UNIVERSITY OF LONDON

CO2226 ZA

BSc Examination

COMPUTING AND INFORMATION SYSTEMS, CREATIVE COMPUTING AND COMBINED DEGREE SCHEME

Software Engineering, Algorithms design and analysis

Date and Time: Wednesday 11 May 2016: 14.30 – 17.30

Duration: 3 hours

There are SIX questions on this paper. Candidates should answer **FOUR** questions (**TWO** from **PART A** and **TWO** from **PART B**). The mark for each part of a question are indicated at the end of the part in [.] brackets.

Only your first **TWO** answers from **PART A** and your first **TWO** answers from **PART B**, in the order that they appear in your answer book, will be marked.

There are 100 marks available on this paper.

A hand held calculator may be used when answering questions on this paper but it must not be pre-programmed or able to display graphics, text or algebraic equations. The make and type of machine must be stated clearly on the front cover of the answer book.

© University of London 2016

UL16/0065

Part A

Question 1

a) Explain briefly what is the purpose of activity diagrams in UML. Which phase of the software process would we create them in?

[5]

b) SchoolTournaments Ltd is a company specialising in organising football leagues with teams coming from different schools; they offer a number of different competitions that school teams can enter; every competition has a published deadline after which no entries will be accepted. The following rules apply:

- Each school can be represented with multiple teams and decide on which competition they choose to enter; a student can only participate in one of the school teams (characteristics such as his position on the roster, height, weight and so on should be recorded).
- In exceptional circumstances and with proper justification, a team can be made up with players from different schools.
- Every school has to appoint a head coach, who will be able to logon to the online system and will be responsible for a team coach for each one of the school teams that enters the competition.
- Each team should choose a name, the competition they want to enter and nominate one of its players as the captain.
- After the deadline for entering a competition, the schedules are generated and published.
- Changes to match days are allowed only by the administrator of the system. If a change is made, there is a deadline of a week (five working days) for any further changes to be made, subject to the agreement of the two head coaches whose teams are involved in the match.
- If there is a change it should be accompanied by a reason and after the deadline of a week expires no further changes are allowed.
- The statistics of each match are recorded and the score as well as the start-up teams, the substitutes, the scorers and any yellow or red card(s) as well as the referee of the match have to be available on the system.
- At the same time the league table should show the points each team has won and the full schedule of matches for the whole season should be available.
- The administrator of the system should be able to see all running matches (matches which are in progress at the time of his login) and every head coach should be able to see the ones relating to the teams

from their school as well as the history of the school matches in all competitions for the current year when he logs in.
- These statistics are kept for three years and after this period they are deleted from the database.

Develop a class diagram for the above scenario using the notions starting with a capital letter as class names, and suggest class attributes with name and type, as well as methods with name and return type. Illustrate associations, aggregations, and generalisation relationships between the objects.

[20]

Question 2

a) Explain briefly the meaning and benefits of static operations and attributes on classes. You may use examples to illustrate your answer.

[5]

b) Prepare a sequence diagram to illustrate the process of entering the information for a new team in the tournament – the question is using the same scenario as in **Question 1b)**. The scenario reads as follows:
   - The head coach of the school identifies himself by entering the username and the password. he types the name of the new team (the selection should be confirmed) and selects the competition he wishes the team to enter.
   - He would then proceed to define the team's coach and the captain of the team after creating him first as a player.
   - Once the team is entered, the competition object should be queried for the schedule of team and this should be returned to the head coach.
   - Final confirmation that the information is saved into the system should be presented to the head coach as well.

You may assume that neither the team's coach, nor the captain have a previous entry in the system.

[20]

Question 3

a) What is the difference between white and black box testing? You may use an example to illustrate your answer

[5]

b) Create a state machine diagram describing the behaviour of a match object described in **Question 1b).** The following rules apply:
   - The match object will initially be created when the deadline for entering the specific competition in the tournament has ended.
   - Once it is given a date and place, it becomes scheduled. If any changes are made, the state will have to change to rescheduled and after the specified period it will become locked.
   - It will go into pending mode until the date it is scheduled for.
   - Once match day arrives, it will change to running and after the advertised end time it will be updated and after a week archived.
   - After the agreed time, it will be deleted.

Design the state machine diagram using state transitions and labels with three parts.

[20]

Part B

Question 4

a) What is a linked list? You might use an example to illustrate your answer

[4]

b) What are the advantages and disadvantages of using a linked list as opposed to using an array?

[4]

c) What is a stack? Provide two different ways in which a stack can be implemented.

[10]

d) Illustrate how a queue with the elements 1, 12, 4, 72, 16 will be constructed and explain the process for removing 4 from the queue.

[7]

Question 5

a) What is the process of resolving collisions when using hashing with the linear probing method? You may use an example to illustrate your answer

[5]

b) Assuming a hashing function of $h(k) = (k^2 + 1) \mod 12$, provide the hash codes for the values 1, 123, 14, 21, 12 and 45. What do we mean by saying a collision occurred? Use the linear probing method to resolve any collisions where they exist

[8]

c) What is a recursive algorithm and what are its principles? You may use an example to illustrate your answer

[5]

d) Provide a **recursive** algorithm which takes two arrays as arguments (A and B) and appends array B to array A by forming array C; so the function will look like **append(A, B, C)** where C would be the output of the algorithm and A and B the input arrays; you do not need to worry about implementation details, only the pseudocode is needed.

[7]

Question 6

    a) Using ShellSort, sort the following list of integers: 3, 21, 52, 15, 12, 225, 34, 45,7, 3, 19 and 21.

[8]

    b) What is the definition of a graph? You may use an example to illustrate your answer

[6]

    c) You have the following adjacency matrix for a graph:

$$A = \begin{pmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 \end{pmatrix}$$

Draw the graph and digraph, explain the process from this matrix and write the adjacency list for the graph.

[11]

END OF PAPER