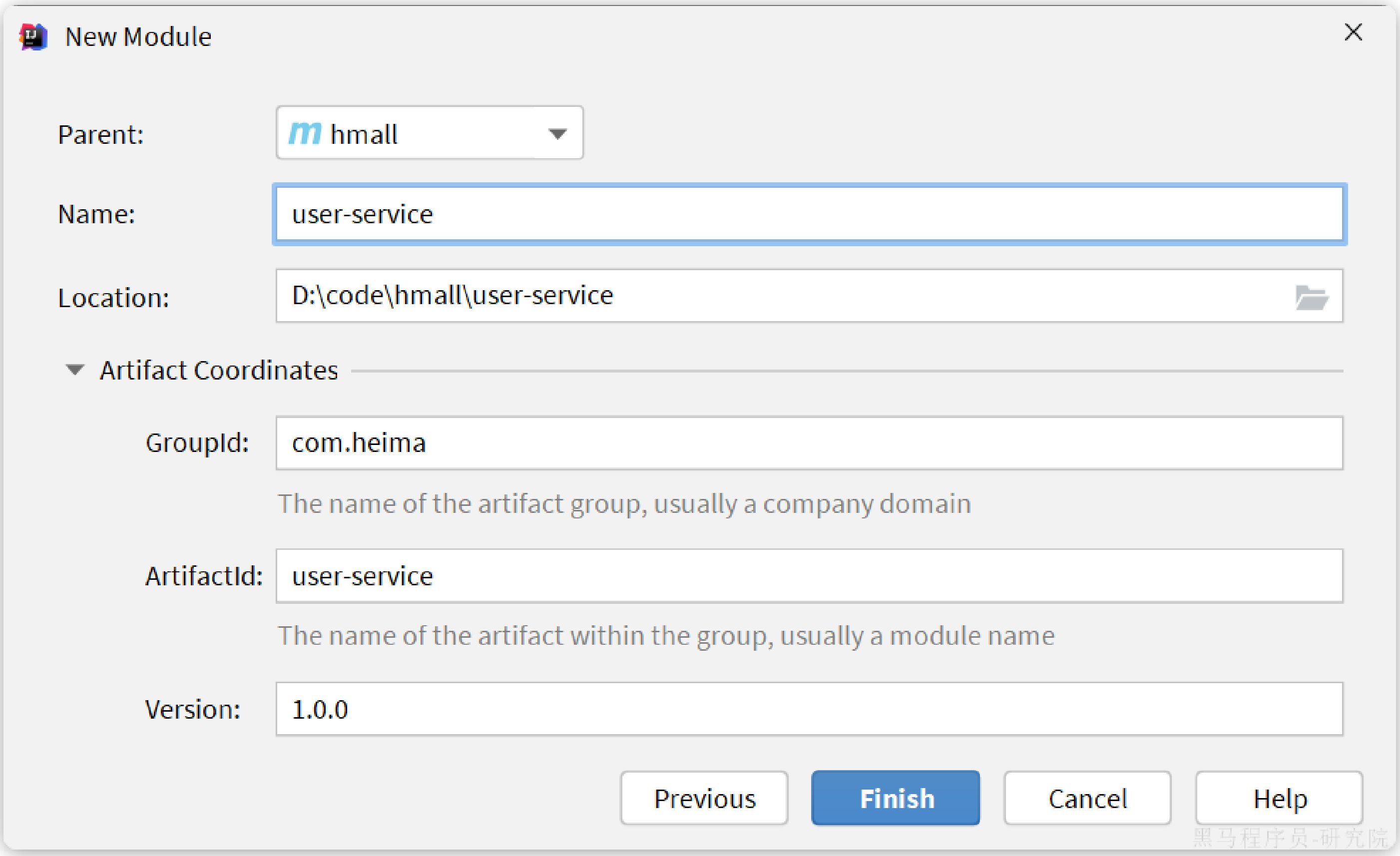
微服务拆分作业参考

作业尽量自己完成，实在觉得有困难的，再来查看本篇内容

1.用户服务

1.1.创建项目

在hmall下新建一个module，命名为user-service：



Parent: hmall

Name: user-service

Location: D:\code\hmall\user-service

Artifact Coordinates

GroupId: com.heima

The name of the artifact group, usually a company domain

ArtifactId: user-service

The name of the artifact within the group, usually a module name

Version: 1.0.0

1.2.依赖

user-service的pom.xml文件内容如下：

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
```

```xml
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <parent>
        <artifactId>hmall</artifactId>
        <groupId>com.heima</groupId>
        <version>1.0.0</version>
    </parent>
    <modelVersion>4.0.0</modelVersion>

    <artifactId>user-service</artifactId>

    <properties>
        <maven.compiler.source>11</maven.compiler.source>
        <maven.compiler.target>11</maven.compiler.target>
    </properties>

    <dependencies>
        <!--common-->
        <dependency>
            <groupId>com.heima</groupId>
            <artifactId>hm-common</artifactId>
            <version>1.0.0</version>
        </dependency>
        <!--api-->
        <dependency>
            <groupId>com.heima</groupId>
            <artifactId>hm-api</artifactId>
            <version>1.0.0</version>
        </dependency>
        <!--web-->
        <dependency>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-starter-web</artifactId>
        </dependency>
        <!--数据库-->
        <dependency>
            <groupId>mysql</groupId>
            <artifactId>mysql-connector-java</artifactId>
        </dependency>
        <!--mybatis-->
        <dependency>
            <groupId>com.baomidou</groupId>
            <artifactId>mybatis-plus-boot-starter</artifactId>
        </dependency>
        <!--nacos 服务注册发现-->
        <dependency>
```

```
                <groupId>com.alibaba.cloud</groupId>
                <artifactId>spring-cloud-starter-alibaba-nacos-
discovery</artifactId>
            </dependency>
        </dependencies>
        <build>
            <finalName>${project.artifactId}</finalName>
            <plugins>
                <plugin>
                    <groupId>org.springframework.boot</groupId>
                    <artifactId>spring-boot-maven-plugin</artifactId>
                </plugin>
            </plugins>
        </build>
</project>
```

1.3.启动类

在user-service中的 `com.hmall.user` 包下创建启动类：

```java
package com.hmall.user;

import org.mybatis.spring.annotation.MapperScan;
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;

@MapperScan("com.hmall.user.mapper")
@SpringBootApplication
public class UserApplication {
    public static void main(String[] args) {
        SpringApplication.run(UserApplication.class, args);
    }
}
```

1.4.配置文件

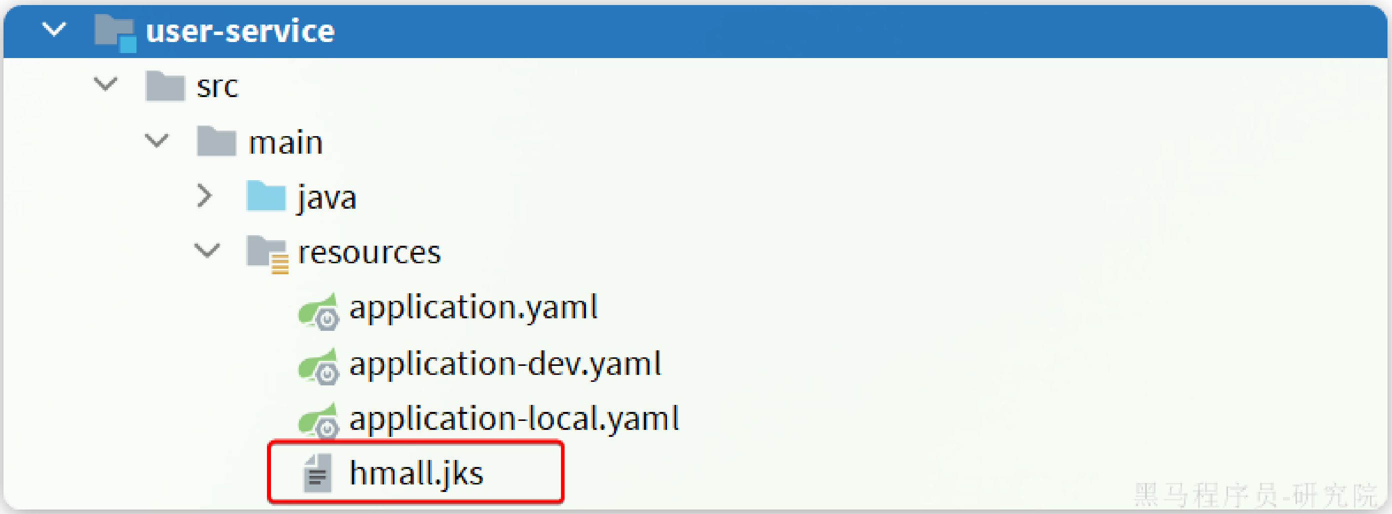
从 `hm-service` 项目中复制3个yaml配置文件到 `user-service` 的 `resource` 目录。

其中 `application-dev.yaml` 和 `application-local.yaml` 保持不变。 `application.yaml` 如下：

```yaml
server:
  port: 8084
spring:
  application:
    name: user-service # 服务名称
  profiles:
    active: dev
  datasource:
    url: jdbc:mysql://${hm.db.host}:3306/hm-user?useUnicode=true&characterEncoding=UTF-8&autoReconnect=true&serverTimezone=Asia/Shanghai
    driver-class-name: com.mysql.cj.jdbc.Driver
    username: root
    password: ${hm.db.pw}
  cloud:
    nacos:
      server-addr: 192.168.150.101 # nacos地址
mybatis-plus:
  configuration:
    default-enum-type-handler: com.baomidou.mybatisplus.core.handlers.MybatisEnumTypeHandler
  global-config:
    db-config:
      update-strategy: not_null
      id-type: auto
logging:
  level:
    com.hmall: debug
  pattern:
    dateformat: HH:mm:ss:SSS
  file:
    path: "logs/${spring.application.name}"
knife4j:
  enable: true
  openapi:
    title: 用户服务接口文档
    description: "信息"
    email: zhanghuyi@itcast.cn
    concat: 虎哥
    url: https://www.itcast.cn
    version: v1.0.0
    group:
      default:
        group-name: default
        api-rule: package
        api-rule-resources:
          - com.hmall.user.controller
hm:
```

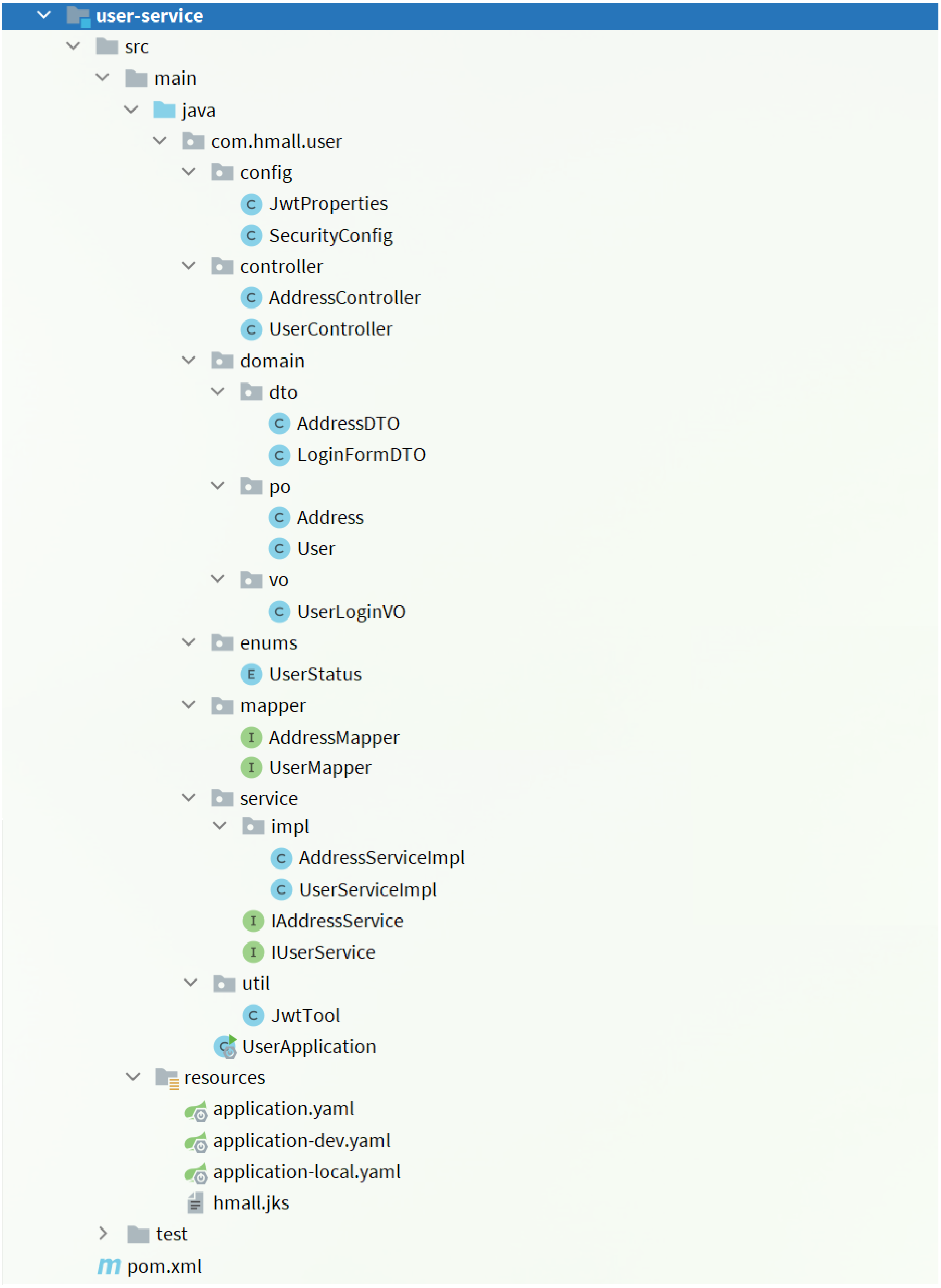
```yaml
jwt:
  location: classpath:hmall.jks
  alias: hmall
  password: hmall123
  tokenTTL: 30m
```

将hm-service下的hmall.jks文件拷贝到user-service下的resources目录，这是JWT加密的秘钥文件：



1.5.代码

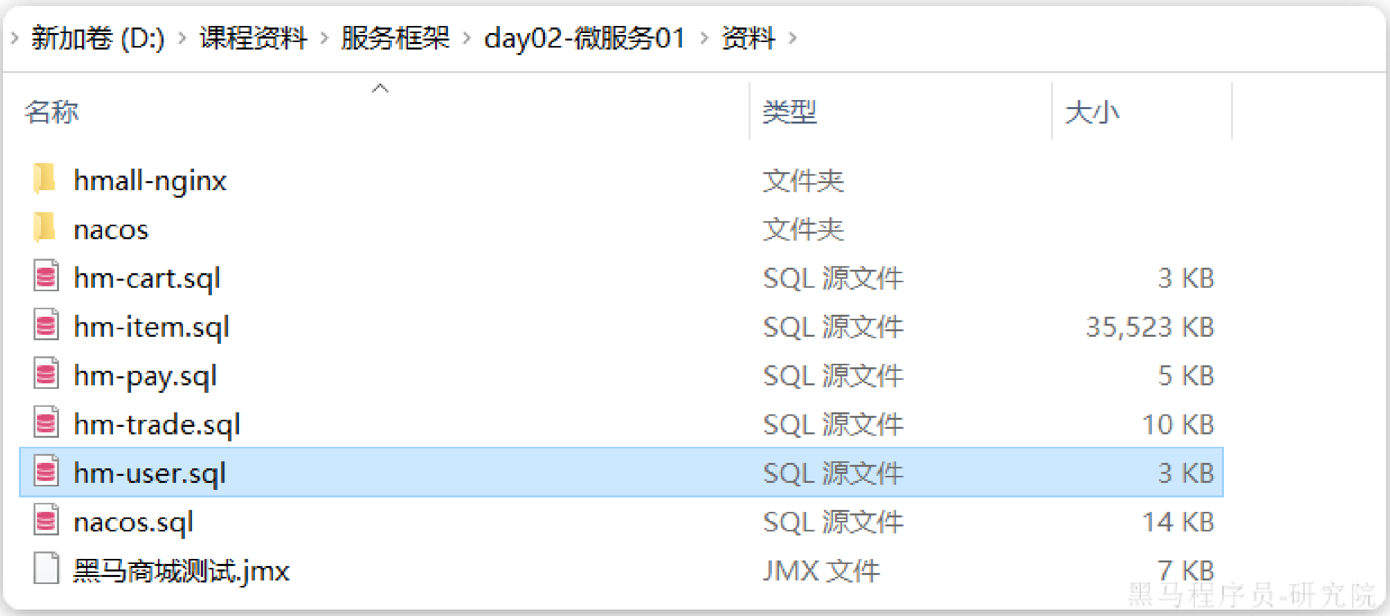
复制hm-service中所有与user、address、jwt有关的代码，最终项目结构如下：



```
user-service
  src
    main
      java
        com.hmall.user
          config
            JwtProperties
            SecurityConfig
          controller
            AddressController
            UserController
          domain
            dto
              AddressDTO
              LoginFormDTO
            po
              Address
              User
            vo
              UserLoginVO
          enums
            UserStatus
          mapper
            AddressMapper
            UserMapper
          service
            impl
              AddressServiceImpl
              UserServiceImpl
            IAddressService
            IUserService
          util
            JwtTool
          UserApplication
      resources
        application.yaml
        application-dev.yaml
        application-local.yaml
        hmall.jks
    test
  pom.xml
```

1.6.数据库

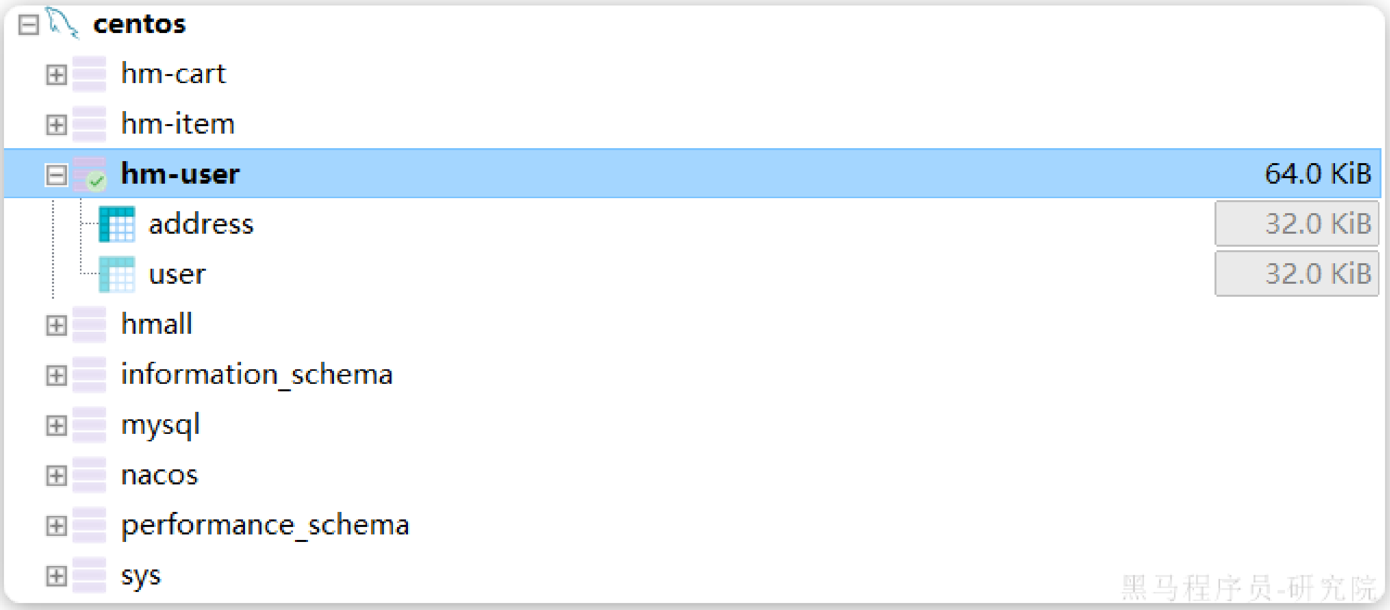
user-service也需要自己的独立的database，向MySQL中导入课前资料提供的SQL：



› 新加卷 (D:) › 课程资料 › 服务框架 › day02-微服务01 › 资料 ›

名称	类型	大小
hmall-nginx	文件夹	
nacos	文件夹	
hm-cart.sql	SQL 源文件	3 KB
hm-item.sql	SQL 源文件	35,523 KB
hm-pay.sql	SQL 源文件	5 KB
hm-trade.sql	SQL 源文件	10 KB
hm-user.sql	SQL 源文件	3 KB
nacos.sql	SQL 源文件	14 KB
黑马商城测试.jmx	JMX 文件	7 KB

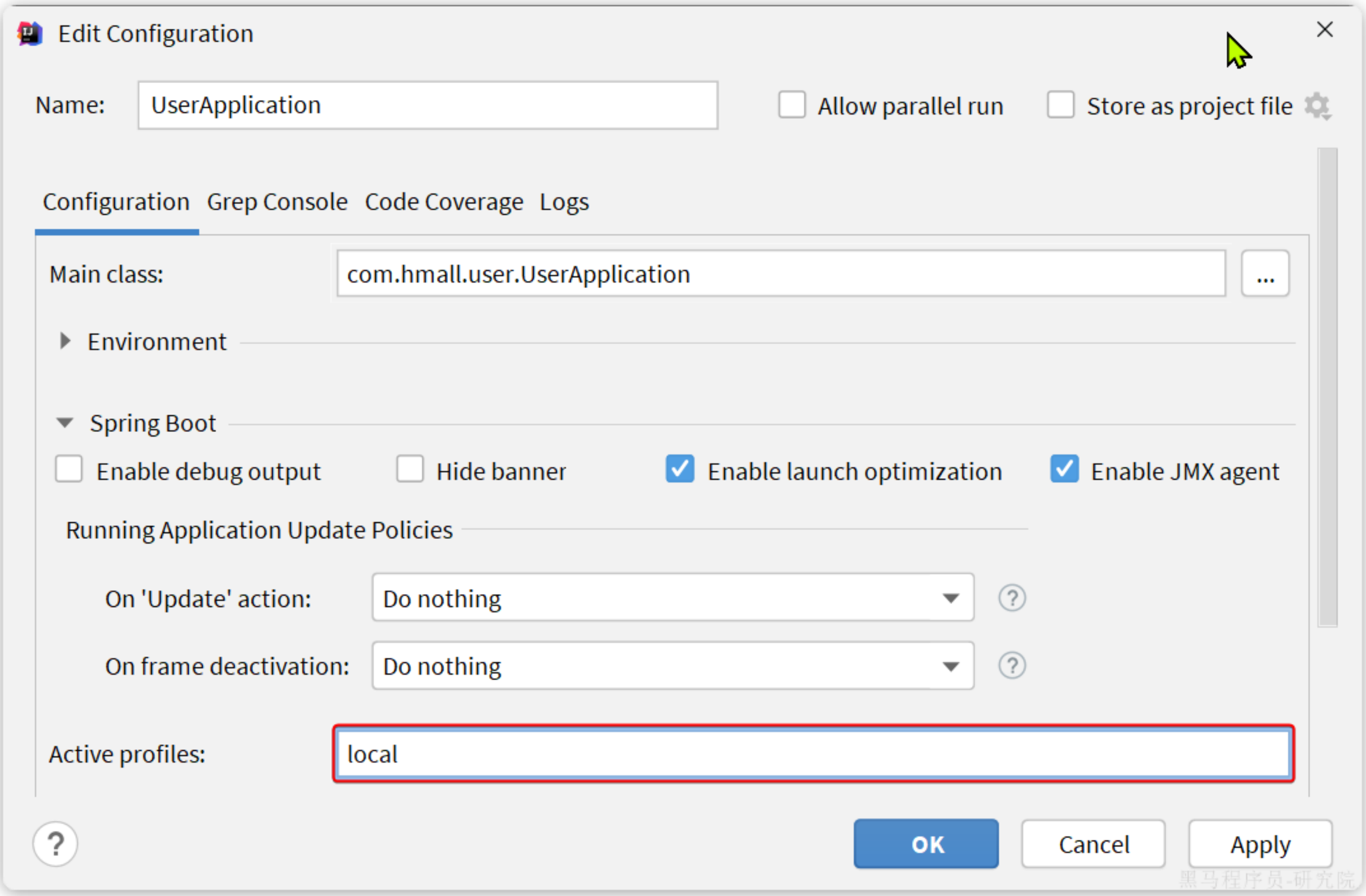
导入结果如下：



```
centos
  hm-cart
  hm-item
  hm-user                                  64.0 KiB
    address                                32.0 KiB
    user                                   32.0 KiB
  hmall
  information_schema
  mysql
  nacos
  performance_schema
  sys
```

1.7.配置启动项

给user-service配置启动项，设置profile为local：



Name: UserApplication

Main class: com.hmall.user.UserApplication

[ ] Enable debug output [ ] Hide banner [✓] Enable launch optimization [✓] Enable JMX agent

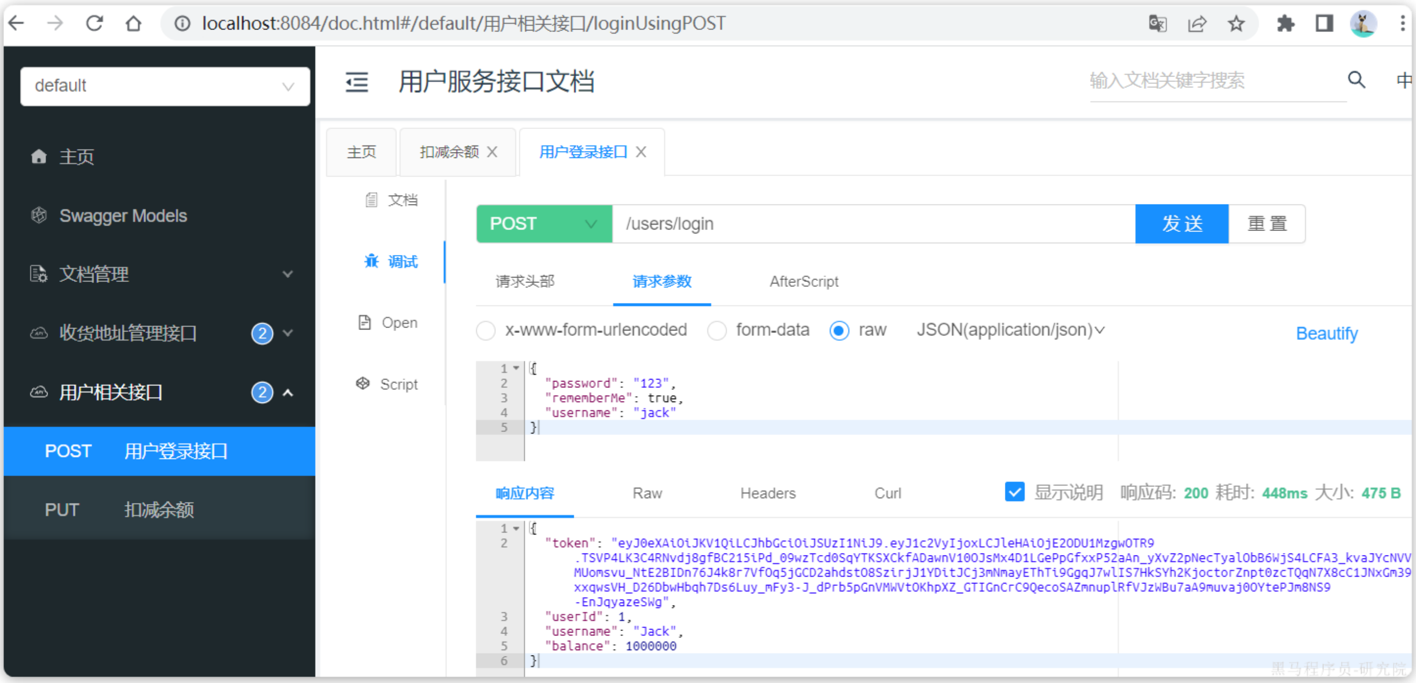
On 'Update' action: Do nothing

On frame deactivation: Do nothing

Active profiles: local

1.8.测试

启动UserApplication，访问http://localhost:8084/doc.html#/default/用户相关接口/loginUsingPOST，测试登录接口：



POST /users/login

x-www-form-urlencoded form-data [✓ raw] JSON(application/json)

```
{
  "password": "123",
  "rememberMe": true,
  "username": "jack"
}
```

[✓] 显示说明 响应码: 200 耗时: 448ms 大小: 475 B

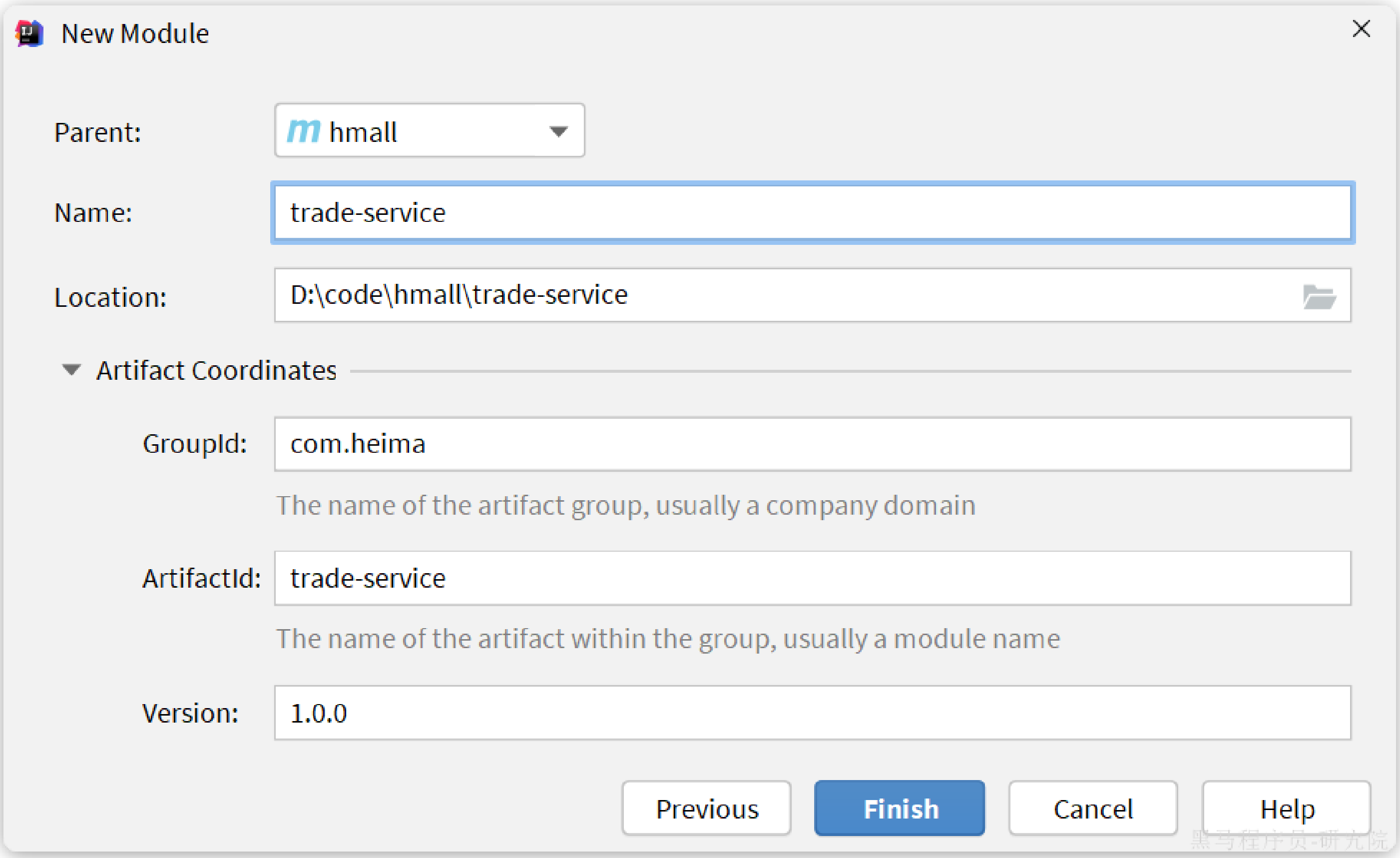
```
{
  "token": "eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiJ9.eyJ1c2VyIjoxLCJleHAiOjE2ODU1MzgwOTR9
      .TSVP4LK3C4RNvdj8gfBC215iPd_09wzTcd0SqYTKSXCkfADawnV10OJsMx4D1LGePpGfxxP52aAn_yXvZ2pNecTyalObB6WjS4LCFA3_kvaJYcNVV
      MUomsvu_NtE2BIDn76J4k8r7VfOq5jGCD2ahdstO8SzirjJ1YDitJCj3mNmayEThTi9GgqJ7wlIS7HkSYh2KjoctorZnpt0zcTQqN7X8cC1JNxGm39
      xxqwsVH_D26DbwHbqh7Ds6Luy_mFy3-J_dPrb5pGnVMWVtOKhpXZ_GTIGnCrC9QecoSAZmnuplRfVJzWBu7aA9muvaj0OYtePJm8NS9
      -EnJqyazeSWg",
  "userId": 1,
  "username": "Jack",
  "balance": 1000000
}
```

用户服务测试通过。

2.交易服务

2.1.创建项目

在hmall下新建一个module，命名为trade-service：



New Module

Parent: hmall

Name: trade-service

Location: D:\code\hmall\trade-service

Artifact Coordinates

GroupId: com.heima

The name of the artifact group, usually a company domain

ArtifactId: trade-service

The name of the artifact within the group, usually a module name

Version: 1.0.0

2.2.依赖

trade-service的pom.xml文件内容如下：

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0
http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <parent>
        <artifactId>hmall</artifactId>
        <groupId>com.heima</groupId>
        <version>1.0.0</version>
    </parent>
    <modelVersion>4.0.0</modelVersion>

    <artifactId>trade-service</artifactId>

    <properties>
        <maven.compiler.source>11</maven.compiler.source>
        <maven.compiler.target>11</maven.compiler.target>
    </properties>

    <dependencies>
        <!--common-->
        <dependency>
            <groupId>com.heima</groupId>
            <artifactId>hm-common</artifactId>
            <version>1.0.0</version>
        </dependency>
        <!--api-->
        <dependency>
            <groupId>com.heima</groupId>
            <artifactId>hm-api</artifactId>
            <version>1.0.0</version>
        </dependency>
        <!--web-->
        <dependency>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-starter-web</artifactId>
        </dependency>
        <!--数据库-->
        <dependency>
            <groupId>mysql</groupId>
            <artifactId>mysql-connector-java</artifactId>
        </dependency>
        <!--mybatis-->
        <dependency>
            <groupId>com.baomidou</groupId>
            <artifactId>mybatis-plus-boot-starter</artifactId>
        </dependency>
        <!--nacos 服务注册发现-->
        <dependency>
            <groupId>com.alibaba.cloud</groupId>
            <artifactId>spring-cloud-starter-alibaba-nacos-discovery</artifactId>
        </dependency>
    </dependencies>
    <build>
        <finalName>${project.artifactId}</finalName>
        <plugins>
            <plugin>
```

```xml
                <groupId>org.springframework.boot</groupId>
                <artifactId>spring-boot-maven-plugin</artifactId>
            </plugin>
        </plugins>
    </build>
</project>
```

2.3.启动类

在trade-service中的 `com.hmall.trade` 包下创建启动类：

```java
package com.hmall.trade;

import org.mybatis.spring.annotation.MapperScan;
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.cloud.openfeign.EnableFeignClients;

@EnableFeignClients(basePackages = "com.hmall.api.client",
defaultConfiguration = DefaultFeignConfig.class)
@MapperScan("com.hmall.trade.mapper")
@SpringBootApplication
public class TradeApplication {
    public static void main(String[] args) {
        SpringApplication.run(TradeApplication.class, args);
    }
}
```

2.4.配置文件

从 `hm-service` 项目中复制3个yaml配置文件到 `trade-service` 的 `resource` 目录。

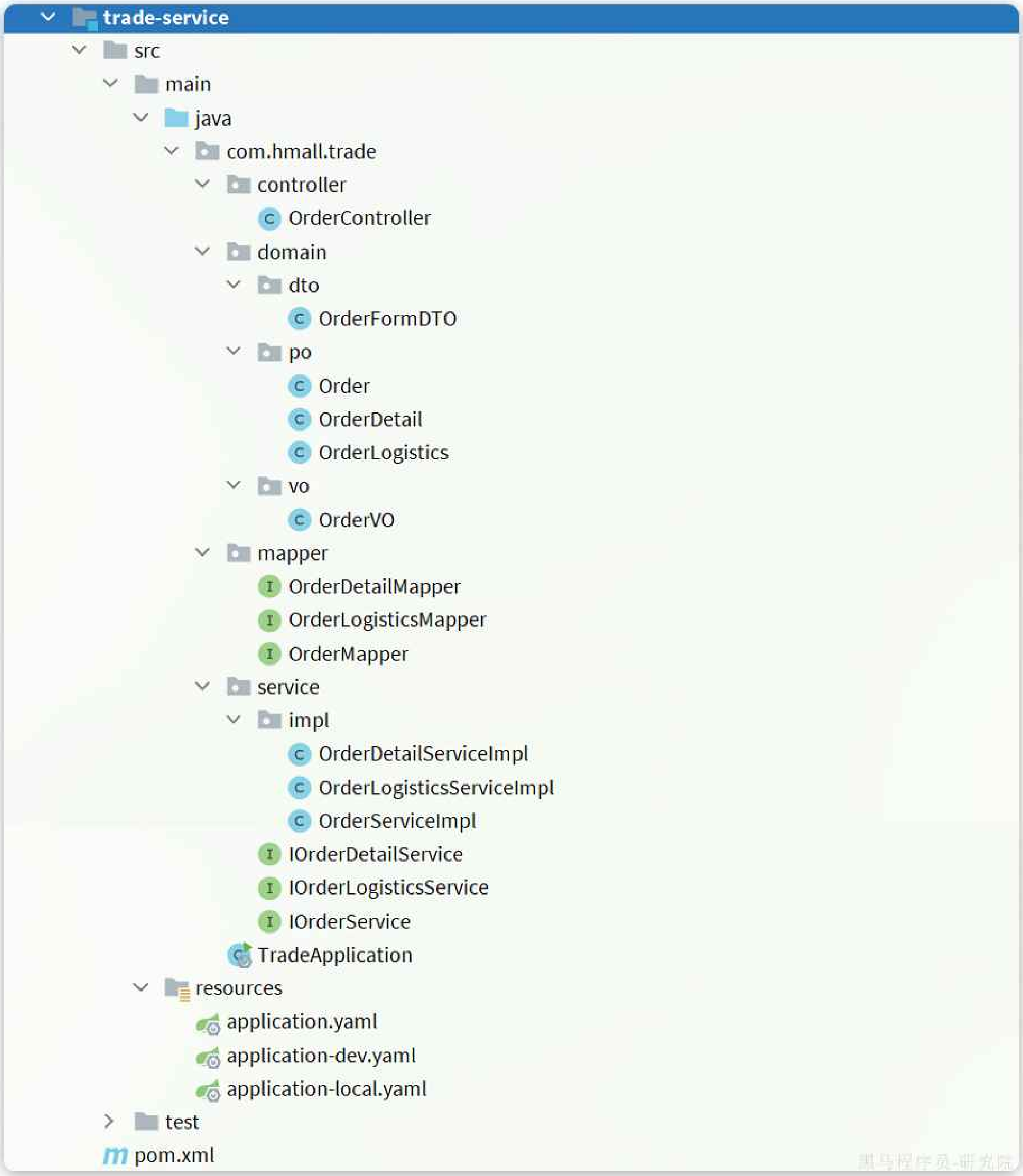
其中 `application-dev.yaml` 和 `application-local.yaml` 保持不变。`application.yaml` 如下：

```yaml
server:
  port: 8085
spring:
  application:
    name: trade-service # 服务名称
  profiles:
    active: dev
  datasource:
    url: jdbc:mysql://${hm.db.host}:3306/hm-trade?useUnicode=true&characterEncoding=UTF-8&autoReconnect=true&serverTimezone=Asia/Shanghai
    driver-class-name: com.mysql.cj.jdbc.Driver
    username: root
    password: ${hm.db.pw}
  cloud:
    nacos:
      server-addr: 192.168.150.101 # nacos地址
mybatis-plus:
  configuration:
    default-enum-type-handler: com.baomidou.mybatisplus.core.handlers.MybatisEnumTypeHandler
  global-config:
    db-config:
      update-strategy: not_null
      id-type: auto
logging:
  level:
    com.hmall: debug
  pattern:
    dateformat: HH:mm:ss:SSS
  file:
    path: "logs/${spring.application.name}"
knife4j:
  enable: true
  openapi:
    title: 交易服务接口文档
    description: "信息"
    email: zhanghuyi@itcast.cn
    concat: 虎哥
    url: https://www.itcast.cn
    version: v1.0.0
    group:
      default:
        group-name: default
        api-rule: package
        api-rule-resources:
          - com.hmall.trade.controller
```

2.5.代码

2.5.1.基础代码

复制hm-service中所有与trade有关的代码，最终项目结构如下：



```
trade-service
  src
    main
      java
        com.hmall.trade
          controller
            OrderController
          domain
            dto
              OrderFormDTO
            po
              Order
              OrderDetail
              OrderLogistics
            vo
              OrderVO
          mapper
            OrderDetailMapper
            OrderLogisticsMapper
            OrderMapper
          service
            impl
              OrderDetailServiceImpl
              OrderLogisticsServiceImpl
              OrderServiceImpl
            IOrderDetailService
            IOrderLogisticsService
            IOrderService
          TradeApplication
      resources
        application.yaml
        application-dev.yaml
        application-local.yaml
    test
  pom.xml
```

在交易服务中，用户下单时需要做下列事情：

- **根据id查询商品列表**
- 计算商品总价

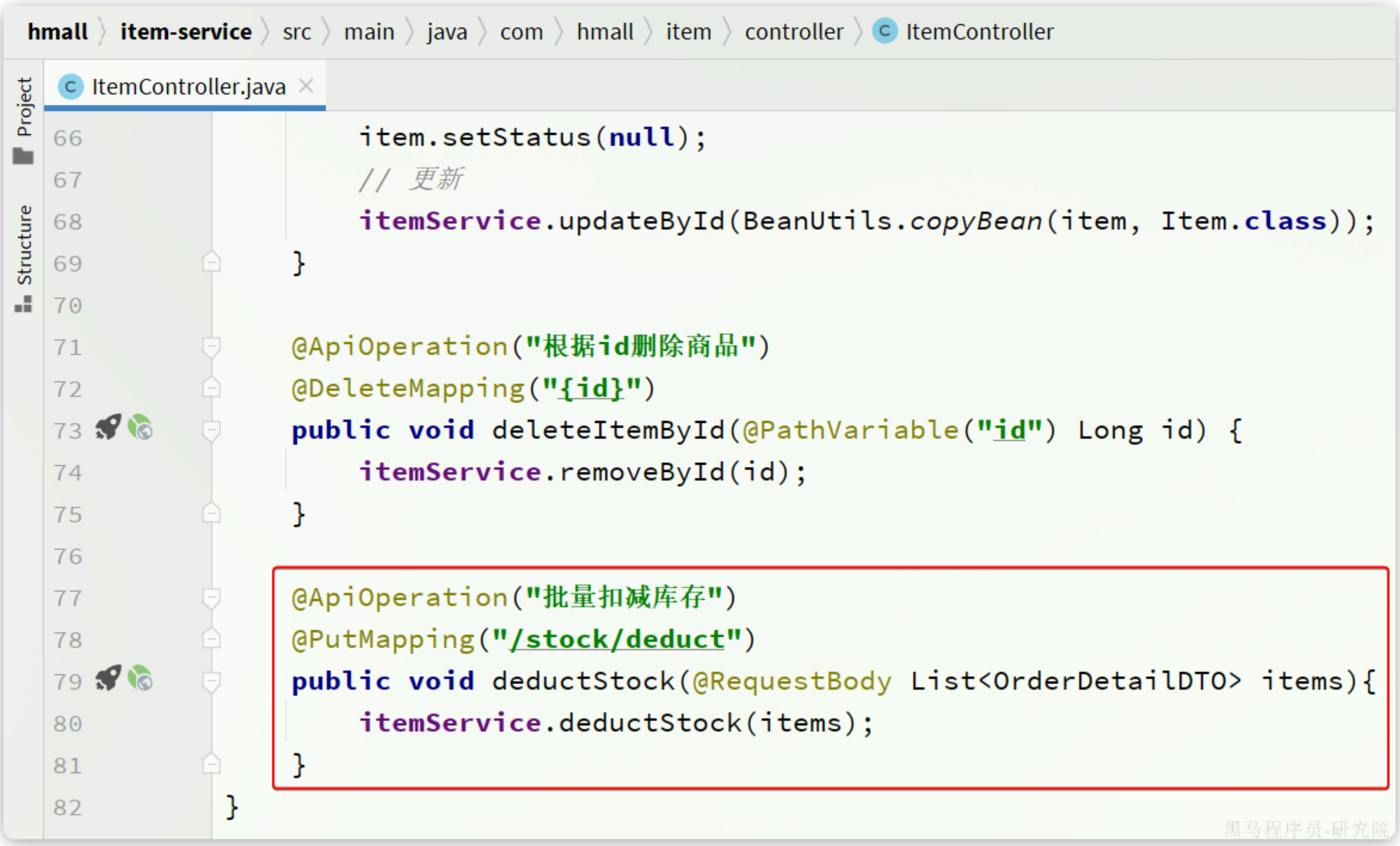
- 保存订单
- **扣减库存**
- **清理购物车商品**

其中，查询商品、扣减库存都是与商品有关的业务，在item-service中有相关功能；清理购物车商品是购物车业务，在cart-service中有相关功能。

因此交易服务要调用他们，必须通过OpenFeign远程调用。我们需要将上述功能抽取为FeignClient.

2.5.2.抽取ItemClient接口

首先是**扣减库存**，在 `item-service` 中的对应业务接口如下：

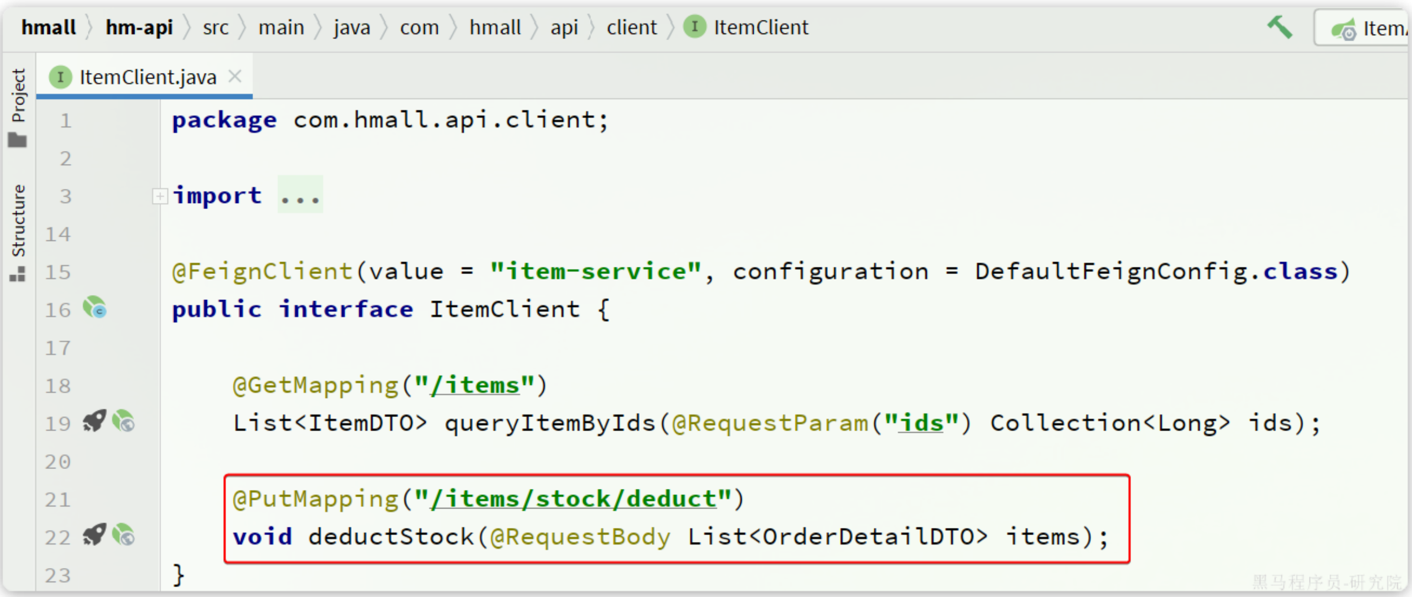


hmall 〉 item-service 〉 src 〉 main 〉 java 〉 com 〉 hmall 〉 item 〉 controller 〉 ItemController

ItemController.java

```java
        item.setStatus(null);
        // 更新
        itemService.updateById(BeanUtils.copyBean(item, Item.class));
    }

    @ApiOperation("根据id删除商品")
    @DeleteMapping("{id}")
    public void deleteItemById(@PathVariable("id") Long id) {
        itemService.removeById(id);
    }

    @ApiOperation("批量扣减库存")
    @PutMapping("/stock/deduct")
    public void deductStock(@RequestBody List<OrderDetailDTO> items){
        itemService.deductStock(items);
    }
}
```

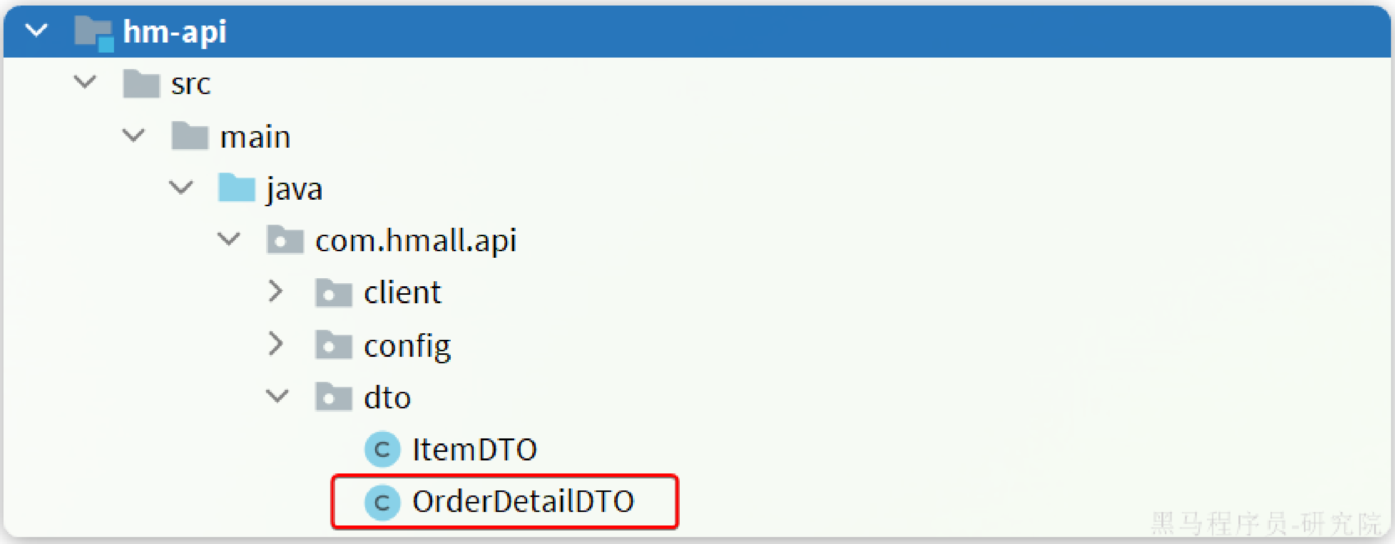
我们将这个接口抽取到 `hm-api` 模块的 `com.hmall.api.client.ItemClient` 中:


hmall 〉 hm-api 〉 src 〉 main 〉 java 〉 com 〉 hmall 〉 api 〉 client 〉 ItemClient

ItemClient.java

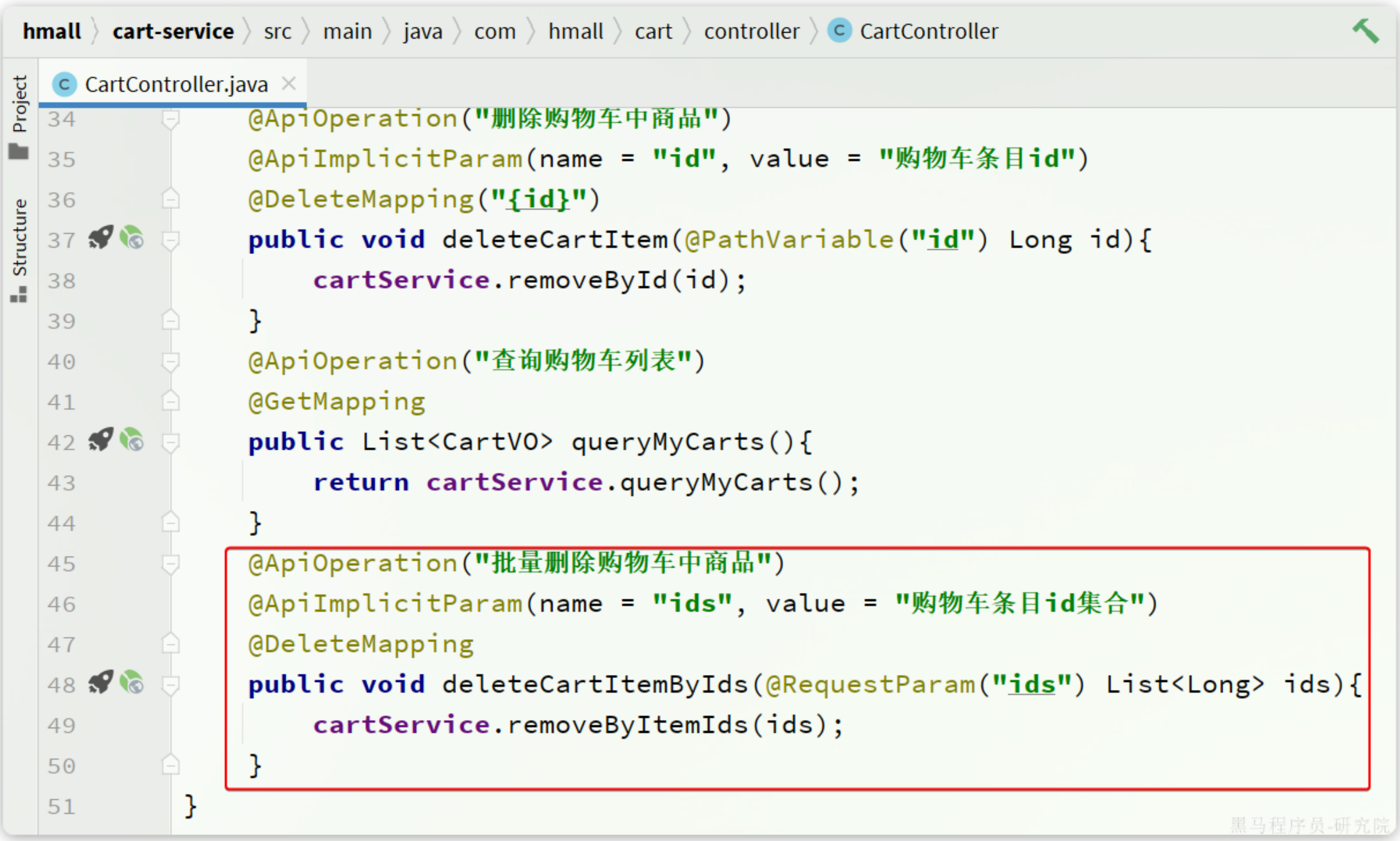
```java
package com.hmall.api.client;

import ...

@FeignClient(value = "item-service", configuration = DefaultFeignConfig.class)
public interface ItemClient {

    @GetMapping("/items")
    List<ItemDTO> queryItemByIds(@RequestParam("ids") Collection<Long> ids);

    @PutMapping("/items/stock/deduct")
    void deductStock(@RequestBody List<OrderDetailDTO> items);
}
```

将接口参数的 `OrderDetailDTO` 抽取到 `hm-api` 模块的 `com.hmall.api.dto` 包下：



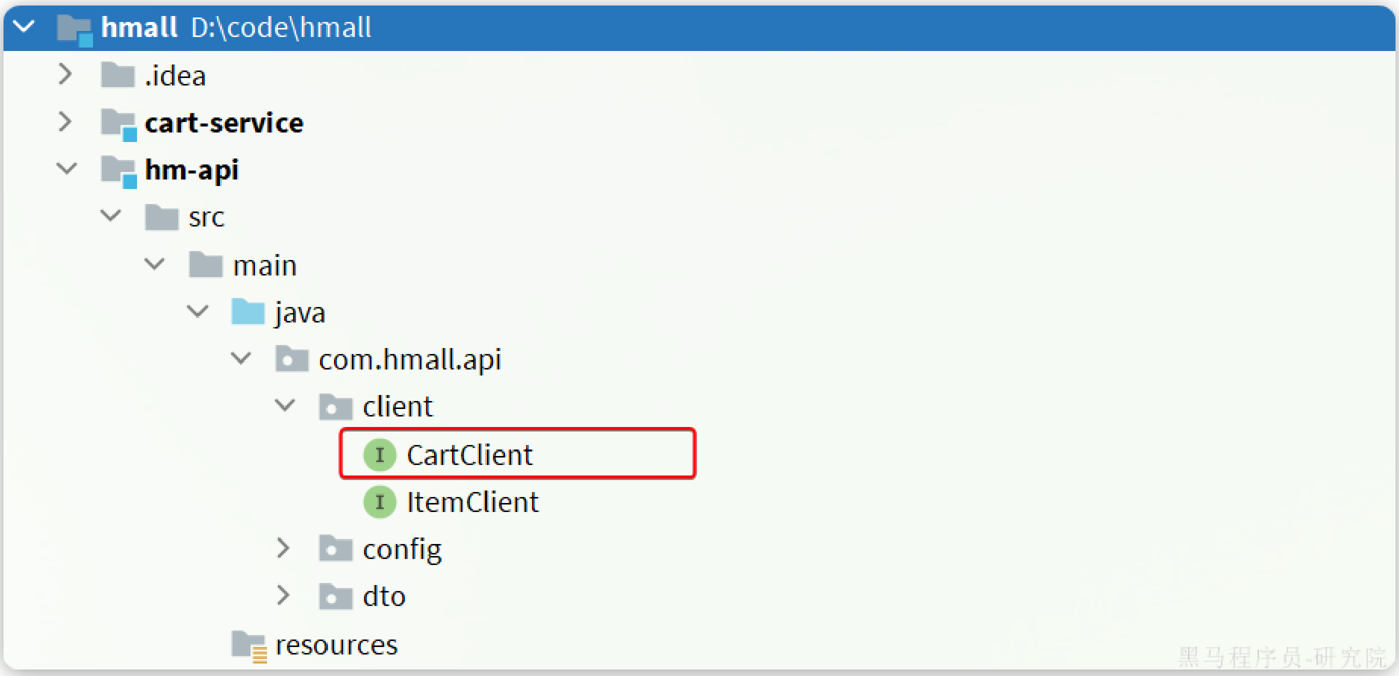
2.5.3.抽取CartClient接口

接下来是**清理购物车商品**，在 `cart-service` 中的对应业务接口如下：



```
hmall 〉 cart-service 〉 src 〉 main 〉 java 〉 com 〉 hmall 〉 cart 〉 controller 〉 CartController
CartController.java
    @ApiOperation("删除购物车中商品")
    @ApiImplicitParam(name = "id", value = "购物车条目id")
    @DeleteMapping("{id}")
    public void deleteCartItem(@PathVariable("id") Long id){
        cartService.removeById(id);
    }
    @ApiOperation("查询购物车列表")
    @GetMapping
    public List<CartVO> queryMyCarts(){
        return cartService.queryMyCarts();
    }
    @ApiOperation("批量删除购物车中商品")
    @ApiImplicitParam(name = "ids", value = "购物车条目id集合")
    @DeleteMapping
    public void deleteCartItemByIds(@RequestParam("ids") List<Long> ids){
        cartService.removeByItemIds(ids);
    }
}
```

我们在 `hm-api` 模块的 `com.hmall.api.client` 包下定义一个 `CartClient` 接口：



代码如下：

```java
package com.hmall.api.client;

import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.web.bind.annotation.DeleteMapping;
import org.springframework.web.bind.annotation.RequestParam;

import java.util.Collection;

@FeignClient("cart-service")
public interface CartClient {
    @DeleteMapping("/carts")
    void deleteCartItemByIds(@RequestParam("ids") Collection<Long> ids);
}
```

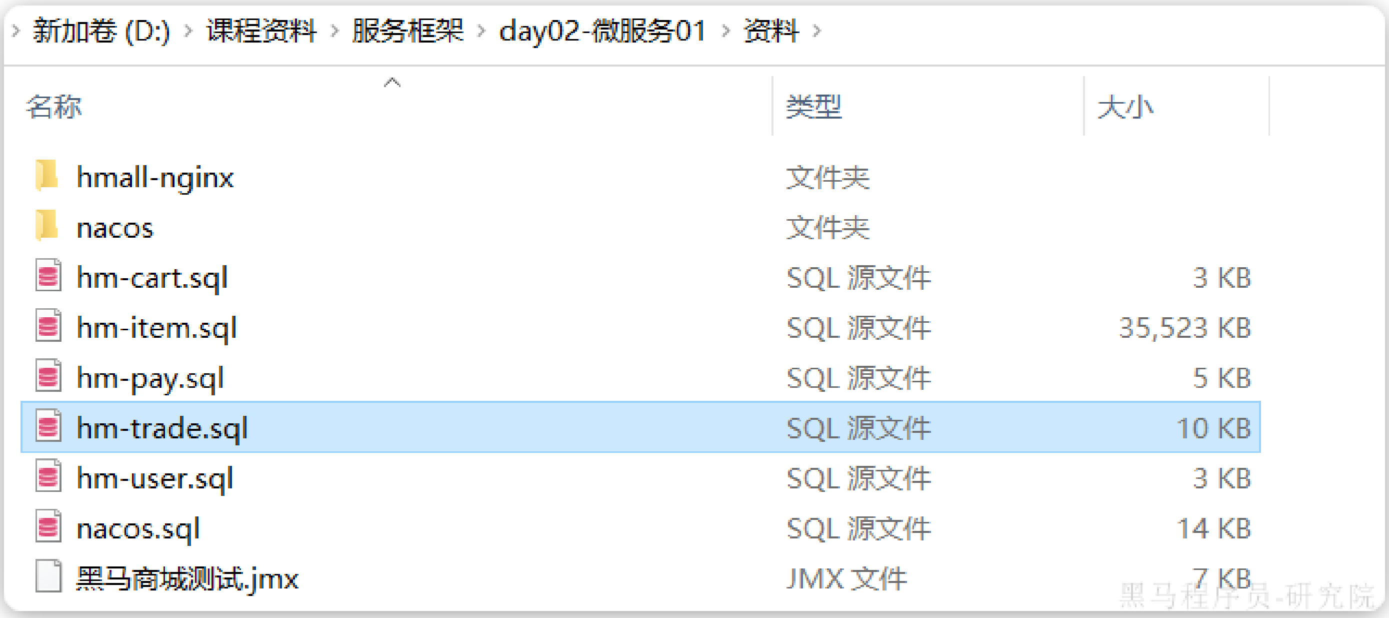
2.5.4.改造OrderServiceImpl

接下来，就可以改造OrderServiceImpl中的逻辑，将本地方法调用改造为基于FeignClient的调用，完整代码如下：

```java
package com.hmall.trade.service.impl;

import com.baomidou.mybatisplus.extension.service.impl.ServiceImpl;
import com.hmall.api.client.CartClient;
import com.hmall.api.client.ItemClient;
import com.hmall.api.dto.ItemDTO;
import com.hmall.api.dto.OrderDetailDTO;
import com.hmall.common.exception.BadRequestException;
import com.hmall.common.utils.UserContext;
import com.hmall.trade.domain.dto.OrderFormDTO;
import com.hmall.trade.domain.po.Order;
import com.hmall.trade.domain.po.OrderDetail;
import com.hmall.trade.mapper.OrderMapper;
import com.hmall.trade.service.IOrderDetailService;
import com.hmall.trade.service.IOrderService;
import lombok.RequiredArgsConstructor;
import org.springframework.stereotype.Service;
import org.springframework.transaction.annotation.Transactional;

import java.util.ArrayList;
import java.util.List;
import java.util.Map;
import java.util.Set;
import java.util.stream.Collectors;

/**
 * <p>
 * 服务实现类
 * </p>
 */
@Service
@RequiredArgsConstructor
public class OrderServiceImpl extends ServiceImpl<OrderMapper, Order> implements IOrderService {

    private final ItemClient itemClient;
    private final IOrderDetailService detailService;
    private final CartClient cartClient;

    @Override
    @Transactional
    public Long createOrder(OrderFormDTO orderFormDTO) {
        // 1.订单数据
        Order order = new Order();
        // 1.1.查询商品
        List<OrderDetailDTO> detailDTOS = orderFormDTO.getDetails();
        // 1.2.获取商品id和数量的Map
        Map<Long, Integer> itemNumMap = detailDTOS.stream()
                .collect(Collectors.toMap(OrderDetailDTO::getItemId, OrderDetailDTO::getNum));
        Set<Long> itemIds = itemNumMap.keySet();
        // 1.3.查询商品
        List<ItemDTO> items = itemClient.queryItemByIds(itemIds);
        if (items == null || items.size() < itemIds.size()) {
            throw new BadRequestException("商品不存在");
        }
        // 1.4.基于商品价格、购买数量计算商品总价：totalFee
        int total = 0;
        for (ItemDTO item : items) {
            total += item.getPrice()  itemNumMap.get(item.getId());
        }
        order.setTotalFee(total);
        // 1.5.其它属性
        order.setPaymentType(orderFormDTO.getPaymentType());
        order.setUserId(UserContext.getUser());
        order.setStatus(1);
        // 1.6.将Order写入数据库order表中
        save(order);

        // 2.保存订单详情
        List<OrderDetail> details = buildDetails(order.getId(), items, itemNumMap);
        detailService.saveBatch(details);

        // 3.扣减库存
        try {
            itemClient.deductStock(detailDTOS);
        } catch (Exception e) {
            throw new RuntimeException("库存不足！");
        }

        // 4.清理购物车商品
        cartClient.deleteCartItemByIds(itemIds);
        return order.getId();
    }

    private List<OrderDetail> buildDetails(Long orderId, List<ItemDTO> items, Map<Long, Integer> numMap) {
        List<OrderDetail> details = new ArrayList<>(items.size());
        for (ItemDTO item : items) {
            OrderDetail detail = new OrderDetail();
            detail.setName(item.getName());
            detail.setSpec(item.getSpec());
            detail.setPrice(item.getPrice());
            detail.setNum(numMap.get(item.getId()));
            detail.setItemId(item.getId());
            detail.setImage(item.getImage());
            detail.setOrderId(orderId);
            details.add(detail);
        }
        return details;
    }
}
```

2.6.数据库

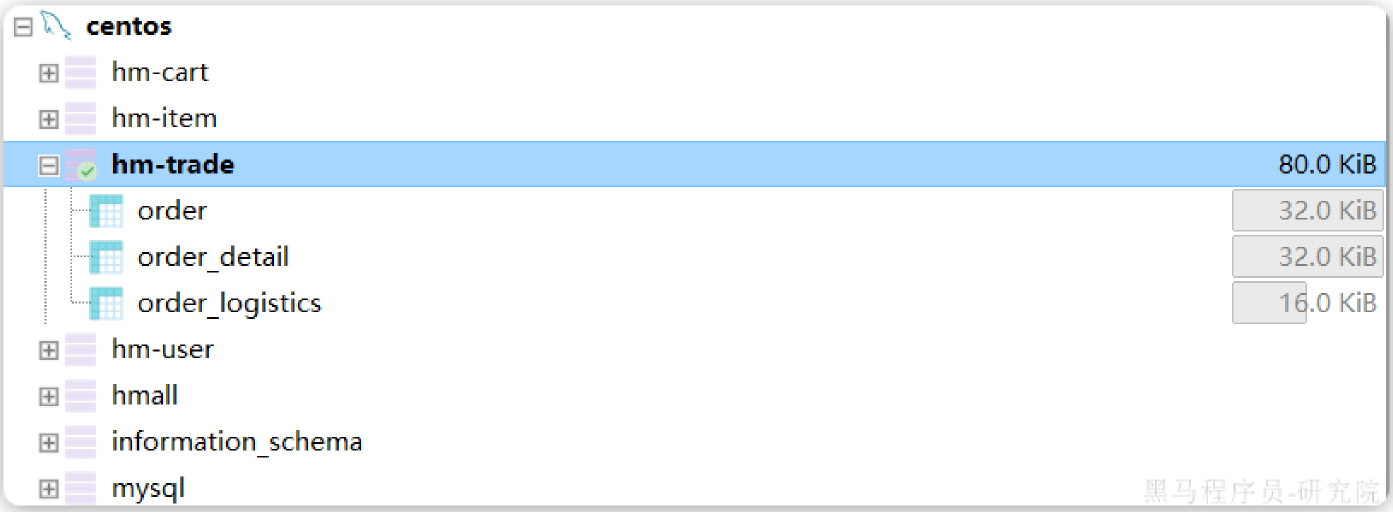
trade-service也需要自己的独立的database，向MySQL中导入课前资料提供的SQL：



› 新加卷 (D:) › 课程资料 › 服务框架 › day02-微服务01 › 资料 ›

名称	类型	大小
hmall-nginx	文件夹	
nacos	文件夹	
hm-cart.sql	SQL 源文件	3 KB
hm-item.sql	SQL 源文件	35,523 KB
hm-pay.sql	SQL 源文件	5 KB
hm-trade.sql	SQL 源文件	10 KB
hm-user.sql	SQL 源文件	3 KB
nacos.sql	SQL 源文件	14 KB
黑马商城测试.jmx	JMX 文件	7 KB

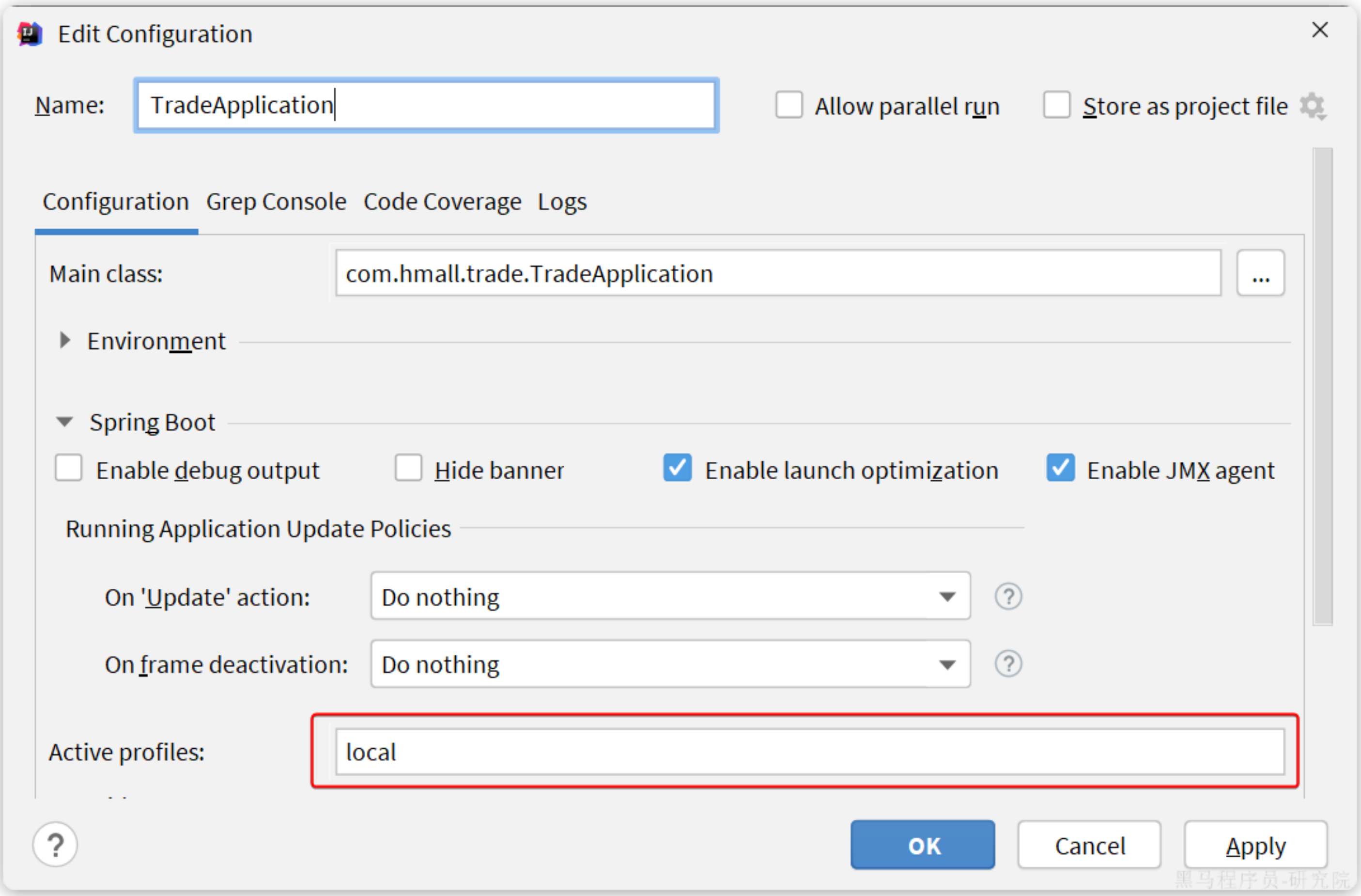
导入结果如下：



```
centos
  hm-cart
  hm-item
  hm-trade                          80.0 KiB
    order                           32.0 KiB
    order_detail                    32.0 KiB
    order_logistics                 16.0 KiB
  hm-user
  hmall
  information_schema
  mysql
```

2.7.配置启动项

给trade-service配置启动项，设置profile为local：



Name: TradeApplication

Main class: com.hmall.trade.TradeApplication

Environment

Spring Boot

Enable debug output ☐ Hide banner ☐ Enable launch optimization ✓ Enable JMX agent ✓

Running Application Update Policies

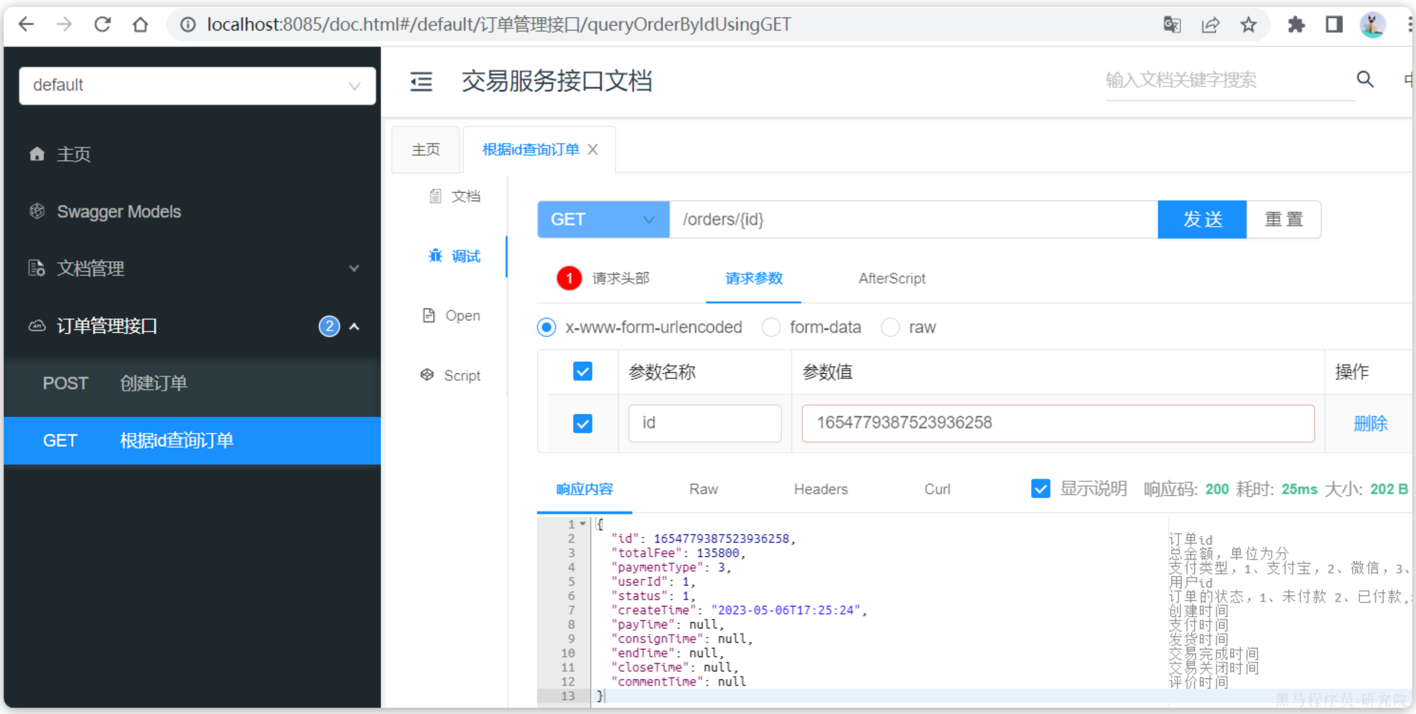
On 'Update' action: Do nothing

On frame deactivation: Do nothing

Active profiles: local

2.8.测试

启动TradeApplication，访问http://localhost:8085/doc.html，测试查询订单接口：



localhost:8085/doc.html#/default/订单管理接口/queryOrderByIdUsingGET

GET /orders/{id}

参数名称	参数值
id	1654779387523936258

响应码: 200 耗时: 25ms 大小: 202 B

```
{
  "id": 1654779387523936258,
  "totalFee": 135800,
  "paymentType": 3,
  "userId": 1,
  "status": 1,
  "createTime": "2023-05-06T17:25:24",
  "payTime": null,
  "consignTime": null,
  "endTime": null,
  "closeTime": null,
  "commentTime": null
}
```

```
订单id
总金额，单位为分
支付类型，1、支付宝，2、微信，3、
用户id
订单的状态，1、未付款 2、已付款，
创建时间
支付时间
发货时间
交易完成时间
交易关闭时间
评价时间
```

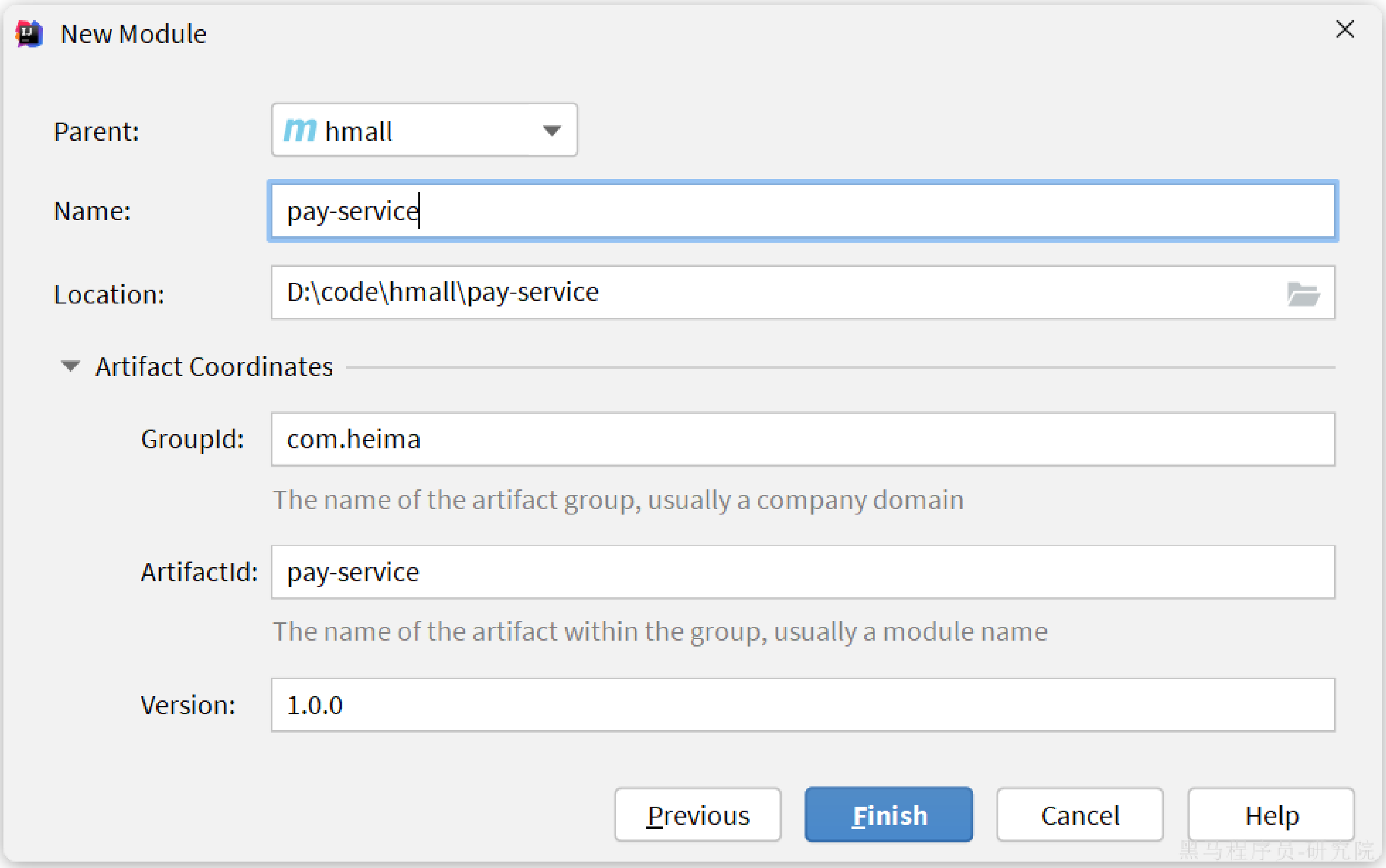
请求参数：1654779387523936258，交易服务测试通过。

注意，创建订单接口无法测试，因为无法获取登录用户信息。

3.支付服务

3.1.创建项目

在 `hmall` 下新建一个module，命名为 `pay-service`：



Parent: hmall

Name: pay-service

Location: D:\code\hmall\pay-service

Artifact Coordinates

GroupId: com.heima

The name of the artifact group, usually a company domain

ArtifactId: pay-service

The name of the artifact within the group, usually a module name

Version: 1.0.0

3.2.依赖

`pay-service` 的 `pom.xml` 文件内容如下：

```xml
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0"
         xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 
http://maven.apache.org/xsd/maven-4.0.0.xsd">
    <parent>
        <artifactId>hmall</artifactId>
        <groupId>com.heima</groupId>
        <version>1.0.0</version>
    </parent>
    <modelVersion>4.0.0</modelVersion>

    <artifactId>pay-service</artifactId>

    <properties>
        <maven.compiler.source>11</maven.compiler.source>
        <maven.compiler.target>11</maven.compiler.target>
    </properties>

    <dependencies>
        <!--common-->
        <dependency>
            <groupId>com.heima</groupId>
            <artifactId>hm-common</artifactId>
            <version>1.0.0</version>
        </dependency>
        <!--api-->
        <dependency>
            <groupId>com.heima</groupId>
            <artifactId>hm-api</artifactId>
            <version>1.0.0</version>
        </dependency>
        <!--web-->
        <dependency>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-starter-web</artifactId>
        </dependency>
        <!--数据库-->
        <dependency>
            <groupId>mysql</groupId>
            <artifactId>mysql-connector-java</artifactId>
        </dependency>
        <!--mybatis-->
        <dependency>
            <groupId>com.baomidou</groupId>
            <artifactId>mybatis-plus-boot-starter</artifactId>
        </dependency>
        <!--nacos 服务注册发现-->
        <dependency>
            <groupId>com.alibaba.cloud</groupId>
            <artifactId>spring-cloud-starter-alibaba-nacos-discovery</artifactId>
        </dependency>
    </dependencies>
    <build>
        <finalName>${project.artifactId}</finalName>
        <plugins>
            <plugin>
                <groupId>org.springframework.boot</groupId>
                <artifactId>spring-boot-maven-plugin</artifactId>
            </plugin>
        </plugins>
    </build>
</project>
```

3.3.启动类

在pay-service中的 `com.hmall.pay` 包下创建启动类：

```java
package com.hmall.pay;

import org.mybatis.spring.annotation.MapperScan;
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.cloud.openfeign.EnableFeignClients;

@EnableFeignClients(basePackages = "com.hmall.api.client", defaultConfiguration = DefaultFeignConfig.class)
@MapperScan("com.hmall.pay.mapper")
@SpringBootApplication
public class PayApplication {
    public static void main(String[] args) {
        SpringApplication.run(PayApplication.class, args);
    }
}
```

3.4.配置文件

从 `hm-service` 项目中复制3个yaml配置文件到 `trade-service` 的 `resource` 目录。

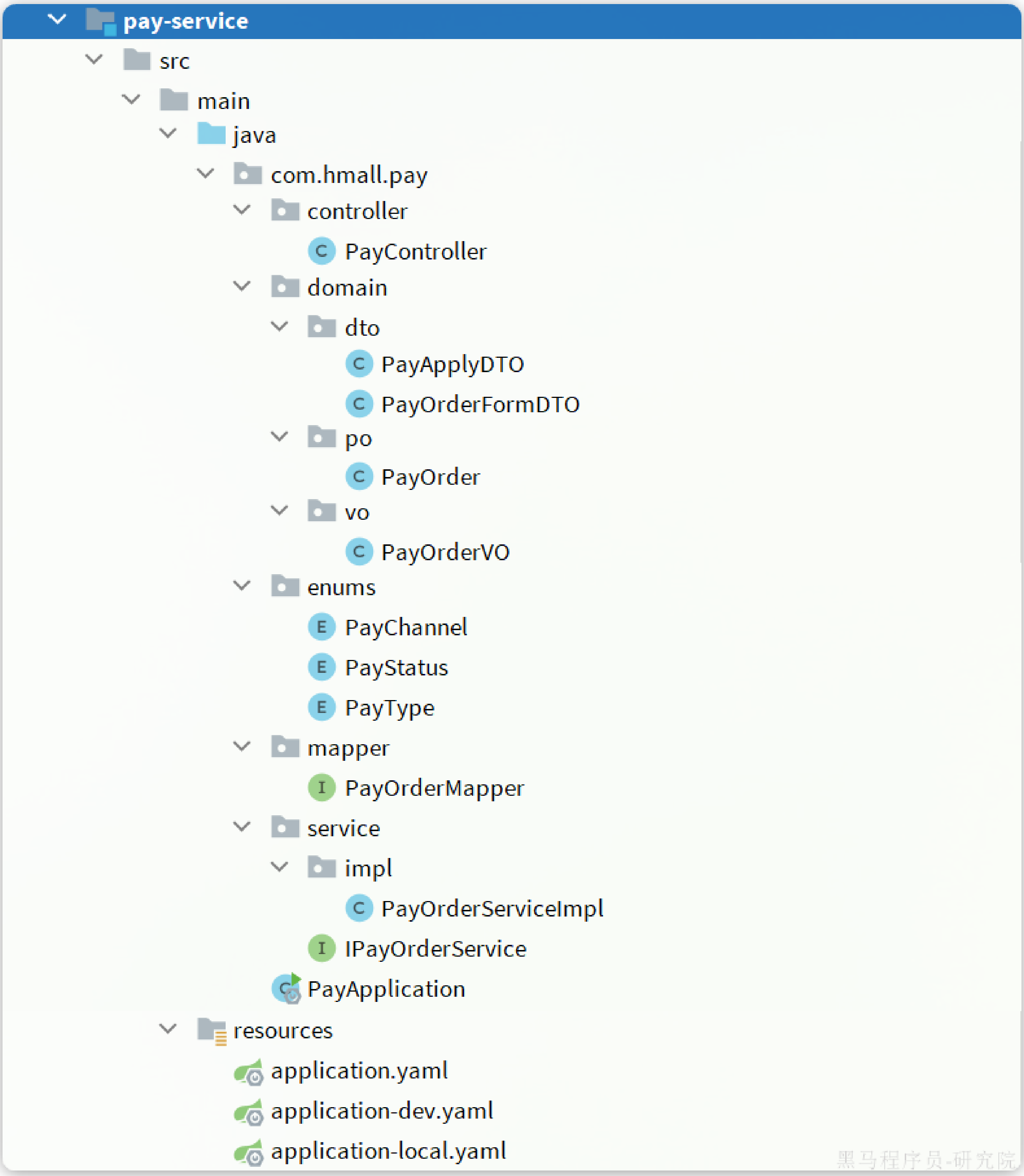
其中 `application-dev.yaml` 和 `application-local.yaml` 保持不变。 `application.yaml` 如下：

```yaml
server:
  port: 8086
spring:
  application:
    name: pay-service
  profiles:
    active: dev
  datasource:
    url: jdbc:mysql://${hm.db.host}:3306/hm-pay?useUnicode=true&characterEncoding=UTF-8&autoReconnect=true&serverTimezone=Asia/Shanghai
    driver-class-name: com.mysql.cj.jdbc.Driver
    username: root
    password: ${hm.db.pw}
  cloud:
    nacos:
      server-addr: 192.168.150.101
mybatis-plus:
  configuration:
    default-enum-type-handler: com.baomidou.mybatisplus.core.handlers.MybatisEnumTypeHandler
  global-config:
    db-config:
      update-strategy: not_null
      id-type: auto
logging:
  level:
    com.hmall: debug
  pattern:
    dateformat: HH:mm:ss:SSS
  file:
    path: "logs/${spring.application.name}"
knife4j:
  enable: true
  openapi:
    title: 支付服务接口文档
    description: "支付服务接口文档"
    email: zhanghuyi@itcast.cn
    concat: 虎哥
    url: https://www.itcast.cn
    version: v1.0.0
    group:
      default:
        group-name: default
        api-rule: package
        api-rule-resources:
          - com.hmall.pay.controller
```

3.5.代码

3.5.1.基础代码

复制hm-service中所有与支付有关的代码，最终项目结构如下：



```
pay-service
  src
    main
      java
        com.hmall.pay
          controller
            PayController
          domain
            dto
              PayApplyDTO
              PayOrderFormDTO
            po
              PayOrder
            vo
              PayOrderVO
          enums
            PayChannel
            PayStatus
            PayType
          mapper
            PayOrderMapper
          service
            impl
              PayOrderServiceImpl
            IPayOrderService
          PayApplication
      resources
        application.yaml
        application-dev.yaml
        application-local.yaml
```

在支付服务中，基于用户余额支付时需要做下列事情：

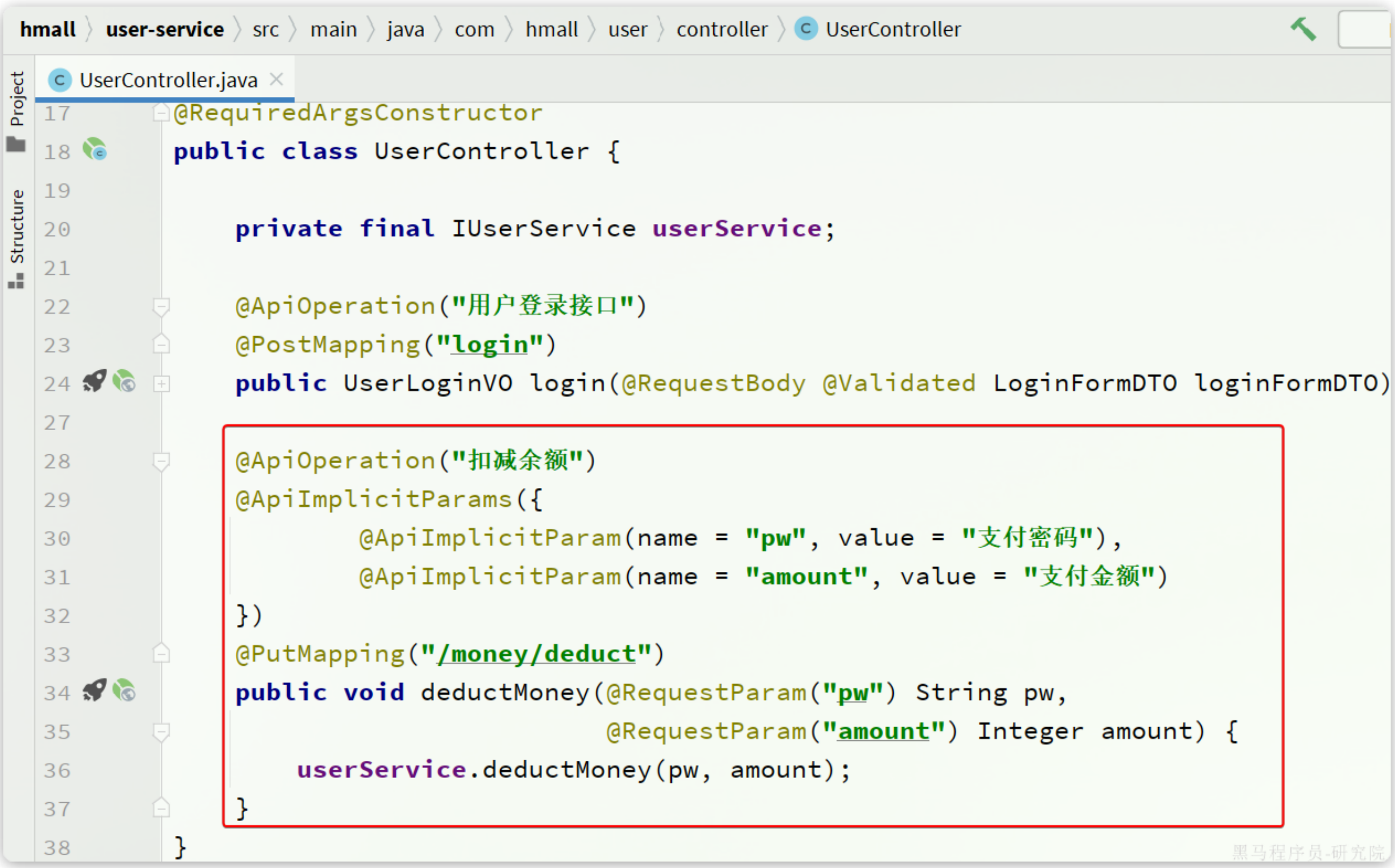
- **扣减用户余额**
- 标记支付单状态为已支付

- **标记订单状态为已支付**

其中，**扣减用户余额**是在 `user-service` 中有相关功能；**标记订单状态**则是在 `trade-service` 中有相关功能。因此交易服务要调用他们，必须通过OpenFeign远程调用。我们需要将上述功能抽取为FeignClient.

2.5.2.抽取UserClient接口

首先是**扣减用户余额**，在 `user-service` 中的对应业务接口如下：

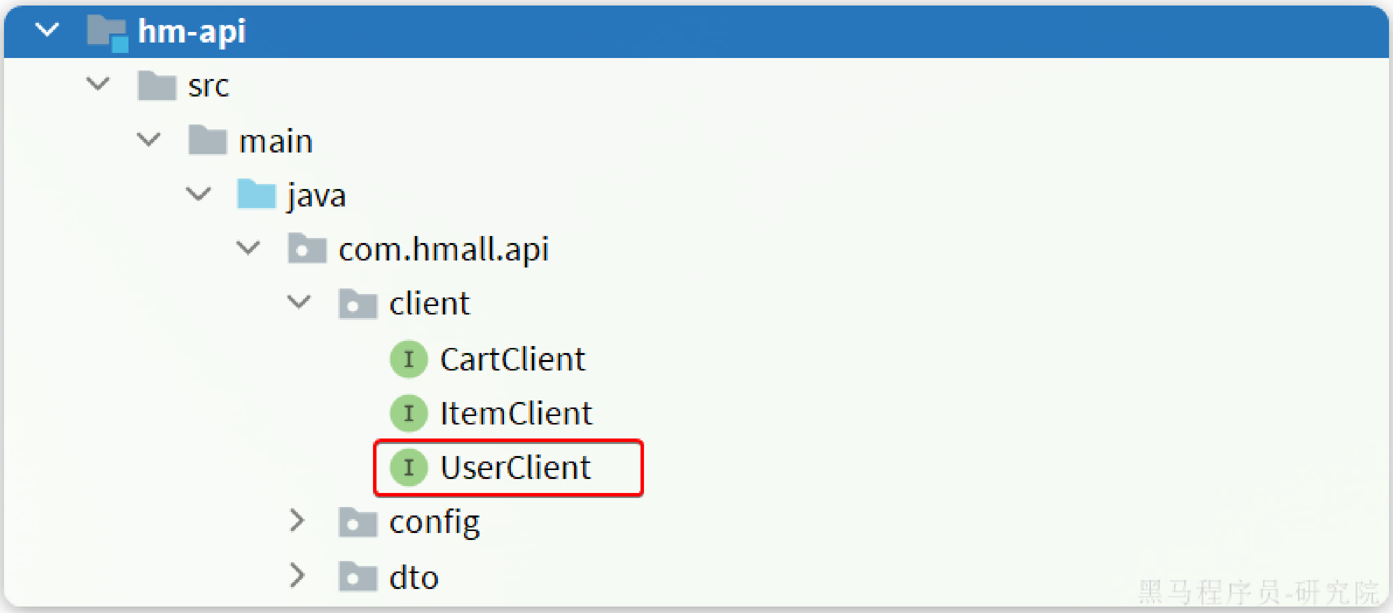


hmall 〉 user-service 〉 src 〉 main 〉 java 〉 com 〉 hmall 〉 user 〉 controller 〉 UserController

UserController.java

```java
@RequiredArgsConstructor
public class UserController {

    private final IUserService userService;

    @ApiOperation("用户登录接口")
    @PostMapping("login")
    public UserLoginVO login(@RequestBody @Validated LoginFormDTO loginFormDTO)

    @ApiOperation("扣减余额")
    @ApiImplicitParams({
            @ApiImplicitParam(name = "pw", value = "支付密码"),
            @ApiImplicitParam(name = "amount", value = "支付金额")
    })
    @PutMapping("/money/deduct")
    public void deductMoney(@RequestParam("pw") String pw,
                            @RequestParam("amount") Integer amount) {
        userService.deductMoney(pw, amount);
    }
}
```

我们将这个接口抽取到 `hm-api` 模块的 `com.hmall.api.client.UserClient` 中:



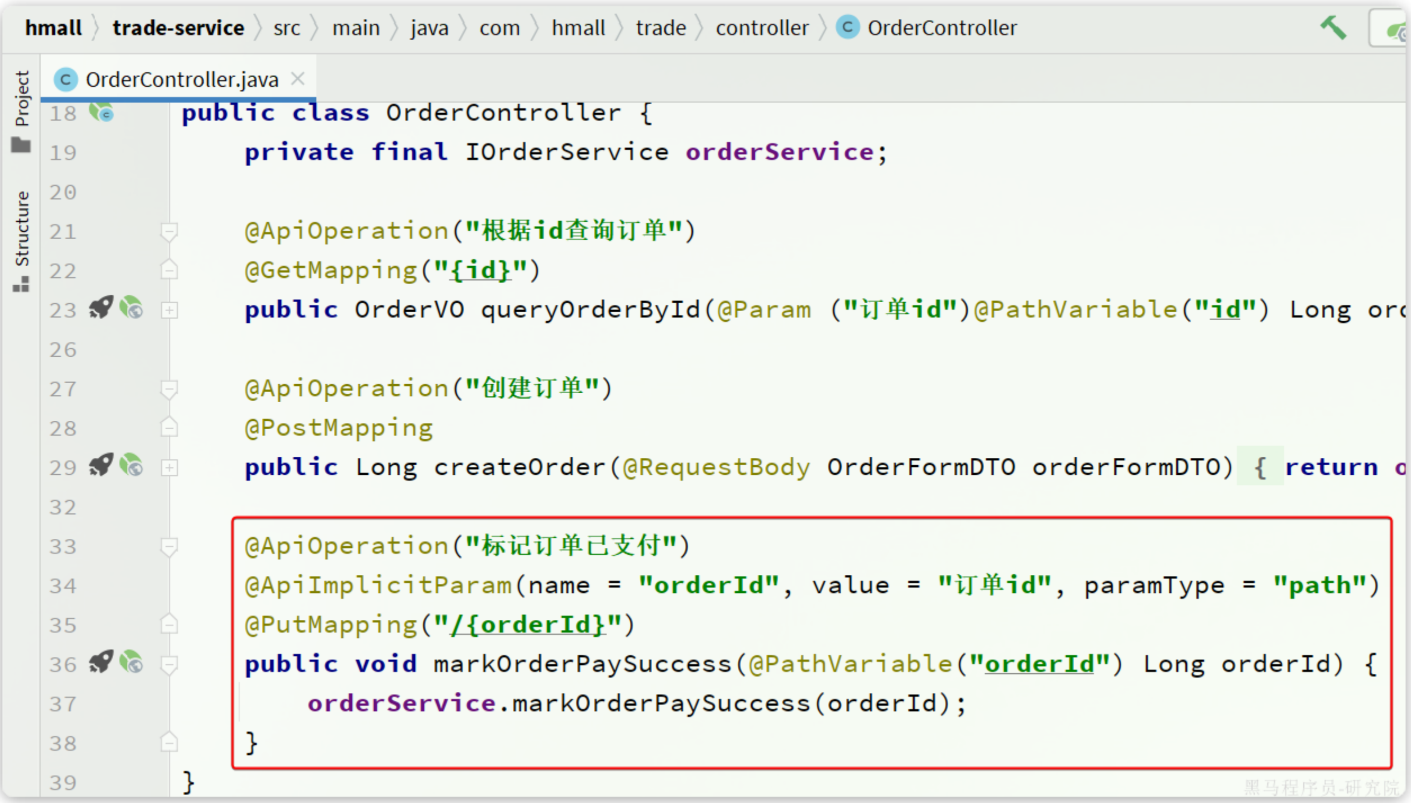
hm-api
src
main
java
com.hmall.api
client
CartClient
ItemClient
UserClient
config
dto

具体代码如下：

```java
package com.hmall.api.client;

import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.web.bind.annotation.PutMapping;
import org.springframework.web.bind.annotation.RequestParam;

@FeignClient("user-service")
public interface UserClient {
    @PutMapping("/users/money/deduct")
    void deductMoney(@RequestParam("pw") String pw,@RequestParam("amount") Integer amount);
}
```

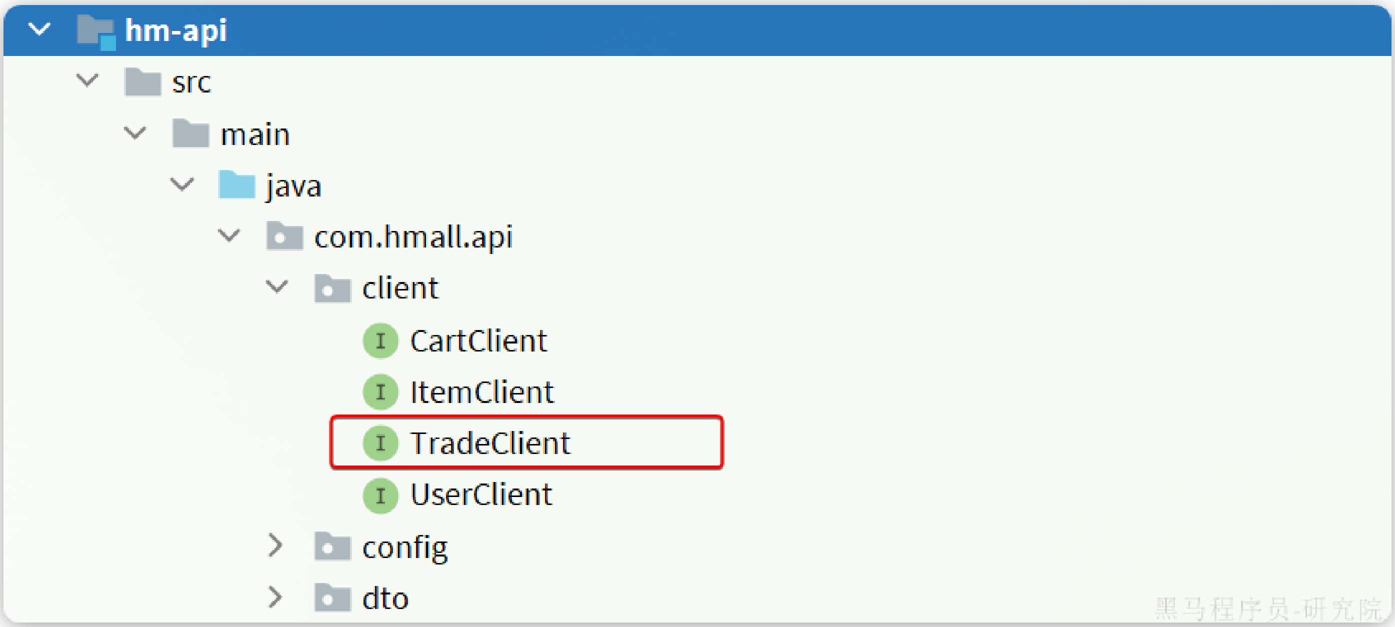
2.5.3.抽取TradeClient接口

接下来是**标记订单状态**，在 `trade-service` 中的对应业务接口如下：


hmall 〉 trade-service 〉 src 〉 main 〉 java 〉 com 〉 hmall 〉 trade 〉 controller 〉 OrderController
OrderController.java
Project
Structure
黑马程序员-研究院

```java
public class OrderController {
    private final IOrderService orderService;

    @ApiOperation("根据id查询订单")
    @GetMapping("{id}")
    public OrderVO queryOrderById(@Param ("订单id")@PathVariable("id") Long or

    @ApiOperation("创建订单")
    @PostMapping
    public Long createOrder(@RequestBody OrderFormDTO orderFormDTO) { return o

    @ApiOperation("标记订单已支付")
    @ApiImplicitParam(name = "orderId", value = "订单id", paramType = "path")
    @PutMapping("/{orderId}")
    public void markOrderPaySuccess(@PathVariable("orderId") Long orderId) {
        orderService.markOrderPaySuccess(orderId);
    }
}
```

我们将这个接口抽取到 `hm-api` 模块的 `com.hmall.api.client.TradeClient` 中:



代码如下:

```java
package com.hmall.api.client;

import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.web.bind.annotation.PathVariable;
import org.springframework.web.bind.annotation.PutMapping;

@FeignClient("trade-service")
```

```java
public interface TradeClient {
    @PutMapping("/orders/{orderId}")
    void markOrderPaySuccess(@PathVariable("orderId") Long orderId);
}
```

2.5.4.改造PayOrderServiceImpl

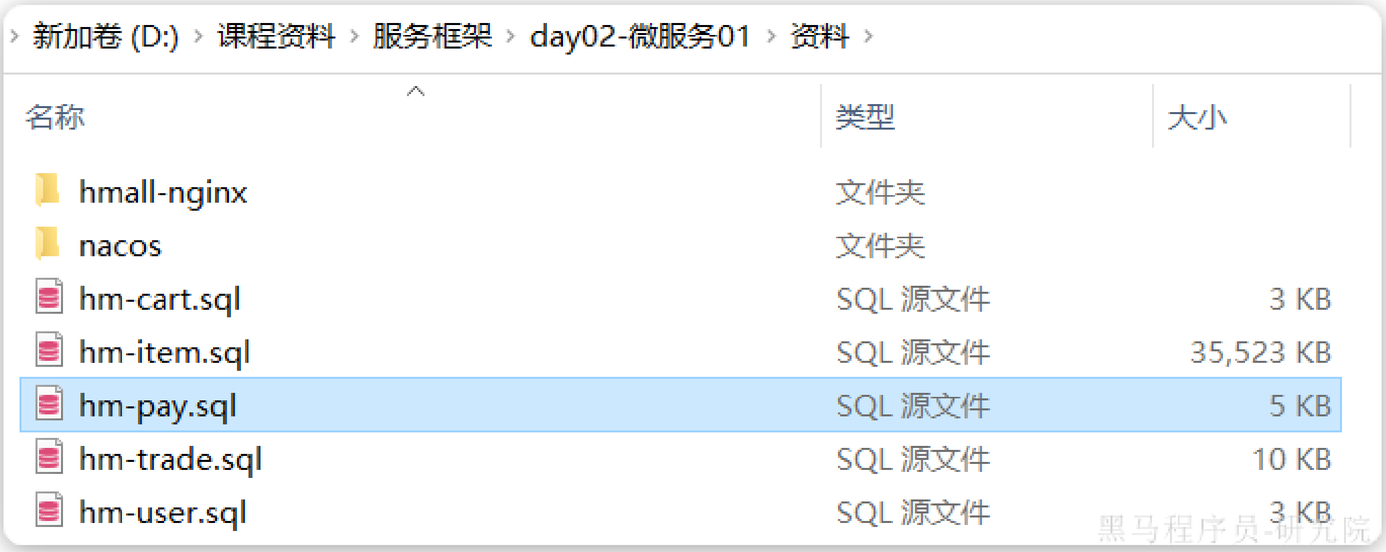
接下来，就可以改造`PayOrderServiceImpl`中的逻辑，将本地方法调用改造为基于`FeignClient`的调用，完整代码如下：

```java
package com.hmall.pay.service.impl;

import com.baomidou.mybatisplus.core.toolkit.IdWorker;
import com.baomidou.mybatisplus.core.toolkit.StringUtils;
import com.baomidou.mybatisplus.extension.service.impl.ServiceImpl;
import com.hmall.api.client.TradeClient;
import com.hmall.api.client.UserClient;
import com.hmall.common.exception.BizIllegalException;
import com.hmall.common.utils.BeanUtils;
import com.hmall.common.utils.UserContext;
import com.hmall.pay.domain.dto.PayApplyDTO;
import com.hmall.pay.domain.dto.PayOrderFormDTO;
import com.hmall.pay.domain.po.PayOrder;
import com.hmall.pay.enums.PayStatus;
import com.hmall.pay.mapper.PayOrderMapper;
import com.hmall.pay.service.IPayOrderService;
import lombok.RequiredArgsConstructor;
import org.springframework.stereotype.Service;
import org.springframework.transaction.annotation.Transactional;

import java.time.LocalDateTime;

/**
 * <p>
 * 支付订单 服务实现类
 * </p>
 *
 */
@Service
@RequiredArgsConstructor
public class PayOrderServiceImpl extends ServiceImpl<PayOrderMapper, PayOrder> implements IPayOrderService {

    private final UserClient userClient;

    private final TradeClient tradeClient;

    @Override
    public String applyPayOrder(PayApplyDTO applyDTO) {
        // 1.幂等性校验
        PayOrder payOrder = checkIdempotent(applyDTO);
        // 2.返回结果
        return payOrder.getId().toString();
    }

    @Override
    @Transactional
    public void tryPayOrderByBalance(PayOrderFormDTO payOrderDTO) {
        // 1.查询支付单
        PayOrder po = getById(payOrderDTO.getId());
        // 2.判断状态
        if(!PayStatus.WAIT_BUYER_PAY.equalsValue(po.getStatus())){
            // 订单不是未支付，状态异常
            throw new BizIllegalException("交易已支付或关闭！");
        }
        // 3.尝试扣减余额
        userClient.deductMoney(payOrderDTO.getPw(), po.getAmount());
        // 4.修改支付单状态
        boolean success = markPayOrderSuccess(payOrderDTO.getId(), LocalDateTime.now());
        if (!success) {
            throw new BizIllegalException("交易已支付或关闭！");
        }
        // 5.修改订单状态
        tradeClient.markOrderPaySuccess(po.getBizOrderNo());
    }

    public boolean markPayOrderSuccess(Long id, LocalDateTime successTime) {
        return lambdaUpdate()
                .set(PayOrder::getStatus, PayStatus.TRADE_SUCCESS.getValue())
                .set(PayOrder::getPaySuccessTime, successTime)
                .eq(PayOrder::getId, id)
                // 支付状态的乐观锁判断
                .in(PayOrder::getStatus, PayStatus.NOT_COMMIT.getValue(), PayStatus.WAIT_BUYER_PAY.getValue())
                .update();
    }


    private PayOrder checkIdempotent(PayApplyDTO applyDTO) {
        // 1.首先查询支付单
        PayOrder oldOrder = queryByBizOrderNo(applyDTO.getBizOrderNo());
        // 2.判断是否存在
        if (oldOrder == null) {
            // 不存在支付单，说明是第一次，写入新的支付单并返回
            PayOrder payOrder = buildPayOrder(applyDTO);
            payOrder.setPayOrderNo(IdWorker.getId());
            save(payOrder);
            return payOrder;
        }
        // 3.旧单已经存在，判断是否支付成功
        if (PayStatus.TRADE_SUCCESS.equalsValue(oldOrder.getStatus())) {
            // 已经支付成功，抛出异常
            throw new BizIllegalException("订单已经支付！");
        }
        // 4.旧单已经存在，判断是否已经关闭
        if (PayStatus.TRADE_CLOSED.equalsValue(oldOrder.getStatus())) {
            // 已经关闭，抛出异常
            throw new BizIllegalException("订单已关闭");
        }
        // 5.旧单已经存在，判断支付渠道是否一致
        if (!StringUtils.equals(oldOrder.getPayChannelCode(),
applyDTO.getPayChannelCode())) {
            // 支付渠道不一致，需要重置数据，然后重新申请支付单
            PayOrder payOrder = buildPayOrder(applyDTO);
            payOrder.setId(oldOrder.getId());
            payOrder.setQrCodeUrl("");
            updateById(payOrder);
            payOrder.setPayOrderNo(oldOrder.getPayOrderNo());
            return payOrder;
        }
        // 6.旧单已经存在，且可能是未支付或未提交，且支付渠道一致，直接返回旧数据
        return oldOrder;
    }

    private PayOrder buildPayOrder(PayApplyDTO payApplyDTO) {
        // 1.数据转换
        PayOrder payOrder = BeanUtils.toBean(payApplyDTO, PayOrder.class);
        // 2.初始化数据
        payOrder.setPayOverTime(LocalDateTime.now().plusMinutes(120L));
        payOrder.setStatus(PayStatus.WAIT_BUYER_PAY.getValue());
        payOrder.setBizUserId(UserContext.getUser());
        return payOrder;
    }
    public PayOrder queryByBizOrderNo(Long bizOrderNo) {
        return lambdaQuery()
                .eq(PayOrder::getBizOrderNo, bizOrderNo)
```

```
                  .one();
    }
}
```

2.6.数据库

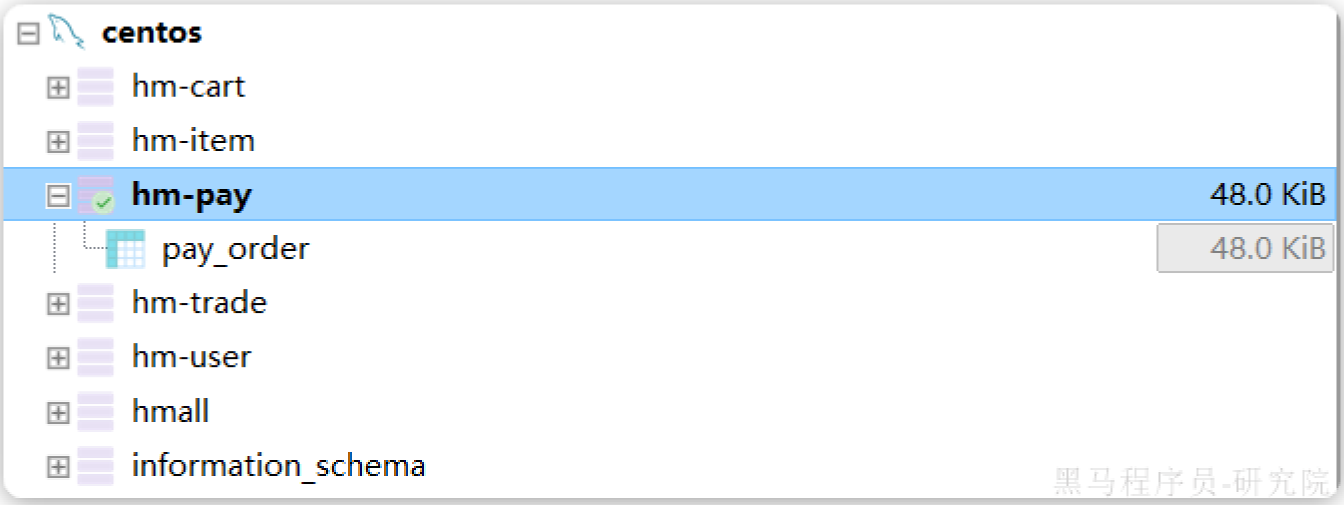
`pay-service` 也需要自己的独立的database，向MySQL中导入课前资料提供的SQL：



› 新加卷 (D:) › 课程资料 › 服务框架 › day02-微服务01 › 资料 ›

名称	类型	大小
hmall-nginx	文件夹	
nacos	文件夹	
hm-cart.sql	SQL 源文件	3 KB
hm-item.sql	SQL 源文件	35,523 KB
hm-pay.sql	SQL 源文件	5 KB
hm-trade.sql	SQL 源文件	10 KB
hm-user.sql	SQL 源文件	3 KB

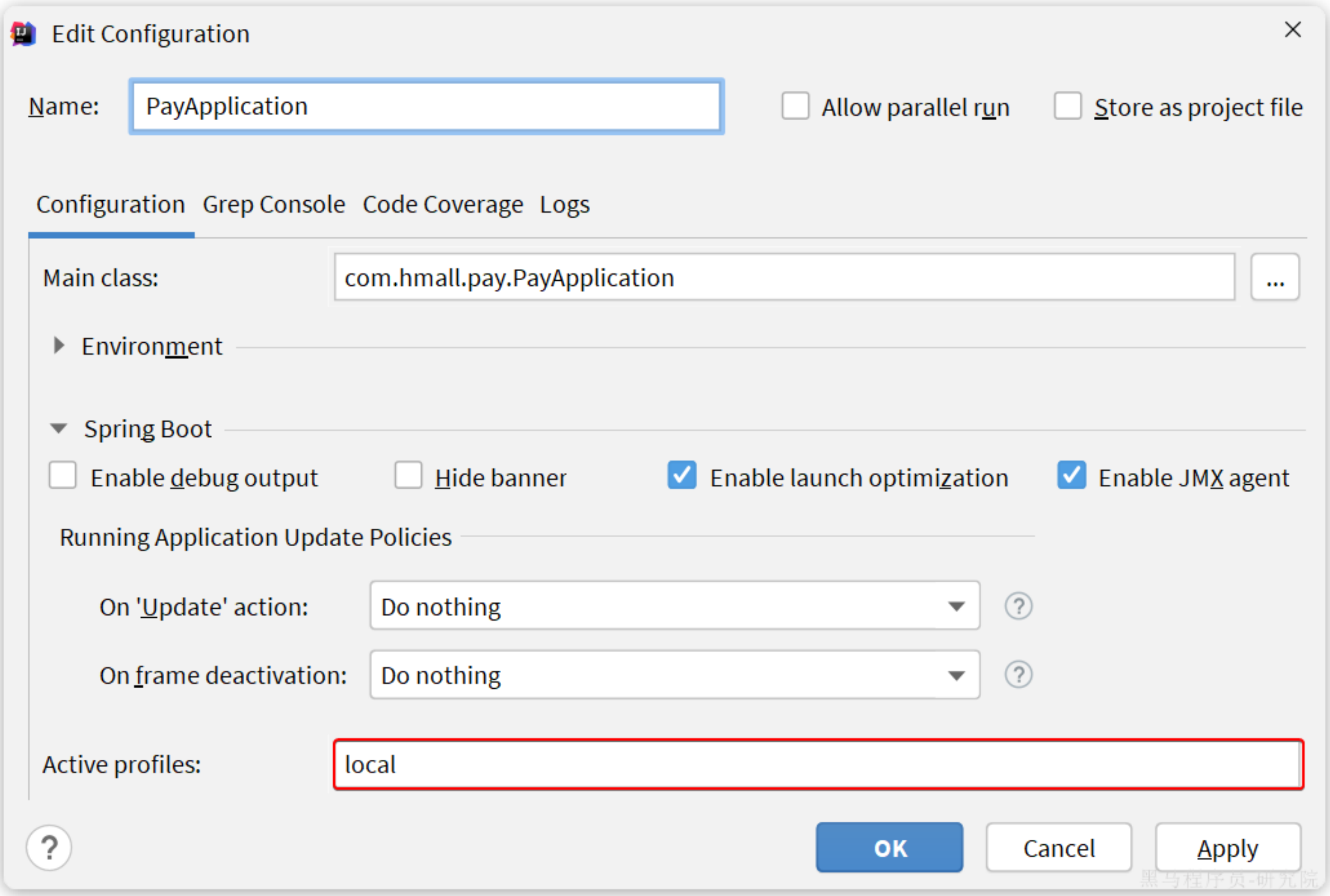
导入结果如下：



```
centos
  hm-cart
  hm-item
  hm-pay                                   48.0 KiB
    pay_order                              48.0 KiB
  hm-trade
  hm-user
  hmall
  information_schema
```

2.7.配置启动项

给 `pay-service` 配置启动项，设置profile为 `local` ：


Edit Configuration

Name: PayApplication

- [ ] Allow parallel run
- [ ] Store as project file

Configuration　Grep Console　Code Coverage　Logs

Main class: com.hmall.pay.PayApplication

Environment

Spring Boot

- [ ] Enable debug output
- [ ] Hide banner
- [x] Enable launch optimization
- [x] Enable JMX agent

Running Application Update Policies

On 'Update' action: Do nothing

On frame deactivation: Do nothing

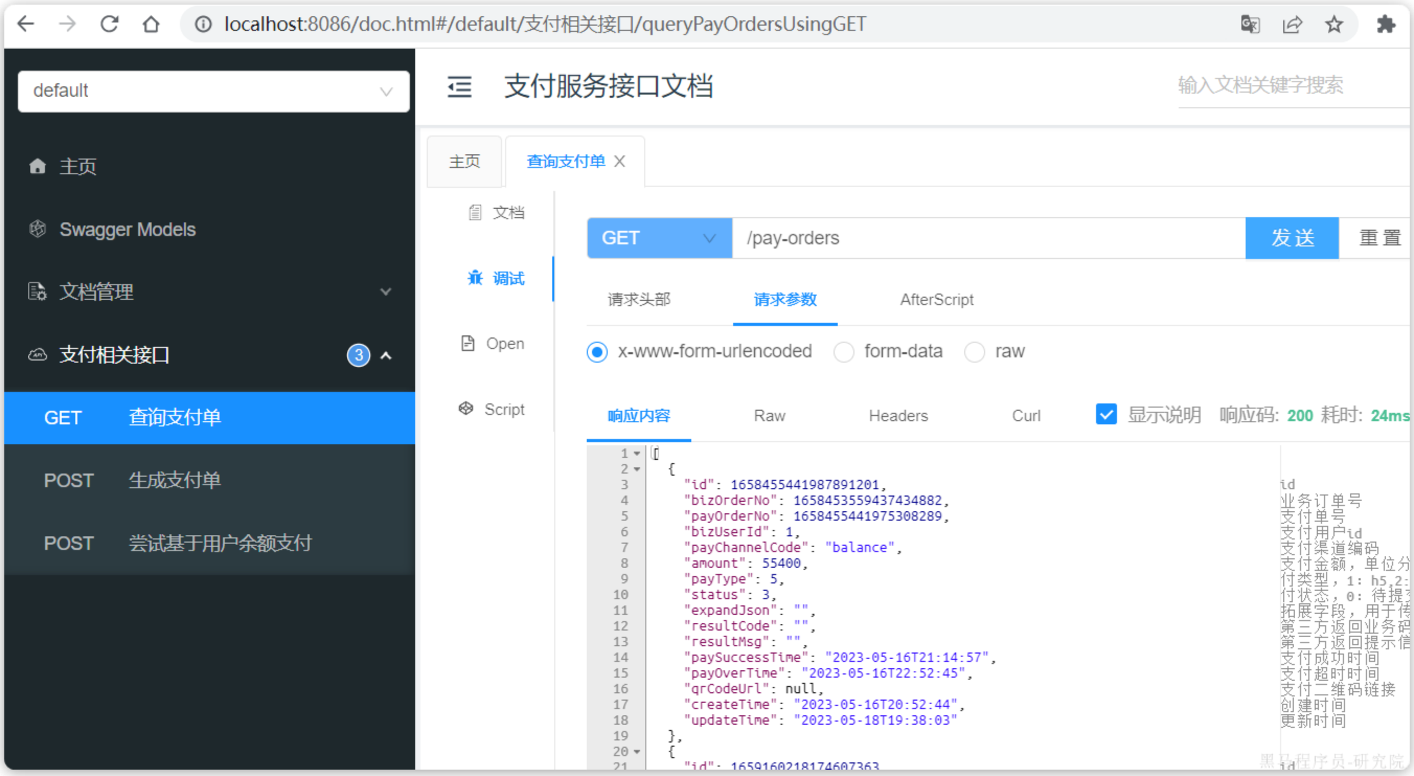
Active profiles: local

2.8.测试

在支付服务的PayController中添加一个接口方便测试：

```java
@ApiOperation("查询支付单")
@GetMapping
public List<PayOrderVO> queryPayOrders(){
    return BeanUtils.copyList(payOrderService.list(), PayOrderVO.class);
}
```

启动PayApplication，访问http://localhost:8086/doc.html，测试查询订单接口：



GET /pay-orders

(● x-www-form-urlencoded) form-data raw

[✓ 显示说明] 响应码: 200 耗时: 24ms

```
[
  {
    "id": 1658455441987891201,                    id
    "bizOrderNo": 1658453559437434882,            业务订单号
    "payOrderNo": 1658455441975308289,            支付单号
    "bizUserId": 1,                               支付用户id
    "payChannelCode": "balance",                  支付渠道编码
    "amount": 55400,                              支付金额，单位分
    "payType": 5,                                 付类型，1: h5,2:
    "status": 3,                                  付状态，0: 待提
    "expandJson": "",                             拓展字段，用于传
    "resultCode": "",                             第三方返回业务码
    "resultMsg": "",                              第三方返回提示信
    "paySuccessTime": "2023-05-16T21:14:57",      支付成功时间
    "payOverTime": "2023-05-16T22:52:45",         支付超时时间
    "qrCodeUrl": null,                            支付二维码链接
    "createTime": "2023-05-16T20:52:44",          创建时间
    "updateTime": "2023-05-18T19:38:03"           更新时间
  },
  {
    "id": 1659160218174607363
```

支付服务测试通过。