The Open University of Sri Lanka
Bachelor of Software Engineering
Department of Electrical and Computer Engineering
ECX 4265 – Data Structures & Algorithms
Final Examination 2012/2013

Date: 17th August 2013	**Time: 0930 - 1230hrs**

Note: Answer FIVE questions ONLY.

Q1.

(a) Assume that you have to prepare 25 pieces of cupcakes for one of your friend's birthday party. Another friend is coming to help you and you need to tell her exactly how to make the cupcakes.

The steps to follow are:

1. Preheat oven to 350 degrees F.
2. Mix the flour, baking powder, baking soda, cocoa and salt.
3. In a large bowl, mix the butter and sugar and add the eggs one at a time, beating well with each addition.
4. Add the flour mixture with the milk; beat well.
5. Fill the muffin cups 3/4 full.
6. Bake for 15 to 17 minutes in the preheated oven,
7. Decorate with your favourite icing flavor.

Write a pseudo code algorithm for the above given steps for making cupcakes. Your algorithm should contain at least one condition and a loop.

(8 marks)

(b) Describe the features of a good algorithm by giving examples from what you have written for part (a).

(4 marks)

(c) State how you can identify the incorrectness of an algorithm. Give an example for the method you described.

(4 marks)

(d) Describe two methods that can be used to compare and contrast algorithms with respect to time. (4 marks)

Q2.

You are supposed to arrange a set of hats in different arrangement patterns according to their colour. Assume that there are three (03) red colour hats, two (02) blue colour hats, and two (02) white colour hats.

00

(a) Write a pseudo code algorithm to insert all the hats into a linked set of buckets (similar to a linked list) according to the colour order red, blue and white. Similar colour hats will be together. (6 marks)

(b) Remove the hats one by one and insert them into vertical buckets (similar to stack data structure) separated according to the colours. That is all red colour hats have to be in one bucket and so on. Write a pseudo code for this action. (8 marks)

(c) Write a pseudo code algorithm for removing the middle hat from the red colour vertical bucket. (6 marks)

Q3. Assume that you have to arrange a group of students in a queue according to the alphabetical order of their last name.

(a) Write a pseudo code algorithm to insert 10 students into a queue. (8 marks)

(b) Write a pseudo code algorithm to remove the 7th student from the queue. (6 marks)

(c) Write a pseudo code algorithm to form a circle from the remaining students. (6 marks)

Q4.

(a) There are many situations where we need to check whether the parentheses in a mathematical expression are nested correctly. In doing so the rules to follow are,

1. There are an equal number of right and left parentheses.
2. Every right parenthesis is preceded by a matching left parenthesis.

(i) Write a pseudo code algorithm to test whether the parentheses are nested correctly according to the above rules in a given mathematical expression. (8 marks)

(ii) Hand trace how the above written algorithm will work on the below expression

$7 - ((x \times ((x + y) / (J - 3)) + y)$ (3 marks)

(b) The nodes of a tree structure can be stored in an array as given below.

0	1	2	3	4	5	6	7	8
A	B	C	D	E	F	G	H	I

(i) Build an almost complete binary tree from the above nodes. (3 marks)

(ii) Write a pseudo code/java algorithm to traverse the above tree in pre order. (6 marks)

Q5.

You are asked to sort the numbers in the below given array into ascending order.

2	1	5	4	3	6

Use the following sorting techniques to sort the array. For each technique you have to write the contents of the array each time that the sort algorithm changes it. Then state how many comparison operations and how many swaps are performed in the sorting.

(a) Selection Sort

(b) Insertion Sort

(c) Bubble sort (5 marks each)

(d) Usually one swap operation equals seven comparison operations in terms of their executing time. By comparing the number of swaps and comparison operations of each of the above sort algorithms, which of these sort method is most efficient in sorting this array.

(5 marks)

Q6.

(a) Hand traces the following set of numbers given in an array using quick sort. Assume the pivot as the first element.

int A[ ] = { 3, 1, 4, 1, 5, 9, 2, 6, 5, 3, 5, 8, 9}

(6 marks)

(b) Write the pseudo code algorithm for quick sort.

(5 marks)

(c) Sort the same data set given in part (a) using quick sort by taking the pivot as the median. (6 marks)

(d) Write the pseudo code algorithm for selecting the median in a given data set.

(3 marks)

Q7.

(a) Compare and contrast different searching methods known to you in terms of efficiency.

(4 marks)

(b) Write a pseudo code algorithm for binary search. (6 marks)

(c) Explain how you can search number 59 in the following set of numbers using binary search. You should clearly state each and every step in your search.

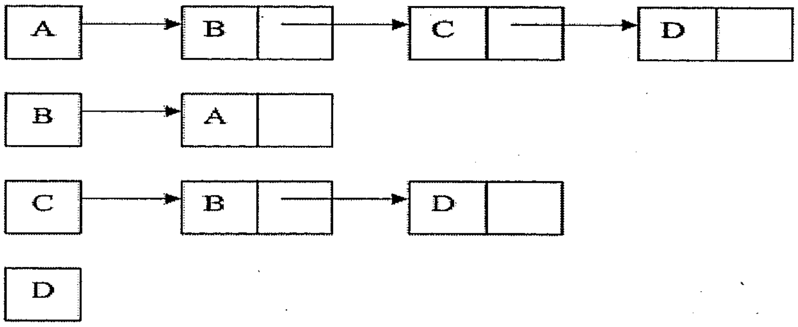
[23, 28, 31, 48, 53, 59, 72] (5 marks)

(d) Build a binary search tree by inserting the input sequence 44, 22, 77, 55, 99, 83, 33. You should clearly explain the steps involved. (5 marks)

0(

Q8.

(a) Below is an adjacency list representation of a directed graph where there are no weights assigned to the edges).



(i) Draw a picture of the directed graph that has the above adjacency list representation. (3 marks)

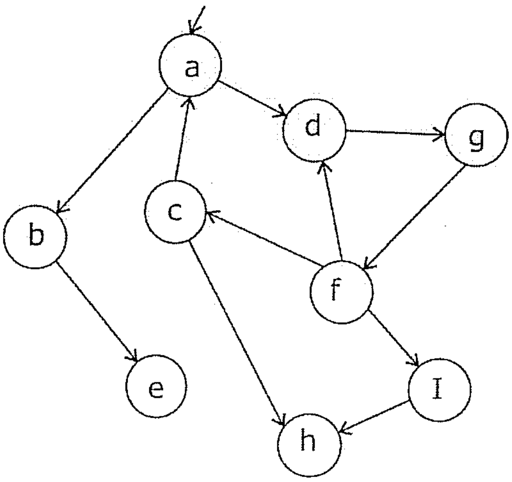
(ii) Another way to represent a graph is an adjacency matrix. Draw the adjacency matrix for the above graph. (3 marks)

(b) Consider a hash table of size 7 with hash function h(k) = k mod 7. Draw the table that results after inserting, the values 19, 26, 13, 48, 17 in the given order for the following three cases.

(i) When collisions are handled by separate chaining.
(ii) When collisions are handled by linear probing.
(iii) When collisions are handled by double hashing using a second hash function h'(k) = 5 – (k mod 5).

(2 marks each)

(c) List the *breadth first* and *depth first* search sequences for the following graph. Assume the search starts at node 'a'.



The End (8 marks)