UNIVERSITY OF RUHUNA

BACHELOR OF SCIENCE (GENERAL) DEGREE LEVEL I (SEMESTER II) EXAMINATION – JANUARY 2018

SUBJECT : COMPUTER SCIENCE
COURSE UNIT: COM 1213/COM121β (Data Structures & Algorithms) TIME: 2 hours

Answer *four (04)* questions *including question one (01)*.

1.

a. In each of the following question, state whether the statement is True or False, giving reasons.

i. A complete binary tree with a height of h can have more nodes than a full binary tree with a height of h
ii. A stack follows a FIFO (first-in-first-out) rule.
iii. In a circular doubly linked list with 10 nodes, we will need to change 4 links if we want to delete a node other than the head node.
iv. The core data structure of Depth-First Search is a queue

b. Consider the following situations and write most appropriate data structure to use in each situation.

i. To reverse a given word in a program.
ii. To model a transportation network.
iii. To handle interruptions in real-time systems.

c. Write a situation where ***Quick sort*** algorithm is most appropriate.

d. Sort the following elements into ascending order using ***Merge sort*** algorithm. Show the intermediate steps clearly.

28, 13, 6, 84, 62, 12, 70

Continue...

2.

a.

i. Write two (02) basic features of stack ADT.

ii. Evaluate the following expression using stack ADT. Write the content of stack structure in all intermediate steps clearly.

2 3 2 4 + - *

b. Suppose you are asked to use array based implementation of a normal queue to execute following operations.

Enqueue(6), enqueue(4), enqueue(8), dequeue(), enqueue(7), dequeue(), enqueue(3), enqueue(9)

i. Draw the behavior of queue data structure after execution of each operation. Assume that the array size is 5. Show front, rear and queue size references clearly.

ii. Identify any problems occurred in executing above operations.

c. Propose a suitable data structure to overcome the problems you identified in 2(b)(ii). Clearly show the behavior of proposed data structure after executing the above 2(b) operations.

d.

i. Draw the max heap after inserting following elements in the given order.
3, 4, 2, 1, 5, 6

ii. Redraw the above binary heap after deleting the maximum value. Show intermediate steps clearly.

3.

a.

i. Write two (02) advantages of using a linked list data structure.

ii. In a linked list, each node contains minimum of two fields. Explain them.

b. Consider an implementation of unsorted singly linked list. Suppose it has a representation with a head pointer only. What is the time complexity of insertion of an element at the front of the linked list?

c. How many links are to be changed if one node other than the head node is to be deleted in the following types of linked lists?

i. Singly (Singular) linked list

ii. Doubly linked list

iii. Circular doubly linked list

Continue...

d.

i. Complexity of an algorithm is determined by two factors. Explain them.

ii. Write the time complexity of the following code segment.

```
int sum = item[0];
int j = 1;
while (j < n) {
        sum += item[j];
        ++j;
}
```

4.

a. Explain the difference between a full binary tree and a complete binary tree using a suitable illustration.

b. Write the minimum and maximum number of nodes in a strictly binary tree of depth 3. Draw trees in each case.

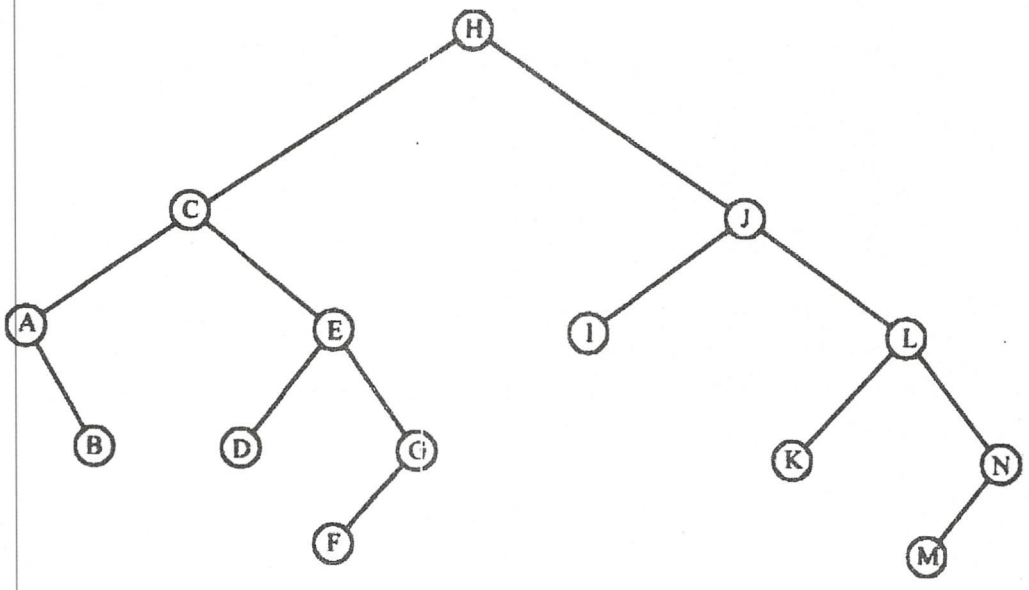
c. Consider the following expression.

{[(8/2)*3]+[2*5] }/ [(3+1)/2]

i. Draw an expression tree for the above expression.

ii. Write the equivalent prefix and postfix expressions.

d. Consider the following binary search tree, which is not an AVL tree. Write the AVL operations which are necessary to rebalance the tree. Show the resulting AVL tree and the operations you have used to rebalance the tree.



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5.

a.

i. Suppose G1 is a graph with 5 vertices and 7 edges. Write the formal definition of the graph G1.

ii. State whether the G1 is a complete graph or not. Justify your answer.

iii. Draw a directed graph with five vertices and seven edges. Exactly one of the edges should be a loop.

iv. Suppose G2 is a graph with V={1,2,3,4,5,6} and E= {(1, 2) , (1, 3), (1, 4) , (2, 4) , (3, 4) , (1, 5) , (4, 6), (5,1), (3,3)}.
Draw the G2 graph according the given description. Identify any loops and cycles in the graph.

b. Consider the following adjacency matrix.

	A	B	C	D	E
A	1	0	0	1	0
B	1	0	0	0	0
C	1	0	0	0	0
D	0	0	0	0	1
E	0	1	1	0	0

i. Draw the corresponding graph for the above given adjacency matrix.

ii. State whether the graph is directed or undirected giving reasons.

iii. Write the Depth First (DFS) and Breadth First (BFS) Searches of the above graph starting at vertex A.

c. Consider the following adjacency list.

P	→	Q	4	→	R	25			
Q	→	Q	6	→	T	5	→	X	10
R	→	P	25	→	S	8	→	T	15
S	→	X	20						
T	→	R	15	→	X	30			
X	→	S	20						

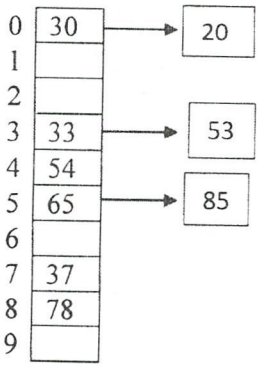
i. Draw the corresponding graph for the above given list.

ii. Write the adjacency matrix for the given list.

iii. Write the Breadth First (BFS) of the above graph, you drew in c.(i) starting at vertex R.

Continue...

d. Consider the following hash table with elements inserted.



i. Identify the problems occurred in above hash table.

ii. Write an example of a hash function that can be used to create the above hash table.

----------*End*----------