UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE AND ENGINEERING

COMPUTER SCIENCE THREE

SOFTWARE ENGINEERING WITH OBJECTS AND COMPONENTS 1

Thursday 6 June 2002

09:30 to 11:00

Examiners:

Prof. K. Turner (External)

Prof. C. Stirling (Chairman)

INSTRUCTIONS TO CANDIDATES

Answer any TWO questions.

All questions carry equal weight.

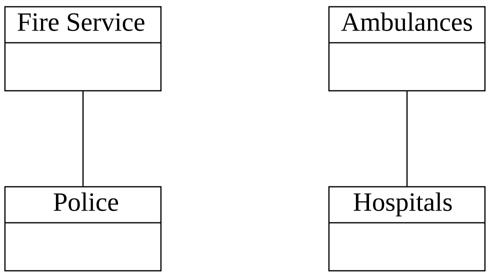
1. Lothian Emergency Services desire a software system to assist their Incident Coordinator's handling of "code red" emergencies (such as major traffic accidents). The activities to be supported are as follows:

    In the event of a "code red" emergency the Fire Service select appropriate equipment, deal with the incident (including assisting casualties into ambulances), and appoint a senior member as "incident coordinator". The incident coordinator classifies the incident by type and communicates this classification to the emergency services (Fire, Police and Ambulance) and the Hospital Service. The Hospital Service must designate one hospital as "red alert", designate two supporting hospitals as "amber alert", and inform the Ambulance Service of this. The Ambulance Service's priorities are to transport serious casualties from the accident site to the red hospital and to transport minor casualties to the amber hospitals. Occasionally the red hospital will request patients be transferred by ambulance to amber hospitals. The Police Service assist by escorting ambulances transporting serious casualties. The Police also seal the area around the incident and secure all direct roads between the incident and alert hospitals. Monitoring and review of the handling of the incident is the responsibility of the incident coordinator, as is dealing with the press.

    (a) The first activity in managing a design project such as this is *planning*. Name any 5 phases of the planning process. [*5 marks*]

    (b) Construct a use case diagram and corresponding use cases from the above description of code red incidents. [*8 marks*]

    (c) The following preliminary class model has been proposed for implementing this system:

    CRC cards can be used to validate a class model such as this. Name 4 things you might look for when using CRC cards. [*4 marks*]

QUESTION CONTINUES ON NEXT PAGE

(d) Two more detailed use cases are suggested below. For each of them, construct sequence or collaboration diagrams for a representative scenario and use this diagram to check the validity of the class diagram given above. Identify any errors in the class diagram.

i. The incident coordinator designates a secure area near the accident to be the *Press Viewing Area* and informs the Police of this. The Police must also inform the Fire Service. [*4 marks*]

ii. The incident coordinator request that the Fire Service select appropriate ambulance routes. The coordinator informs the Police of these. The Police then inform the Ambulance Services. [*4 marks*]

2. The bank "Abacus Ltd." has recently acquired the mortgage company "BrownHorse Co." and must merge their two computer-based records systems. They expect this to be a straightforward task, as each system is implemented using object-oriented components.

   (a) "Components are units of reuse and replacement". Provide a more detailed definition of components. [*5 marks*]

   (b) Use noun-phrase identification, or any other appropriate technique, to construct from the following description a single class model which merges both companies accounts. The preliminary class model should identify the classes and their associations, but need not specify attributes or methods. You should label the associations with suitably descriptive labels and any multiplicities. [*8 marks*]

   > Both banks have customers, who may each have any number of accounts. Abacus provide cheque accounts and savings accounts. Abacus has an analysis department who periodically review a selection of cheque accounts to identify market trends. Abacus' marketing department use information provided by the analysts to determine advertising strategies. The marketing department may occasionally review cheque accounts directly. BrownHorse are a mortgage company who provide mortgage accounts for their customers. They also provide house insurance, and every mortgage must have an associated insurance policy. Finally, BrownHorse have an internal team of auditors who periodically review all mortgage accounts.

   (c) Abacus intend to use encapsulation (or "software wrapping"), a form of preventive maintenance, to reuse essential software from BrownHorse's systems, rather than re-implementing it. Define two other forms of preventive maintenance and, for each, a reason why encapsulation might be preferable. [*4 marks*]

   (d) Abacus might be wrong in thinking that merging the two systems will be straightforward. Define *risk* and describe the 3 main activities in documenting the risks of a project such as this. List any significant risks you forsee for this project. [*8 marks*]

3. A software-based traffic controller is required for the “Wexford” road tunnel. The tunnel has 3 lanes running north-south and traffic signals at both the north and south entrances which indicate the status of each lane. Consider the following description of the operating states of the traffic signals:

> The west lane is reserved for northbound traffic and the east lane is reserved for southbound traffic. The central lane is typically closed, but in times of heavy traffic may be designated either as northbound only or as southbound only (traffic in either direction is only ever light or heavy). The central lane must always close before it is permitted to change to either northbound or southbound. If northbound traffic changes from light to heavy, the central lane will change to northbound unless it is already southbound. Similarly, if southbound traffic changes from light to heavy, the central lane will change to southbound unless it is already northbound. When the central lane is open, owing to heavy traffic, it will close again as soon as traffic becomes light. Any lane (east, west or central) may be closed at any time in the event of an emergency.

(a) Any proposed system will be subject to rigorous testing. List any four recommended principles of testing. [*4 marks*]

(b) Construct a UML statechart for traffic signals in the 3 lanes of the tunnel. Your statechart should be constructed as a compound statechart, with 1 superstate for each lane. [*4 marks*]

(c) Construct a second UML statechart for the traffic controller, which sends messages to the traffic signals in the event of changes in traffic. Your statechart should illustrate the use of either guarded transitions and/or decision diamonds, and should include actions consistent with your first statechart. [*6 marks*]

(d) Using your above statecharts as examples, describe *structural testing* (also known as *glass box testing*) and how it may be used to validate this system. [*6 marks*]

(e) Once thoroughly tested, the deployment of any proposed system will have to be carefully considered. List five issues that deployment modelling should consider. [*5 marks*]