DSA

23221

Assignment No. 09

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Title: Heap Sort

Aim: To implement heap Sort

Problem statement: To implement heap Sort to given set of values using min and max heap

Theory:

Heap is specialized tree based data structure which is an almost complete tree that satisfi heap property. The heap is one maximally efficient implementations of an abstract data type called priority queue in heap the highest (or lowest) priority element is always stored at root. However a heap is not sorted structure it can be regarded as partially ordered A heap is a usefull dat structure when it is necessary to repeatedly remove object with highest or lowest priority A common implementation of heap is binary heap in which the tree is binary tree.

property:

1) Its complete tree i.e all levels are completely filled except possibly the last level and the last level has all the keys (as left as possible)
2) A binary heap is either a min heap or a max heap

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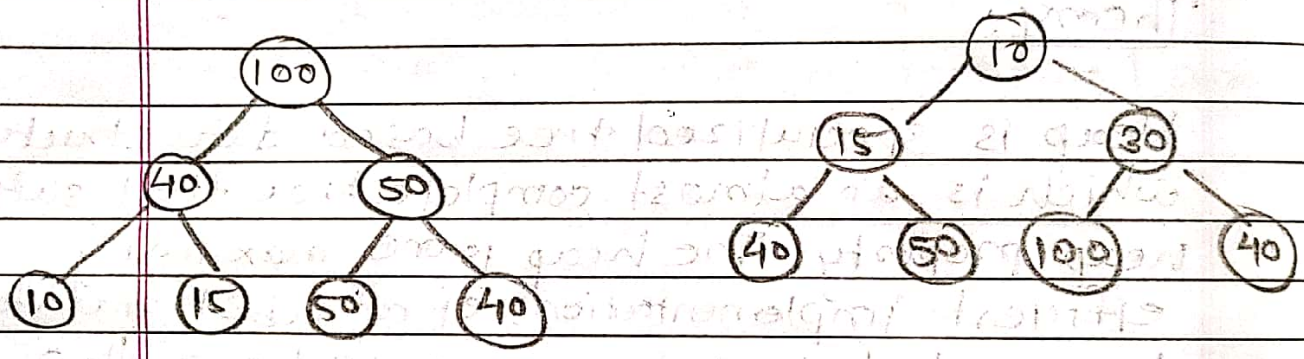
Max heap: The key present at root node must be greater amoung the keys present at all of its children.

Min heap: key present at root node must be minimum amoung the keys present at all of its children.




max heap

min heap

Binary heap presentation:

A binary heap is a sample binary tree, typically represented as array
The root element will be at arr[0] let 'i' be index of node

arr[(2*i)+1] = left child of the node
arr[(2*i)+2] = right child of node

## Applications of heap data structure

1) Heap sort: One of the best sorting method being inplace with no quadratic worst case scenarios.

2) Selection Algorithm: finding the min, max both min & max median or even the 'kth' largest element can be done in linear time using heaps

3) Graph Algorithms: By using heaps as internal traversal data structure, runtime will be reduced by polynomial order.
eg. prim's minimum spanning tree
Dijkstra's shortest path problem

For sorting in increasing order, max heap is used for sorting in descending order min heap is used

## Validations:

1. Limit validations
2. Data can be integer

## Test cases:

1. Sortest pinpot
2. Completely unsorted input
3. Partially sorted input

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## Conclusion:

Heap sort is comparison based sorting technique based on binary heap data structure space complexity of heap sort constant. Time complexity is of O n(log n) in all three cases. Heap sort is more efficient that quick sort and merge sort. As for quick sort worst case complexity is O(n²) and that for heapSort it is always O n(log n).