System Analysis and Design

Tuesday 15th January 2008

Time: 14:00 - 17:00

Please answer ALL Questions in Section A
and ONE Question in Section B

Each Section is worth 50% of the marks for this examination paper

The use of electronic calculators is NOT permitted
Section A

Section A comprises of multichoice questions and therefore cannot be published.
Rapid Transit Ticketing and Access Control System

An automatic ticket gate is being manufactured for a rapid transit system (like the London Underground). The gate will be positioned at entrances to the system and sell tickets to different zones on the system. The gate will only permit people to enter the system once they have purchased a ticket.

A selection console will have 4 buttons indicating the zone for which a ticket is to be purchased (zones 1, 2, 3 and 4). The user will press the zone they require (process 1), the system will lookup the price of the ticket (process 2) in a ‘zone charge file’ and a display will indicate the value of the coins which need to be entered, i.e. the ticket price (process 3).

The system will then allow the user to enter coins, one at a time (process 4). Once a coin has been entered, the system will not allow another coin to be entered until the previous coin has been validated. After each coin is entered, the machine will shut the coin entry slot and determine how much money remains to be entered (process 5). If more money is required, the display is updated with the value of coins still to be entered before the ticket can be issued (process 3).

When sufficient coins have been entered, the machine will issue a ticket (process 7), return any change (process 6) and open the machine’s gate to allow the user to pass through the entrance barrier (process 8). An electronic eye detects when the user is clear of the barrier and the gate will then be shut (process 9).

The transaction can be cancelled at any time during coin entry by the user pressing a CANCEL button on the selection console. The transaction cannot be cancelled once the full payment has been entered.

You should make reference to the case study in answering the following questions. Marks will be awarded for both correctness and accuracy of your answers.

a) Explain the relationship between an event and a process (sometimes called an action). Using the above case study, give an example of a related event and action. (10 marks)

b) The GATE CONTROL process is a control process in a data flow which determines the behaviour of the system. Complete the data flow diagram on the answer sheet for this question, so that it shows the appropriately annotated control flows between the gate control process and other processes. (17 marks)

c) Draw a state-transition diagram which fully documents the behaviour of the GATE CONTROL process. To gain full marks, the names used on the state-transition diagram must be consistent with the names used in the data flow diagram of part b) of this question. (15 marks)

d) Explain why a developer may not include control processes and control flows into a data flow diagram when it is first constructed. (8 marks)
32. **Library Reservation System**

A library lending and reservation system is under construction for the University of Cheshire. In the university’s library there are a number of library items, which can be subdivided into written works (e.g. books, magazines etc.) and recorded items (e.g. music, games etc.). All items have a unique ID number and a title.

Written works are classified into those items which can be borrowed and those items which cannot be borrowed (reference items). All written works have a publisher and ISBN (a unique book reference number). Recorded items are made up from one or more media (e.g. CDs, tapes, vinyl disks, DVDs etc.). Each media item has a media reference number which uniquely identifies the item.

For items which can be borrowed (written or recorded), the system must store the number of times the item has been borrowed (increasing the count immediately the item is borrowed) and, when on loan, must record the date the item is due to be returned.

Library items, which can be borrowed, can have a reservation made for them by library members. Library items can be interrogated to see whether (a) they can be reserved (since reference items cannot be reserved) and (b) whether there is a reservation currently for the item.

The system will record library members, with a membership number, name and number of items currently borrowed. Library members can borrow items, return items and make reservations. The maximum number of items which can be borrowed must not exceed 6.

When a library member attempts to borrow a library item, the system must first check to see whether the item is out on loan and, if not, whether the library member has a reservation for the library item. If a reservation exists and is made by the library member, the reservation can be cancelled and the library item lent out. If a reservation exists for the library item, but is for a different library member, the library item cannot be borrowed by that library member and must remain available for the library member who reserved the item.

When a library item is returned, a check must be made to see if the item has been returned late, in which case a fine is charged.

a) Draw a class model for the above case study, showing only those attributes and operations necessary to implement the case study as described. You should not add attributes or operations which are not needed for the case study as described—if you do this, you will lose marks. (26 marks)

b) Draw a sequence diagram showing the message interaction when a library member wishes to borrow a library item. Your diagram should be consistent with the model in part (a). (12 marks)

c) Draw a statechart for library items which can be borrowed (ignore reference items), showing the states through which a library item can pass (e.g. on loan). Your diagram should be consistent with the model in part (a). (12 marks)

**END OF EXAMINATION**