.OpenFeign 其他

7.1 OpenFeign 的日志功能

从前面的测试中我们可以看出，没有任何关于远程调用的日志输出，如请头，参数

Feign 提供了日志打印功能，我们可以通过配置来调整日志级别，从而揭开 Feign 中 Http 请求的所有细节

7.1.1 OpenFeign 的日志级别



```
/**
 * Controls the level of logging.
 */
public enum Level {
  /**
   * No logging.
   */
  NONE,
  /**
   * Log only the request method and URL and the response status code and execution t
   */
  BASIC,
  /**
   * Log the basic information along with request and response headers.
   */
  HEADERS,
  /**
   * Log the headers, body, and metadata for both requests and responses.
   */
  FULL
}

/**
 * Logs to System.err
```

NONE 默认的，不显示日志

BASE 仅记录请求方法，URL ，响应状态码及执行时间

HEADERS 在 BASE 之上增加了请求和响应头的信息

FULL 在 HEADERS 之上增加了请求和响应的正文及无数据

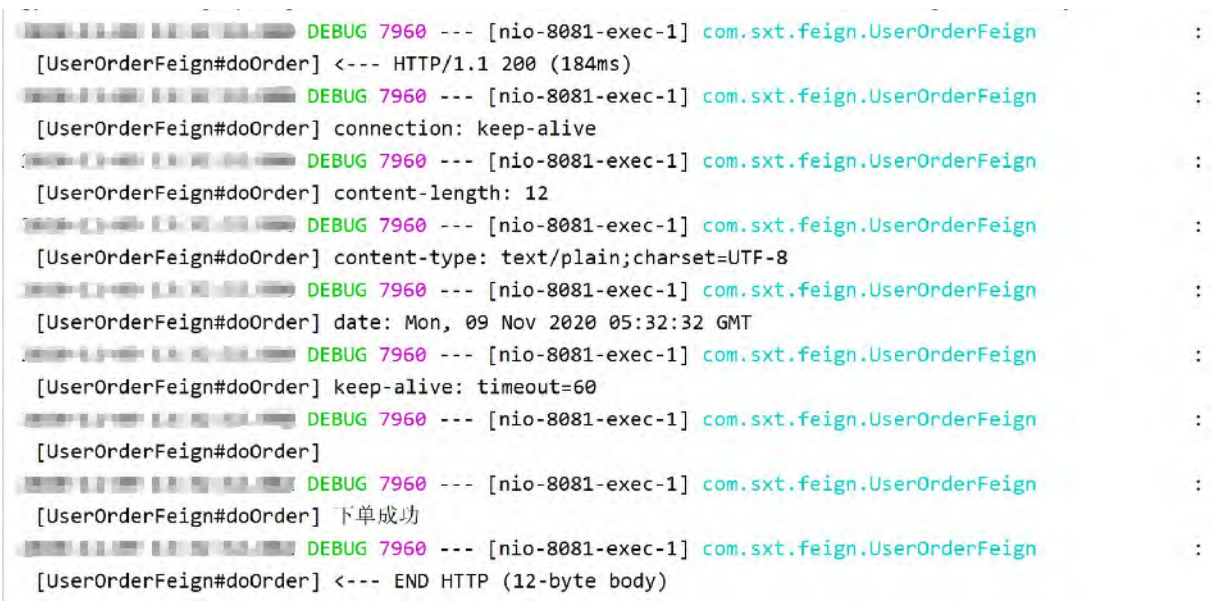
7.1.2 创建配置类

```
package com.bjpowernode.config;

import feign.Logger;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;

@Configuration
public class FeignConfig {

    @Bean
    Logger.Level feignLogger() {
        return Logger.Level.FULL;
    }

}
```

7.1.3 修改配置文件

```
logging:
    level:
        com.bjpowernode.feign.UserOrderFeign: debug
```

7.1.4 调用测试



```
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] <--- HTTP/1.1 200 (184ms)
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] connection: keep-alive
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] content-length: 12
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] content-type: text/plain;charset=UTF-8
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] date: Mon, 09 Nov 2020 05:32:32 GMT
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] keep-alive: timeout=60
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder]
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] 下单成功
[redacted] DEBUG 7960 --- [nio-8081-exec-1] com.sxt.feign.UserOrderFeign            :
 [UserOrderFeign#doOrder] <--- END HTTP (12-byte body)
```