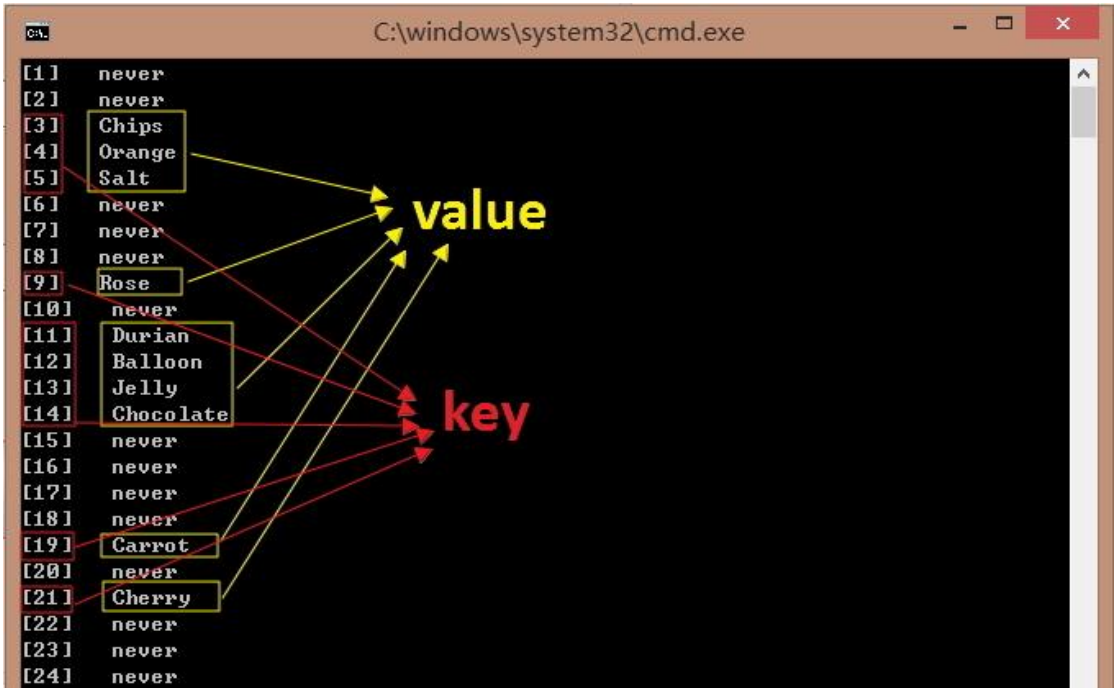
The following techniques were used to develop the recording system

- Use of a hash table to store information (pages 1-3)
- Use of data files to record information (pages 3-4)
- Use of Java Swing to create Graphical User Interface (pages 5-8)
- Use of Boolean to handle exceptions (pages 9-10)

Technique 1: Hash table

A hash table is a data structure used to implement an associative array with keys and values. I use this data structure to store all Goods records in Mining's store, because it has a high efficiency in searching, O(1). A hash table functions as shown below.

Graph 1



As shown in the above screenshot (Graph 1), in a hash table, every Goods record has its unique value and hence find its corresponding key to store its information. The rest of the keys have a null record indicated "never".

To successfully store a Goods record, the name of the goods needs to be translated into a value and use this value to find its key. It can be achieved by the algorithm below.

Graph 2

```
private int getLoc(String name)
{
    int loc=hashFunction(name);
    if(!table[loc].getName().equals("never")){
        for(int count=0;count<table.length;count++){
            if(table[(loc+probe(count))%COUNT].getName().equals("never")){
                return(loc+probe(count))%COUNT;
            }
        }
    }
    else{
        return loc;
    }
    return -1;
}

private int hashFunction(String name){
    int sum=0;
    for(int count=0;count<name.length();count++){
        char character=name.charAt(count);
        int ascii=(int)character;
        sum=sum+ascii;
    }
    return sum%COUNT;
}

private int probe(int attempt){
    int rtn=(int)(Math.pow((double)attempt,2.0));//attempt's power of 2. This is the quadratic probbing
    return rtn;
}
```

In the algorithm above (Graph 2), method *int getLoc(String name)* is used to translate the parameter *name* into an *int* number value. I define the sum of the ASCII value of each character of *name* to be the value of this Goods record and value % *COUNT* (the length of the hash table which is 100) to be the corresponding key for the value by the method *int hashFunction(String name)*. For example, the value of “Orange” is 79+114+97+110+103+101=604, and its key will be 604%100=4. Therefore the Goods record of “Orange” will be store in the hash table with key of 4 (As shown in Graph 1).

I also use the quadratic probing method if the keys clash with each other. For example, the value of “Salt” is 404 and its key will be 4, crushing with the key of “Orange”. At this time, the method *int probe(int attempt)* will return 1^2=1 to add up the value to 405 and change the key to 405%100=5. Therefore, the Goods record of “Salt” will be store in the hash table with key of 5 (As shown in Graph 1). If a third Goods has the key of 4, the probing method will return 2^2=4 to change the key to 4+4=8. The forth one will have the key $4+3^2=4+9=13$, etc.

The advantage of using a hash table should be its high efficiency of searching.

Graph 3

```
private int search(String name) {
    int loc = hashFunction(name);
    int prb;
    for (int count=0;count< table.length;count++) {
        prb = probe(count);
        if (table[(loc+prb) % table.length].getName().equals(name))
            return (loc+prb) % table.length;
        if (table[(loc+prb) % table.length].getName().equals("never"))
            return -1;
    }
    return -1;
}
```

The Big O notation for searching method *int search(String name)* (shown in Graph 3) in a hash table is O(1), that is because it can quickly find out the key of a Goods record from its *name* and locate it.

Technique 2: Data file

I use data file to record down all information about Goods and SalesPerson in Mining's store so that these valuable information will not be volatile or disappear when restarting the recording system. Instead, information can be stored permanently to generate reports.

Graph 4

```
public void writeSalesperson()
{
    try{
        RandomAccessFile f=new RandomAccessFile("Sales Record.dat","rw");
        for(int i=0;i<PERSON;i++){
            String name=record[i].getName();
            if(name.length()>24)
                name=name.substring(0,24);
            f.seek(34*i);
            f.writeUTF(name);
            double sales=record[i].getSales();
            f.seek(34*i+26);
            f.writeDouble(sales);
        }
        f.close();
    }
    catch(IOException e)
    {
        System.out.println(e.getMessage());
    }
}
```

In the screenshot (Graph 4), I use RandomAccessFile to create a data file "*Sales Record.dat*" that I can read and write on. Each SalesPerson record has

the length of 34 bits, with 26 bits to store its name and 8 bits to store its sales. After creating such file, an icon will appear in the folder:

Graph 5

To read SalesPerson records from the file, I write method *readSalesperson()* (see Graph 6 below):

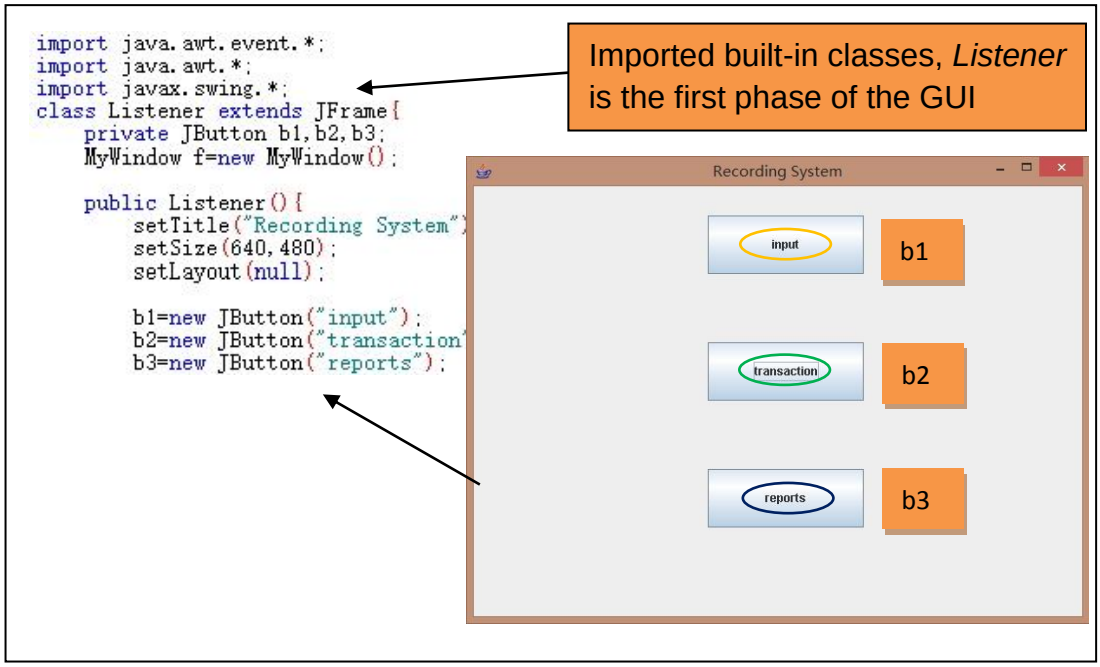
Graph 6

```
public void readSalesperson(){
    try{
        String name=null;
        double sales=0.0;
        RandomAccessFile f=new RandomAccessFile("Sales Record.dat","r");
        long records=f.length()/34;
        for(int i=0;i<records;i++){
            f.seek(34*i);
            name=f.readUTF();
            f.seek(34*i+26);
            sales=f.readDouble();
            record[i]=new SalesPerson();
            record[i].set(name,sales);
        }
        f.close();
    }
    catch(IOException e)
    {
        System.out.println(e.getMessage());
    }
}
```

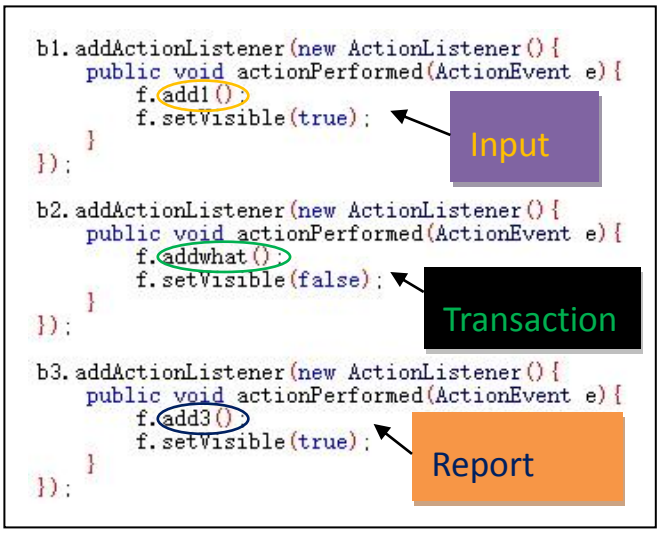
At this time, the file will be read only. Find the number of SalesPerson records as I divide the file length by length of a record which is 34. Read out name and sales of each record and store back to the array *record*. In the same way, I use another data file to store the hash table *table*. I use the methods *writeSalesperson()* or *writeTable()* every time *record* or *table* is updated, in order to prevent data loss. When the Recording System is restarted, the array and the hash table will read out the data stored previously from the data files to keep the system running.

Technique 3: Graphical User Interface (GUI)

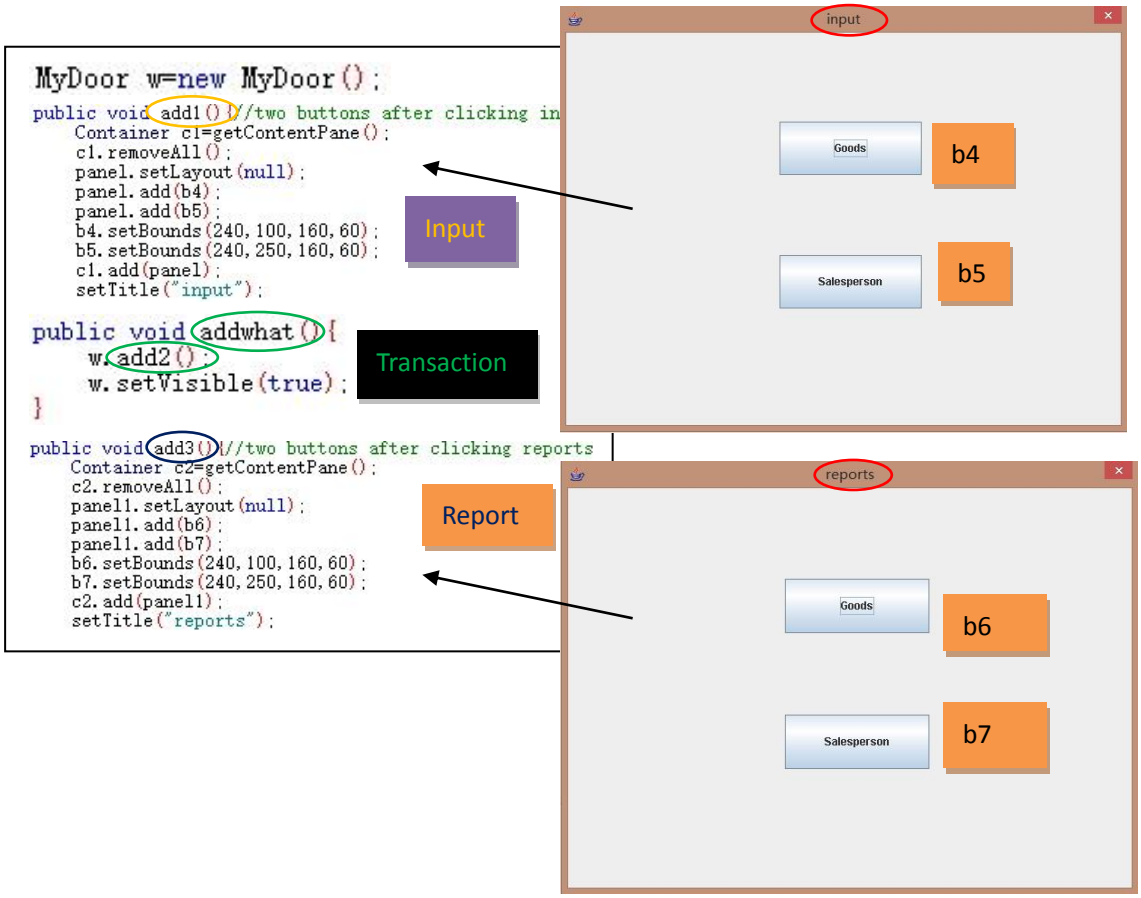
I use Java Swing to develop a Graphical User Interface (GUI) for the Recording System in order to increase its learnability, memorability, and satisfaction for Mining. The increase in usability makes the system more convenient and easier for Mining to use.



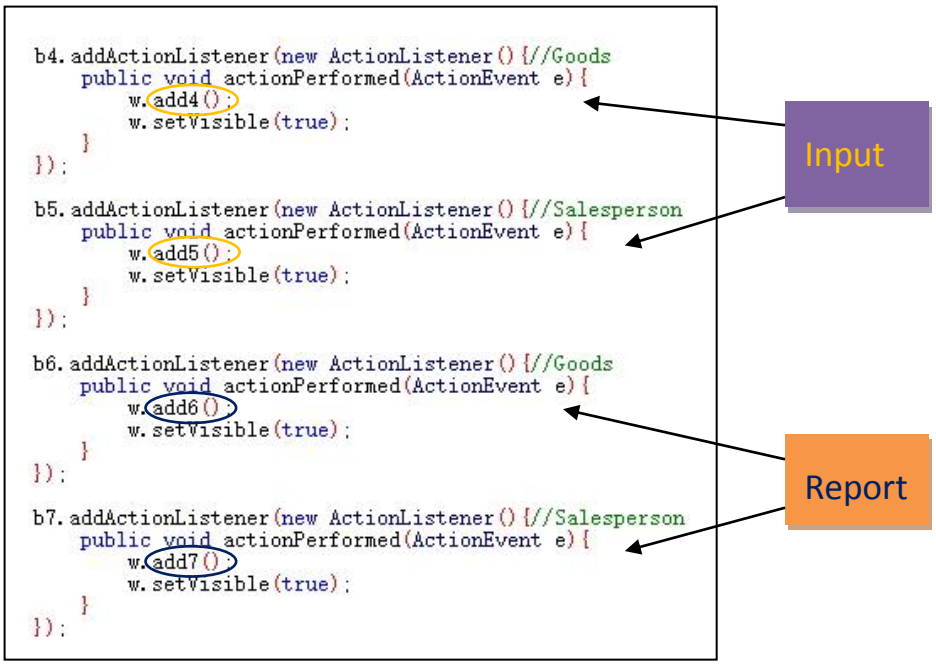
I attach *ActionListener* to *JButton b1, b2, b3* (see screenshot below)



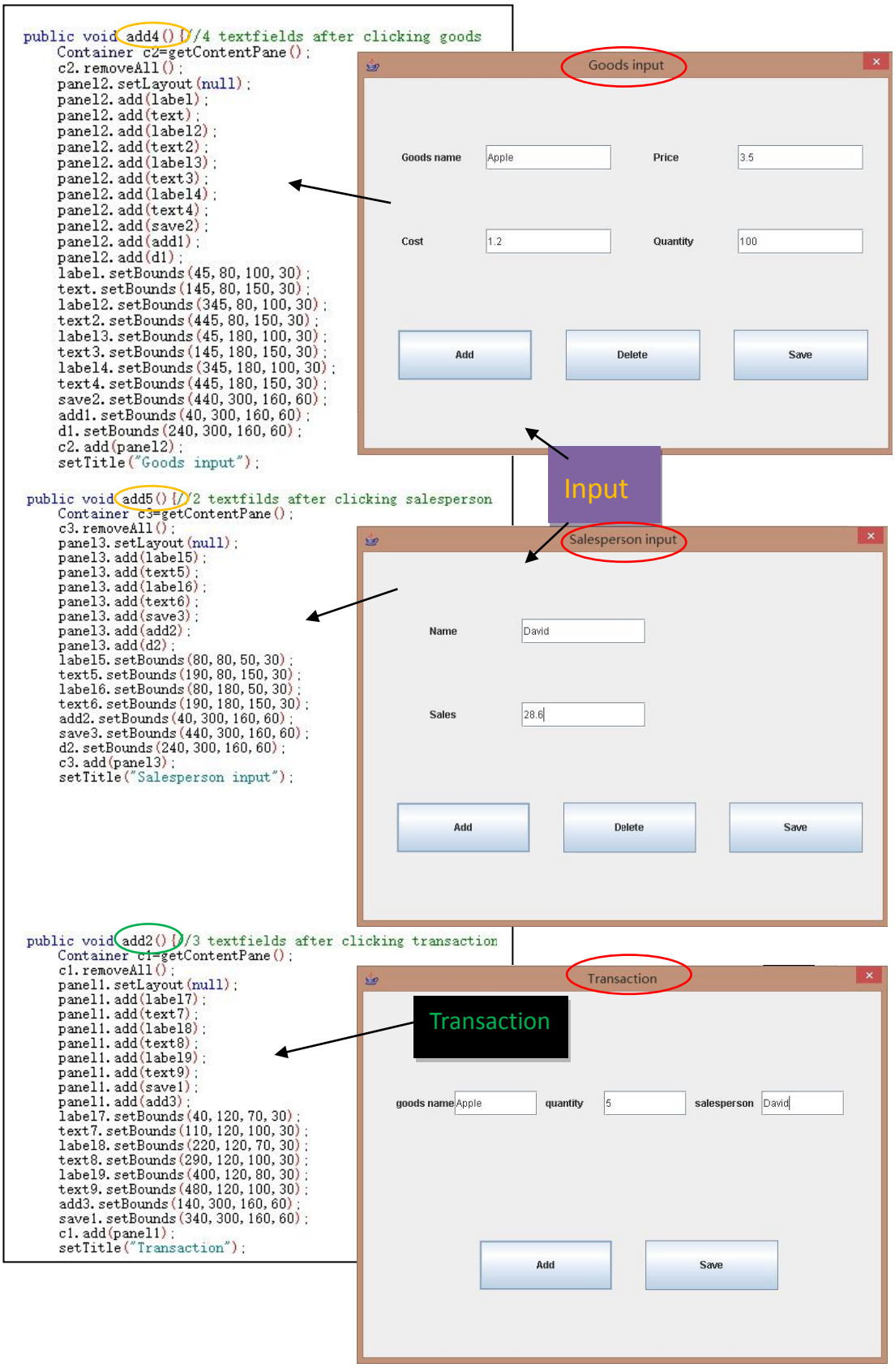
I will come to class *MyWindow*, the second phase of the GUI, when I click these buttons.



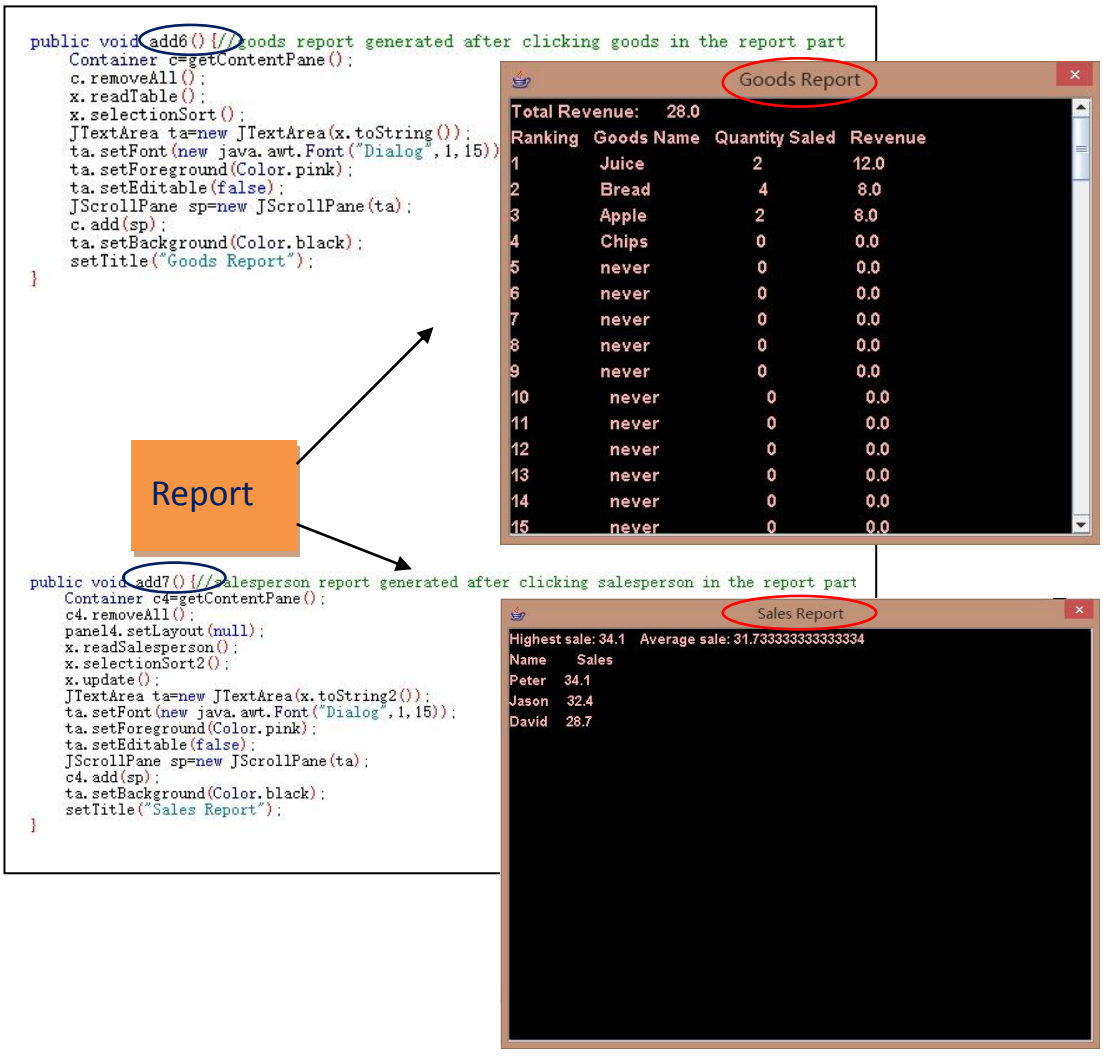
I also attach *ActionListener* to *JButton b4, b5, b6, b7* (see screenshot below)



Clicking these buttons, I then come to the final phase of the GUI, *MyDoor*.



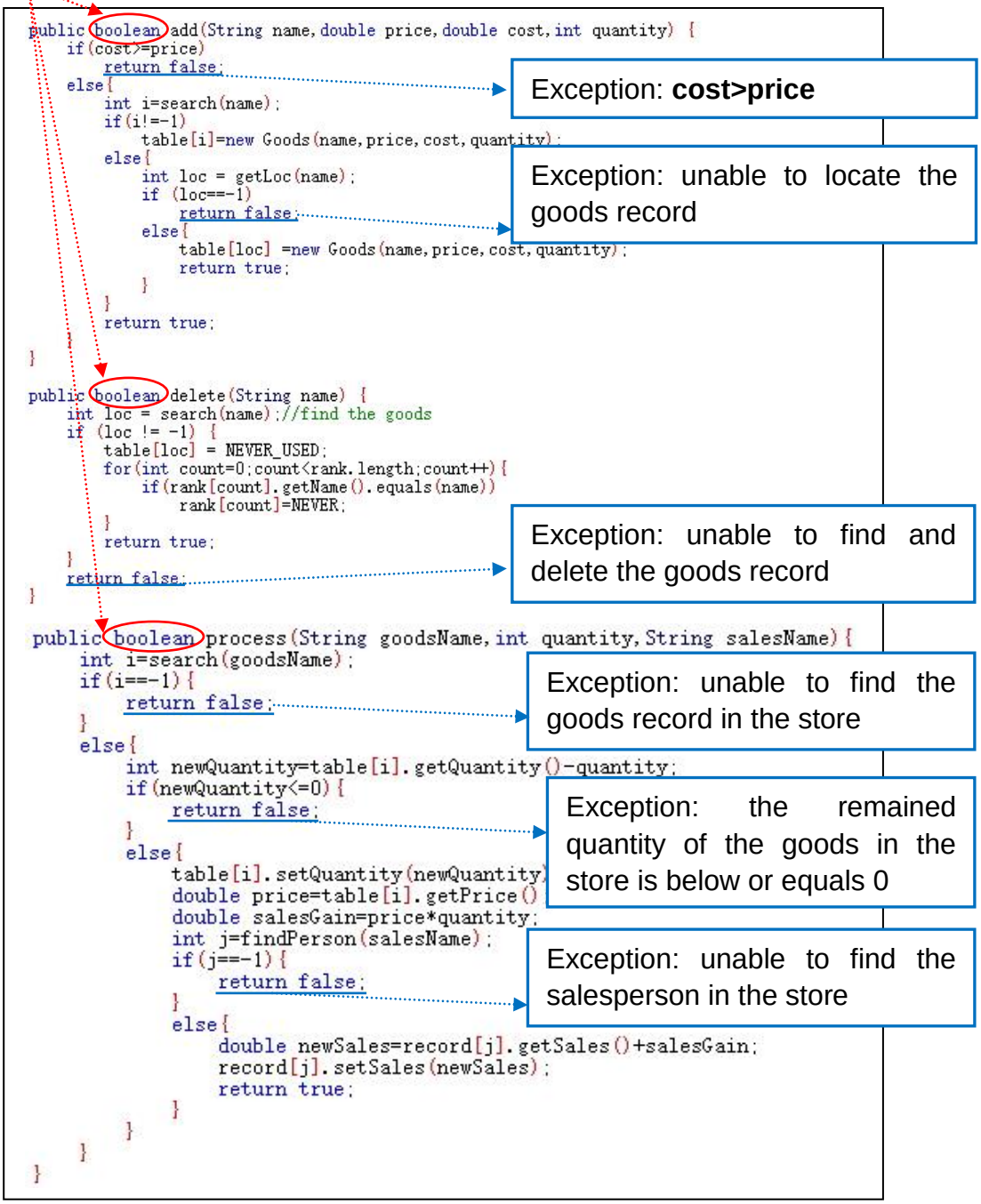
The final part of the recording system is the Report section. I choose cannot-be-edited JTextArea (see below) to be the platform for the reports of Goods and SalesPerson.



Technique 4: Boolean

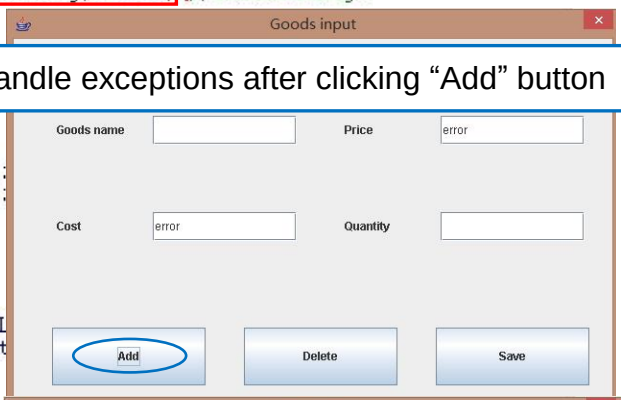
In this recording system, I design Boolean to handle exceptions that may occur during process. For example, if the cost of a product is higher than its price, this is an abnormal situation and needs exception handling to prevent system breakdown. Thus exception handling increases the system's fault tolerance and usability, and thus guarantees Mining to run the Recording System smoothly.

First, set methods with return type of boolean instead of void methods

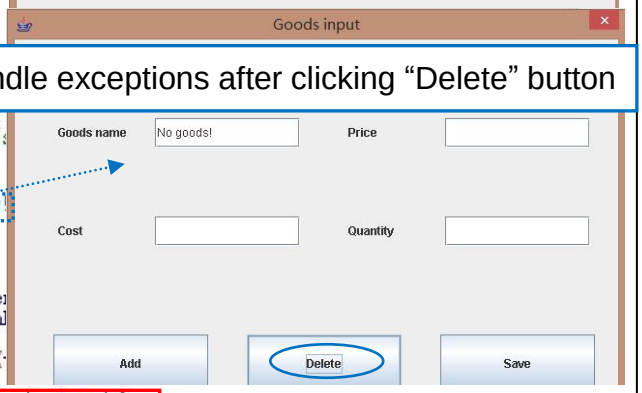


Then use the **if** loop to take the value of Boolean to decide the actions afterward

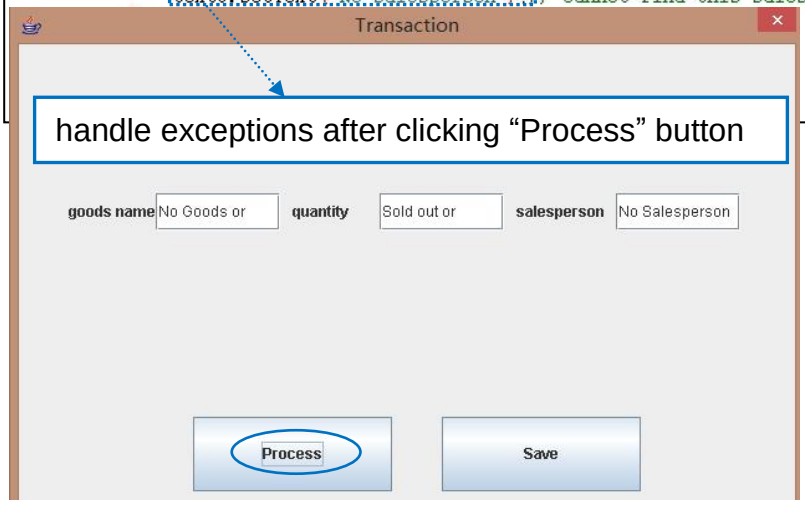
```
add1.addActionListener(new ActionListener(){
    public void actionPerformed(ActionEvent e){
        String name=text.getText();
        double price=Double.parseDouble(text2.getText());
        double cost=Double.parseDouble(text3.getText());
        int quantity=Integer.parseInt(text4.getText());
        if(x.add(name,price,cost,quantity)==true){//successfully
            text.setText("");
            text2.setText("");
            text3.setText("");
            text4.setText("");
        }
        else{
            text.setText("");
            text2.setText("error");
            text3.setText("error");
            text4.setText("");
        }
    }
});

save2.addActionListener(new ActionL
    public void actionPerformed(Act
        x.writeTable();
    }
});

d1.addActionListener(new Act
    public void actionPerfor
        String name=text.getText()
        if(x.delete(name)==true)//
            text.setText("");
        else
            text.setText("No goods!
    }
});

add3.addActionListene
    public void actionPerformed(Actionl
        String name=text7.getText();
        int quantity=Integer.parseInt(
        String sName=text9.getText();
        if(x.process(name,quantity,sName)==true){
            text7.setText("");
            text8.setText("");
            text9.setText("");
        }
        else{
            text7.setText("No Goods or");//cannot find this Goods in the hash table
            text8.setText("Sold out or");//Goods' quantity equals or below 0
            text9.setText("No Salesperson");// cannot find this salesperson in the record
```



handle exceptions after clicking “Add” button



handle exceptions after clicking “Delete” button



handle exceptions after clicking “Process” button

(Word count: 937 words)