THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATION
Diploma

OBJECT ORIENTED PROGRAMMING

3rd May 2001 – 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. The following figure models some aspects of a file system using a class diagram, where directories contain subdirectories and files. A file system consists of a set of files below a root directory and users can own directories and files, read files and have a home directory.
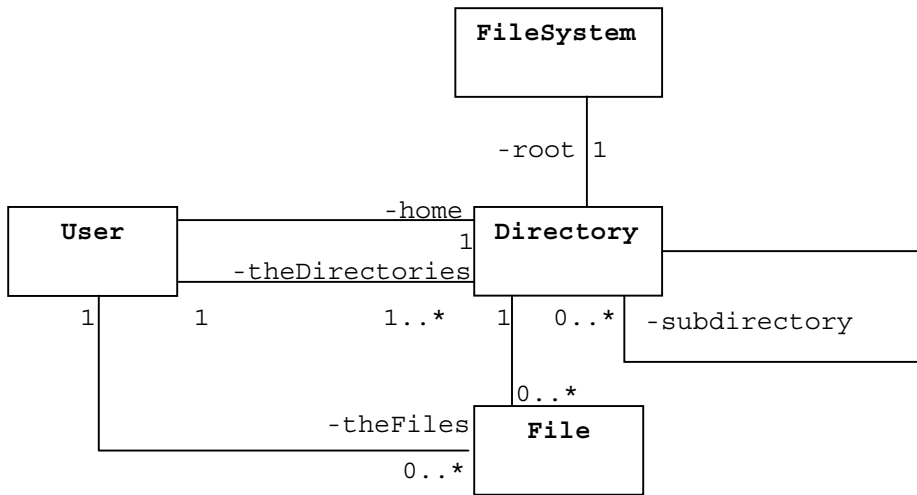
a) Present a diagram showing an example file system, a user object corresponding to your account, your home directory, a subdirectory called "mail", a file called "autoexec.bat" in your home directory, and a file called "message" in the "mail" directory. **(5 marks)**

b) The specification of the file system can be made more contemporary with files and nested directories if a new class "Node" is introduced. This is a superclass to both "File" and "Directory". Redraw the class diagram using this new class to reduce the number of relations in the original model. **(9 marks)**

c) Does the introduction of this new "Node" class have any effect on the diagram you drew for part *a)*? If so, then elaborate. **(4 marks)**

d) The introduction of the "Node" class in part *c)* recasts the diagram into a standard design pattern. What is this pattern and what are its characteristics? **(7 marks)**

2 *a)* Explain what is meant by the term "pattern" in the context of object-oriented development. **(5 marks)**

b) Describe any FOUR of the following patterns, detailing the nature of the problem they address, and the basis of the solution they offer.

   i) Singleton;
   ii) Observer;
   iii) Composite;
   iv) Decorator;
   v) Abstract factory;
   vi) Visitor. **(15 marks)**

c) Present class diagrams for the patterns and give suitable examples for their deployment. **(5 marks)**

3 Explain what is meant by ANY FIVE of the following used in the context of object-oriented development, giving suitable examples.

   i) Public, protected and private visibility of class methods and attributes;
   ii) The principle of substitution;
   iii) Polymorphism and dynamic binding;
   iv) Designing to an interface;
   v) No concrete superclasses;
   vi) Templates and/or generic classes. **(25 marks)**

4 *a)* Explain what is meant by the techniques "black-box testing" and "white-box testing" and how they may be used when testing object-oriented software. **(10 marks)**

b) Explain the purpose of "integration testing" and how it is used to assure the quality of object-oriented systems. Why is the integration testing of an object-oriented system likely to be more complex than that for a system developed using a top-down decomposition approach? **(5 marks)**

c) Discuss whether, when testing a subclass, it is safe to assume that all the methods inherited from a previously tested superclass will function correctly. **(5 marks)**

d) In the traditional waterfall approach to systems design, testing takes place in a separate phase of development. Discuss whether this is appropriate when constructing object-oriented software. **(5 marks)**

5 *a)* Compare and contrast the following approaches to programming: structured programming, programming using abstract data types and object-oriented programming. **(15 marks)**

b) Describe the claimed advantages of the object-oriented programming approaches. **(10 marks)**

6 A department store employs a number of sales assistants. Sales assistants are normally stationed at tills. The first thing sales assistants do when they arrive at a till is to log on to the sales system to which all tills are connected. Logging on identifies them to the system. At the end of the day, or whenever they are moved to another department, the sales assistants log off the till. Only recognised users may log on to a till. The System Manager registers users with the system. The System Manager may also remove users from the system. When a customer wishes to purchase an item, they approach a sales assistant who receives a payment from the customer (which may be in the form of cash, credit card or cheque) enters it into the till and records the item that has been purchased. Occasionally, customers are dissatisfied with the purchases they have made and return them. They take them to a sales assistant who refunds their money and records the return of the item via the till. The advantage of this system to the department store is that it enables managers to get regular sales reports showing how well given items are selling.

a) Draw a use case diagram for the system. **(15 marks)**

b) Develop a use case description of the way a customer purchases goods. Your answer should include both a normal sequence and an alternate sequence. **(10 marks)**