University of Glasgow

Friday 29 April 2016 (2:00 pm - 3:30 pm)
(1 hour 30 minutes)

DEGREES OF MSci, MEng, BEng, BSc, MA and MA (Social Sciences)

COMPUTER SCIENCE 2P: JAVA AND OBJECT ORIENTED SOFTWARE ENGINEERING 2

Answer all 4 questions

This examination paper is worth a total of 60 marks.

The use of a calculator is not permitted in this examination.

INSTRUCTIONS TO INVIGILATORS

Please collect all exam question papers and exam answer scripts and retain for school to collect. Candidates must not remove exam question papers

1. This question deals with the Java programming language. (15 marks total)

(a) Consider the following Java class:

```
public class example {

   public static void main(String[]z) {
      java.util.ArrayList VALUES = new java.util.ArrayList();
      try {
         VALUES.add("one");
         VALUES.add(2);
      } catch (Exception ex) {
         ex.printStackTrace();
      }

      for(int Fred = 0; Fred < VALUES.size(); Fred++) {
         System.out.println(VALUES.get(Fred)); }
   }

}
```

Identify five stylistic problems with this code (1 mark each) [5]

(b) Clearly explain the difference between the following pairs of Java concepts:

- A **static** method and an **instance** method (2 marks)
- Method **overriding** and method **overloading** (2 marks)
- **I/O Streams** and the **Stream API** (2 marks)
- The access modifiers **private**, **protected**, **"default"**, and **public** (4 marks)

[10]

2. This question deals with Java class design. (15 marks total)

First, read the following description of an online shopping system for books:

> The online system sells a range of books. Every book in the system has a unique identifier (a positive integer), a price (represented as a real number), along with strings representing its title, author, and publisher. In addition, every book has an integer property representing the number of copies of that book in stock; if the number is zero, then the book is out of stock, otherwise it is available.
>
> Users can put books into an online shopping basket. For simplicity, we will assume that a user will only put a single copy of each book into the basket. The shopping basket provides only the ability to add a book to the basket; at this time, there is no support for removing a book. A book is only added to the basket if it is (i) not already in the basket and (ii) not out of stock.

(a) Write a class definition for `Book`, incorporating all of the attributes mentioned above. You should also define a public constructor for `Book`, which should initialise all instance fields to

sensible values. The constructor should assign a unique identifier value to each instance. You do not need to define any instance methods. [6]

(b) Write a class definition for `ShoppingBasket`, incorporating the book-adding functionality mentioned above. You may assume that the `Book` class provides any necessary get/set methods. If one of the conditions for adding a book to the basket is violated, your implementation should throw an `IllegalArgumentException` instead of adding it. [6]

(c) Imagine that the shopping system is to be expanded to sell CDs in addition to books. Describe how you would modify the classes defined above to deal with this situation. You may illustrate your answer with fragments of Java source code, but this is not essential. [3]

3. This question concerns modelling software behaviour in UML (15 marks total)

(a) Distinguish between inclusion and extension use case relationships. [2]

(b) Describe the role of the following control nodes in an activity diagram

i. ●

ii. ◉

iii. ⊗

[3]

(c) First read the following description of an inventory control system:

> In order to generate an invoice a clerk must log in. If a clerk is a first time user, one must have themselves registered. There should be an option for a user to register oneself within the login page. Any user can use the system to view products online. The option of login is also provided when a user views products online.

- Draw a use case diagram for the system. [5]

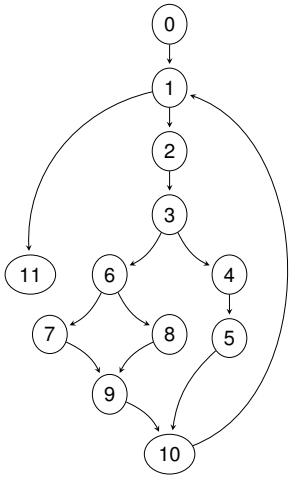
(d) Assume an activity involving **process purchase order**. A requested order is the input parameter of the activity. After an order is accepted and all required information is filled, payment is accepted and order is shipped. Draw an activity diagram that represents this process. [5]

4. This question concerns software testing (15 marks total)

(a) Distinguish between branch coverage and statement coverage in a program code. [2]

(b) What is an independent path in a program code? [2]

(c) Assume the following control flow graph:



- Determine the cyclomatic complexity of the graph. (3 marks)
- List all the independent paths in the graph. (2 marks)

[5]

(d) Consider the following program code

```
int f1(int x,int y){
1 while (x != y){
2   if (x>y) then
3       x=x-y;
4   else y=y-x;
5 }
6 return x;
}
```

- Determine the set of linearly independent paths (2 marks)
- Prepare test cases to force execution along each path (4 marks)

[6]

END OF QUESTION PAPER