

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION Diploma

OBJECT ORIENTED PROGRAMMING

29th April 2002, 2.30 p.m.-4.30 p.m.

Answer FOUR questions out of SIX. All questions carry equal marks.

Time: TWO hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

1. Operations and attributes of a class are given the following *visibility scopes*: public, protected and private.
 - a) Explain the meaning of these three scoping terms. **(9 marks)**
 - b) Describe how each visibility scope would be used for both an attribute and an operation. Identify and explain where good programming practice is being adopted. **(12 marks)**
 - c) Identify a fourth level of scoping that might prove useful. What are the merits and the deficiencies of this scheme? **(4 marks)**

2. For each of the following concepts:
 - i) constructor
 - ii) method overloading
 - iii) method overriding
 - iv) polymorphism
 - a) provide a definition of the concept; **(12 marks)**
 - b) provide code which demonstrates the use of the concept written in an object oriented language with which you are familiar. **(13 marks)**

3. a) Explain the following terms:
 - i) abstract class
 - ii) single inheritance
 - iii) multiple inheritance **(9 marks)**
 - b) State with an appropriate example what is meant by the term *abstraction*. **(8 marks)**
 - c) Discuss the importance of abstraction in making software reuse possible. **(8 marks)**

[Turn over

4. The drawing in Figure 1 below is representative of the output which might be constructed while using an interactive drawing tool. In the drawing there are a number of rectangular shapes that are connected by lines. The sample diagram shows rectangles, plain lines and lines decorated with arrowheads. It might be envisaged that the user selects the required shape to draw from a palette then places each into the drawing.

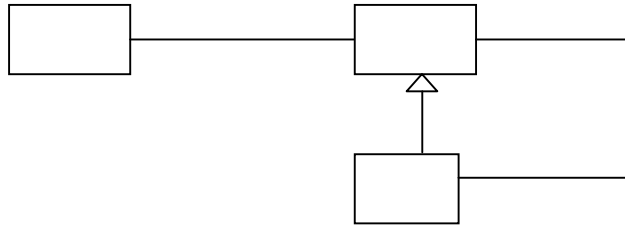


Figure 1

- a) Prepare a class diagram for this drawing tool to compose and edit typical diagrams as shown above. In support of this class diagram you must provide an analysis of the objects in the problem and the relationships that exist between them. **(8 marks)**
- b) For each class you should propose typical features (attributes and operations) that you would expect of such classes, explaining their purpose. **(7 marks)**
- c) Figure 2 below, presents a possible flowchart that might be constructed with the drawing tool. In it there is a decision box (diamond shape) in addition to the original shapes [previously, there were only rectangles].

Construct a class diagram for this revised drawing tool.

(10 marks)

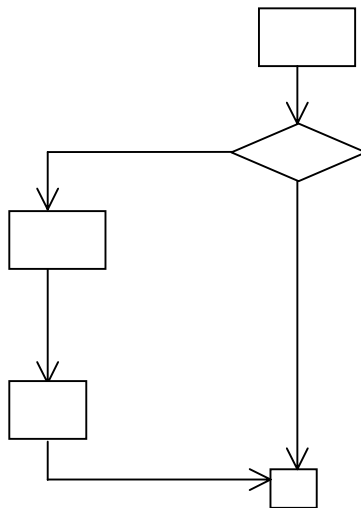


Figure 2

5. The class diagram in Figure 3 below presents a class hierarchy in which Aaaa is a superclass to both Bbbb and Cccc. The superclass Aaaa has an implementation for some operation mmm.

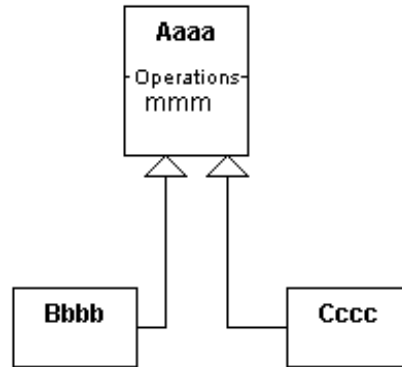


Figure 3

- a) Present a general scheme whereby the implementation of the operation mmm can include some specific behaviours from the subclasses Bbbb and Cccc. **(9 marks)**
- b) If some object of the class Bbbb receives the message mmm, provide a detailed explanation of the execution flow of this message and any subsequent messages and the recipients of all these messages. What would be the difference, if any, if the receiver of the message mmm were of the class Aaaa? **(7 marks)**

Consider a set of data values, such as that found in a spreadsheet, which are to be presented in a number of views. The spreadsheet data is to be presented: *i*) in the conventional manner of a two-dimensional table; *ii*) as a bar chart; and *iii*) as a pie chart. When the data set is changed, then all of the views must be updated to reflect the revisions.

- c) Suggest a suitable class diagram for this scenario, identifying the motivation for its use, and demonstrating the applicability of its structure for this situation. Specifically, you should seek to ensure that the views are treated uniformly. **(9 marks)**
6. A college operates courses in the following way. A college administrator is responsible for introducing courses and removing courses from the college's offering. Students may enrol for courses that are on offer. To enrol, a student must consult with an administrator. The administrator will check that the student is eligible for the course. Students can only enrol if the course exists, if they possess the correct educational background and if they can pay the fees for the course. Students may withdraw from a course by visiting an administrator. Once enrolled, students attend sessions that are delivered by a tutor. The tutor sets examinations. Students attend examinations. After the examinations the student receives feedback on their performance from the tutor.
- a) Draw a use case diagram for this system. **(15 marks)**
- b) Develop a use case description of the way a student enrolls. Your answer should include a normal sequence and an alternate sequence. **(10 marks)**