Vavuniya Campus of the University of Jaffna

First Examination in Information and Communication Technology - 2017

Second Semester - March/April 2019

ICT1213 Data Structures

Answer Five Questions Only

Time : Three hours

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1. (a) What is meant by a data structure in computer programming and explain why it is important for the programming. [20%]

   (b) State the main difference between *an algorithm* and *a program*. [15%]

   (c) Classify the data structures with the aid of examples. [15%]

   (d) Write a Java statement to declare and initialize an array. [10%]

   (e) Write a Java statement to create a two-dimensional array. [10%]

   (f) Write three differences between an array and a linked list. [15%]

   (g) Write Java codes to represent a two dimensional *ragged array* in Figure 1 given below: [15%]

[This question is continued on the next page]

3	5	7	9
2	4		
5	6	7	8
6			

Figure 1: A Ragged Array

2. (a) Write an algorithm for *linear search.* [20%]

(b) i. Write a method to search an item in a sorted list using the *binary search* technique. [30%]

ii. Consider an array with twelve elements as shown in Figure 2.

	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
List	4	8	19	25	34	39	45	48	66	75	89	95

Figure 2: An Array List with 12 elements

A. Trace the binary search algorithm to determine whether 75 is in the list. [15%]

B. Trace the binary search algorithm to determine whether 50 is in the same list. [15%]

(c) Compare the performances of the above linear search technique and binary search technique. [20%]

3. (a) Write a *merge sort algorithm* for a list of integers. [25%]

(b) Derive the sorted array of the following twelve integers using the above algorithm. 43, 7, 10, 23, 18, 4, 19, 5, 66, 14, 2, 0. [25%]

(c) Write an algorithm to sort a list of integers using the *selection sort.* [20%]

(d) Using the algorithm in part(c) to sort the list of integers in part(b). [15%]

(e) Compare the merge sort and selection sort algorithms and their performances. [15%]

4. (a) Define *directed* and *undirected* graph with suitable examples. [20%]

(b) Write an algorithm for each of the following traversals in a graph data structure.

i. *Breadth first traversal* [25%]

ii. *Depth first traversal* [25%]

(c) Trace out the breadth first traversal and depth first traversal for the graph depicted below. The traversals start from vertex A.

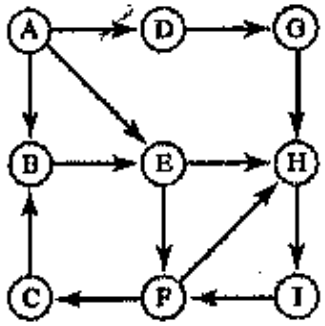

Figure 3: A Directed Graph

[20%]

(d) Write three applications of a graph data structure in computing. [10%]

5. (a) Define a *tree* data structure in your own words. [15%]

(b) Consider the following tree T:

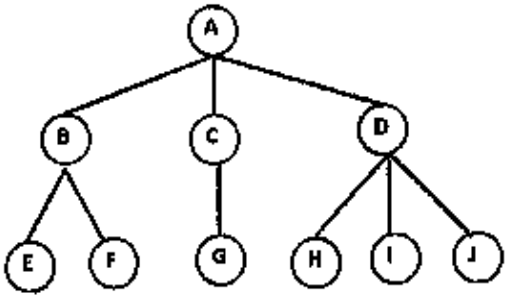

Figure 4: Tree T

[This question is continued on the next page]

Identify each of the following from the tree T:

i. *Root node*

ii. *Leaf nodes*

iii. *Siblings* of *node C* and *Siblings* of *node G*

iv. *A subtree*

v. *Depth* [20%]

(c) Represent the above tree T in a list. [15%]

(d) i. Define a *binary tree.* [10%]

ii. Calculate the maximum number of nodes in a binary tree of depth k. [10%]

iii. Determine the order of nodes for each of the following traversals of given binary tree in Figure 5:

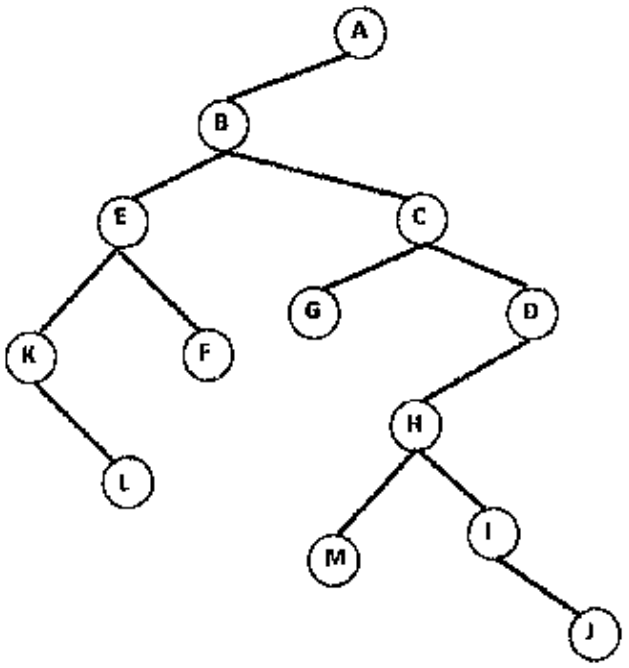

Figure 5: A Binary Tree

A. *Inorder traversal*

B. *Preorder traversal*

C. *Postorder traversal* [30%]

6. (a) Describe a *linked list* data structure in your own words. [10%]

(b) Define a class for a *singly linked list*. [10%]

(c) Suppose a linked list is shown in Figure 6, where *head* references the first Node and the *tail* references the last Node.

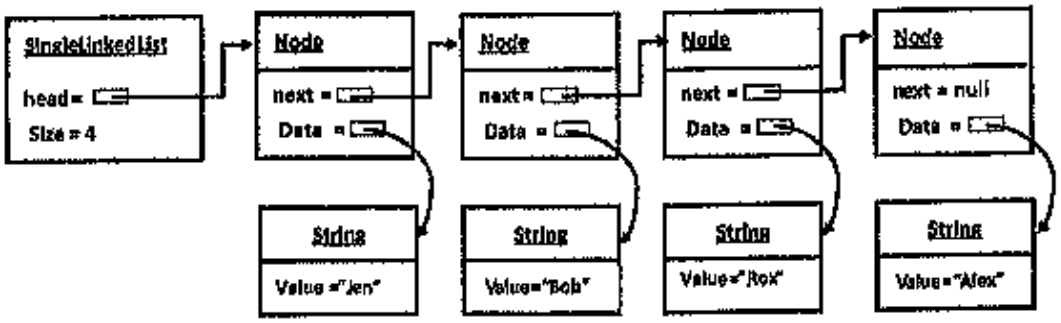

Figure 6: A linked List

Perform each of the following operations on the above linked list in sequence with drawing the resultant linked list after the execution of each operation:

i. insert "Micky" before "Bob". [20%]

ii. remove "Micky". [20%]

iii. insert "Nicky" before "Jen". [20%]

iv. remove "Alex". [20%]