The Open University of Sri Lanka
Bachelor of Software Engineering
Department of Electrical and Computer Engineering
ECX 4265 – Data Structures & Algorithms
Final Examination 2014/2015

Date: 20th September 2015	**Time: 0930 - 1230hrs**

< INSTRUCTIONS>

1. Answer **Question 1** in **Part A**, which is **compulsory**.
2. Answer **4 questions out of 7** given in **Part B**.
3. This is a closed book exam and no reference books and materials are allowed.

PART A (Compulsory Question)

Q1. When the papers of the ECX4235 Data Structures and Algorithm course is marked, the academic coordinator wants to find out some information related to the course. After that he wants to sort out the data set, find out the lowest/highest mark, find marks of given students etc. In order to do these operations answer the below questions.

(i) Insert marks with the registration numbers of students to a suitable dynamic data structure for further processing. You have to write a pseudo code algorithm for declaring the data structure and for inserting data. (6 marks)

(ii) After marking the Kandy regional center answer scripts the lecturer entered them to the data structure you created in part (i). Then he wanted to arrange them to ascending order and he decided to compare each mark with every adjacent mark in the data structure. Write a pseudo code algorithm for this task. (8 marks)

(iii) After marking all answer scripts the lecturer found a paper with zero marks. Taking it as the lowest mark he wanted to arrange the marks into ascending order. Write a pseudo code algorithm that works by finding the smallest mark from the unsorted sublist and exchange it with the leftmost unsorted element. (8 marks)

(iv) Once all the marks are sorted into ascending order the lecturer wanted to find the marks of the student bearing the registration number 71754. He wanted to implement a more efficient searching method hence decided to check the required number with the middle number of the list and proceed with the searching. Accordingly write a pseudo code algorithm to find the marks of the above stated student. (8 marks)

(v) After all the marks are put into the sorted order he found one 'under protest' unmarked script. Write a pseudo code algorithm to enter that particular mark to the appropriate position in the data structure declared in part (i).

(6 marks)

(vi) Calculate the running time for the pseudo code written in part (iii). You have to clearly indicate the steps in between. (4 marks)

PART B

Q2.

(i) Compare and contrast nonlinear data structures with linear data structures by giving examples for each. (4 marks)

(ii) Assume that you are at the first position of a Bank queue to be served and there are few people behind you. A lady expecting a child comes to join the queue and you think of giving her the first place with the consent from those who are behind and you go to the second position.

(a) Assuming that you can simulate the above scenario, write a pseudo code algorithm to declare a queue structure. (3 marks)

(b) Write a pseudo code algorithm to insert the expecting lady to the first position of the queue. (4 marks)

(c) The third person in the queue gets a phone call and leaves the queue. Write a pseudo code algorithm to remove the third person in the queue assuming there are some more persons behind. (4 marks)

Q3.

(i) Give characteristics of hashing giving a real world example. (3 marks)

(ii) Insert the following numbers to a one column table of size seventeen (17) according to below given collision resolving methods.

2, 32, 43, 16, 77, 51, 1, 17, 42, 111

(a) Use linear probing to resolve collisions,
(b) Use separate chaining to resolve collisions. (3 ×2= 6 marks)

(iii) In a double hashing situation following two hash functions are used.

1. h1(k) = k mod 17
2. h2(k) = 1+ k mod 13

(a) Calculate hash values for hash function 2. (2 marks)
(b) Insert the data set to a hash table after double hash. (4 marks)

Q4.

A graph is a pair G = (V ; E), where V is the set of vertices (or nodes) and E the set of edges of the graph. In a directed graph, or digraph, the edges have a direction. In a weighted directed graph, a number is attached to each edge.

Dijkstra's algorithm finds shortest paths in weighted directed graphs. Consider the directed graph G1with the set of vertices A; B; C; D; E and eight weighted edges given by the following triples:

(A; B; 9); (A; C; 2); (A; D; 6); (C; D; 3); (C; E; 1); (D; B; 2); (E; B; 3); (E; D; 1):
For example, the triple (A; B; 9) says there is an edge from A to B with weight 9.

(i) Draw the graph clearly indicating vertices along with directions and weights. (4 marks)

(ii) Draw the corresponding adjacency matrix for the above graph. (4 marks)

(iii) Run Dijkstra's algorithm on this graph with start vertex A and target vertex B. (4 marks)

(iv) What is the cost of the shortest path from A to B. (3 points)

Q5.

(i) Insert the following data set into a binary search tree according to the given order.

87, 36. 22, 15, 56, 85, 48, 90, 72, 6 (4 marks)

(ii) Write a pseudo code algorithm to find a value in the middle of the tree. (3 marks)

(iii) Write a pseudo code algorithm for pre order traversal of the tree and give the resulting output. (4 marks)

(iv) Construct a binary tree considering the following traversals of a tree.

Preorder = { 7, 10, 4, 3, 1, 8, 11, 2}
Inorder = {4, 10, 3, 1. 7, 11, 8, 2} (4 marks)

Q6.

Consider the data set given below.

87, 36, 22, 15, 56, 85, 48, 90, 72, 6

(i) (a) Write a pseudo code algorithm for merge sort. (4 marks)

(b) Give the output data set after applying merge sort to the above data set. (4 marks)

(ii) Give the output data set after applying quick sort to the above data set. Consider pivot as the left most element. (5 marks)

(iii) Compare and contrast merge sort with quick sort. (2 marks)

Q7.

(i) Describe essential features in a recursive algorithm. (2 marks)

(ii) Write a pseudo code algorithm to reverse a given set of data using

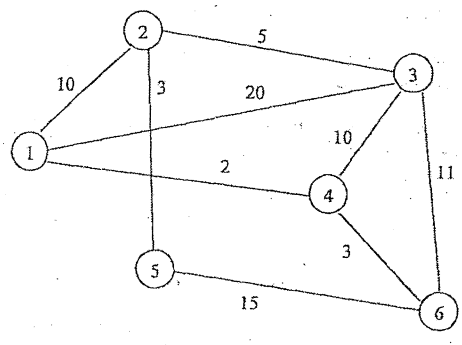
(a) Iterative method
(b) Recursive method

(3 × 2 = 6)

(iii) Write a pseudo code algorithm to transfer elements from stack S_1 to stack S_2 so that the elements from S_2 are in the same order as on S_1. Clearly write any assumptions you make. (5 marks)

(iv) Compare and contrast currently available methods for comparing algorithms with respect to time efficiency. (2 marks)

Q8.



(i) Write the pseudo code algorithm for depth first search. (4 marks)

(ii) List the *breadth first* and *depth first* search sequences for the above graph. Assume the search starts at node '1'.

(iii) Draw the expression tree for a*(b+c)*(d*e+f). (4 marks)

(iv) (a) "Time complexity is more important than space complexity". Critically analyse this statement using an example. (3 marks)

(b) Calculate the time complexity of the below given algorithm with respect to big O notation.

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For I = 1 to n
   For j = 1 to i
      K[i][j] = i+j
   End for
End for
```

(4 marks)

The End