《软件体系结构与设计模式》大作业报告

姓名	职务	学号	组内成绩	小组成绩	个人成绩
王少博	组长	181110315			
王钟杰	组员	181110316			
初征	组员	181110303			
丁文琪	组员	181110304			
付宽	组员	181110306			
董成相	组员	181110305			
凌龙	组员	181110311			

哈尔滨工业大学（威海）计算机科学与技术学院

2020 年秋季学期

前　　言

一、本课程的主要任务

本课程主要讲述典型的软件设计模式与体系结构的特点及其典型应用。本课程还讨论了如何在软件体系结构的设计中应用具体的设计模式。通过对于软件设计模式与软件体系结构的学习，可以给学生提供大型软件设计的完整的新观点与新技术。通过本课程的学习，学生能够应用基本的软件设计模式与体系结构设计与编写 Java 程序，从而加深对面向对象设计原则的理解，为成为一名高水平的软件工程师打下基础。

二、本课程的要求

本课程涵盖 10 个设计模式与 11 个软件体系结构。课程的重点：讲清楚各个软件设计模式的结构与典型的交互；讲清楚各个软件体系结构的架构与各个组成组件之间的交互情况。课程的难点：设计模式的典型交互与实现，软件体系结构的各个层的典型交互与实现。教学内容与教学要求如下所述：工厂方法模式，抽象工厂模式，适配器模式，桥接模式，策略模式与状态模式，访问者模式，中介者模式，观察者模式；MVC 架构与层次架构，主程序-子程序架构与面向对象架构，数据流系统，数据流体系结构-案例分析与程序设计，事件驱动体系结构-理论，客户端/服务器体系结构，P2P 风格的体系结构与网格计算体系结构，SOA 架构与云计算架构。

三、作业的验收内容（以小组为单位）

1) Java 程序源代码（电子稿形式）；**要求使用 Eclipes, Idea 或者其它的 Java 集成开发环境(IDE)开发；你的程序要合理地分成若干个 package 以体现软件设计模式或软件体系结构。然后提交的时候，对于每个程序都要有一份可执行的 xxx.jar 文件与一个你的程序的源代码文件包（需要压缩）。**

2) 作业报告（电子稿形式）；

3) 将以上 1）和 2）中所包含的 3 项内容放到一个文件夹中，然后打成一个压缩包，发送到邮箱 mikesun725@aliyun.com 中，包名为张 xx-王 xx-李 xx-赵 xx-黄 xx-秦 xx；在包名中不要包含学生号。

4) 每个小组提交一份纸质作业报告（即 2）所述报告的打印稿）。

四、本作业共 13 个题目，要求全部完成，共占课程总成绩的 20%，每 6-7 人一组。

Homework 2: 抽象工厂模式(Abstract Factory Pattern)

作业描述：The following class diagram represents a design in abstract factory pattern to query about the features of different types of buildings. See the source code for the implementation of the following class diagram.

1) Run the AbstractFactoryGUI first to be familiar with the program

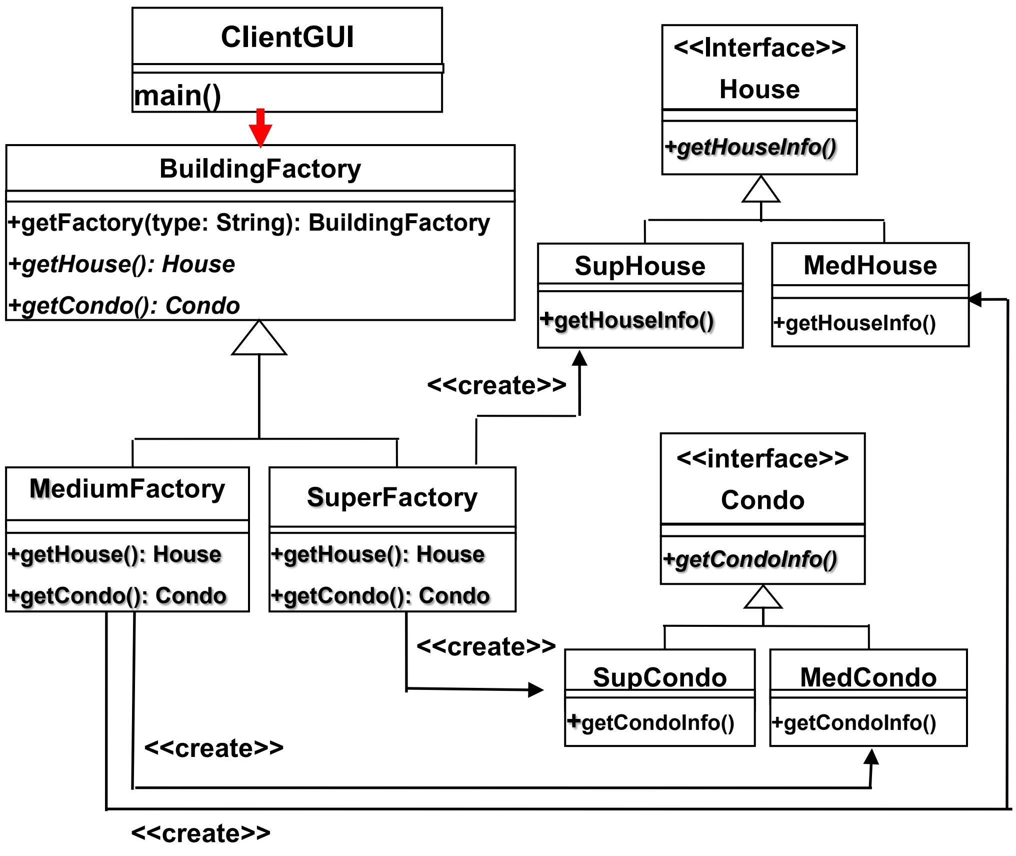


Fig 1 Design of building information system in the abstract factory pattern

2) In the avove design, add a class hierarchy named SemiDetacher with 2 subclasses named SupSemiDe and MedSemiDe and similar interface and methods as class hierarchy House and class hierarchy Condo do.

3) Then you need to modify the corresponding part in the class BuildingFactory and its subclass to allow the objects of subclasses of

SemiDetacher be created

4) Implement the modified class diagram, adding possible code as needed.
5) Run object of the class AbstractFactoryGUI to test the program with new function.

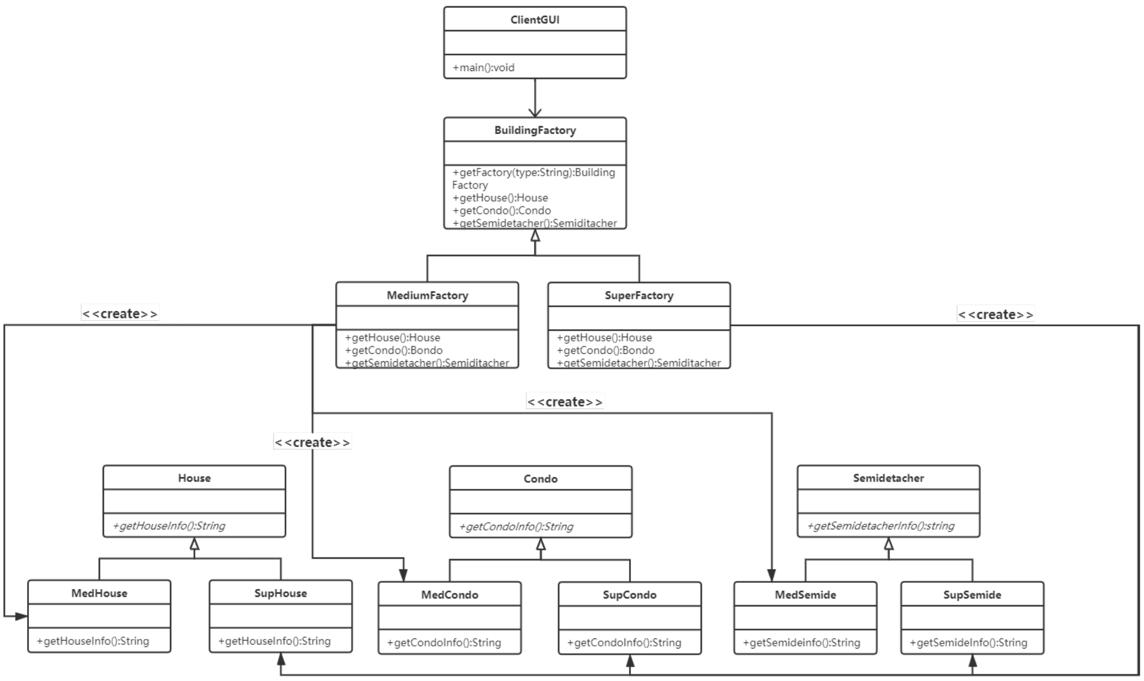
作业报告部分

1. Describe your finished homework.

a) Tell me what classes have you added to the existing class hierarchy?
b) Explain the relationship between the existing classes and the newly added classes.

(1) 添加了 SupSemiDe,MedSemiDe,SemiDetacher 三个类。
(2) SemiDetacher 是抽象类，SupSemiDe,MedSemiDe 是其子类。SemiDetacher 和 House 和 Condo 所处层次相同，都是房屋的抽象类；名字带 Sup 和 Med 的都是不同房屋的具体子类。通过抽象类 BuildingFactory 创建 MediumFactory 和 SuperFactory 两个工厂子类。这两个工厂子类分别负责 Sup 和 Med 两种不同规格房屋的创造。

2. Draw your new class diagram here



3. **When a user chooses semi-detatcher and click on search, what methods will be called? List all of them in correct order.**
   (1) 首先调用 GUI 中 ButtonListener 类里的 actionPerformed 方法。(触发按钮)
   (2) cmbHouseClass.getSelectedItem()和 cmbHouseType.getSelectedItem()，获用用户选中的房屋种类和房屋大小。
   (3) BuildingFactory.getFactory(clas) 获取相应房屋大小的房屋工厂类。(Med 工厂或者是 Sup 工厂)
   (4) type.equals(ClientGUI. SEMIDETACHER)用户选择符合 Semidetacher。
   (5) bf.getSemiDetacher() 通过创造的房屋工厂获得一个相应的房屋对象。
   (6) SemiDe.getSemiDetacherInfo() 通过刚刚获得的房屋对象获得房屋信息。
   (7) putHouseInfoToScreen(filename) 通过上一步获得的房屋信息（文件名称）将信息输出到 GUI 界面之中。

4. **After you add the required class SemiDetacher hierarchy,**
   a) **What classes in the BuildingFactory class hierarchy have been affected?**
   b) **What methods have you added to the class hierarchy?**
   (1) 添加三个层次类后，还额外改变了 BuildingFactory，MediumFactory 和 SupFactory 这三个类。
   (2) BuildingFactory 中加入了抽象方法 public abstract SemiDetacher getSemiDetacher();
   (3) MediumFactory 中加入了创造 MedSemiDe 的方法 public SemiDetacher getSemiDetacher()
   (4) SuperFactory 中加入了创造 SupSemiDe 的方法 public SemiDetacher getSemiDetacher()

5. **Discuss the similarity and differences between factory method pattern and the abstract factory pattern in no more that 120 words.**
   (1) 工厂方法和抽象工厂方法的工厂都是具有层次关系的，具体工厂都是继承于(抽象)工厂父类。

(2) 工厂方法的每一个工厂只负责生产一个对象。而抽象工厂方法中的每一个工厂负责生产一组对象。

(3) 工厂方法一定遵循开闭原则，而抽象工厂方法不一定遵循开闭原则，是否遵守开闭原则由所扩展的内容决定。

(4) 二者都实现了创建对象的责任分割，简化了复杂的条件语句。

6. Discuss about the method getFactory(String type) in the class BuildingFactory.

a) What is the functionality of this class?

b) If we cancel this method from class BuildingFactory, then what do we need to do in the class AbstractFactoryGUI?

c) Point out advantages of the method getFactory(String type).

(1) getFactory( ) 通过用户参数的输入生成 Super 或者 Medium 两种规格不同的工厂.

(2) 在 GUI 类的 actionPerformed 方法中添加对用户输入进行筛选的条件语句，通过用户的输入直接创建不同规格的工厂.

(3) BuildingFactory 可以看作是创造具体工厂的抽象工厂，通过这个类对工厂再次进行抽象，实现了责任的分割,以及简化了繁琐的条件语句.

Homework 4: 桥接模式(Bridge Pattern)

作业描述（特工信息保密系统）：

The following design represents an agent information system. Agents’ information should be encrypted and then saved into a text file or a database. There are two ways to encrypt agent’s name and code number, represented by classes EncryptedInfo1 and EncryptedInfo2.

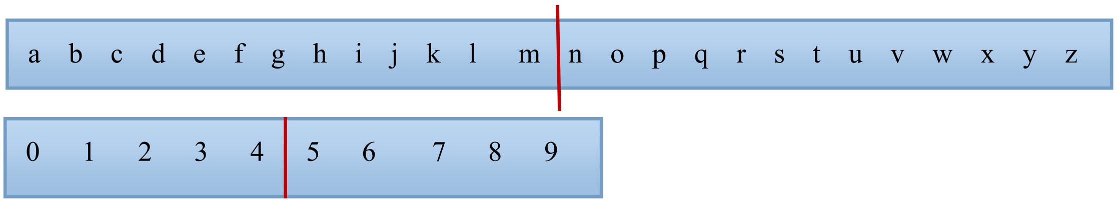
EncryptedInfo1的加密算法：折叠算法

1） 将26个英文字母按照顺序排列，加密的时候，以折叠的方式进行：

a←→z, b←→y, ...,m←→n

2） 大写字母也是如此。大写字母加密为大写字母。

3） 数字加密也以此方式进行0←→9,1←→8,2←→7,3←→6, 4←→5

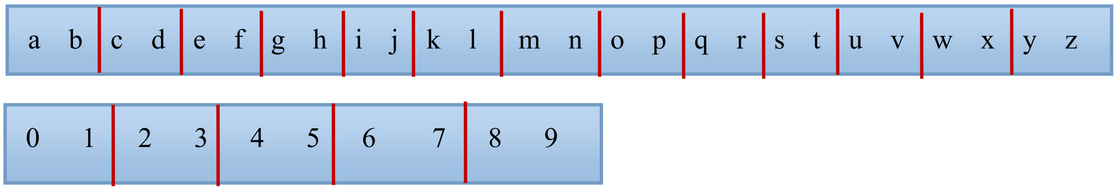


EncryptedInfo2的加密算法：分组互换算法

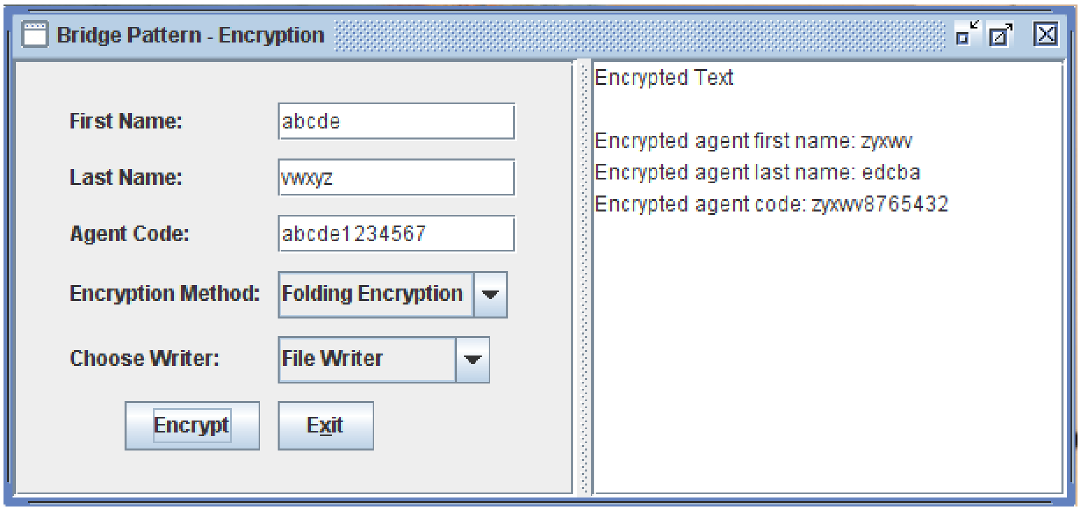
1） 将26个英文字母按照顺序排列，按照如下方式两两分成一组，本组内部加密的时候互换：　　　a←→b, c←→d，..., w←→x, y←→z。

2） 大写字母的加密方式也是如此，大写字母加密为大写字母。

3） 数字加密：0←→1, 2←→3,4←→5, 6←→7, 8←→9

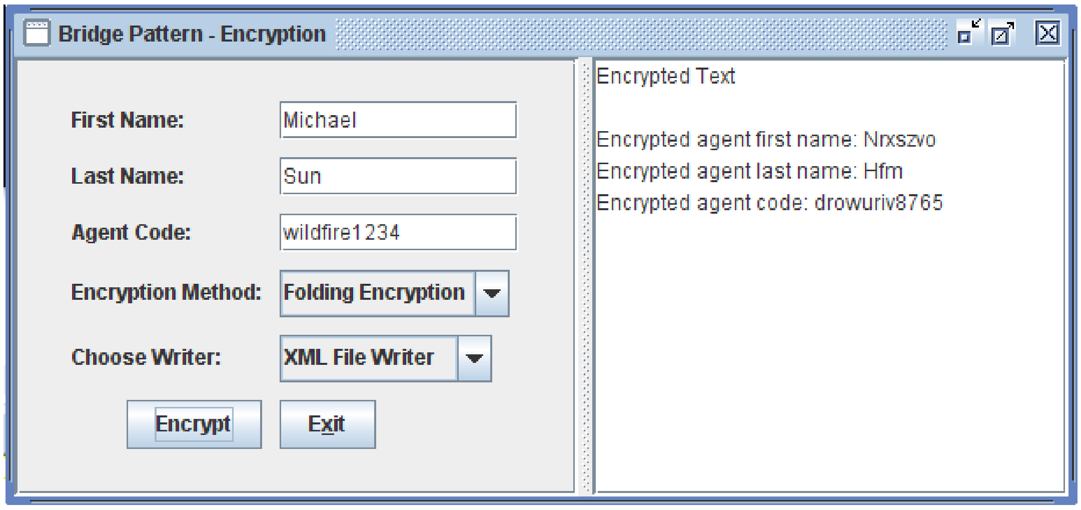


程序运行界面如下



First Name: abcde
Last Name: vwxyz
Agent Code: abcde1234567
Encryption Method: Folding Encryption
Choose Writer: File Writer

```
Encrypted Text

Encrypted agent first name: zyxwv
Encrypted agent last name: edcba
Encrypted agent code: zyxwv8765432
```



First Name: Michael
Last Name: Sun
Agent Code: wildfire1234
Encryption Method: Folding Encryption
Choose Writer: XML File Writer

```
Encrypted Text

Encrypted agent first name: Nrxszvo
Encrypted agent last name: Hfm
Encrypted agent code: drowuriv8765
```

设计类图如下

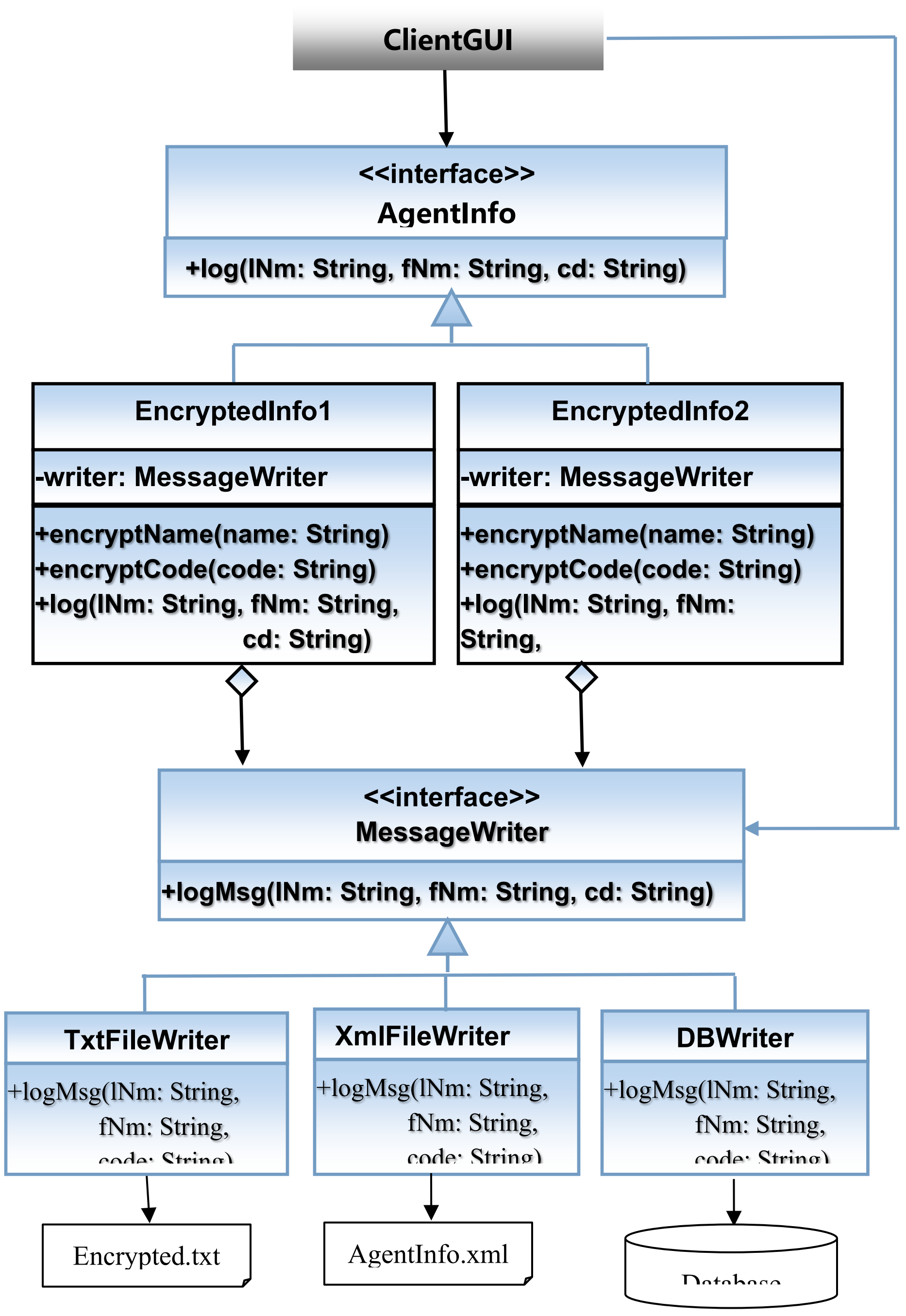

ClientGUI
<<interface>>
AgentInfo
+log(lNm: String, fNm: String, cd: String)
EncryptedInfo1
-writer: MessageWriter
+encryptName(name: String)
+encryptCode(code: String)
+log(lNm: String, fNm: String, cd: String)
EncryptedInfo2
-writer: MessageWriter
+encryptName(name: String)
+encryptCode(code: String)
+log(lNm: String, fNm: String,
<<interface>>
MessageWriter
+logMsg(lNm: String, fNm: String, cd: String)
TxtFileWriter
+logMsg(lNm: String, fNm: String,
XmlFileWriter
+logMsg(lNm: String, fNm: String,
DBWriter
+logMsg(lNm: String, fNm: String,
Encrypted.txt
AgentInfo.xml

Fig. 1 Design class diagram for agent information system

Your task:

You are required to write a class EncryptedInfo3 to encrypt agent' s last name, first name and code number.

a) **The class should be in the same format as EncryptedInfo1 and EncryptedInfo2, and provide a different encryption method**
b) **EncryptedInfo3 should encrypt the last name, first name and code number as described below as CaesarCypher: To encrypt a word, we replace the letter a with b, b with c, and so on, up to z, which is replaced by a. This is called the rotate-1 Caesar cipher. When a digital number between 0 and 9 is encountered, the rule to rotate is 0→1, 1→2,...,8→9 and 9→0. For example:**

   Plain text: Mike

   Encrypted text: Njlf

   Plain text: Sun

   Encrypted text: Tvo

   Plain text: Shanben56

   Encrypted text: Tibocfo67
c) **Modify the class ClientGUI to allow choice EncryptedInfo3 to be shown in the GUI.**

- **Note: 特工密码长度为12位，由英文字母与0，1，…，9阿拉伯数字组成。**
- **The length for a code is exactly 12, formed by mixed characters and digital numbers.**

作业报告部分

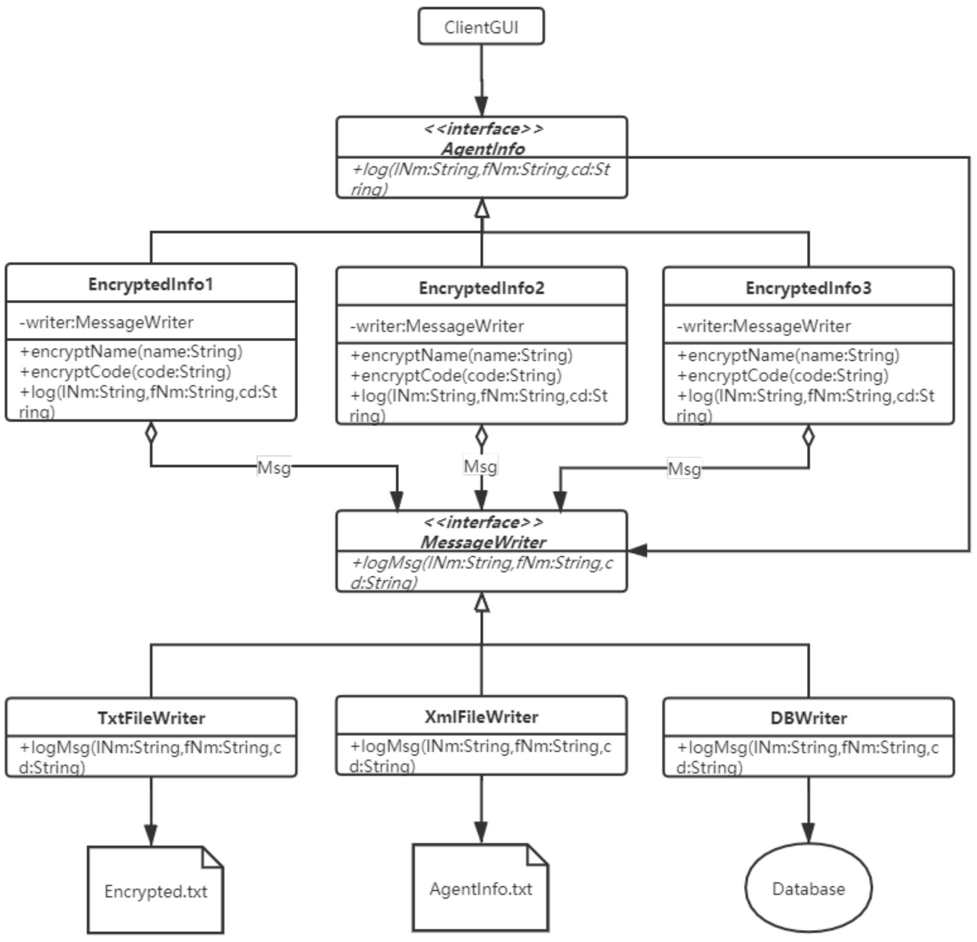
1. Describe your finished homework, including

- **a) What classes have been added to the existing class hierarchy?**
- **b) Explain the relationship between the existing classes and the newly added classes.**

(1) 我添加了 EncryptedInfo3 类。

(2) 这个类继承自 AgentInfo 类，与其余的两个 Encryption 处于同一个层次。同时，这个类继承了 MessageWriter。

2. Draw your new class diagram here


ClientGUI
<<interface>> AgentInfo
+log(lNm:String,fNm:String,cd:String)
EncryptedInfo1
-writer:MessageWriter
+encryptName(name:String)
+encryptCode(code:String)
+log(lNm:String,fNm:String,cd:String)
EncryptedInfo2
-writer:MessageWriter
+encryptName(name:String)
+encryptCode(code:String)
+log(lNm:String,fNm:String,cd:String)
EncryptedInfo3
-writer:MessageWriter
+encryptName(name:String)
+encryptCode(code:String)
+log(lNm:String,fNm:String,cd:String)
Msg
Msg
Msg
<<interface>> MessageWriter
+logMsg(lNm:String,fNm:String,cd:String)
TxtFileWriter
+logMsg(lNm:String,fNm:String,cd:String)
XmlFileWriter
+logMsg(lNm:String,fNm:String,cd:String)
DBWriter
+logMsg(lNm:String,fNm:String,cd:String)
Encrypted.txt
AgentInfo.txt
Database

3. Answer questions as below: after you add class EncryptedInfo3,

a) Do you need to recompile class EncryptedInfo1 and EncryptedInfo2?

b) Do you need to recompile class AgentInfo?

c) Do you need to recompile class FileWriter or DBWriter?

(1) 不需要重新编译 EncryptedInfo1 和 EncrypetdInfo2。

(2) 不需要重新编译 AgentInfo

(3) 不需要重新编译 FileWriter 和 DBWriter。

(4) 这就是桥接模式的优点。

4. In class EncryptedInfo1, there is a constructor

```
public EncryptedInfo1(MessageWriter l){
      writer = l;
 }
```

Why do we use type MessageWriter as the parameter type and why don’t we use type FileWriter or DBWriter as the parameter type?

(1) 首先，根据我们一贯的设计原则，要尽量依赖于抽象而不是依赖于具体。

(2) 由于依赖的是抽象类，解除了和具体类的耦合。新增具体类和修改具体类时，不会受到牵连。

(3) 可以实现动态配置，也就是在运行的时候才决定使用哪个子类，做到了动态。

(4) 改变抽象类的时候不需要重新编译客户类。

(5) 对用户隐藏了实现的细节。

5. In class ClientGUI , we have the source code

```
MessageWriter writer;
                    …
if( logWay.compareTo(ClientGUI.DBWRITER)==0 )
    writer = new DBWriter();
if( logWay.compareTo(ClientGUI.FILEWRITER)==0 )
    writer = new FileWriter();
```

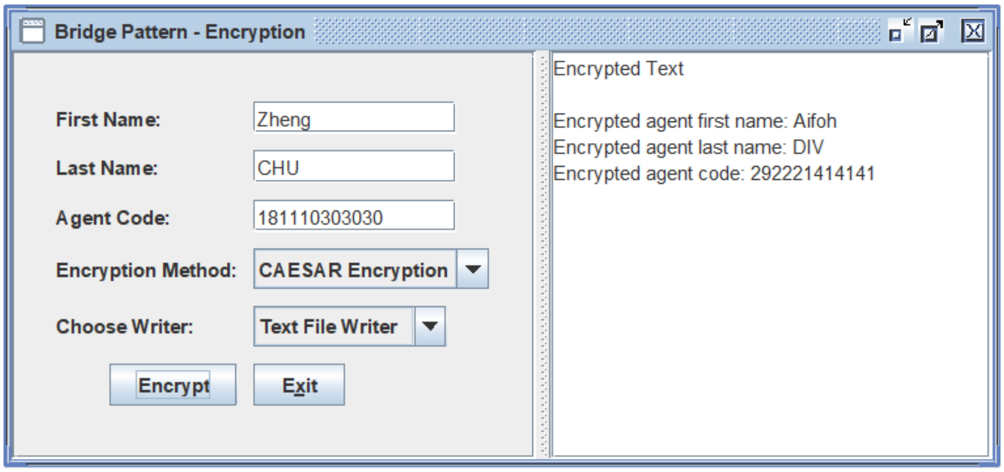
What is the advantage of writing code above?

(1) 不采用具体类而是采用抽象类，降低了耦合度。
(2) 修改具体类的时候不需要重新编译。
(3) 添加新具体类的时候只需要修改少量客户代码的条件语句。

6. If we add a class named ConsolWriter parallel to DBWriter, do we need to recompile any classes?

不需要重新编译。因为客户类依赖的是抽象而不是具体。

7. Test your finished program. List your test input and output from running your program.



First Name: Zheng
Last Name: CHU
Agent Code: 181110303030
Encryption Method: CAESAR Encryption
Choose Writer: Text File Writer

```
Encrypted Text

Encrypted agent first name: Aifoh
Encrypted agent last name: DIV
Encrypted agent code: 292221414141
```

Homework 6: 策略模式(Strategy Pattern)

作业描述(This Homework needs only a little bit coding)：The following class diagram represents a design in strategy pattern to sort integer arrays using different algorithms. This homework requires you

1. **Run the program ClientGUI first to see how an integer array is sorted.**
2. **Add a strategy sub class to implement SortAlgorithm to do Bidirectional bubbleSort. Thus you can name this class BidirBubbleSort. Note that the BidirBubbleSort.java file is already in the same package and what you need to do is just add it to the strategy class hierarchy.**
3. **In ClientGUI, modify the JcomboBox part to add an option to allow bidirectional bubble Sort.**

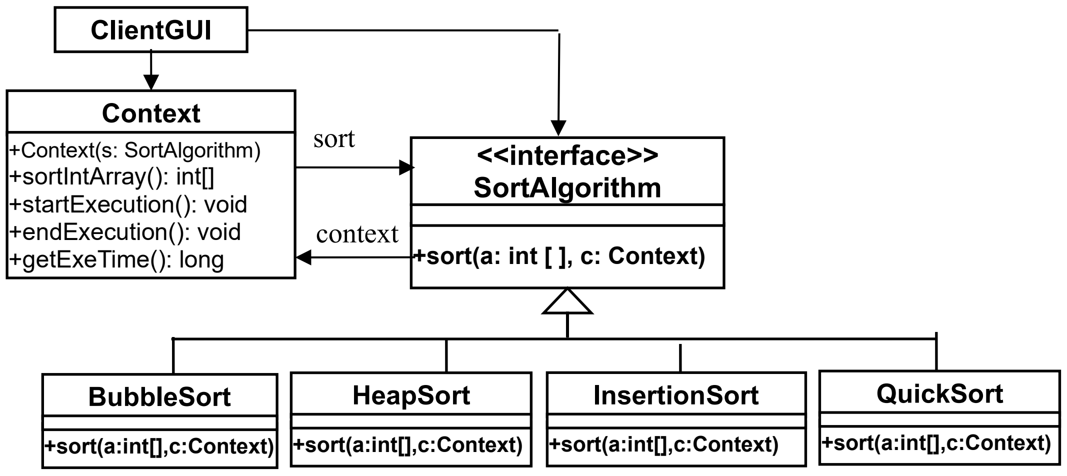


Fig 1. The Design of the Sorting Integer Array Problem in example 7.2 of the book

作业报告部分

1. Describe your finished homework, including

a) **What classes have been added to the existing class hierarchy?**

b) **Specify the relationship between the existing classes and the newly added classes.**

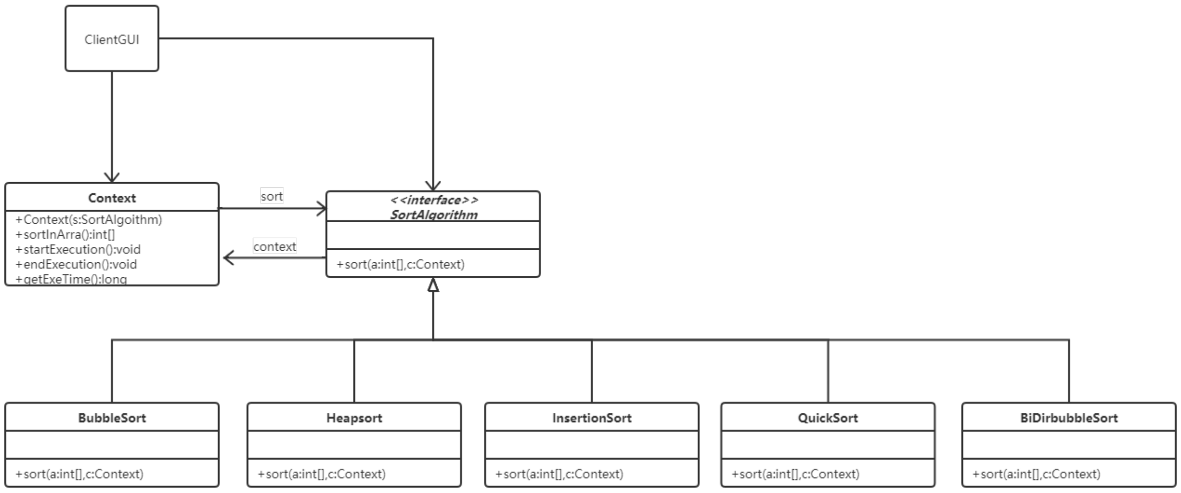
c) **What code has been added to what class?**

(1) **BidirBubbleSort 类。**

(2) **BidirBubbleSort 类继承自 SortAlgorithm 接口，Context 类聚合一个具体的算法对象，再在这个算法对象中调用 Context，进行排序。**

(3) **ClientGUI 加入了一些界面的代码，以及选择双向排序的条件语句。在 BidirBubbleSort 类中加入了计时器内容。**

2. Draw your new class diagram here



3. Describe the typical interactions of the design in Fig 1 above in details

(1) **用户首先创建 Context 类，然后聚合一个特定的算法类。**

(2) **调用 context 类的排序方法。**

(3) **Context 的排序方法中调用 algorithm 类的排序方法。**

(4) **algorithm 类的排序方法中调用 context 类的计时器方法。**

(5) **最后在 GUI 中显示计时和排序信息。**

4. Discussions of the extensibility issues.

1) After you add your new class BidirBubbleSort in the strategy class hierarchy,

a) Do you have to change the Context class?

No

b) Do you have to change the Client class ClientGUI?

Yes

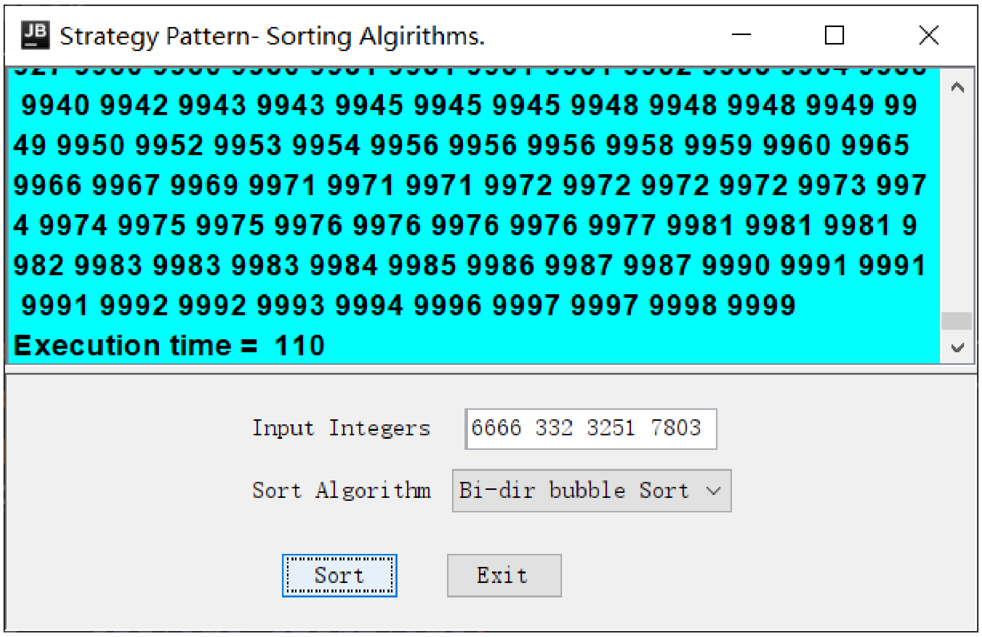
2) If you have changed the code for a sort(a:int[],c:Context) method in a sub-strategy class in the strategy class hierarchy,

a) Do you have to change or recompile the Context class?

b) Do you have to change or recompile the Client class ClientGUI?

不需要重新编译 Context 和 ClientGUI 类。

5. Test your program by outputing typical input and output from running your new program



```
[illegible]
 9940 9942 9943 9943 9945 9945 9945 9948 9948 9948 9949 99
49 9950 9952 9953 9954 9956 9956 9956 9958 9959 9960 9965
9966 9967 9969 9971 9971 9971 9972 9972 9972 9972 9973 997
4 9974 9975 9975 9976 9976 9976 9976 9977 9981 9981 9981 9
982 9983 9983 9983 9984 9985 9986 9987 9987 9990 9991 9991
 9991 9992 9992 9993 9994 9996 9997 9997 9998 9999
Execution time =  110
```

Input Integers: 6666 332 3251 7803

Sort Algorithm: Bi-dir bubble Sort

Homework 9: 中介者模式(Mediator Pattern)

Homework Description: See the following class diagram for the Mediator pattern implementation of collaboration program for Hotel, Airline and Tour.

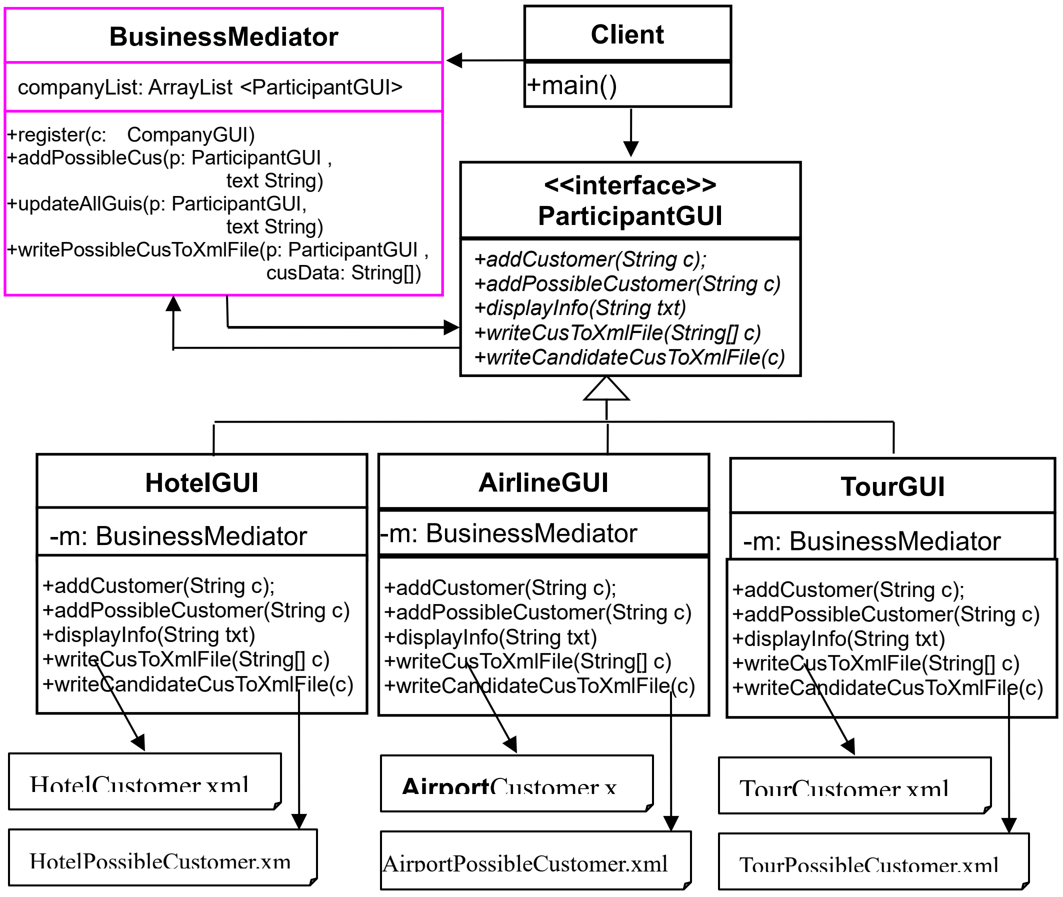
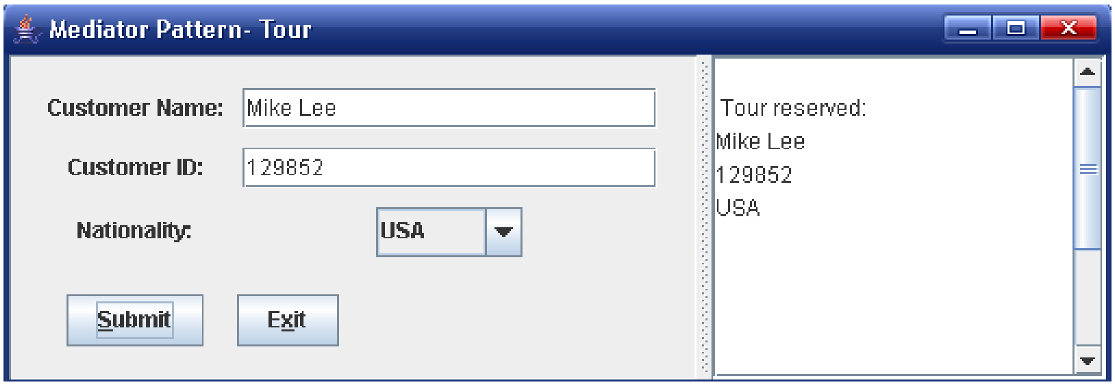

BusinessMediator
companyList: ArrayList <ParticipantGUI>
+register(c: CompanyGUI)
+addPossibleCus(p: ParticipantGUI , text String)
+updateAllGuis(p: ParticipantGUI, text String)
+writePossibleCusToXmlFile(p: ParticipantGUI , cusData: String[])
Client
+main()
<<interface>> ParticipantGUI
+addCustomer(String c);
+addPossibleCustomer(String c)
+displayInfo(String txt)
+writeCusToXmlFile(String[] c)
+writeCandidateCusToXmlFile(c)
HotelGUI
-m: BusinessMediator
AirlineGUI
-m: BusinessMediator
TourGUI
-m: BusinessMediator
+addCustomer(String c);
+addPossibleCustomer(String c)
+displayInfo(String txt)
+writeCusToXmlFile(String[] c)
+writeCandidateCusToXmlFile(c)
HotelCustomer.xml
HotelPossibleCustomer.xm
AirportCustomer.x
AirportPossibleCustomer.xml
TourCustomer.xml
TourPossibleCustomer.xml

图 1 利用中介者模式设计的信息共享程序

The three graphical user interfaces for the Hotel, Airline and Tour are as below.


Mediator Pattern- Tour

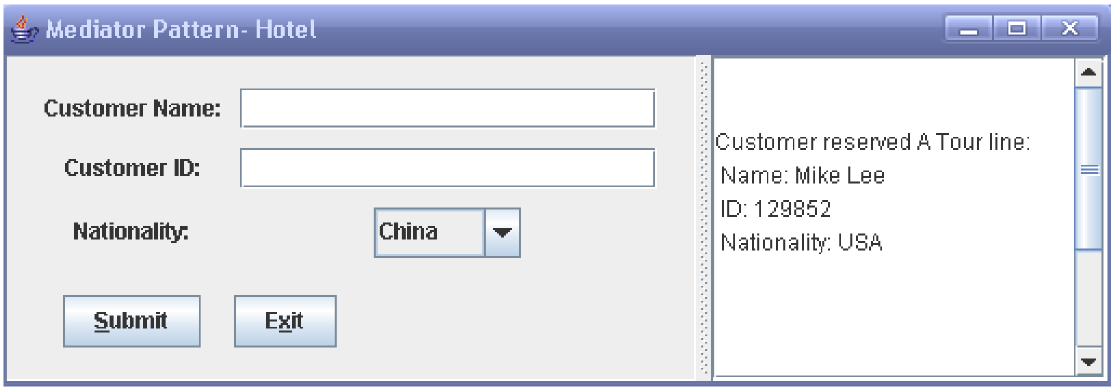
Customer Name: Mike Lee

Customer ID: 129852

Nationality: USA

Tour reserved:
Mike Lee
129852
USA

图 2 旅游公司输入客户信息


Mediator Pattern- Hotel

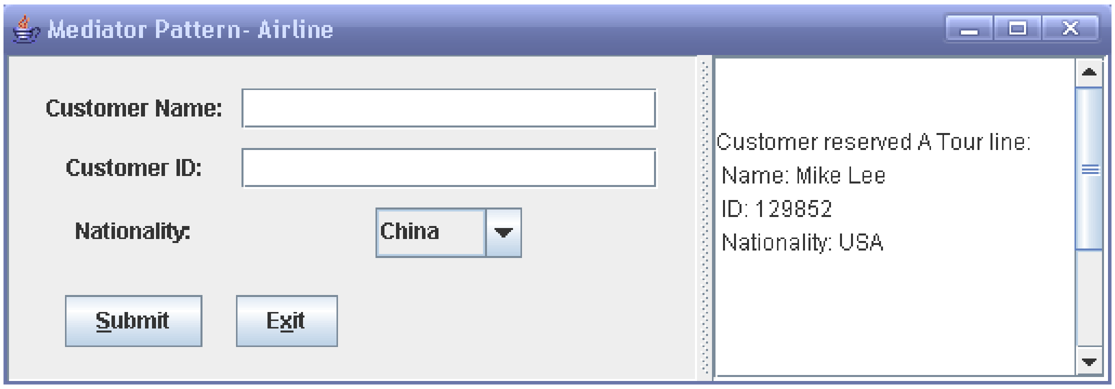
Customer Name:

Customer ID:

Nationality: China

Customer reserved A Tour line:
Name: Mike Lee
ID: 129852
Nationality: USA

图 3 宾馆界面同步获得旅游公司输入的客户信息


Mediator Pattern- Airline

Customer Name:

Customer ID:

Nationality: China

Customer reserved A Tour line:
Name: Mike Lee
ID: 129852
Nationality: USA

图 4 机场界面同步获得旅游公司输入的客户信息

当在一个用户图形界面，例如 Tour，中输入 Mike Lee，1239852，选择 USA 然后点击按钮“Submit”，则程序会通过 BusinessMediator 对象，将这些客户信息转发给 Hotel 和 Airline 对象，并且显示在相应的用户图形界面上。这些客户数据也被写到了以下的数据文件 TourCustomer.xml，HotelPossibleCustomer.xml 和 AirportPossibleCustomer.xml 中。

Homework requirement:

1. **Run the program before you go any further**
2. **(Coding) Add another class named TouriststoreGUI （旅游商店）such that the 4 classes HotelGUI, AirflightGUI, TourGUI and TouriststoreGUI will interact though the BusinessMediator in the same way as before (use the mediator pattern). Note that you need to create files TourStoreCustomer.xml and TourStorePossibleCustomer.xml and relavent customer information needs to be added to the above files.**

项目报告部分

1. Describe your finished homework, including

   a) What class has been added to the existing class hierarchy?

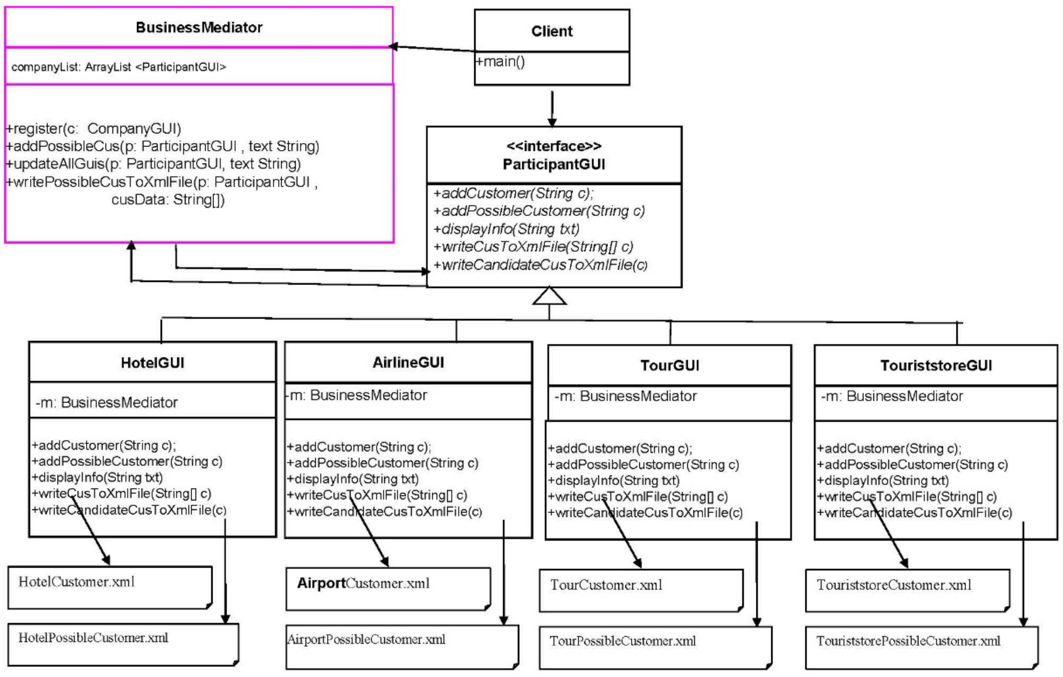
   b) The relationship between the existing classes and the newly added class

Answer:

a) TouriststoreGUIc class

b) The relationship between class ParticipantGUI and the newly added class is an inheritance relationship and the newly added class inherits from ParticipantGUI, and the relationship between class BusinessMediator and the newly added class is an aggregation relationship.

2. Draw your new complete class diagram here


BusinessMediator
companyList: ArrayList <ParticipantGUI>
+register(c: CompanyGUI)
+addPossibleCus(p: ParticipantGUI , text String)
+updateAllGuis(p: ParticipantGUI, text String)
+writePossibleCusToXmlFile(p: ParticipantGUI , cusData: String[])
Client
+main()
<<interface>> ParticipantGUI
+addCustomer(String c);
+addPossibleCustomer(String c)
+displayInfo(String txt)
+writeCusToXmlFile(String[] c)
+writeCandidateCusToXmlFile(c)
HotelGUI
-m: BusinessMediator
AirlineGUI
TourGUI
TouriststoreGUI
HotelCustomer.xml
HotelPossibleCustomer.xml
AirportCustomer.xml
AirportPossibleCustomer.xml
TourCustomer.xml
TourPossibleCustomer.xml
TouriststoreCustomer.xml
TouriststorePossibleCustomer.xml

3. In HotelGUI object, when you enter name entry as "Rose Black", id number entry as "555888999", and choose the nationality as "USA", and then click on button "Submit" to save the customer information into file HotelCustomer.xml, what methods in what class will have been invoked, list all of them in correct order.

Answer:

The methods in HotelGUI

- setCusName();
- setCusID();
- setCusNation();
- getCusName();
- getCusID();
- getCusNation();
- writeCusToXmlFile();
- askMedSaveCusInfo();

The methods in BusinessMediator

- bMediator.writePossibleCusToXmlFile();

The methods in HotelGUI:

- displayInfo();
- addCustomer();
- askMedAddCus();

The methods in AirflightGUI:

- addPossibleCustomer();

The methods in TourGUI:

- addPossibleCustomer();

The methods in TouriststoreGUI:

- addPossibleCustomer();

The methods in HotelGUI:

- askMedUpdate();

The methods in BusinessMediator

- updateAllGuis();

The methods in AirflightGUI:

- displayInfo();

The methods in TourGUI:

- displayInfo();

The methods in TouriststoreGUI:

- displayInfo()

4. Discussion

a) **Describe the functionality of the BusinessMediator class.**

b) **Explain how the mediator pattern works?**

c) **How the method updateAllGuis(ParticipantGUI p, String text) in the BusinessMediator class works?**

Answer

(1) The BusinessMediator will keep a reference of each of the interacting objects(HotelGUI, AirflightGUI, TourGUI and TouriststoreGUI) and receive the message from all the objects,and provide methods to call the participating objects(HotelGUI, AirflightGUI, TourGUI and TouriststoreGUI).

(2) Firstly, Mediator object call the methods named *register* to save objects. A object calls a method of mediator object, and then the mediator object calls methods in other objects. These objects also call back the methods in Mediator object. Mediator object calls the object .Mediator object in turn call other objects

(3) An Iterator is defined that iterates through the companyList elements (ParticipantGUIl instantiation object), and if the element is not p, the displayInfo method of the element (ParticipantGUIl instantiation object) is called to print the information.

5. [Extendibility Issue] Discussion:

a) **After you add the new class TouriststoreGUI, do you have to modify class ParticipantGUI?**

b) **After you add the new class TouriststoreGUI, do you have to modify class HotelGUI?**

c) **After you add the new class TouriststoreGUI, do you have to modify class AirlineGUI?**

d) **After you add the new class TouriststoreGUI, do you have to modify class TourGUI?**

e) **After you add the new class TouriststoreGUI, do you have to modify class BusinessMediator?**

Answer: I don’t need to modify all these classes.

Project 1: Encryption by Using Layered Architecture

问题描述: The purpose of this project is to design an agent information system by using three-layer layered architecture. The agent information is encrypted and then saved into some specific text files. In the design below, the graphical user interface includes a class nemed ClientGUI for sending user’s request. The application layer contains a class hierarchy named Encryption to actually encrypt agent info and calls class TxtFileWriter, which saves the encrypted data into files Folding.txt, and Group-swap.txt. The agent information to be encrypted includes agent’s last name, first name, and agent code. The agent code can be mixed characters with digital numbers. The length of the code is 12.

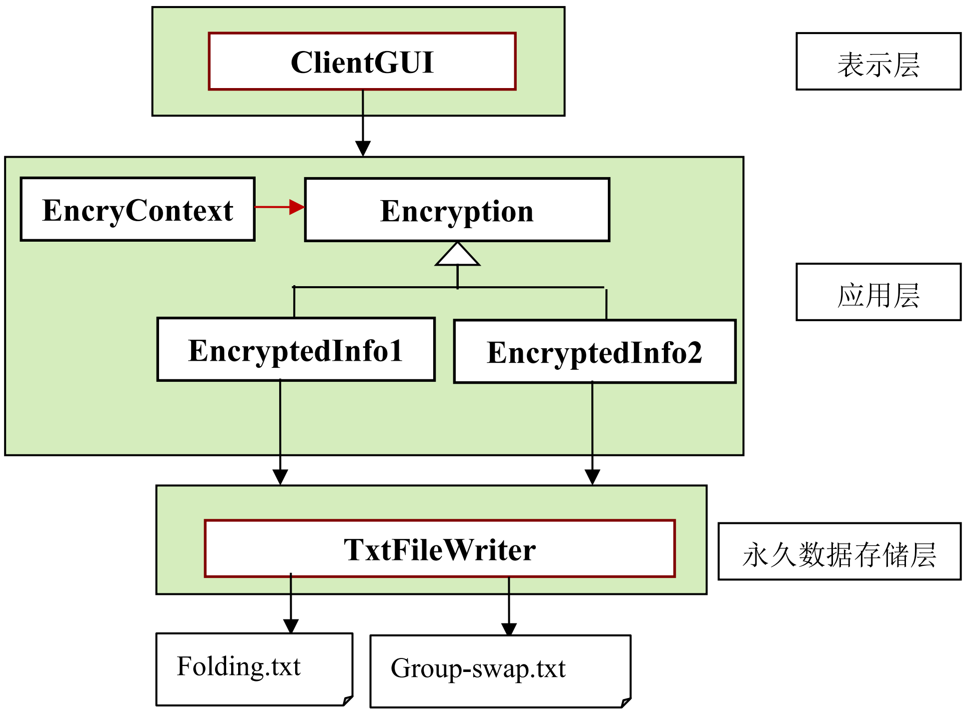


Fig 1. Software architecture for the agent information system

算法描述：

Class EncryptedInfo1 encrypts agent information using Encryption Algorithm1 (折叠算法) as below.

Precondition: a text file to be encrypted contains only English characters and digital numbers. The algorithm is:

a→z, b→y, ...m→n, y→b, z→a

0→9, 1→8, 2→7, 3→6, 4→5, 5→4, 6→3, 7→2, 8→1, 9→0

Upper case letters are also encrypted the same way (Upper case letters are encrypted into Upper case letters).

Class EncryptedInfo2 encrypts agent information using Encryption Algorithm2 (分组互换算法).

Precondition: a text file to be encrypted contains only English characters and digital numbers. The algorithm is:

a→b, b→a; c→d, d→c; e→f, f→e;, ..., y→z, z→y

0→1, 1→0; 2→3, 3→2; ...8→9, 9→8

Upper case letters are also encrypted the same way (Upper case letters are encrypted into Upper case letters) .

Class diagram is as Fig 2.

The source code for the above class diagram has been written in Java. The encrypted agent information from EncryptedInfo1 is saved into a file named Folding.txt and encrypted agent information from EncryptedInfo2 is saved into a file named Group-swap.txt. Both text files are in the same folder as the Java source files.

The class diagram is as below.

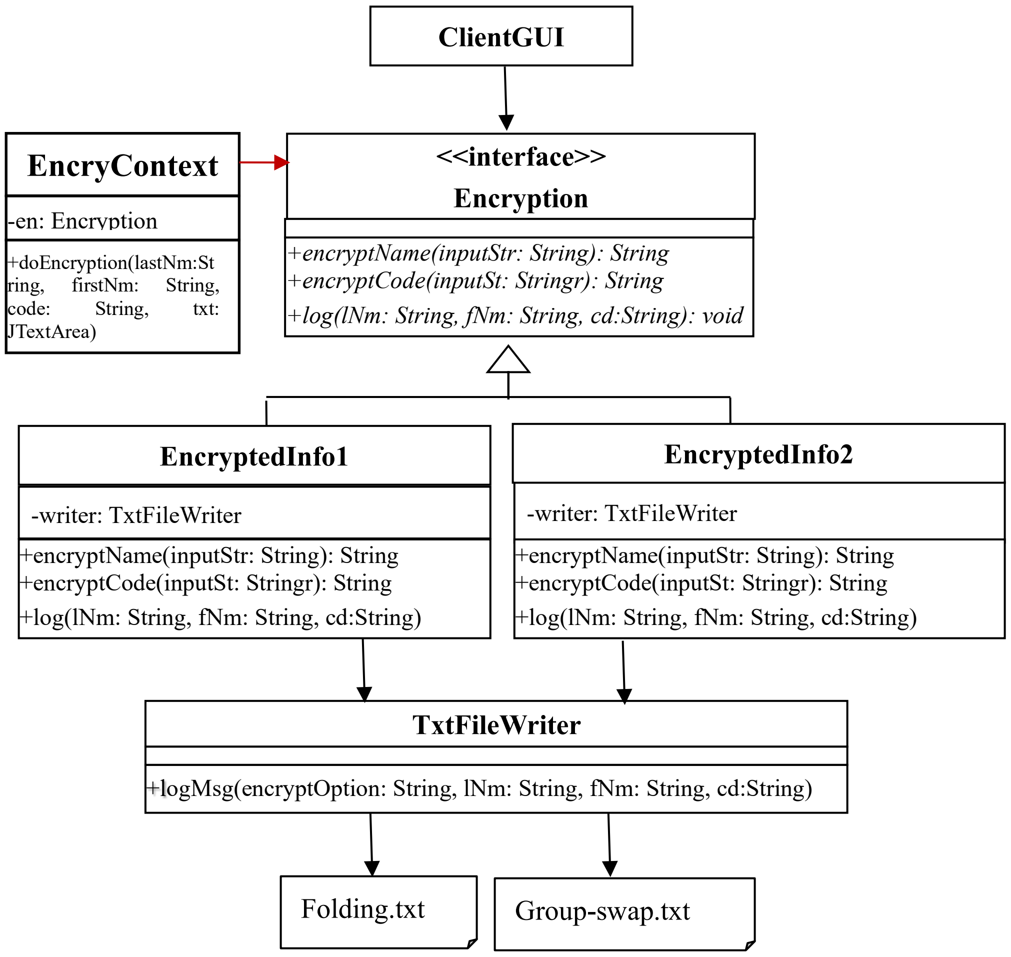

ClientGUI
<<interface>>
Encryption
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String): void
EncryContext
-en: Encryption
+doEncryption(lastNm:String, firstNm: String, code: String, txt: JTextArea)
EncryptedInfo1
-writer: TxtFileWriter
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String)
EncryptedInfo2
-writer: TxtFileWriter
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String)
TxtFileWriter
+logMsg(encryptOption: String, lNm: String, fNm: String, cd:String)
Folding.txt
Group-swap.txt

Fig 2. The class diagram for the agent information system

你的任务：

1) **在以上已经存在的设计中，新增加第三种加密算法. Now you are required to write a class EncryptedInfo3 to encrypt agent’s last name, first name and code number.**

   a) **The class should be in the same format as EncryptedInfo1 and EncryptedInfo2, and provides a different encryption method**

b) EncryptedInfo3 should encrypt the last name, first name and code number as described below as CaesarCypher: To encrypt a word, we replace the letter a with b, b with c, and so on, up to z, which is replaced by a. This is called the rotate-1 Caesar cipher. When a digital number between 0 and 9 is encountered, the rule to rotate is 0□1, 1□2,…,8□9 and 9□0. For example:

Agent first name: Mike
Encrypted agent first name: Njlf
Agent last name: Sun
Encrypted agent last name: Tvo
Agent code: WildWolf7489
Encrypted agent code: XjmeXpmg8590

c) Modify the class ClientGUI to allow choice EncryptedInfo3 to be shown in the GUI.

d) The encrypted agent information should be saved into a text file Caesar.txt.

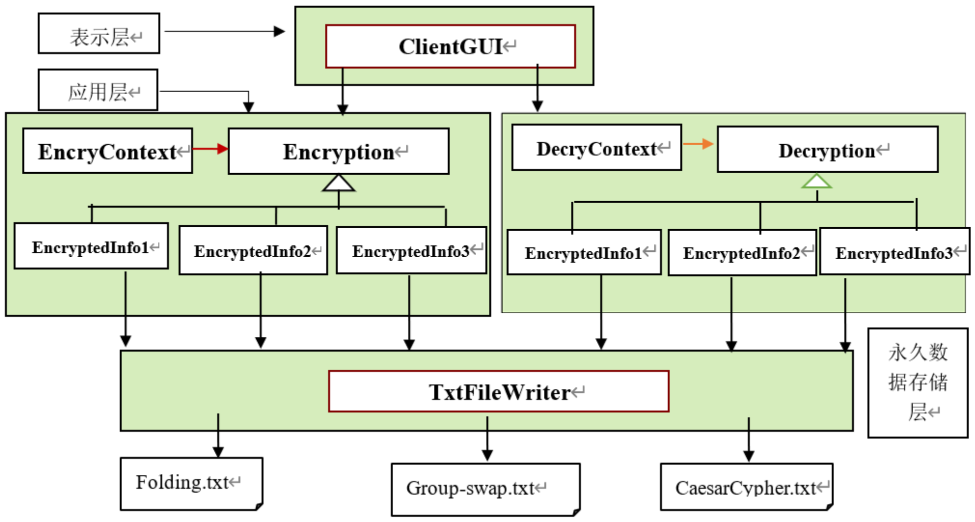
2) 在应用层，增加相应的解密算法层次类 Decryption，该类带有三个相应的解密子类。分别从三个加密文件中读出的 agent 加密信息，可以通过此层次类解密，然后显示在用户图形界面上。

3) 在用户图形界面上增加解密按钮，以便对各个加密文件所存的内容进行解密，然后显示的用户图形界面上。

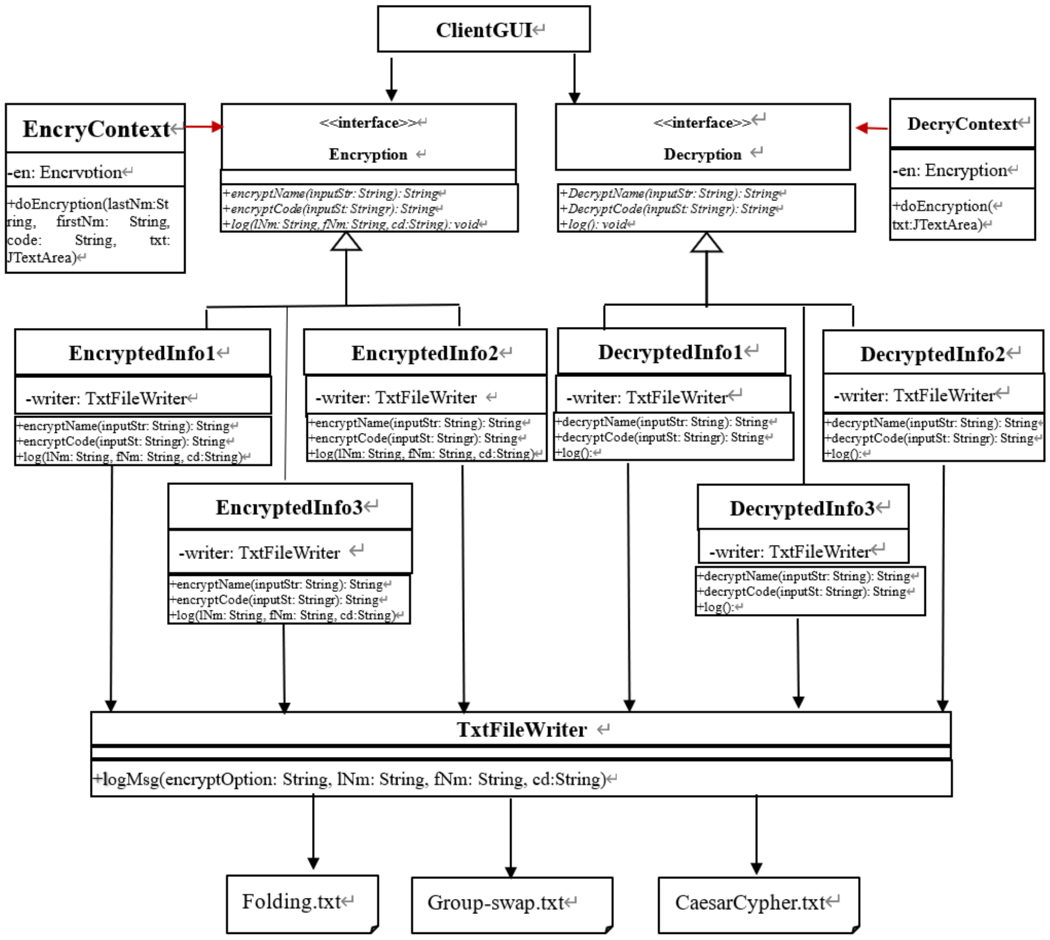
【注】为了方便起见，你也可以使用另外一个文件夹包含全部的解密程序和 text 文档。

项目报告部分

1. Draw your software architecture for your new agent information encryption system



2. Draw class diagram for your new agent information encryption system


ClientGUI
EncryContext
-en: Encryption
+doEncryption(lastNm:String, firstNm: String, code: String, txt: JTextArea)
<<interface>>
Encryption
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String): void
<<interface>>
Decryption
+DecryptName(inputStr: String): String
+DecryptCode(inputSt: Stringr): String
+log(): void
DecryContext
-en: Encryption
+doEncryption(txt:JTextArea)
EncryptedInfo1
-writer: TxtFileWriter
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String)
EncryptedInfo2
-writer: TxtFileWriter
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String)
DecryptedInfo1
-writer: TxtFileWriter
+decryptName(inputStr: String): String
+decryptCode(inputSt: Stringr): String
+log():
DecryptedInfo2
-writer: TxtFileWriter
+decryptName(inputStr: String): String
+decryptCode(inputSt: Stringr): String
+log():
EncryptedInfo3
-writer: TxtFileWriter
+encryptName(inputStr: String): String
+encryptCode(inputSt: Stringr): String
+log(lNm: String, fNm: String, cd:String)
DecryptedInfo3
-writer: TxtFileWriter
+decryptName(inputStr: String): String
+decryptCode(inputSt: Stringr): String
+log():
TxtFileWriter
+logMsg(encryptOption: String, lNm: String, fNm: String, cd:String)
Folding.txt
Group-swap.txt
CaesarCypher.txt

3. To implement all the required functionalities, what classes have you added to the application layer?

答：在应用层添加的类有 EncryptedInfo3，新添加的编码方法类，DecryContext，Decryption 接口，DecryptedInfo1, DecryptedInfo2, DecryptedInfo3,三个用于解码的方法类。

4. Which design pattern has been used in the application layer?

答：使用了桥接模式(Bridge Pattern)

5. **Answer question: When you add a new class in the application layer, will the data file access layer be affected or not?**
   答： 不会。在应用层新加一个类的时候，因为数据层和应用层是隔离开封装的，不会影响数据层的信息。
6. **Answer question: When you add a new class in the application layer, will the user interface layer be affected or not?**
   答：不会，图形界面层和应用层以及数据层之间都封装了，因此在应用层之间类方法等不会影响其他层次。
7. **Answer question: When you add a new method in the TxtFileWriter class, will the user interface layer or the application layer be affected or not?**
   答：不会。在 TxtFileWriter class 中添加方法的时候，除了 TxtFileWriter class 会受到影响之外，其余的图形界面层和应用层之间，是不会收到影响的，因为各自部分已经封装。

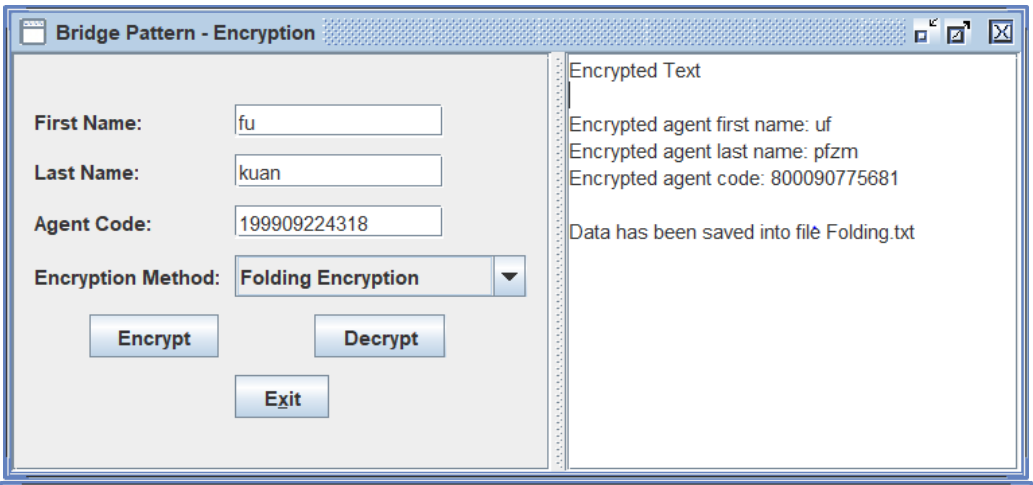
8. **If you want the user interface layer to initialize a request to save some data into the data files, what classes need to call?**
   答：需要调用的类有：ClineGUI 类，Encrycontext 类，Encryption 类。然后加密算法类 EncryptedInfo1，EncryptedInfo2，EncryptedInfo3，其中之一，最后使用 TextFileWriter 类和 FileUtil 类进行写入文件。

9. **In your program,**
   1) **Does the application layer call the user interface layer?**
   2) **Does the data files access layer call the application layer or the user interface layer?**

   (3) 应用层会调用用户界面层获取用户选择进行对应的执行加密算法
   (4) 数据文件访问层调用应用层，从应用层获取对应的加密好的信息，然后写入文件进行存储，不调用用户界面层。

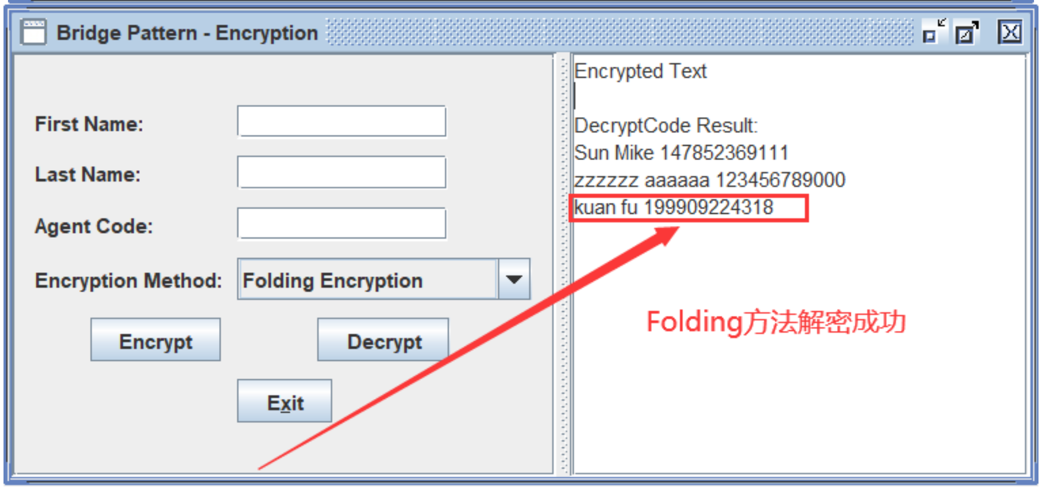
10. 测试与验证部分：List at least 3 group of typical input and output from running your program, corresponding to 3 ways to encrypt and decrypt agent information

(1) Folding：


Bridge Pattern - Encryption

First Name: fu
Last Name: kuan
Agent Code: 199909224318
Encryption Method: Folding Encryption

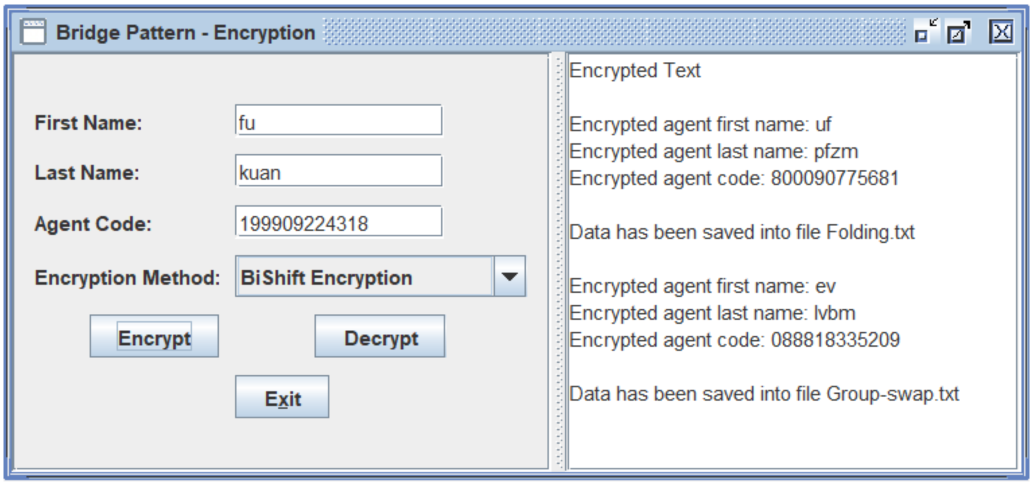
```
Encrypted Text

Encrypted agent first name: uf
Encrypted agent last name: pfzm
Encrypted agent code: 800090775681

Data has been saved into file Folding.txt
```


Bridge Pattern - Encryption

First Name:
Last Name:
Agent Code:
Encryption Method: Folding Encryption

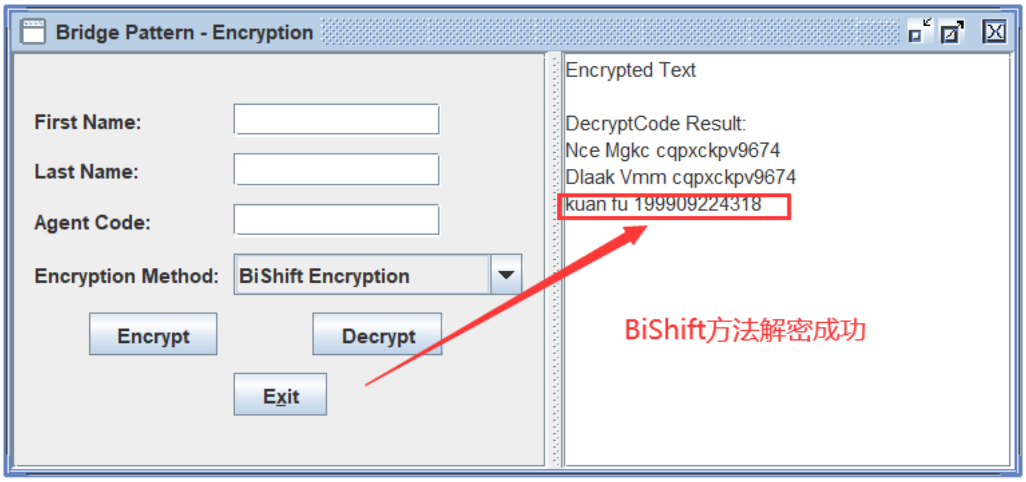
```
Encrypted Text

DecryptCode Result:
Sun Mike 147852369111
zzzzzz aaaaaa 123456789000
kuan fu 199909224318
```

(2) BiShift：



First Name: fu
Last Name: kuan
Agent Code: 199909224318
Encryption Method: BiShift Encryption

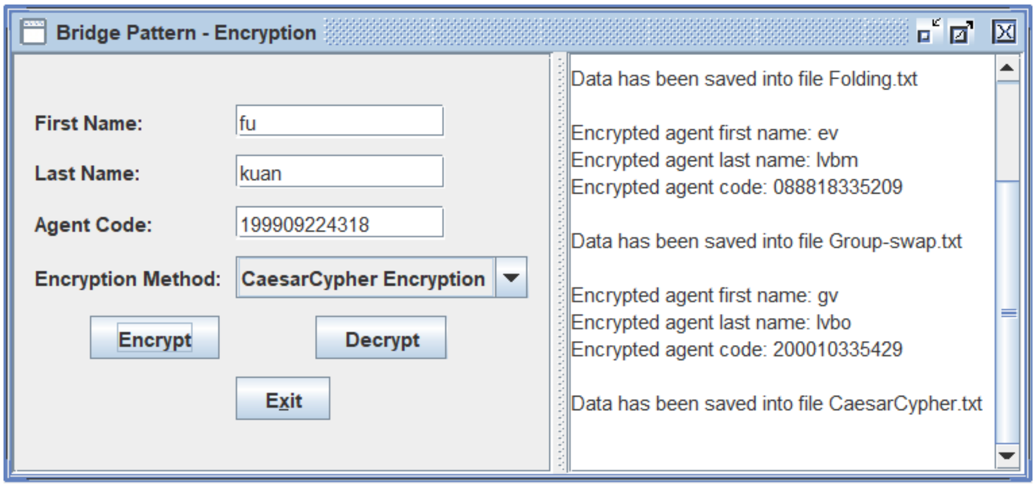
```
Encrypted Text

Encrypted agent first name: uf
Encrypted agent last name: pfzm
Encrypted agent code: 800090775681

Data has been saved into file Folding.txt

Encrypted agent first name: ev
Encrypted agent last name: lvbm
Encrypted agent code: 088818335209

Data has been saved into file Group-swap.txt
```



Encryption Method: BiShift Encryption

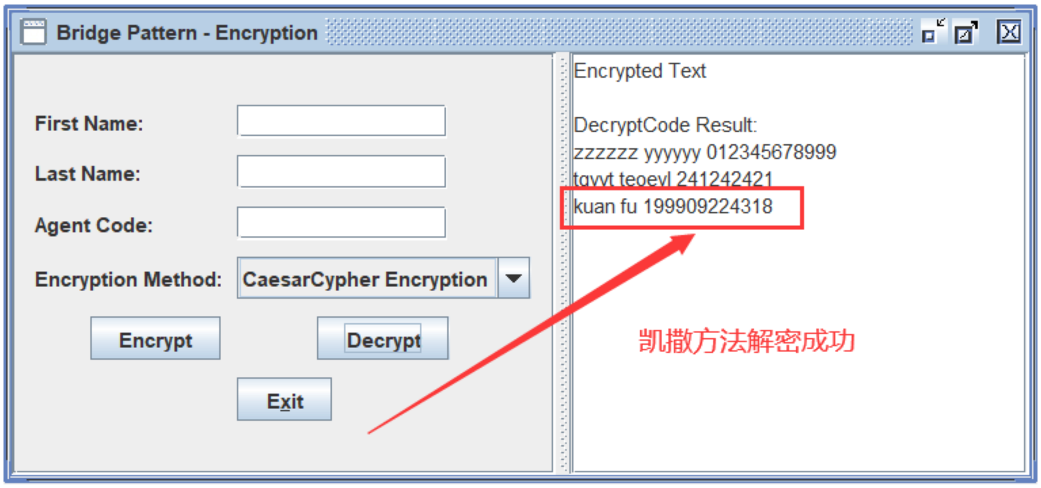
```
Encrypted Text

DecryptCode Result:
Nce Mgkc cqpxckpv9674
Dlaak Vmm cqpxckpv9674
kuan fu 199909224318
```

(3) Caesar：



First Name: fu
Last Name: kuan
Agent Code: 199909224318
Encryption Method: CaesarCypher Encryption

```
Data has been saved into file Folding.txt

Encrypted agent first name: ev
Encrypted agent last name: lvbm
Encrypted agent code: 088818335209

Data has been saved into file Group-swap.txt

Encrypted agent first name: gv
Encrypted agent last name: lvbo
Encrypted agent code: 200010335429

Data has been saved into file CaesarCypher.txt
```



First Name:
Last Name:
Agent Code:
Encryption Method: CaesarCypher Encryption

```
Encrypted Text

DecryptCode Result:
zzzzzz yyyyyy 012345678999
tgvyt teoevl 241242421
kuan fu 199909224318
```

Project 3: Text File Encryption in Pipes-and-filters Architecture

项目需求部分：实现一个多次加密程序

Do text file encryption by using the pipes and filters architecture. Suppose that we have 3 encryption algorithms as following:

Encryption Algorithm 1 (折叠算法). Precondition: a text file to be encrypted contains only English characters and digital numbers. The algorithm is:

a→z, b→y, ...m→n, y→b, z→a

0→9, 1→8, 2→7, 3→6, 4→5, 5→4, 6→3, 7→2, 8→1, 9→0

Upper case letters are also encrypted the same way (Upper case letters are encrypted into Upper case letters).

Encryption Algorithm 2(分组互换算法). Precondition: a text file to be encrypted contains only English characters and digital numbers. The algorithm is:

a→b, b→a; c→d, d→c; e→f, f→e;, ..., y→z, z→y

0→1, 1→0; 2→3, 3→2; ...8→9, 9→8

Upper case letters are also encrypted the same way (Upper case letters are encrypted into Upper case letters) .

Encryption Algorithm 3 (Caesar cipher, rotation 1): Precondition: a text file to be encrypted contains only English characters and digital numbers. The algorithm is: for the 26 English characters, you replace the letter a with b, b with c, and so on, up to z, which is replaced by a. When a digital number between 0 and 9 is encountered, the rule to rotate is 0→1, 1→2,...,8→9 and 9→0.

a→b, b→c; c→d, d→e; e→f, ...,y→z, z→a

0→1, 1→2; 2→3, 3→4; 4→5, 5→6,6→7,7→8, 8→9, 9→0

Upper case letters are also encrypted the same way (Upper case letters are encrypted into Upper case letters)

The program should be designed using pipes and filters architecture, which contains filters as below:

1) **InFilter reads the file to be encrypted in character stream format and parses the file. The parsed data is written to the output pipe as char stream;**
2) **EncrFilter1 reads character stream from its source pipe, use Encryption algorithm 1 to encrypt the incoming characters and numbers, and then write the resultant data into sink pipe as character stream;**
3) **EncrFilter2 reads character stream from its source pipe, use Encryption algorithm 2 to encrypt the incoming characters and numbers, and then write the resultant data into sink pipe as character stream;**
4) **EncrFilter3 reads character stream from its source pipe, use Encryption algorithm 3 to encrypt the incoming characters and numbers, and then write the resultant data into sink pipe as character stream;**
5) **OutFilter reads character stream from the source stream (through source pipe), and then write the resultant data into a file named Updated.txt in directory "EncryptedFiles" and onto the right textArea on the GUI (the original file content will be shown on the left textArea)**

The logic design of the pipeline is as the following.

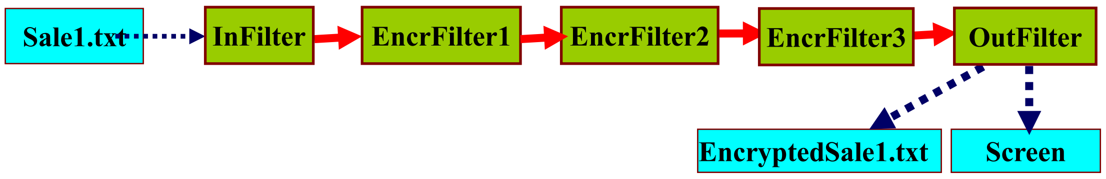


Fig 1. The logical design of the encryption system

The class diagram design is as below.

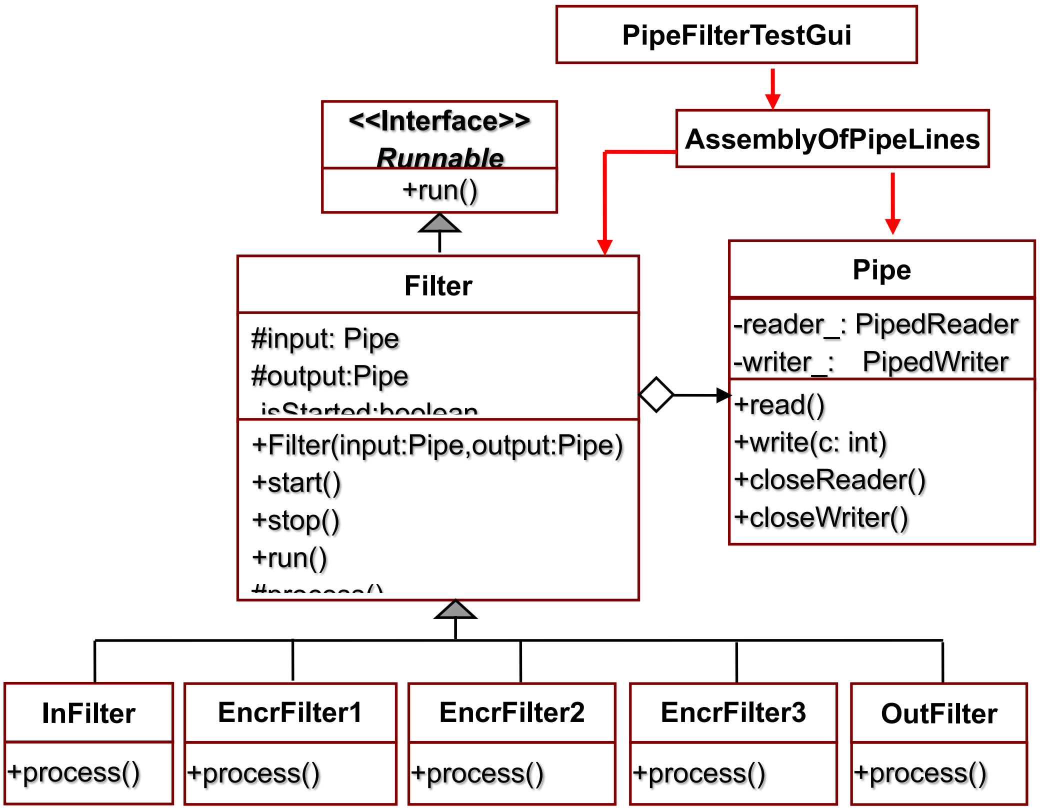


Fig 2. The design of encryption program using pipes and filters architecture

你的任务：

1) **在以上设计中，InFilter 类，EncrFilter1 类，和 OutFilter 类已经实现。你的任务是写代码实现 EncrFilter2 类和 EncrFilter3 类（提示：在写代码之前，运行程序，会对你的理解有所帮助）。**
2) **要求你的经过 3 次复合加密过滤器处理的文件，显示在图形界面右端的文本框中和相应的文件夹 EncryptedFiles 中的相应的文件 EncryptedSalesman1, EncryptedSalesman2,或者 EncryptedSalesman3 之中。**
3) **与加密类似地，按照以上类似的管道-过滤器架构设计并且实现一个针对以上算法的解密系统，可以将以上的整个加密程序，包括用户图形界面类，复制为另外一个文件**

夹，然后少许修改代码，而成为一个解密系统。注意，解密系统的过滤器的顺序与加密系统过滤器的顺序相反。

4) **对解密系统进行测试：使用已经被三次加密的数据，进行解密运算，如果最后得到未加密之前的原始数据，则说明你的加密系统是正确的（目的是验证你的加密算法的正确性)。**

项目报告部分(Report Part)

1. **Answer question: When you add a new sub class of Filter, what class needs to be modified in order for using the new sub class?**

答：AssemblyOfPipeLines 类需要修改。需要在这个类中创建新的管道，以及创建新的 EncryFilter 对象。并且使用多线程同时运行这些 encryptFilter 对象。

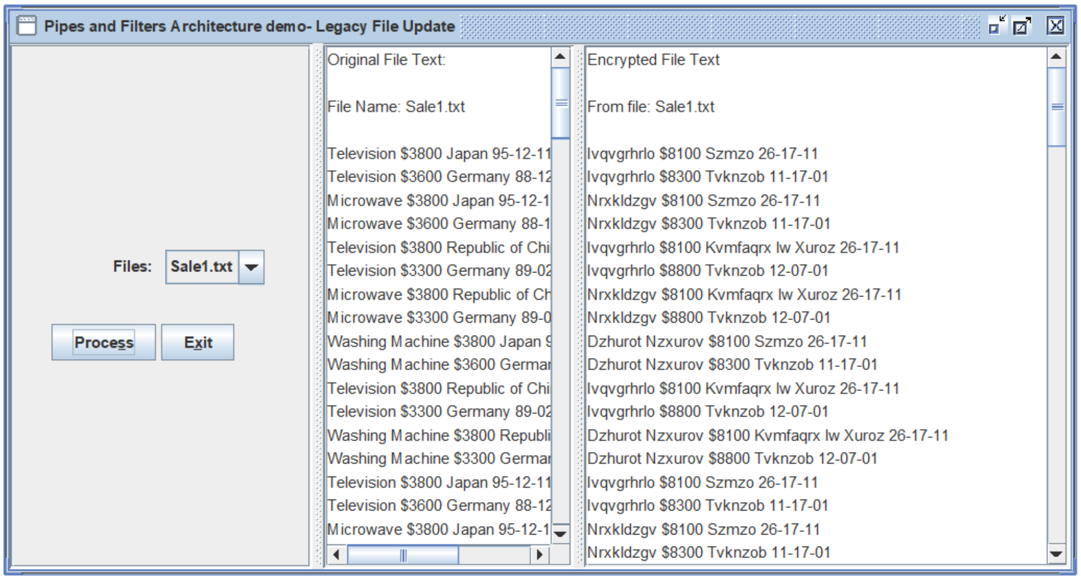
2. **Answer question: What makes the data flow through the pipeline?**

答：首先 InFilter 读入一个字符，写入 Output 端。之后 EncrFilter 从 In 的输出端读取一个字符，并且进行处理后写入输出端。每一个 EncrFilter 读取上一个的输出，之后处理发送到自己的输出端，最后由 OutPutFilter 读取并且输出到屏幕上。

3. **Answer question: What “all the filters can work simultaneously” mean?**

答：与批处理不同，批处理必须等前一个任务结束了，后面一个任务才能使用前面一个任务的输出作为自己的输入开始执行。他们的执行是依次序执行。 而管道过滤器则可以使用多线程的方式，多个处理程序同时运行。一次读取一个字符，之后处理并且输出。

4. **验证部分**
   1) **List typical input and output from running your encryption program**
   2) **use your decryption system to decrypt the output file from encryption to get the original file (如果你解密以后得到了原始文件，则证明你的加/解密算法的实现是正确的).**

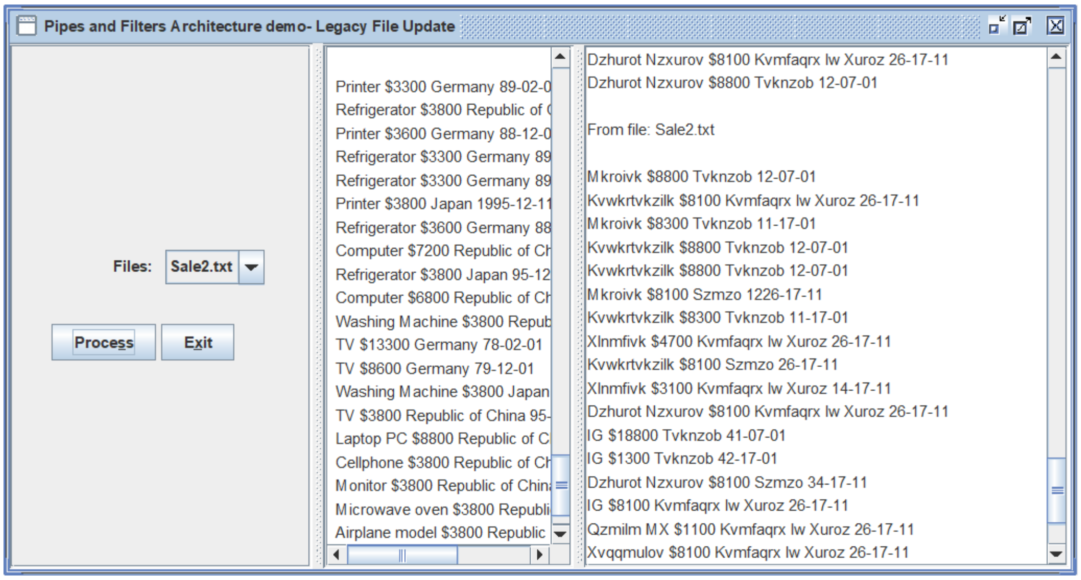


Files: Sale1.txt

```
Original File Text:

File Name: Sale1.txt

Television $3800 Japan 95-12-11
Television $3600 Germany 88-12
Microwave $3800 Japan 95-12-1
Microwave $3600 Germany 88-1
Television $3800 Republic of Chi
Television $3300 Germany 89-02
Microwave $3800 Republic of Ch
Microwave $3300 Germany 89-0
Washing Machine $3800 Japan 9
Washing Machine $3600 Germa
Television $3800 Republic of Chi
Television $3300 Germany 89-02
Washing Machine $3800 Republi
Washing Machine $3300 Germa
Television $3800 Japan 95-12-11
Television $3600 Germany 88-12
Microwave $3800 Japan 95-12-1
```

```
Encrypted File Text

From file: Sale1.txt

Ivqvgrhrlo $8100 Szmzo 26-17-11
Ivqvgrhrlo $8300 Tvknzob 11-17-01
Nrxkldzgv $8100 Szmzo 26-17-11
Nrxkldzgv $8300 Tvknzob 11-17-01
Ivqvgrhrlo $8100 Kvmfaqrx lw Xuroz 26-17-11
Ivqvgrhrlo $8800 Tvknzob 12-07-01
Nrxkldzgv $8100 Kvmfaqrx lw Xuroz 26-17-11
Nrxkldzgv $8800 Tvknzob 12-07-01
Dzhurot Nzxurov $8100 Szmzo 26-17-11
Dzhurot Nzxurov $8300 Tvknzob 11-17-01
Ivqvgrhrlo $8100 Kvmfaqrx lw Xuroz 26-17-11
Ivqvgrhrlo $8800 Tvknzob 12-07-01
Dzhurot Nzxurov $8100 Kvmfaqrx lw Xuroz 26-17-11
Dzhurot Nzxurov $8800 Tvknzob 12-07-01
Ivqvgrhrlo $8100 Szmzo 26-17-11
Ivqvgrhrlo $8300 Tvknzob 11-17-01
Nrxkldzgv $8100 Szmzo 26-17-11
Nrxkldzgv $8300 Tvknzob 11-17-01
```

图 1 - 加密

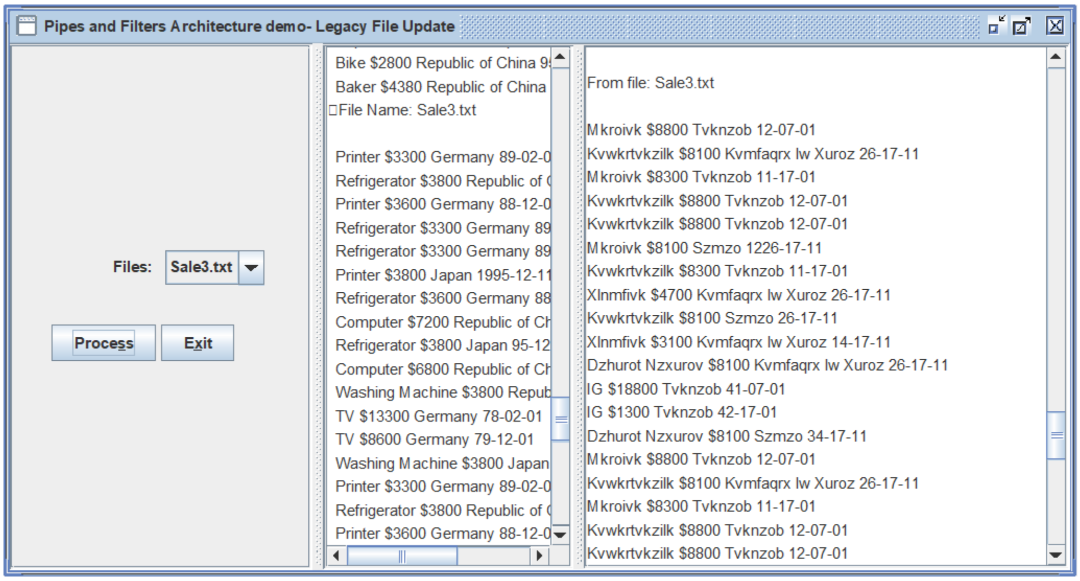


Files: Sale2.txt

```
  Printer $3300 Germany 89-02-0
  Refrigerator $3800 Republic of
  Printer $3600 Germany 88-12-0
  Refrigerator $3300 Germany 89
  Refrigerator $3300 Germany 89
  Printer $3800 Japan 1995-12-11
  Refrigerator $3600 Germany 88
  Computer $7200 Republic of Ch
  Refrigerator $3800 Japan 95-12
  Computer $6800 Republic of Ch
  Washing Machine $3800 Repub
  TV $13300 Germany 78-02-01
  TV $8600 Germany 79-12-01
  Washing Machine $3800 Japan
  TV $3800 Republic of China 95-
  Laptop PC $8800 Republic of C
  Cellphone $3800 Republic of Ch
  Monitor $3800 Republic of Chin
  Microwave oven $3800 Republi
  Airplane model $3800 Republic
```

```
Dzhurot Nzxurov $8100 Kvmfaqrx lw Xuroz 26-17-11
Dzhurot Nzxurov $8800 Tvknzob 12-07-01

From file: Sale2.txt

Mkroivk $8800 Tvknzob 12-07-01
Kvwkrtvkzilk $8100 Kvmfaqrx lw Xuroz 26-17-11
Mkroivk $8300 Tvknzob 11-17-01
Kvwkrtvkzilk $8800 Tvknzob 12-07-01
Kvwkrtvkzilk $8800 Tvknzob 12-07-01
Mkroivk $8100 Szmzo 1226-17-11
Kvwkrtvkzilk $8300 Tvknzob 11-17-01
Xlnmfivk $4700 Kvmfaqrx lw Xuroz 26-17-11
Kvwkrtvkzilk $8100 Szmzo 26-17-11
Xlnmfivk $3100 Kvmfaqrx lw Xuroz 14-17-11
Dzhurot Nzxurov $8100 Kvmfaqrx lw Xuroz 26-17-11
IG $18800 Tvknzob 41-07-01
IG $1300 Tvknzob 42-17-01
Dzhurot Nzxurov $8100 Szmzo 34-17-11
IG $8100 Kvmfaqrx lw Xuroz 26-17-11
Qzmilm MX $1100 Kvmfaqrx lw Xuroz 26-17-11
Xvqqmulov $8100 Kvmfaqrx lw Xuroz 26-17-11
```

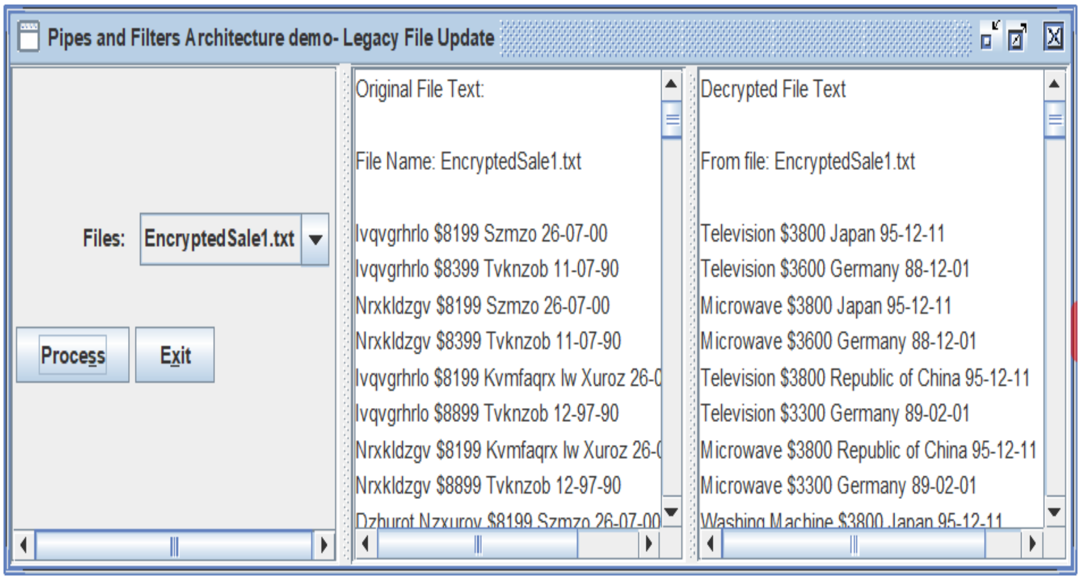
图 2 - 加密



```
Bike $2800 Republic of China 9
Baker $4380 Republic of China
□File Name: Sale3.txt

Printer $3300 Germany 89-02-0
Refrigerator $3800 Republic of (
Printer $3600 Germany 88-12-0
Refrigerator $3300 Germany 89
Refrigerator $3300 Germany 89
Printer $3800 Japan 1995-12-11
Refrigerator $3600 Germany 88
Computer $7200 Republic of Ch
Refrigerator $3800 Japan 95-12
Computer $6800 Republic of Ch
Washing Machine $3800 Repub
TV $13300 Germany 78-02-01
TV $8600 Germany 79-12-01
Washing Machine $3800 Japan
Printer $3300 Germany 89-02-0
Refrigerator $3800 Republic of (
Printer $3600 Germany 88-12-0
```

```
From file: Sale3.txt

Mkroivk $8800 Tvknzob 12-07-01
Kvwkrtvkzilk $8100 Kvmfaqrx lw Xuroz 26-17-11
Mkroivk $8300 Tvknzob 11-17-01
Kvwkrtvkzilk $8800 Tvknzob 12-07-01
Kvwkrtvkzilk $8800 Tvknzob 12-07-01
Mkroivk $8100 Szmzo 1226-17-11
Kvwkrtvkzilk $8300 Tvknzob 11-17-01
Xlnmfivk $4700 Kvmfaqrx lw Xuroz 26-17-11
Kvwkrtvkzilk $8100 Szmzo 26-17-11
Xlnmfivk $3100 Kvmfaqrx lw Xuroz 14-17-11
Dzhurot Nzxurov $8100 Kvmfaqrx lw Xuroz 26-17-11
IG $18800 Tvknzob 41-07-01
IG $1300 Tvknzob 42-17-01
Dzhurot Nzxurov $8100 Szmzo 34-17-11
Mkroivk $8800 Tvknzob 12-07-01
Kvwkrtvkzilk $8100 Kvmfaqrx lw Xuroz 26-17-11
Mkroivk $8300 Tvknzob 11-17-01
Kvwkrtvkzilk $8800 Tvknzob 12-07-01
Kvwkrtvkzilk $8800 Tvknzob 12-07-01
```

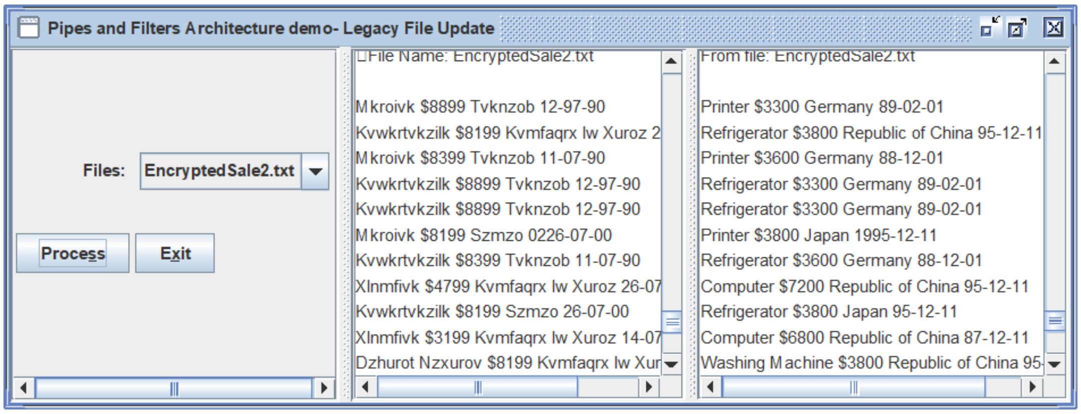
图 3 - 加密



```
Original File Text:

File Name: EncryptedSale1.txt

lvqvgrhrlo $8199 Szmzo 26-07-00
lvqvgrhrlo $8399 Tvknzob 11-07-90
Nrxkldzgv $8199 Szmzo 26-07-00
Nrxkldzgv $8399 Tvknzob 11-07-90
lvqvgrhrlo $8199 Kvmfaqrx lw Xuroz 26-0
lvqvgrhrlo $8899 Tvknzob 12-97-90
Nrxkldzgv $8199 Kvmfaqrx lw Xuroz 26-0
Nrxkldzgv $8899 Tvknzob 12-97-90
Dzhurot Nzxurov $8199 Szmzo 26-07-00
```

```
Decrypted File Text

From file: EncryptedSale1.txt

Television $3800 Japan 95-12-11
Television $3600 Germany 88-12-01
Microwave $3800 Japan 95-12-11
Microwave $3600 Germany 88-12-01
Television $3800 Republic of China 95-12-11
Television $3300 Germany 89-02-01
Microwave $3800 Republic of China 95-12-11
Microwave $3300 Germany 89-02-01
Washing Machine $3800 Japan 95-12-11
```

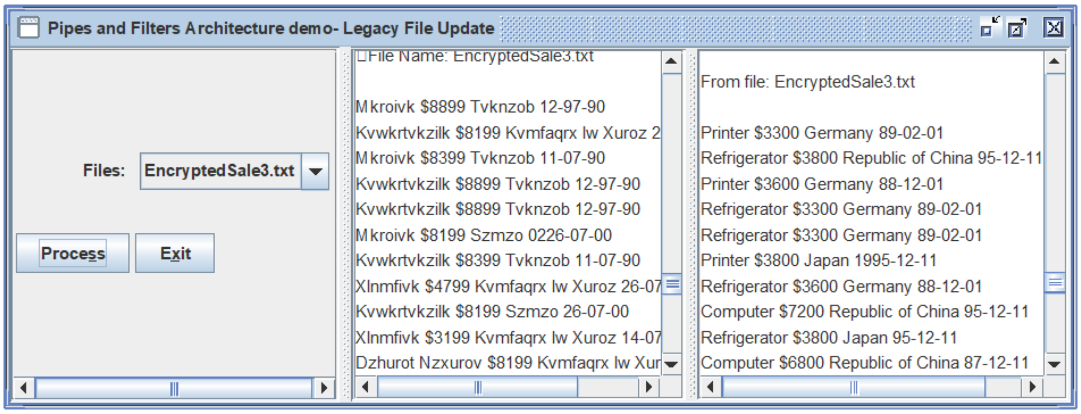
图 4 - 解密



```
□File Name: EncryptedSale2.txt

Mkroivk $8899 Tvknzob 12-97-90
Kvwkrtvkzilk $8199 Kvmfaqrx lw Xuroz 2
Mkroivk $8399 Tvknzob 11-07-90
Kvwkrtvkzilk $8899 Tvknzob 12-97-90
Kvwkrtvkzilk $8899 Tvknzob 12-97-90
Mkroivk $8199 Szmzo 0226-07-00
Kvwkrtvkzilk $8399 Tvknzob 11-07-90
Xlnmfivk $4799 Kvmfaqrx lw Xuroz 26-07
Kvwkrtvkzilk $8199 Szmzo 26-07-00
Xlnmfivk $3199 Kvmfaqrx lw Xuroz 14-07
Dzhurot Nzxurov $8199 Kvmfaqrx lw Xur
```

```
From file: EncryptedSale2.txt

Printer $3300 Germany 89-02-01
Refrigerator $3800 Republic of China 95-12-11
Printer $3600 Germany 88-12-01
Refrigerator $3300 Germany 89-02-01
Refrigerator $3300 Germany 89-02-01
Printer $3800 Japan 1995-12-11
Refrigerator $3600 Germany 88-12-01
Computer $7200 Republic of China 95-12-11
Refrigerator $3800 Japan 95-12-11
Computer $6800 Republic of China 87-12-11
Washing Machine $3800 Republic of China 95
```

图 5 - 解密



```
□File Name: EncryptedSale3.txt

Mkroivk $8899 Tvknzob 12-97-90
Kvwkrtvkzilk $8199 Kvmfaqrx lw Xuroz 2
Mkroivk $8399 Tvknzob 11-07-90
Kvwkrtvkzilk $8899 Tvknzob 12-97-90
Kvwkrtvkzilk $8899 Tvknzob 12-97-90
Mkroivk $8199 Szmzo 0226-07-00
Kvwkrtvkzilk $8399 Tvknzob 11-07-90
Xlnmfivk $4799 Kvmfaqrx lw Xuroz 26-07
Kvwkrtvkzilk $8199 Szmzo 26-07-00
Xlnmfivk $3199 Kvmfaqrx lw Xuroz 14-07
Dzhurot Nzxurov $8199 Kvmfaqrx lw Xur
```

```
From file: EncryptedSale3.txt

Printer $3300 Germany 89-02-01
Refrigerator $3800 Republic of China 95-12-11
Printer $3600 Germany 88-12-01
Refrigerator $3300 Germany 89-02-01
Refrigerator $3300 Germany 89-02-01
Printer $3800 Japan 1995-12-11
Refrigerator $3600 Germany 88-12-01
Computer $7200 Republic of China 95-12-11
Refrigerator $3800 Japan 95-12-11
Computer $6800 Republic of China 87-12-11
```

图 6 - 解密