Dec 2, 2013

cs445 - Object Oriented Design and Programming

Fall 2013

Final Exam

Open books / notes

Starts: **7:30pm**
Ends: **9:30pm**

Name: _____ (print)

ID: A_____

Problem	Max Points	Your Mark	Comments
1	15		3*5
2	5		
3	10		
4	15		5*3
5	10		5*2
6	10		
7	10		
8	5		1+1+3
9	5		
	85		
	Extra credit		
	Total		Your Mark: ____ / 85 =

Do not write on the back of any page!

This paper will be retained in the Computer Science Department until 12/31/2014.

1. This problem is about the observer pattern. Think of a train as a string of train cars. Each car has two couplings, one in front and one in the back, that allows train cars to be coupled to one another. Furthermore, consider all cars to be equipped with breaking lights (to indicate when the train driver hits the break). As a bystander, you can only see the breaking lights of the last car. In this question, you are asked to implement a communication mechanism that signals breaking from one car to the next. Hint: Since we know all classes that are involved in this assignment, we don't have to implement a separate observer class, but we can pack everything into the four classes given below.

```
abstract class Car {
    Car[] Coupling = {null, null};      // Coupling[0]: Car in front
                                        // Coupling[1]: Car in back
    boolean lightson = false;           // True if the breaking lights are on
    void couple (int i, Car c) {
        this.Coupling[i] = c;
        c.Coupling[1-i] = this;
    }
    void notify (boolean state) {
        // Implementation needed
    }
}

class EndOfTrain extends Car {
    void EndOfTrain() {}
}

class Locomotive extends Car {
    void pushBreak() {
        // Implementation needed
    }
    void releaseBreak() {
        // Implementation needed
    }
}

class PassengerCar extends Car { }
```

In this class hierarchy, for example,

```
Locomotive loc = new Locomotive();
loc.couple(0, new EndOfTrain());
PassengerCar c1 = new PassengerCar();
loc.couple(1, c1);
PassengerCar c2 = new PassengerCar();
c1.couple(1, c2);
c2.couple(1, new EndOfTrain());
```

will create a train that is lead by the locomotive `loc` followed by two passenger cars `c1` and `c2`.

(a) Implement the `notify()` method.

(b) Implement the `pushBreak()` method.

(c) Implement the `releaseBreak()` method.

2. Given the classes below:

```
class PoorConditions extends Exception {}
class FlatTire extends Exception {}
class Vehicle {
    public void drive() throws PoorConditions {...}
}

class Car extends Vehicle {
    public void drive() throws PoorConditions, FlatTire {...}
}
```

If a Java compiler would compile this code without error – which it doesn't, but let's assume it does – what would be the problem? Explain with an example of a situation where this would be a problem, and mention the OO design principle that would be violated.

3. Design a virtual fish tank. Your virtual fish tank should be as much like a real fish tank as possible. The fish should be able to do common fish things (swim, eat, die, breathe). The fish tank can contain a number of fish. Like a normal fish tank, there should be a pH level and an oxygen level. The fish should be able to do things that affect those levels and be affected by those levels. If there is not enough oxygen, fish die. If the pH is not in range, fish die. Additionally, the fish need to be fed and the oxygen level needs to be regulated. Create a UML class diagram of your fish tank.

4. Given the Java code below (ignore syntax errors, this code represents design ideas):

```
public class Message {
    public static final int LOGIN = 1;
    public static final int REGISTER = 2;
    public static final int DISCONNECT = 3;
    public int type;
    public String payload;
}

public class MoreMessages extends Message {
    public static final int CHAT = 4;
    public static final int MOVE = 5;
}

public interface IServer {
    public void acceptConnection();
    public void disconnect();
    public void sentTo(User u, Message m);
    public void sendToAll(Message m);
    public void handleMessage(Message m);
}

public class Server implements IServer {
    public void acceptConnection(Socket s) {
```

```
        // accept stuff and set up user
    }
    public void handleMessage(Message m) {
        assert(m.type < 4);
        switch(m.type) {
            case LOGIN: // do stuff
            case REGISTER: // do other stuff
            case DISCONNECT: // do even more stuff
        }
    }
    public void sendToAll(Message m) {
        UserManager um = UserManager.getInstance();
        for (User u : um.getUsers()) {
            u.getConnection().getSocket().send(m);
        }
    }
    // other methods follow
}
```

(a) How could the above code be improved by applying the Open/Closed design principle?

(b) Does the `MoreMessages` class meet the Liskov Substitution Principle? If not, then explain why and what you would change to make the design compliant with LSP.

(c) Does class `Server` meet the Single Responsibility Principle? If not, then explain why and what you would do to improve the design.

(d) Look at the interface `IServer`. Does this comply with the Interface Segregation Principle? If not, then explain why and what you would do to improve the design.

(e) Would you put all the code above into the same package or not? Explain your answer.

5. You were hired to review the design and make suggestions for improvements on some object-oriented software. What would you say to each of the following and how would you fix any problems?

(a) “This class is the main class and handles many of the tasks.”

(b) “We named the Warehouse class Ware because it is easier to type.”

(c) “We are getting tons of code written because there are things we can just copy from similar classes.”

(d) “We had one class inherit from another because the one class needed to access some information in the other class, but we had a problem that some of the inherited methods didn't make sense so we overrode them.”

(e) “We have a type ‘attribute’ in the Payment class and then we case (switch) on the type to handle billing by credit card, purchase order, create a bill, etc.”

6. Construct a class diagram for the following high-level project description: “Packets are sent from one location to another. Packets have a certain weight. Locations are characterized by their transportation facilities, e.g. railway stations, airports and highway connections. Some locations are neighbored, i.e. there exists a direct transportation route between these locations. The transportation route between the locations has a certain length, i.e. the distance between the locations. Planes, trains, and trucks are used for transportation; each plane / train / truck may load a maximum packet weight. For each packet we want to know where it is, i.e. at which location or transport (plane, train, truck).”

7. Given the Java code below

```
class Car {
      public void drive() { /* burn fuel */ }
      public void fillGas() { /* add gas to tank */ }
}
```

I would like to write

```
class ElectricCar extends Car {
      public void drive() { /* use battery */ }
      public void fillGas() {
            throw new UnsupportedOperationException();
      }
      public void replaceBattery() { /* ... */ }
}
```

Is this a good idea? Explain:

8. In this problem you're being asked to provide feedback on the Clean Coders videos. You get full credit for answering the questions regardless of how you answer.

a) Each episode is $12 for a Personal License that allows you to watch the movie on the Internet any number of times you want. Check one:

(i) This price is too high for me, however I'd be willing to pay _____
(ii) The price is about right
(iii) The price seems low, I'd be willing to pay up to _____

b) Check one:

(i) I found the movies to be incredibly helpful in learning OO Design and Programming
(ii) The movies were ok
(iii) I didn't really find much in these movies
(iv) No comment – use this if you didn't watch the movies or you just don't want to express an opinion

c) Suggest three improvements to Uncle Bob such that future releases of these movies are better:

9. On this page you're being asked to provide feedback in regards to the class project. You get full credit for answering the questions regardless of how you answer. Please be candid and thoughtful.

a) Knowing what you now know about the project, what do you wish you would have done differently for the project?

b) What suggestions do you have for how the class project can be made better? Your feedback will be used to improve the experience of future students who take cs445.