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PAGE NO.: 01
DATE:

Data Structures (CER3C3)

Mid Semester Test - III

* Answer of Q. No. 3

- A heap is a complete binary tree, and the binary tree is a tree in which the node can have the utmost two children.
- A heap is a special tree based data structure in which the tree is a complete binary tree.

There are two types of heap.

Max-Heap: In a Max-Heap the key present at the root node must be greatest among the keys present at all of it's children. The same property must be recursively true for all sub-trees in the Binary tree.

Min-Heap: In a Min-Heap the key present at the root node must be minimum among the keys present at all of it's children. The same property must be recursively true for all sub-trees in that Binary Tree.

Working :-

(i) Construct a binary tree with given list of elements.
(ii) Transform the binary tree into Min-Heap.
(iii) Delete the root element from min heap using Heapify method.
(iv) Put the deleted element into the sorted list.

Tanishq Chauhan
21C3184
CS-B

Chauhan Rajshree
PAGE NO: 02
DATE:

(v) Repeat the same until min-heap becomes empty.
(vi) Display the sorted list.

Algorithm

```
insert (a,n)
{
  // Insert a[n] into the heap which is
                    stored in a a[1:n-1].

    i := n; item := a[n];

    while ((i>1) and (a[(i/2)] < item)) do
    {
      a[i] := a[(i/2)]; i := (i/2);
    }
      a[i] := item; return true;
}
```

Tanishq Chauhan
21C3184
CS-B

Chauhan Rajshree
PAGE NO: 03
DATE:

* Answer of Q. No. 1

Average Time Complexity of Different Data Structure

Data Structure	Access Time	Search Time	Insertion Time
Array	O(1)	O(N)	O(N)
Stack	O(N)	O(N)	O(1)
Queue	O(N)	O(N)	O(1)
Singly Linked List	O(N)	O(N)	O(1)
Doubly Linked List	O(N)	O(N)	O(1)
Hash Table	O(1)	O(1)	O(1)
Binary Search Tree	O(log N)	O(log N)	O(log N)
AVL Tree	O(log N)	O(log N)	O(log N)
B Tree	O(log N)	O(log N)	O(log N)

Tanishq Chauhan
21C3184
CS-B

Chauhan Rajshree
PAGE NO.: 04
DATE:

Worst Case Time Complexity of Different Data Structure

Data Structure	Access Time	Search Time	Inseration Time
Array	O(1)	O(N)	O(N)
Stack	O(N)	O(N)	O(1)
Queue	O(N)	O(N)	O(1)
Singly Linked List	O(N)	O(N)	O(1)
Doubly Linked List	O(N)	O(N)	O(1)
Hash Table	O(N)	O(N)	O(N)
Binary Search Tree	O(N)	O(N)	O(N)
AVL Tree	O(log N)	O(log N)	O(log N)
Binary Tree	O(N)	O(N)	O(N)

Tanishq Chauhan
21C3184
CS-B

Chauhan

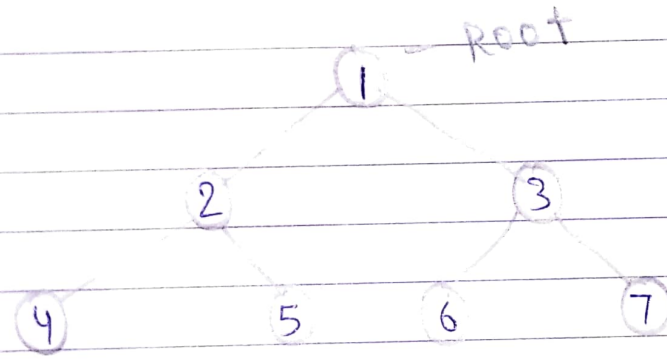
Rajshree
PAGE NO. 05
DATE

* Answer of Q. No. 4

In an inorder traversal the root is visited between the subtrees. Inorder traversal is defined as follow :-

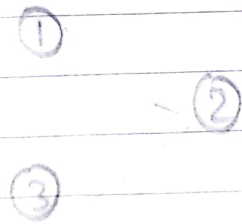
Traverse the left subtree in inorder
Visit the root
Traverse the right subtree in Inorder.

E.g.



Inorder Traversal → 4, 2, 5, 1, 6, 3, 7, 6 of this tree.

E.g.



Input → root = [1, null, 2, 3]
Output = [1, 3, 2]

We are given input as an array in which first element of the array represent the root node.

Tanishq Chauhan
21C3184
CS-B

Chauhan Rajshree
PAGE NO.: 06
DATE:

Procedure to find inorder traversal

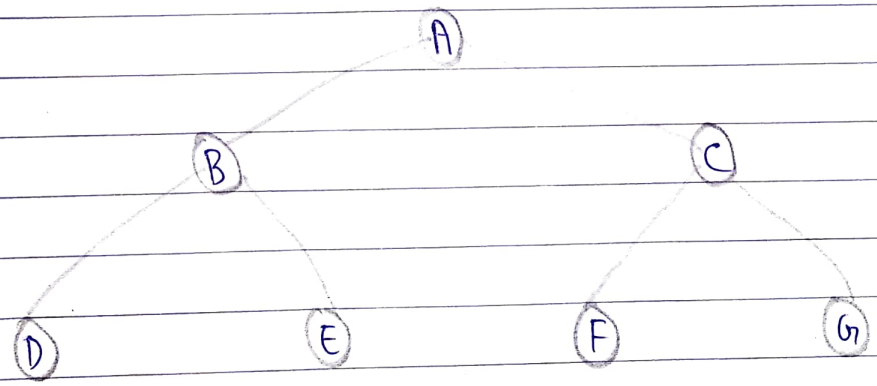
```
int[size] array = new int[size];
        int *index = 0;

void StoreInOrder(noderoot)

{
    if (node == NULL)
        return;

storeInOrder(root.left child());
        array[index++] = root.value;
StoreInOrder[root.rightchild());

}
```



Inorder Sequence :- DBEAFCG

Tanishq Chauhan
21C3184
CS-B

Answer of Q. No. 2

- Hash Table is a data structure which stores data in an associative manner. In a hash table, data is stored in an array format, where each data value has a its own unique index value. Access of data becomes very fast if we know the index of the desired data.

- There is a widely used technique for storing of data called hashing. It does away with the requirement of keeping data sorted and its best case timing complexity is of constant order (O(1)). In its worst time case, hashing algorithm starts behaving like linear search.

- Best case timing behaviour of searching using hashing = O(1).
  Worst case timing behaviour of searching using hashing = O(n).

- In hashing, the record for a key value "key", is directly referred by calculating the address from the key value. Address or location of an element or record, x is obtained by computing some arithmetic function f. f(key) gives the address of x in the table.

- There are two different forms of hashing

(i) Open Hashing or External Hashing
(ii) Close Hashing

Tanishq Chauhan
21CS3184
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Chauhan
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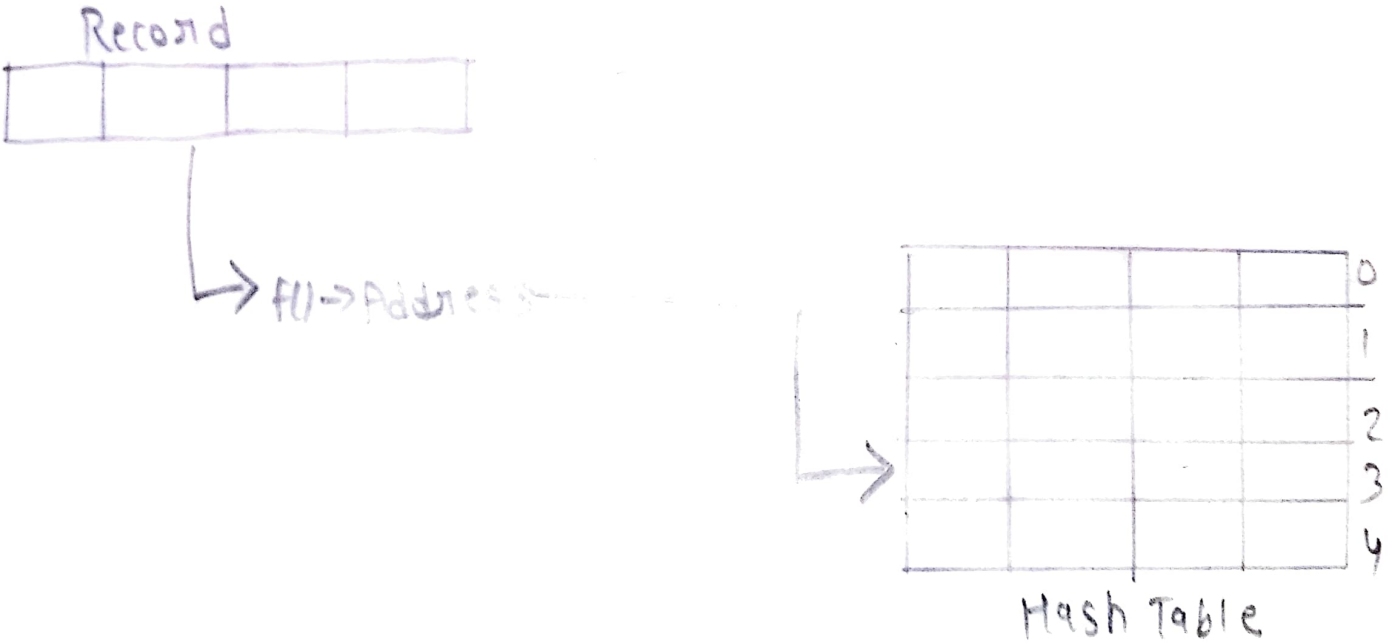

Mapping