DAR ES SALAAM INSTITUTE OF TECHNOLOGY (DIT)

DEPARTMENT: DEPARTMENT OF COMPUTER STUDIES

MODULE NAME: FUNDAMENTALS OF DATA STRUCTURES AND ALGORITHMS

MODULE CODE: (ITT 05216)

GROUP ASSIGNMENT

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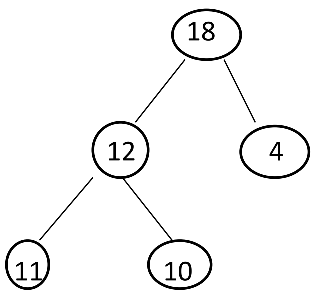
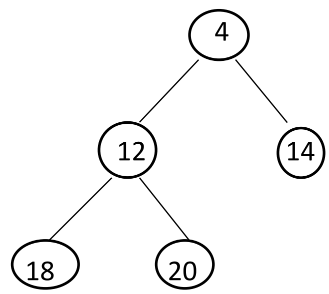
QN. Discuss intensively the tree and graph data structures.

A tree data structure denoted by heap. It can be either a max or a min heap.
A min heap is a tree in which value of each node is less than or equal to value of its children nodes. A max heap is a tree in which value of each node is greater than or equal to value of its children nodes.



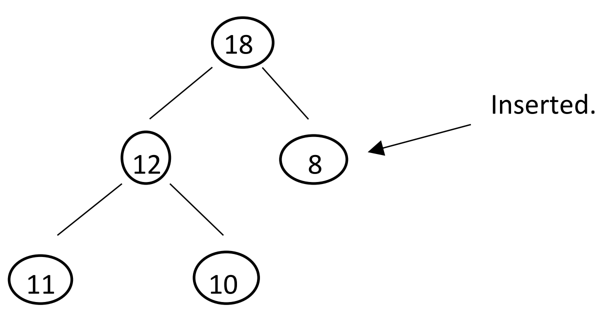
Max Heap.



Min Heap.

Insertion of element in the Heap.

Max heap has a property that value of any node is always greater than the parent node.
If we want to insert 8. We cannot insert eight as left child of 4. This is because the max heap has a property that value of any node is always greater than the parent nodes. Hence, 8 will bubble up 4 will be left child of 8.
When a new node is to be inserted in complete binary tree, we start from bottom and from left child on the current level. The heap is always a complete binary tree.

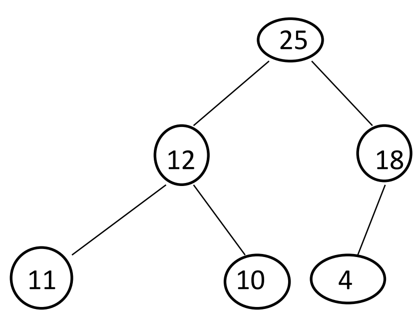


```
Void Heap::insert (int item)

{

int temp;

temp=++size;

while (temp!=1 && heap[temp/2]<item) //moving element down

{

H[temp] = H[temp/2]; temp=temp/2;

//finding the parent

}

H[temp]=item;

}
```

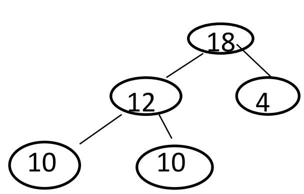
Deletion of element from the heap.

For deletion operation always the maximum element is deleted from heap. In Max heap the maximum element is always present at root. And if root element is deleted then we need to reheapify the tree.

Consider a Max Heap,



Delete root element:25, Now we cannot put either 12 or 18 as root node and that should be greater than all its children elements.



Now we cannot put 4 at the root as it will not satisfy the heap property. Hence we will bubble up 18 and place 18 at root, and 4 at position of 18.

Thus deletion operation can be performed. The time complexity of deletion operation is O(log n).

1. Remove the maximum element which is present at the root. Then a hole is created at the root.

2. Now reheapify the tree. Start moving from root to children nodes. If any maximum element is found then place it at root. Ensure that the tree is satisfying the heap property or not.

3. Repeat the step 1 if any more elements are to be deleted.

```
void heap::delet(int item)

{

int item, temp;

if(size==0)

cout<<"Heap is empty\n"; else

{

item=H[size--];

while(child<=size)

{

if(child<size && H[child]<H[child+1]) child++;

if(item>=H[child])

break;

H[temp]=H[child];

temp=child;

child=child*2;

}

H[temp]=item;

}
```

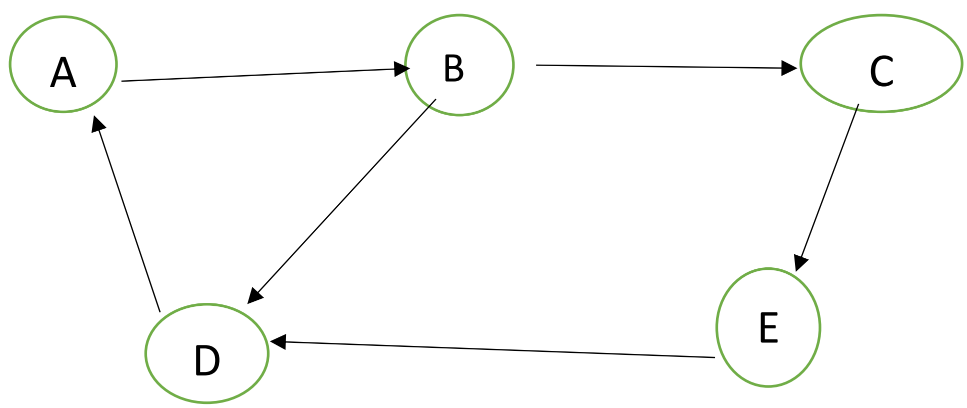
Applications of Heap:

1. Heap is used in sorting algorithms.
2. In priority queue implementation the heap is used.

Graphs data structure

A graph can be defined as group of vertices and edges that are used to connect these vertices. A graph can be seen as a cyclic tree, where the vertices (nodes) maintain any complex relationship among them instead of having parent child relationship. A graph data structure is a non-linear data structures made up of a finite number of nodes or vertices and the edges that connect hem. Are used to address real world problem in which it represents the problem area as a network like telephone network, circuit networks and social networks

A data structure that consist of a set of nodes and a set of edges that relate the nodes to each other, each node contains an element and each edge connects two nodes together and may contain an edge attribute.



Graph terminology

Path: a path can be defined as the sequence of nodes that are followed in order to reach some terminal node V from the initial node U

Closed path: a path will be called as closed path if the initial node is same as terminal node. A path will be closed path if $V_0 = V_N$

Simple path: if all the nodes of the graph are distinct with an exceptional $V_0 = V_N$

Cycle: a cycle can be defined as the path with no repeated edges or vertices except the first and last vertices

Connected graph: a complete graph is the one in which some path exists between every two vertices (u, v) in V. There are no isolated nodes in connected graph

Complete graph: a complete graph is the one which every node is connected with all other nodes

Diagraph: a diagraph is a directed graph in which each edge of the graph is associated with some direction and traversing can be done only in the specified direction

Loop: an edge is associated with the similar end points can be called loop

Adjacent nodes: it two nodes u and v are connected via an edge e, then the nodes u and v are called adjacent node

Degree of the node: a degree of a node is the number of edge that are connected with that node. A node with degree 0 is called as isolated node