UNIVERSITY OF EDINBURGH

FACULTY OF SCIENCE AND ENGINEERING

COMPUTER SCIENCE THREE

SOFTWARE ENGINEERING WITH OBJECTS AND COMPONENTS 1

Wednesday 7 June 2000

14:00 to 15:30

Examiners:

Prof. K. Turner (External)

Prof. G. Brebner (Chairman)

INSTRUCTIONS TO CANDIDATES

Answer any TWO questions.

All questions carry equal weight.

1. Consider the following problem:

   An NHS hospital wishes to implement a system which controls the allocation of patients to hospital beds. The system may be assumed to have an accurate record of all wards in the hospital and how many beds each ward has. The system will also hold the nursing records for hospital patients. At present new patients are admitted to a particular hospital ward. The duty nurses for that ward create a new record for each new patient and allocate them to a particular bed. The duty nurses also record when a patient is discharged from hospital, thereby freeing up the relevant bed. On occasion nurses are required to designate some number of free beds as "reserved" (and thus no longer free). The patient record initially contains a patient reference number, a note of their ailment, and the date of their admission. Nurses should be able to add to these records any notes concerning nursing care or change in patient's health. The hospital managers should be able to check the availability of beds throughout the hospital.

   (a) Describe a method you might use to derive a preliminary class model from this textual description of the system. [*5 marks*]

   (b) Use the method to construct such a class model. 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. [*7 marks*]

   (c) Briefly describe how CRC cards may be used to validate a class model with respect to a set of use cases. [*5 marks*]

   (d) Use CRC cards to check the validity of your class model with respect to the following use cases (you should both draw CRC cards and briefly describe *how* they validate these particular use cases):

   - Bed availability: A hospital manager initiates a request to determine how many beds in the entire hospital are free, how many reserved and how many occupied.
   - Patient arrives on ward: a duty nurse must create a record for this patient and allocate them to a bed.
   - Nurse handover: The senior duty nurse at the end of his/her shift must inform the new staff of any changes during his/her shift (i.e. new patients, patients discharged, changes in patient health, changes to bed status or allocations).

   [*8 marks*]

2. Consider the following brief description of the process of submitting an article for publication in an academic journal:

   > Academics submit draft papers to journal editors; these are then sent on to appropriate reviewers for comment. The paper's author(s) revise the paper in line with these comments and submit the revised version to the publishers. The publishers proof-read the paper and send corrections to the journal editors who ensure that the author(s) make the required corrections. The paper is then ready for publication.

   (a) What, in the OO sense of the word, is an object? [*4 marks*]

   (b) Construct a use case diagram and corresponding use cases for the above system. For each of your use cases you should include brief written descriptions of the main tasks involved. [*8 marks*]

   (c) Use an activity diagram to show how the individual activities in your use case model combine to create the workflow for this process. Pay particular attention to the synchronisation of activities. [*8 marks*]

   (d) Describe the features which UML statecharts offer in addition to those of traditional finite state automata. [*5 marks*]

3. (a) "Components are units of reuse and replacement."

    i. Describe three other kinds of software reuse. For each of these three approaches, describe one major disadvantage that approach has. *[6 marks]*

    ii. Describe how component reuse overcomes the disadvantages you have identified above. *[5 marks]*

    iii. Describe how JavaBeans support component based development. Are all Java components JavaBeans? *[4 marks]*

   (b) The developers of the failed London Ambulance Service's automated despatch system were blamed for, among other things: (i) implementing random parts of the system piecemeal over 10 months; (ii) having poor project management and quality assurance; (iii) taking an idealised world view (where everything always worked perfectly).

    i. Briefly describe three ways in which the developers could have used use cases to address the problems (i) and (ii) above. *[6 marks]*

    ii. Briefly describe how interaction diagrams validate a class model with respect to a use case. In particular, note how this technique can illustrate *failures* in interactions (and thus could have addressed problem (iii) above). *[4 marks]*