University of Sargodha

MSc. 3rd Term Examination 2016.

Subject: I.T **Paper: Data Structures and Algorithms (CMP: 3112)**

Objective Part

Q1. Write short answers of the following in 2-3 lines each. (16*2=32)

1. What is data type?

The data type defines the set of values and set of operations that can be performed on those values. The data and its type is defines before designing the actual program use to process the data.

2. What is data structure?

A data structure is a representation of data and the operations allowed on that data. Many of common data structures store a collection of objects and then provide methods to add new object, to remove an existing object.

3. What is an Algorithm?

Algorithm is a step by step procedure to solve the problem. It takes some value or set of values as input and produces some value, or set of value as output.

4. Define ADT with Example?

ADT stands for Abstract Data Type is a type (or class) for objects whose behavior is defined by a set of value and set of operations.

Example; Arrays, Lists, Queues, Stack and Tree are example of ADT.

5. What is recursive Function? List the four fundamental rules of recursion?

A recursive function is a module or function that call itself in its body. This technique of calling itself is known as recursion. The rules of recursive Function are simple.

a. Every recursive Function must have two or more path.
b. One or more of these paths must be non-recursive.
c. Every recursive path must modify its parameter.

6. How Insertion sort and Selection Sort are different?

Insertion sort is the most efficient sorting technique if the data set required to be sorted is small or if the data set is nearly sorted. It maintains two different array list of equal size. One of which is sorted list whereas the other is unsorted list.

Selection Sort is comparison based in place sorting algorithm. This algorithm selects the element having the smallest value from the given set of data in every pass and interchanges it with the first unsorted element of data.

7. Define divide and conquer rule?

In divide and conquer approach an algorithm works by recursively breaking down a problem into two or more sub-problems of the same and related type until these become simple enough to be solved directly.

8. What is meant by a sorting algorithm is stable?

A sorting algorithm is stable if duplicate element remains in the same relative position after sorting.

9. What is push () operation in stack?

Push operation is used to insert data item at the top of stack.

10. What is Queue?

Queue is a simple data structure, in which data is inserted from one end and access from another end.

11. Differentiate between Stack and Array?

Stack is a data structure in which only most recently inserted item is allowed to access. The last item added to stack is place on the stack.

Array is data structure consisting of collection of elements each is identified by at least one array index or key. In an array new element can be added on any point start mid of end.

12. Define double link list?

A double link list is two way linked lists. Each node maintains two references next and previous. So, a user can move in both directions forward and reverse.

13. What is Min heap?

Min Heap is a heap in which each root is smaller than its children.

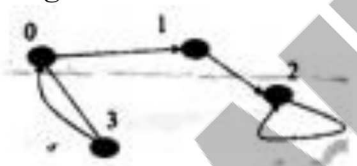
14. Define Binary Tree?

A binary tree is a finite set of elements that is either empty or it can be partitioned into three disjoint sub-sets, a root, a left sub tree and a right sub tree.

15. What is hashing?

The implementation of hash tables to perform insertions, deletions, and finds is called Hashing. In hashing a hash function is used to calculate the location of key. This location is used to save, find and delete a key from hash table.

16. Make an Adjacency Matrix for following?



Answer

Subjective Part (3*16)

Note Attempt any three question out of these.

Q2. Write the algorithm of program to do following

a. **Program to insert a value in a Queue**
b. **Convert the following Infix expression to postfix form using a stack.**
   [(A+B)/(C+D)^(E+F)]+(G+H)/I

Answer:

a. Program to insert a value in a Queue

```
public void enqueue(int x)
 {
     if( isEmpty() )
         back = front = new Node(x);
     else
         back = back.next = new Node(x);
     size++;
 }
```

b. Convert the following Infix expression to postfix form using a stack.
[(A+B)/(C+D)^(E+F)]+(G+H)/I

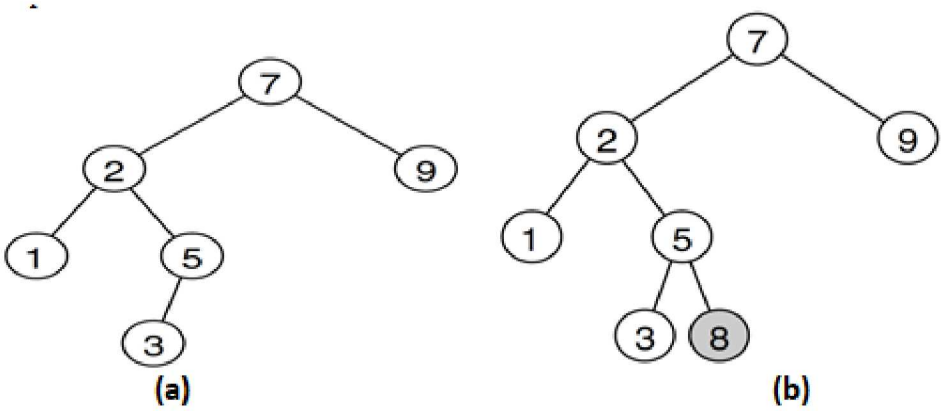
Reading Character	Postfix	Stack
[		[
(		[(
A	A	[(
+	A	[(+
B	AB	[(+
)	AB+	[
/	AB+	[/
(	AB+	[/(
C	AB+C	[/(
+	AB+C	[/(+
D	AB+CD	[/(+
)	AB+CD+	[/
^	AB+CD+	[/^
(	AB+CD+	[/^(
E	AB+CD+E	[/^(
+	AB+CD+E	[/^(+
F	AB+CD+EF	[/^(+
)	AB+CD+EF+	[/^
]	AB+CD+EF+^/	
+	AB+CD+EF+^/	+
(	AB+CD+EF+^/	+(
G	AB+CD+EF+^/G	+(
+	AB+CD+EF+^/G	+(+
H	AB+CD+EF+^/GH	+(+
)	AB+CD+EF+^/GH+	+
/	AB+CD+EF+^/GH+	+/
I	AB+CD+EF+^/GH+I	+/
	AB+CD+EF+^/GH+I/+	

Q3. What is a Binary Search Tree (BST)? What is the possible maximum number of nodes in a binary tree of depth d? Make a BST for the following Sequence of Numbers and traverse in all types of traversals.

45,32,90,21,78,65,87,132,90,96,41,74,92

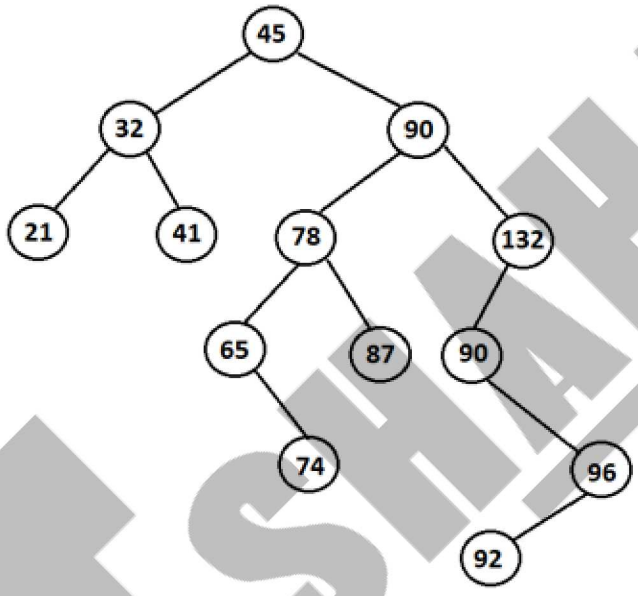
In a binary search tree, for every node X, all keys in X's left sub tree have smaller values than the key in X, and all keys in X's right sub tree have larger values than the key in X.

The binary search tree satisfies the search order property; that is, for every node X in the tree, the values of all the keys in the left sub tree are smaller than the key in X and the values of all the keys in the right sub tree are larger than the key in X. The tree shown in Figure (a) is a binary search tree, but the tree shown in Figure (b) is not because key 8 does not belong in the left sub tree of key 7. The binary search tree property implies that all the items in the tree can be ordered consistently. This property also does not allow duplicate items. We could easily allow duplicate keys; storing different items having identical keys in a secondary structure is generally better. If these items are exact duplicates, having one item and keeping a count of the number of duplicates is best.



A BST with depth d can have at maximum 2^{d-1} Nodes it means that if depth of a BST is 3 then it can have 2^3-1 = 7 Nodes

BST of 45,32,90,21,78,65,87,132,90,96,41,74,92



In-Order Traversal: 21,32,41,45,65,74,78,87,90,90,92,96,132
Pre-Order Traversal: 45,32,21,41,90,78,65,74,87,132,90,96,92
Post-Order Traversal:21,41,32,74,65,87,78,92,96,90,132,90,45
Level-Order Traversal: 45 ,32,90,21,41,78,132,65,87,90,74,96,92

Q4. Draw an 11-item hash table resulting from hashing the Keys. 12,44,13,88,23,94,11,39,20,16, and 5 using the hash function. h(i) = (2i+5) mod 11

Hash Functions = h(i) = (2i+5) mod 11

h(12) = (2*12+5) mod 11 = 29 mod11=7
h(44) = (2*44+5) mod 11 = 93 mod11=5
h(13) = (2*13+5) mod 11 = 31mod11=9
h(88) = (2*88+5) mod 11 = 181 mod11=5
h(23) = (2*23+5) mod 11 = 51 mod11=7
h(94) = (2*94+5) mod 11 = 189 mod11=2
h(11) = (2*11+5) mod 11 = 27 mod11=5
h(39) = (2*39+5) mod 11 = 83 mod11=6
h(20) = (2*20+5) mod 11 = 45 mod11=1
h(16) = (2*16+5) mod 11 = 37 mod11=4
h(05) = (2*05+5) mod 11 = 15 mod11=4

39	20	94	05	16	44	88	12	23	13	11
0	1	2	3	4	5	6	7	8	9	10

Liner probing is used for collision resolution.

Q5. Solve the following array using quick sort method, show procedure step by step.
2,6,7,5,10,9,2,4

Q6. Explain the following operation in double link list.

a. **Insert an Element**
b. **Delete an element.**

a. Insert an Element

1. Create a new Node and set given data in new node. Set the next link of new node to the next pointer of current node.
2. Set previous link to the current node.
3. Set previous link of the node next to the current to the new node.
4. Set next link of the current node to the new node. And move current marker to the new node.
5. Increase size by one.

b. Delete an element.

1. Find the node to delete and move current marker to that node.
2. Set next link of lastCurrentNode to the next link of current node.
3. Move current marker to the next link of current,
4. Set previous of the current node to the lastCurrentNode.
5. Decrease size by one.