Data Structures & Algorithms

Treesort

Tree sort $O(n^2)$

How can we sort data using BST?

1) Insert given data into BST
2) Perform inorder traversal

Time complexity : $O(n^2) + O(n) = O(n^2)$

Can we do better?

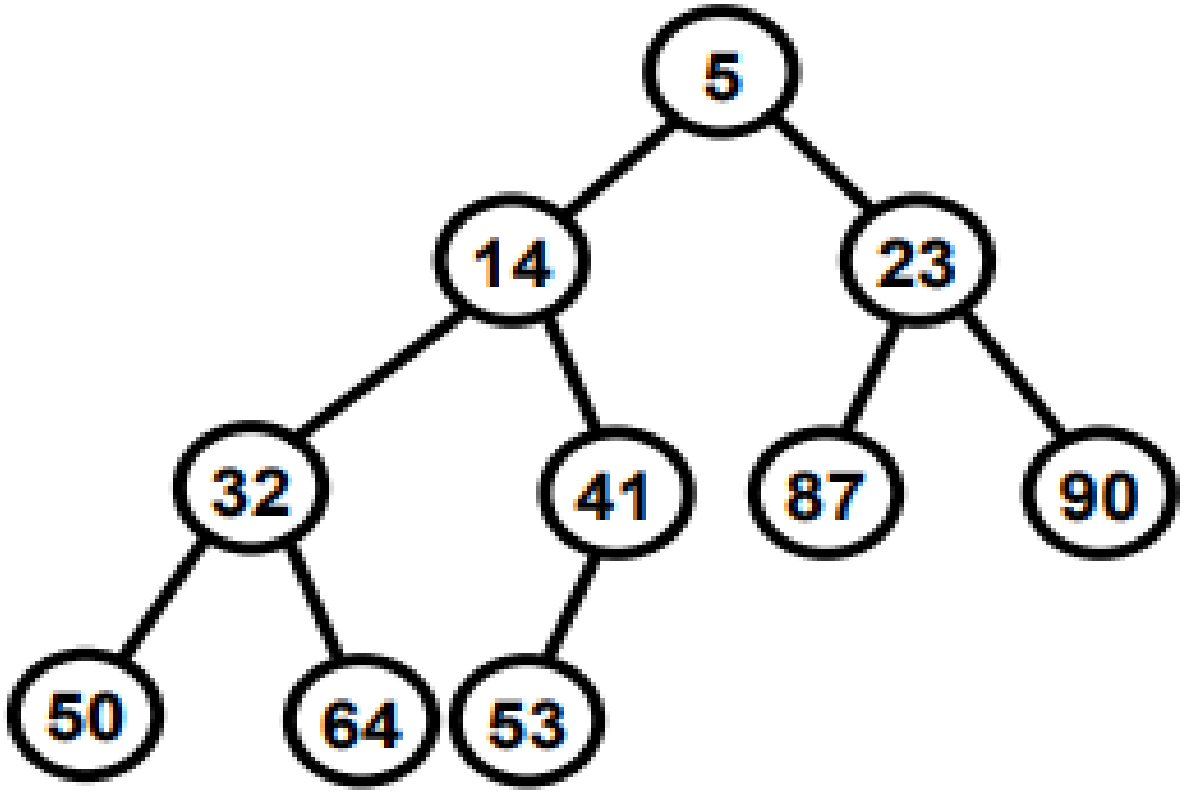
Can we sort using tree in O(nlogn) time?

Tree

Heap and Heapsort

Heap

A binary heap data structure is a complete binary tree where the key stored in each node is either greater than or equal to (max heap) or less than or equal to (min heap) the keys in the node's children.



Heap is well suited data structure for implementing priority queues.

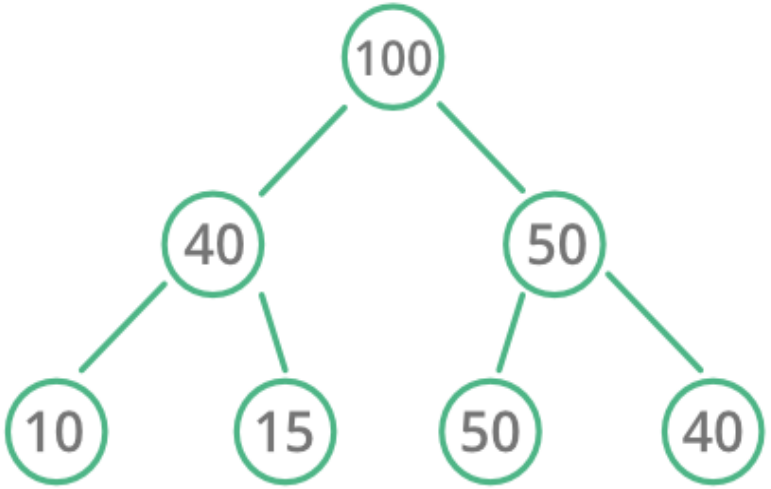
Max and Min Heap

Max-Heap

Heaps where the parent key is greater than the child keys are called max-heaps.

Largest element is stored at the root.

In any subtree, no values are larger than the value stored at subtree root.



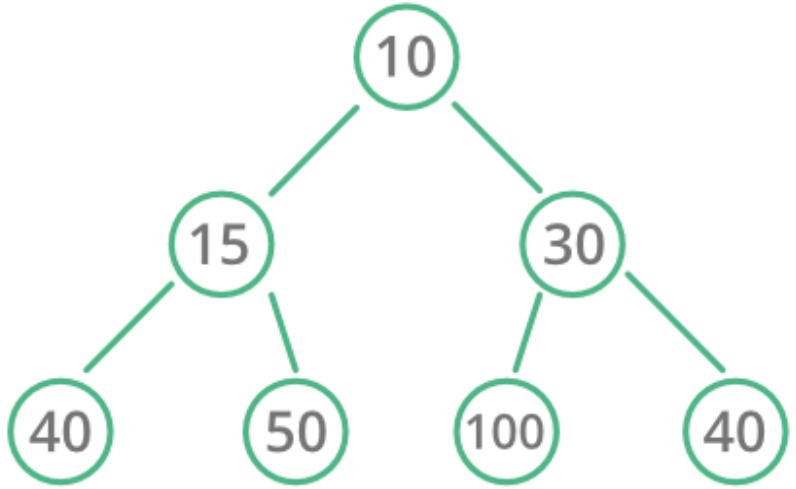
Max Heap

Min-Heap

Heaps where the parent key is less than the child keys are called min-heaps.

Smallest element is stored at the root.

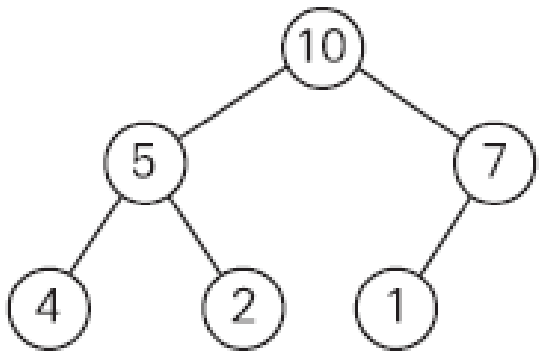
In any subtree, no values are smaller than the value stored at subtree root.

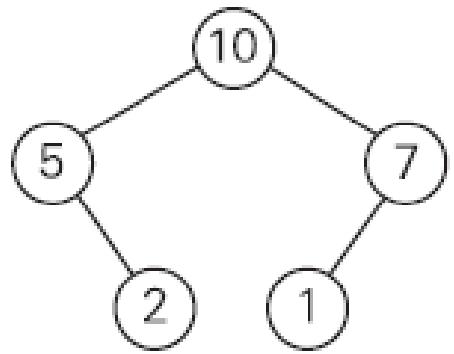


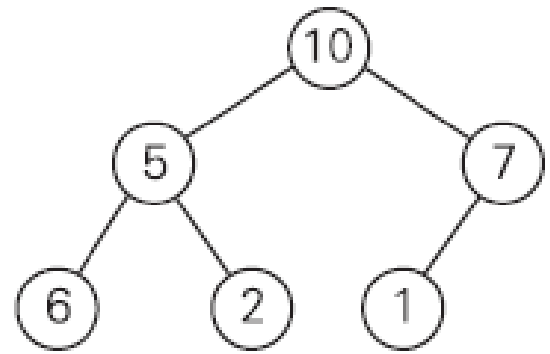
Min Heap

Heap Property

Are these all heap?

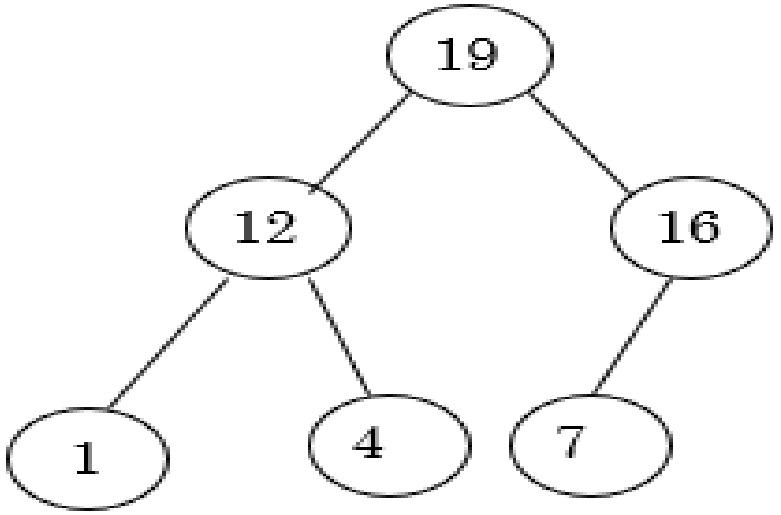






Heap Implementation

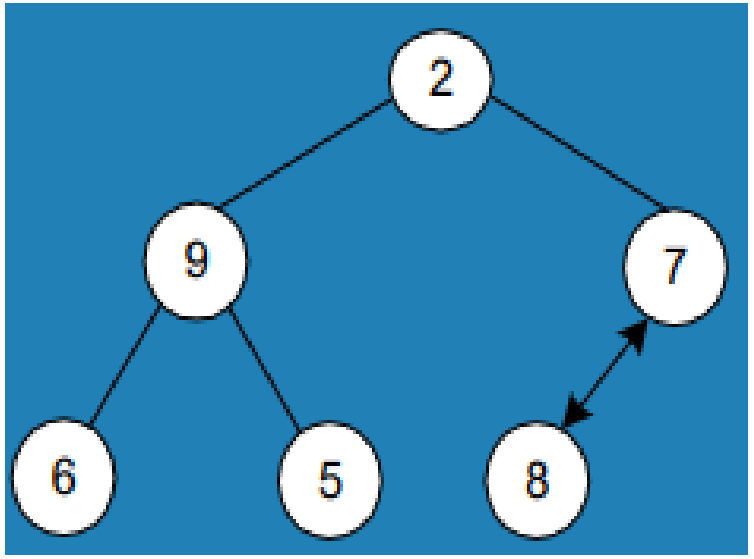
Heaps are commonly implemented with an array.

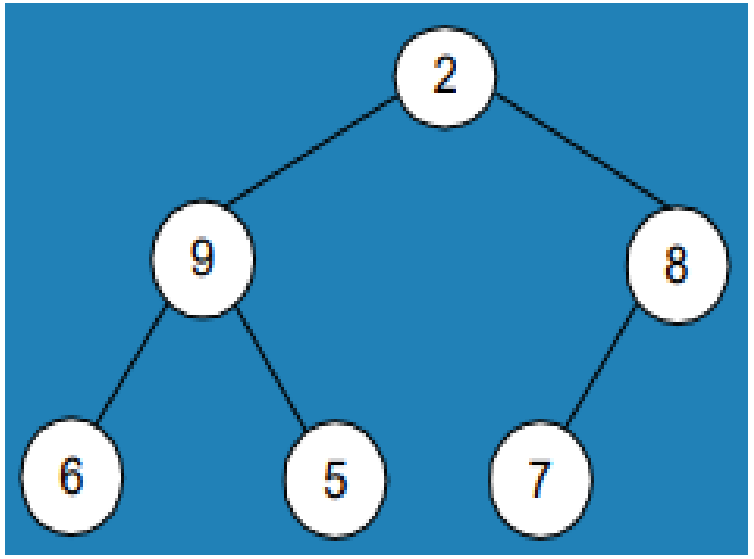


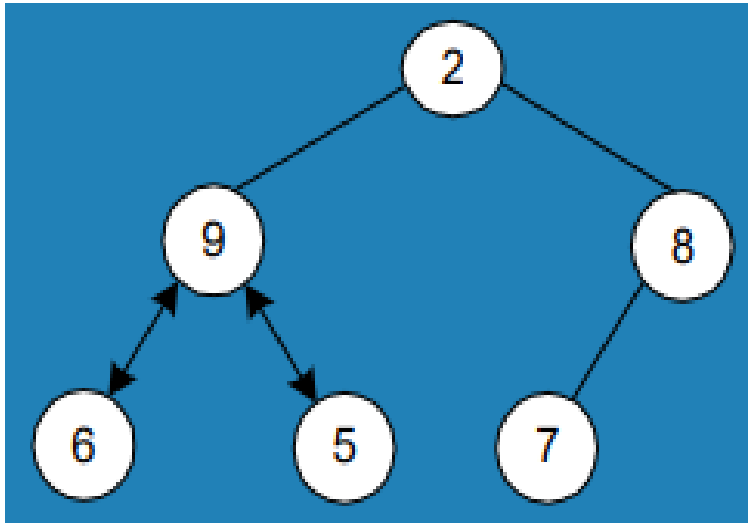
Array A

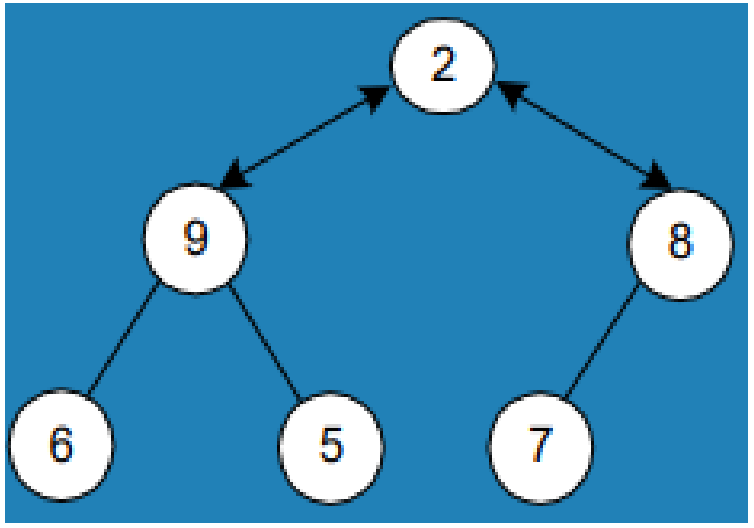
Building/Constructing a heap

Insert the following numbers into an initially empty max heap: 2, 9, 7, 6, 5, 8

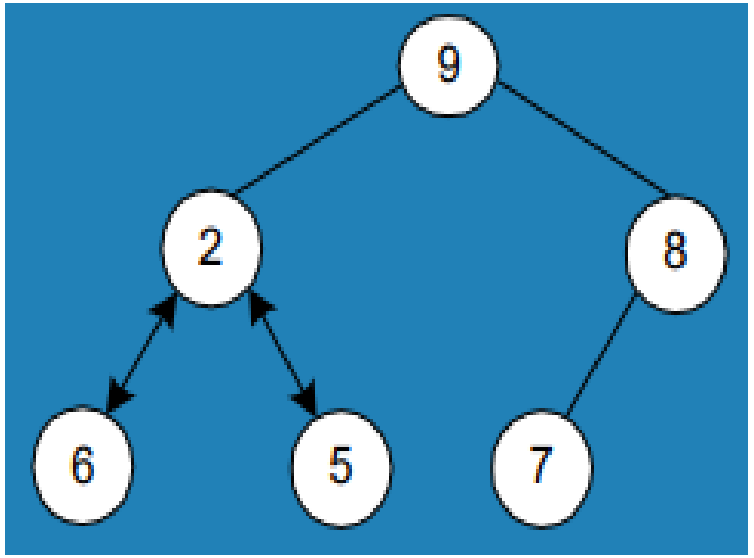


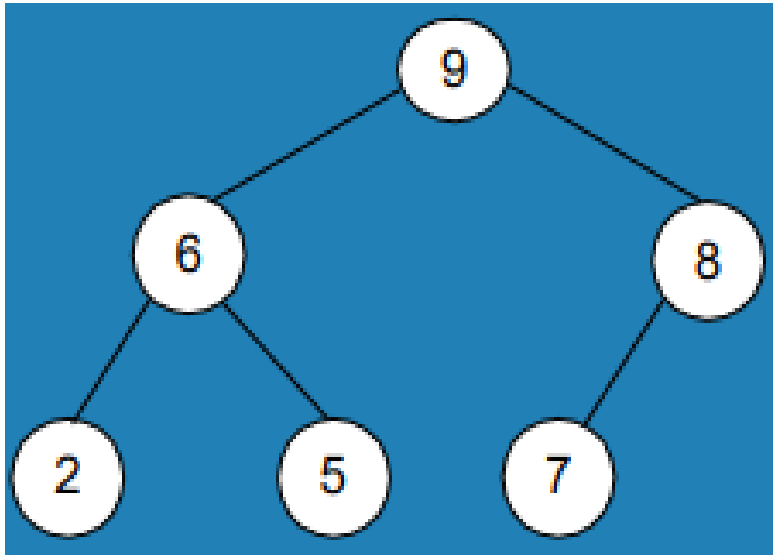






Building/Constructing a heap

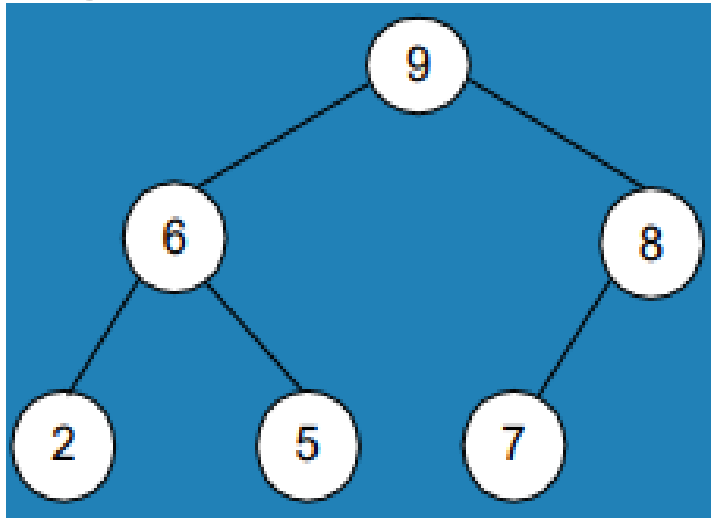


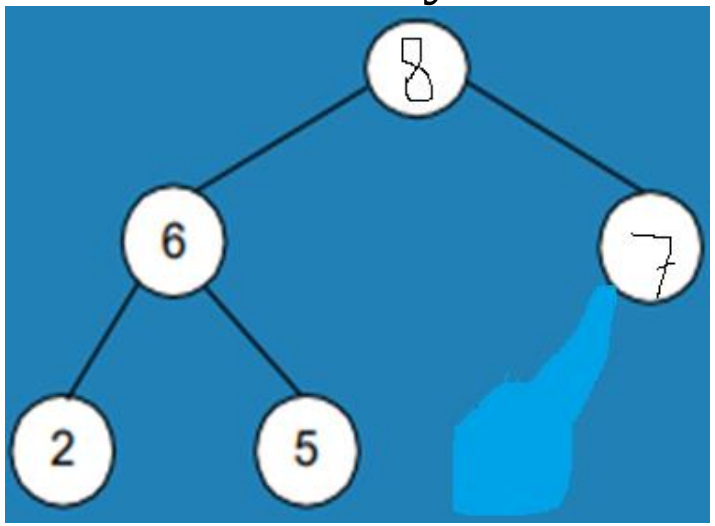


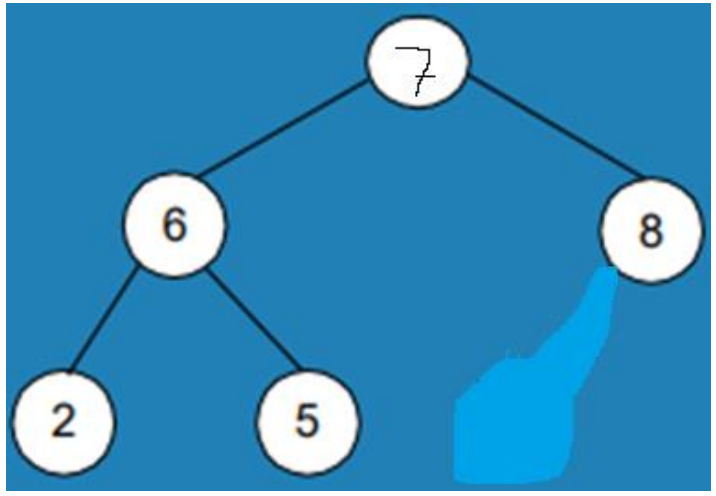
Deleting (node) from a heap

Delheap

We're repeatedly choosing the root (largest item), delete one after another and moving it to the end of our array, finally, return a sorted array of elements.







					9

				8	9

2	5	6	7	8	9

Heapsort

Sort the following numbers 2, 9, 7, 6, 5, 8 by heapsort.

Heapsort is accomplished by building a heap from the given array of elements and then repeatedly delete the root node.

The heapsort algorithm consists of two phases:

Building a heap with the given numbers

Repeatedly delete root n-1 times from the heap that we build already

for both the phases we re-adjust the heap property using heapify

Time complexity : O(nlogn) – in all the cases