Examination in Object Oriented Programming

University of Applied Science Ravensburg-Weingarten
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Date, time	July 22nd, 2015, 10:30 – 12:00 (90 min)
Number of pages	10 pages (including title)
Resources	All accepted resources

Study Progam	Room
AI	C004, D002
EI	C004

Name: ________________________ Matriculation number: ____________

Reminder:

- Please note name and matriculation number on each sheet.
- If you use additional sheets do not forget to note name and matriculation number on them too.

leave blank, please:

Part	1	2	3	4	Sum
max.	15	5	20	14	54
Points					

Part 1

1.1 (11 Points)

Analyse the program given in section **Constructors** of the handout "Programs and JDK-Documentation". Please keep in mind that there might be more dotted lines than actually needed (this holds for all questions).

What is the output of the program just after line 45 `SailingBoat mayFlower = new SailingBoat();` is executed?

What is the additional output of the program just after line 46 `mayFlower.sail()` is executed?

What is the additional output of the program just after line 47 `Watercraft bounty = new SailingBoat();` is executed?

What is the additional output of the program just after line 48 `bounty.move()` is executed?

```
Creating Vehicle: 1
Creating Watercraft: 1
Creating Sails:
Creating SailingBoat: 20

Sailing SailingBoat: 20, sails:  30.0

Creating Vehicle: 1
Creating Watercraft: 1
Creating Sails:
Creating SailingBoat: 20

Moving SailingBoat: 20
```

1.2 (3 Points)

Now we change a part of the definition of class `Sails` as follows:

```
class Sails {
    private float area = 30;
    Sails() {
        System.out.println("Creating Sails: ");
    }
    public float getArea(){
        return area;
    }
}
```

Without any further changes the compiler now signals an error in class `SailingBoat` method `sail()`. Which line(s) of the method cause(s) an error?

Change the method `sail()` so that it can be compiled and it achieves the same effect as the original method, leave class `Sails` unchanged.

```
    void sail(){
        System.out.print("Sailing SailingBoat: " + idNum);
        System.out.println(", sails: " + theSails.getArea());
    }
```

1.3 (1 Point)

Now we add a method call `bounty.sail()` in the method `main()`

```
public static void main(String[] args) {
        SailingBoat mayFlower = new SailingBoat();
        mayFlower.sail();
        Watercraft bounty     = new SailingBoat();
        bounty.move();
        bounty.sail();    // <== new method call
    }
```

Does this method call compile, and if so whats the output of this method call?

The method call does not compile since `bounty` is typed as `Watercraft`. Thus the method `sail()` is not accessible through this reference.

Part 2

2.1 (5 Points) Exception Handling

Analyse the program given in section **Exception** of the handout "Programs and JDK-Documentation".

The program defines some exception classes and a main class. Method `foo()` may throw any of the exceptions defined in the program a well as a runtime-exception.

What is a proper sequence of catch clauses in order to catch each of these exceptions separatly.

```
    catch ( . . . . . ) {
            System.out.println(" --> cought xxxException: ");
```

Replace xxx by "Runtime", "South", "NorthWest" and"'North"'. Fill in the catch clauses in the (in a) proper sequence:

```
      try{
            int result = foo(1);
        }
```

Note: The clauses for catching the `NorthException` and for catching the `SouthException` may be interchanged.

```
          try{
              int result = foo(1);
          }catch(NorthWestException nwex){
              . . . .
          }
          catch(NorthException nex){
              . . . .
          }
          catch(SouthException sex){
              . . . .
          }
          catch(Exception ex){
              . . . .
          }
```

Part 3

Analyse the program given in section **Playlist** of the handout "Programs and JDK-Documentation".

3.1 (4 Points)

In class `PlayList` the method `void addSong(Song aSong)` assigns a new value (a reference) to the member `songList`. The previviusly stored reference should be added to the new song in order to form a linked list as shown in the sketch of the data structure. Note: The songs are added in the following sequence: `Hip_0`, `Hop_1`, `Rap_2`, `Zap_3` and lastly `House_4`.

Complete the method `void addSong(Song aSong)`:

```
public void addSong(Song aSong) {
    aSong.nextSong = songList;
    songList = aSong;
}
```

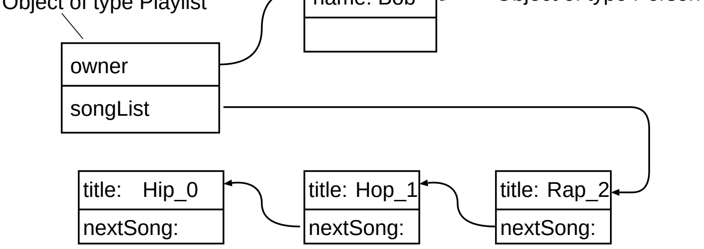
3.2 (4 Points)

The method `public Song removeSong()` removes the first element of the `songList` and returns the removed element. If the `songList` is empty the method just returns `null`.

Complete the method `public Song removeSong()`:

```
public Song removeSong() {
     Song aSong = songList;
     if (aSong != null) {
         songList = aSong.nextSong;
     }
     return aSong;
}
```

Datastructure after removing two elements:



3.3 (6 Points)

The method `public void play()` of class `PlayList` prints the name of the owner of the play-list and all titles of all songs on the song list. (A sample output of the program is given at the end of section **Playlist**.) To do so, it may (should) call other methods given in the program. The method must not change any data in the visited objects.

The method does not throw an exception caused by a null-reference. If it encounters a null-reference it simply does not print out anything related to the reference.

```java
public void play() {
    System.out.println("\n ---------- playing playlist ----------" );
    if (owner != null) {
        owner.print();
    }
    Song currentSong = songList;
    while (currentSong != null) {
        currentSong.play();
        currentSong = currentSong.nextSong;
    }
}
```

3.4 (6 Points)

The method `public void play(int index)` of class `PlayList` prints the title of one song of the song list (song no. index + 1). E. g. if `index` has the value 3 it prints the title of the 4th song of the list.

(See also the sample output of the program given at the end of section **Playlist**.) The method must not change any data in the visited objects.

The method does not throw an exception caused by a null-reference. If it encounters a null-reference it simply does not print out anything related to the reference.

```java
public void play(int index) {
        System.out.println("\nplaying song " + index + " ----------");
        Song currentSong = songList;
        int i = 0;
        while (currentSong != null) {
            if (i == index) {
                currentSong.play();
                break;
            }
            i++;
            currentSong = currentSong.nextSong;
        }
    }
```

Part 4

This part refers to section **Collection and IO** of the handout "Programs and JDK-Documentation". A program writes objects of type `Customer` to a file, reads objets from a file and stores objects in a HashMap.

4.1 Writing to a file

4.1.1 (2 Points)

The method `getDataOutputStream()` creates a buffered output stream (of type `DataOutputStream`) to save data into a file. The program stops if it can not create the stream. Complete the method `getDataOutputStream()` at the ellipsis.

```
DataOutputStream getDataOutputStream(String fileName) {
    DataOutputStream dos = null;
    try {
        FileOutputStream fos = new FileOutputStream(fileName);
        BufferedOutputStream bos = new BufferedOutputStream(fos);
        dos = new DataOutputStream(bos);
    } catch (IOException ioex) {
        ioex.printStackTrace();
    }
    if (dos == null) {
        System.out.println("could not get OutputStream: " + fileName);
        System.exit(-1);
    }
    return dos;
}
```

4.1.2 (2 Points)

The method `saveCustomer()` writes the data of an object of type `Customer` to a `DataOutputStream`. Complete the method `saveCustomer()` at the ellipsis.

```
void saveCustomer(Customer aCustomer, DataOutputStream dos) throws IOExcepti
    dos.writeInt(aCustomer.customerId);
    dos.writeUTF(aCustomer.name);
    dos.writeFloat(aCustomer.volume);
}
```

4.2 Reading from a stream

4.2.1 (2 Points)

The method `getDataInputStream()` creates a buffered output stream (of type DataInputStream) to read data from a file. The program stops if it can not create the stream. Complete the method `getDataInputStream()` at the ellipsis.

```
DataInputStream getDataInputStream(String fileName) {
    DataInputStream dis = null;
    try {
        FileInputStream fis = new FileInputStream(fileName);
        BufferedInputStream bis = new BufferedInputStream(fis);
        dis = new DataInputStream(bis);
    } catch (IOException ioex) {
        ioex.printStackTrace();
    }
    if (dis == null) {
        System.out.println("could not get InputStream: " + fileName);
        System.exit(-1);
    }
    return dis;
}
```

4.2.2 (2 Points)

The method `readCustomer()` reads the data of an object of type `Customer` from a `DataInputStream`. After reading the data it creates an object of type `Customer`. The new object contains the data read from the stream. If the method could not read all data, it returns `null`. Complete the method `readCustomer()` at the ellipsis.

```
Customer readCustomer(DataInputStream dis) {
    Customer aCustomer = null;
    try {
        int theId          = dis.readInt();
        String theName     = dis.readUTF();
        float theVolume    = dis.readFloat();
        aCustomer          = new Customer(theId, theName, theVolume);
        System.out.println("id: " + theId);
    } catch (EOFException ex) {
        System.out.println("done reading file: ");
    }
    catch (IOException ioex) {
        ioex.printStackTrace();
    }
    return aCustomer;
}
```

4.3 Storing Data in a HashMap

4.3.1 (2 Points)

The class PersonDB defines a private variable customerMap. It is a HashMap for storing objects of type Customer. The key to access an object is of type Integer.

Fill in the the proper data type for customerMap and provide the code to create the HashMap. The initial capacity of the HashMap should be 100.

```
public class PersonDB {
    HashMap<Integer, Customer> customerMap;
        :
        :
   void testCustomerIO() {
        custIO.writeCustomerFile(5, fileName);
        customerMap = new HashMap<>(100);
```

4.3.2 (2 Points)

The method readCustomerFile() receives a file name and a HashMap. It opens a stream, reads objects of type Customer from the stream and stores them into the HashMap. The value of the member customerId is the key of the HashMap.

Complete the method readCustomerFile() at the ellipsis.

```
void readCustomerFile(String fileName, HashMap<Integer, Customer> customerMap
    try (DataInputStream dis = getDataInputStream(fileName)) {
        Customer aCustomer;
        while ((aCustomer = readCustomer(dis)) != null) {
            customerMap.put(aCustomer.customerId, aCustomer);
        }
    } catch (Exception ex) {
        ex.printStackTrace();
    }
    return;
}
```

4.3.3 (2 Points)

The method `testCustomerIO()` stores, retrieves and prints some variables of type `Customer`. When the program reaches line 124 the HashMap `customerMap` contains mappings for the keys: 70529, 48372 and 35830.

```
118     void testCustomerIO() {
119                 :
120                 :
121         custIO.readCustomerFile(fileName, customerMap);
122                 :
123                 :
124         Customer aCustomer = custIO.createRandomCustomer();
125         aCustomer.print();
126         customerMap.put(12345, aCustomer);
127         aCustomer = custIO.createRandomCustomer();
128         aCustomer.print();
129         customerMap.put(12345, aCustomer);
130         aCustomer = customerMap.get(12345);
131         aCustomer.print();
132         aCustomer = customerMap.get(1111);
133     }
```

The output of the program starts as follows.

Output of line 125:

```
ID: 61960, Name: Don, Revenue: 4774.1045
```

Output of line 128:

```
ID: 86494, Name: Chris, Revenue: 4137.799
```

What is the output of line 131:

```
ID: 86494, Name: Chris, Revenue: 4137.799
```

What happens in line 132:

Variable `aCustomer` gets the value `null` since the HashMap does not contain a mapping for the key 1111.