University of Sargodha
BS 3th Term Exam 2018
Subject: Computer Science   **Paper: Data Structures & Algorithms (CS-3113)**

Time Allowed: 2:30 Hours   **Maximum Marks: 80**

Objective Part   Compulsory

Q.No.1: Attempt all parts and each require answer 2 – 3 lines   (16*2=32)

1. Define O-notation.

Big O notation is used in Computer Science to describe the performance or complexity of an algorithm. Big O specifically describes the worst-case scenario, and can be used to describe the execution time required or the space used (e.g. in memory or on disk) by an algorithm.

2. What is the minimum number of queues needed when implementing a priority queue?

'2'queues. one is used for storing data... another is used for priorities. Priority queues r applied using 2-D array where it has two rows one for element and second for priority ,so minimum numbers of queues are needed to implement are two.

3. What is a DEQUEUE?

Double ended queue is also a queue data structure in which the insertion and deletion operations are performed at both the ends (front and rear). That means, we can insert at both front and rear positions and can delete from both front and rear positions.

Double ended queue can be represented in two ways:
1) Input Restricted Double Ended Queue
2) Output Restricted Double Ended Queue

4. What are dynamic data structures?

A dynamic data structure (DDS) refers to an organization or collection of data in memory that has the flexibility to grow or shrink in size, enabling a programmer to control exactly how much memory is utilized.

5. Why to use PREFIX and POSTFIX notations when we have simple INFIX notation?

Infix notation is the most common way of writing expressions. Prefix and Postfix notations are other two ways that are good for machines because they can be parsed and evaluated easily. This is one important topic in computer science where we find application of stack data structure.

6. What is an AVL tree?

"An AVL tree is a balanced binary search tree. In an AVL tree, balance factor of every node is either -1, 0 or +1." Balance factor of a node is the difference between the heights of left and right subtrees of that node.

7. There are 8, 15, 13, and 14, nodes in 4 different trees. Which one of them can form a full binary tree? Why?

'15'. In general: There are 2^{n-1} nodes in a full binary tree. By the method of elimination: Full binary trees contain odd number of nodes. So there cannot be full binary trees with 8 or 14 nodes, so rejected. With 13 nodes you can form a complete binary tree but not a full binary tree. So the correct answer is 15.

8. How do you insert a new item in a binary search tree?

In a binary search tree, the insertion operation is performed with O(log n) time complexity. In binary search tree. New node is always inserted as a leaf node. The insertion operation is performed as follows:

Solved by Talha Shahab

Whenever an element is to be inserted, first locate its proper location. Start searching from the root node, then if the data is less than the key value, search for the empty location in the left subtree and insert the data. Otherwise, search for the empty location in the right subtree and insert the data.

9. Differentiate linear from non-linear data structure.

The difference between them is that the linear data structure arranges the data into a sequence and follow some sort of order. Whereas, the non-linear data structure does not organize the data in a sequential manner. The linear data structure is a single level data structure while non-linear data structures are the multilevel data structure.

Examples of the linear data structure are array, queue, stack, linked list, etc. In contrast, tree and graph are the examples of the non-linear data structure.

10. Differentiate file structure from storage structure.

The representation of a particular data structure in the memory of a computer is called a storage structure whereas a storage structure representation in auxiliary memory is often called a file structure.

11. Are linked lists considered linear or non-linear data structures? Give reason.

Non-linear tends to imply a structure beyond a simple sequential pattern. ... A linked list can be considered linear if each node is pointing at another node in contrast to trees and other data structures where there may be multiple pointers within a node. A binary tree for example, is much harder to imagine as a line.

Or

A linear data Structure is what which stores data in a linear format and the traversing is in sequential manner and not in zigzag way. It depends on where you intend to apply **linked lists**. If you based it on storage, a linked list is considered non-linear.

12. Which data structures is applied when dealing with a recursive function?

Recursion, which is basically a function that calls itself based on a terminating condition, makes use of the stack. Using LIFO, a call to a recursive function saves the return address so that it knows how to return to the calling function after the call terminates.

13. What is an ordered list?

The structure of an ordered list is a collection of items where each item holds a relative position that is based upon some underlying characteristic of the item. The ordering is typically either ascending or descending and we assume that list items have a meaningful comparison operation that is already defined.

14. What is Data Abstraction?

Data abstraction is the reduction of a particular body of data to a simplified representation of the whole. Abstraction, in general, is the process of taking away or removing characteristics from something in order to reduce it to a set of essential characteristics.

15. In what areas do data structures applied?

Data structure is important in almost every aspect where data is involved. In general, algorithms that involve efficient data structure is applied in the following areas: numerical analysis, operating system, A.I., compiler design, database management, graphics, and statistical analysis, to name a few.

16. What is the minimum number of nodes that a binary tree can have?

A binary tree can have minimum '2' nodes.

Solved by Talha Shahab

Question No.2: Traversal the following graph using DFS and BFS algorithms.

Question No.3:
   a) Write the pseudo code of insertion sort.

```
insertion sort (Arr,n)
For i=2 to n
temp  <——  Arr[i]
j  <——  i-1
while (j >0 and Arr[j]>temp)
Arr(j+1)= Arr[j]
end while
Arr(j+1)  <——  temp
end for
end.
```

   b) Write the pseudo code of selection sort.

```
Selection sort (Arr,n)
For i=n to 1
max  <——  1
for j=2 to i
if (Arr[j] > Arr[max])then
max = j
end for
temp  <——  Arr[m]
arr[max]  <——  Arr[i]
Arr[i]  <——  temp
end for
end.
```

Question No.6: Write down the algorithm\code for insert, delete, and search elements (nodes) in singly Linked list.

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