On-Line Examination

COMP20341

One and a half hours

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Software Engineering I

Thursday 24th January 2008

Time: 14:00 – 15:30

Please answer any TWO Questions from the THREE Questions provided

In Questions which require you to write Java code, minor errors of syntax will not be penalised

This paper will be taken on-line and this is the paper format which will be available as a back-up

The use of electronic calculators is NOT permitted.
1. The highways agency divides the country's roads into a series of regions. For each region there is a control centre. Operators at these centres need to monitor traffic in their region and update traffic control systems, such as traffic light systems and speed controls, appropriately. All gathered data are kept in one large national database that is then used by many agencies.

The highways agency wishes to update its computer systems. Operators at the highways agency need to be able to view cameras and flow meters for a particular road. In light of information gathered, they need to send out new programs etc. to traffic lights and electronic speed limit signs. Each regional centre needs to gather statistics on road usage from the system to make reports that are sent on paper to the government minister for transport. Road users, and the public, will be able to consult the system to look for traffic troubles etc.

a) Write down a definition for an actor in a use case diagram. (2 marks)

b) From the scenario above, use your definition to write a list of actors. For each actor, briefly justify (in fewer than ten words) your choice using your definition. (Hint: the number of actors does not necessarily correspond to the number of marks). (8 Marks)

c) Draw a use case diagram for this scenario. (10 Marks)
2.  
a) Explain why the set of classes on a **design class diagram** is not usually the same as on the **domain class diagram** from which it was derived.  

b) Which of the following are appropriate to show on a domain class diagram? 

   i) Types of attributes  
   ii) Multiplicities on associations  
   iii) Operations  

   (3 marks)  

c) **Bikes for U** makes bikes to order from components such as wheels, forks etc. You are designing a computer system for the company which will allow a customer to build “virtual” bikes on the web. It will only allow the user to build possible bikes, i.e. ones where all the components are compatible with each other. Once a virtual bike is built, it will tell the user the weight of the bike, based on the weights of the components, and the price, similarly.

   At this stage of the design you are working with a simplified notion of a Bike, which has a FrontWheel, a BackWheel, a Frame, and a Seat. (Other components such as brakes, suspension etc. will be added later).

   Draw a skeleton design class diagram to illustrate the relationships between these five classes. Do not show attributes or operations, but do make the relationships between the classes clear.  

   (4 marks)  

d) Give two operations which could be needed in the BackWheel class in order to help determine whether it was part of a possible bike, showing the parameter and result types clearly. You can make any reasonable assumption about what constitutes a possible bike.  

   (2 marks)  

e) The price of a bike is determined by adding up the prices of the components, and doubling the result. Show how the `getTotalPrice()` method would be written as a Java method on the Bike class. You should assume that prices are represented as ints and the components are held as instance variables.  

   (2 marks)  

f) As it stands the `getTotalPrice()` method has to be changed each time a new type of component is added – otherwise we undercharge the customer. Draw a new skeleton design class diagram which includes an extra design class which will enable us to solve this problem.  

   (4 marks)  

g) Show how the `getTotalPrice()` method could be implemented in this new design.  

   [Hint: assume you have an instance variable which is an array of the appropriate type.]  

   (2 marks)
3. You have been asked to write JUnit test cases for the class Card, an outline of which is given below:

```java
public class Card {
    public static final String CLUBS = "Clubs",
        DIAMONDS = "Diamonds",
        SPADES = "Spades",
        HEARTS = "Hearts";
    String _suit;
    int _value;

    public Card(String suit, int value)
        throws InvalidCardException {
        ...
    }

    public boolean beats(Card card)
        throws InvalidCardException {
        ...
    }
}
```

a) In order to write a representative set of test cases for the constructor of the Card class, you will need to come up with a collection of values for the suit and value parameters that together cover all the major cases. For each parameter, state whether equivalence partitioning or boundary value analysis is best suited to the selection of values for testing. In each case, explain the reason for your decision. (5 marks)

b) Using the test design methods you selected in your answer to part a) of this question, design test cases covering all the major cases for the Card constructor. You should present your answer in the form of a table with the following columns:

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Expected Result</th>
<th>Rationale for Inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>suit</td>
<td>value</td>
<td></td>
</tr>
</tbody>
</table>

(10 marks)

(Question 3 continues on the following page)
c) Extend the following JUnit test class skeleton (by copying it to your answer and amending it) so that it contains a test method for any one of the test cases you designed for your answer to part b) of this question.

```java
import junit.framework.TestCase;

public class CardTest extends TestCase {

    // Describe the intention of the test case
    public void test?????() {
        // Create the test case fixture

        // Execute the test

        // Check that the results are as expected
    }
}
```

(5 marks)