

The Open University of Sri Lanka  
 Bachelor of Software Engineering  
 Department of Electrical and Computer Engineering  
 ECX 4265 – Data Structures & Algorithms  
 Final Examination 2011/2012



Date: 17<sup>th</sup> March 2012

Time: 1400 - 1700hrs

**Note: Answer FIVE questions ONLY.**

**Q1.**

- (a) Describe how you can identify the incorrectness of an algorithm. Give an example for the method you described. (4 marks)
- (b) Describe three methods of designing algorithms by giving an example for each method. (6 marks)
- (c) Briefly describe why it is important to analyze an algorithm before implementation. (4 marks)
- (d) Write a pseudo code algorithm for implementing a simple real life scenario. For example, making a cup of tea. Your algorithm should contain at least one condition and a loop. You need to describe the scenario first. (6 marks)

**Q2.**

- (a) Briefly describe the essential points to be satisfied in writing a recursive algorithm. (3 marks)
- (b) Write a pseudo code algorithm to create a linked list with  $n$  number of nodes. You should include the nodes using a FOR loop. (4 marks)
- (c) (i) Include the numbers 22, 33, 44, 55, 66 into a linked list using a FOR loop. (2 marks)  
 (ii) Write a pseudo code algorithm to delete number 44 from the above list. (3 marks)
- (d) Assume that you have to insert a new integer value  $x$  into a sorted linked list. The linked list is sorted in ascending order and the value to be inserted falls in between the given range of values. Write the pseudo code algorithm to insert the value and you need to comment properly where required. (8 marks)

## Q3.

- (a) Describe the properties of a Queue Data Structure giving a real world example. (3 marks)
- (b) Write a pseudo code algorithm to reverse the contents in an array based queue. For example if the values in the array A are  $[A] = \{12, 5, 3, 7, 15\}$  then the reversed array has to be  $[B] = \{15, 7, 3, 5, 12\}$  (6 marks)
- (c) Write a pseudo code algorithm to reverse a linked queue data structure. (6 marks)
- (d) Compare and contrast the above two methods. (5 marks)

## Q4.

- (a) (i). Compare and contrast tree structures with binary tree structures.  
 (ii) Describe what is a full binary tree structure.  
 (ii) Discuss the differences between terminal nodes and non terminal nodes. (2 marks each)
- (b) Write a pseudo code algorithm to insert a value to a binary tree. (4 marks)
- (c) Draw an expression tree for the expression  $(5 - x) * y + 6 / (x + z)$ . (4 marks)
- (d) Write the following representations for the expression in part (c).  
 (i) Postfix representation  
 (ii) Infix representation  
 (iii) Prefix representation (2 marks each)

## Q5.

- (a) (i) Describe two applications of heaps.  
 (ii) How efficient insertions and removals from a heap. (2 marks each)
- (b) Determine whether the below given array has the heap property. You should clearly state the steps how you determined the heap property.

0	1	2	3	4	5	6	7	8	9	10
	88	66	77	33	44	55	75	30	22	51

- (4 marks)
- (c) Write a pseudo code algorithm to determine whether a given array has the heap property. (6 marks)
- (d) Insert value 75 to the above given (part a) heap maintaining the heap property. (6 marks)

Q6.

- (a) Explain how you perform the selection sort for a given set of values. (3 marks)
- (b) Write the pseudo code for selection sort. (5 marks)
- (c) Trace by hand how you perform selection sort on the below given array.  
`int a[ ] = { 47, 89, 52, 99, 65, 34, 17, 89, 77}` (6 marks)
- (d) (i) Describe why bubble sort is so slow in sorting a given data set.  
 (ii) Suggest an improvement to make the bubble sort faster. (3 marks each)

Q7.

- (a) Describe step by step how the merge sort is performed for a given data set. (4 marks)
- (b) Trace by hand how the merge sort is performed on the following set of numbers.  
`{77, 44, 99, 66, 33, 55, 88, 22}` (5 marks)
- (c) Compare and contrast merge sort with quick sort. (3 marks)
- (d) (i) Write a pseudo code algorithm for binary search. (5 marks)
- (ii) Describe under what conditions sequential search of a given set of values is preferred over binary search. (3 marks)

Q8.

- (a) Consider the following specification of a graph G where  $V(G)$  stands for vertex (nodes) and  $E(G)$  are the edges.  
 $V(G) = \{1, 2, 3, 4, 5\}$   
 $E(G) = \{(1,2), (1,3), (3,3), (3,4), (4,1), (5,2), (4,5), (5,1)\}$
- (i) Draw an undirected graph. (5 marks)
- (ii) Draw the adjacency matrix. (5 marks)
- (b) The following values are to be stored in a hash table  
 25, 42, 96, 101, 102, 162, 197
- (i) Describe how the values are hashed by using division method of hashing with a table size of 7. (5 marks)
- (ii) Clearly show how chaining method can be used for collision resolution. (5 marks)