

# DATA STRUCTURES & ALGORITHMS

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Heap

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# Heap

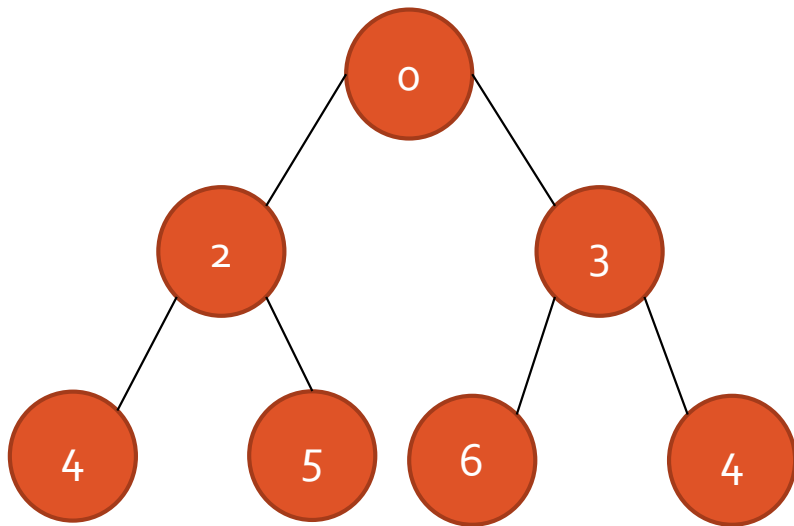
A Heap is a special Tree-based data structure in which the tree is a complete binary tree.

Generally, Heaps can be of two types:

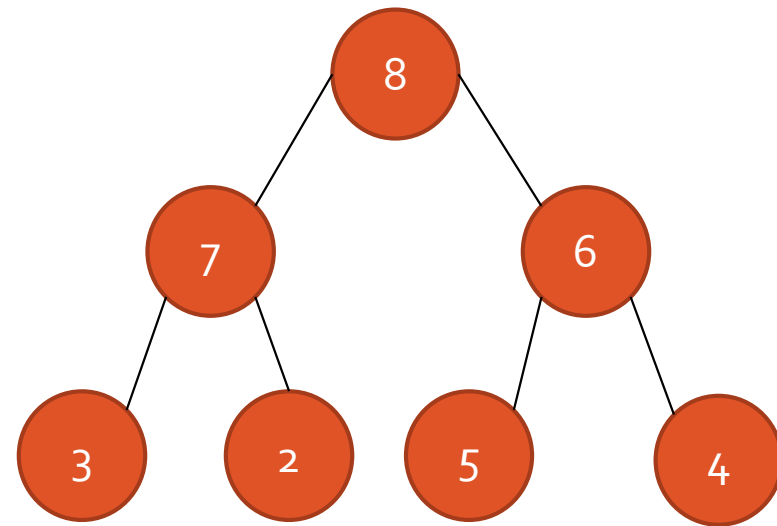
**Min-Heap** – root node is less than or equal to either of its children.

**Max-Heap** – root node is greater than or equal to either of its children.

# Min/ Max Heap



**Min Heap**



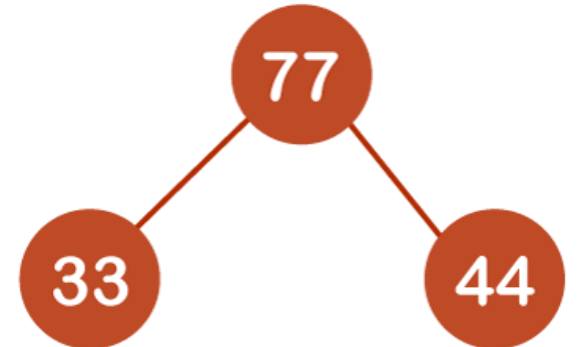
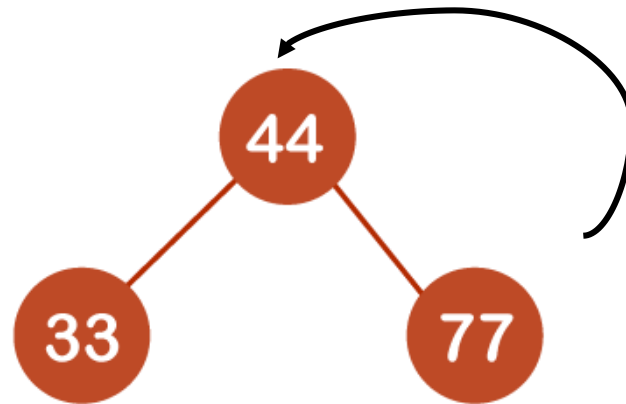
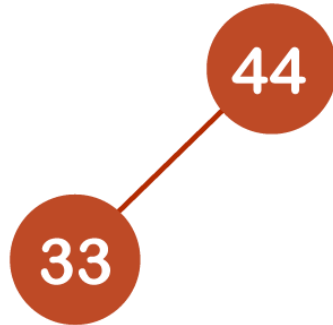
**Max Heap**

# Min/Max Heap Construction Algorithm

1. Create a new node at the end of heap.
2. Assign new value to the node.
3. Compare the value of this child node with its parent.
4. If value of parent is less than/greater than child(min max heap) , then swap them.
5. Repeat step 3 & 4 until Heap property holds.

# Insertion – Max Heap

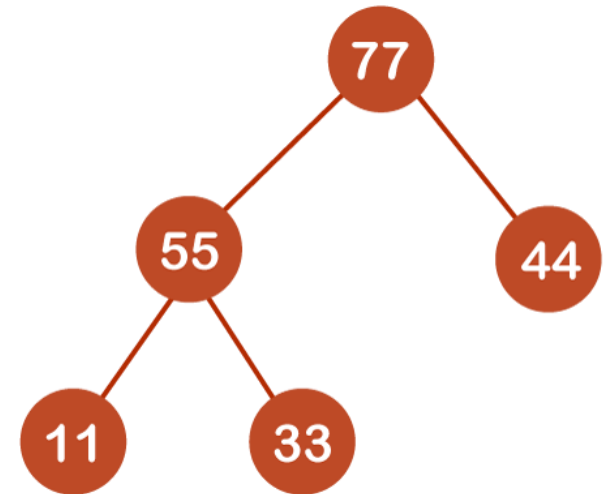
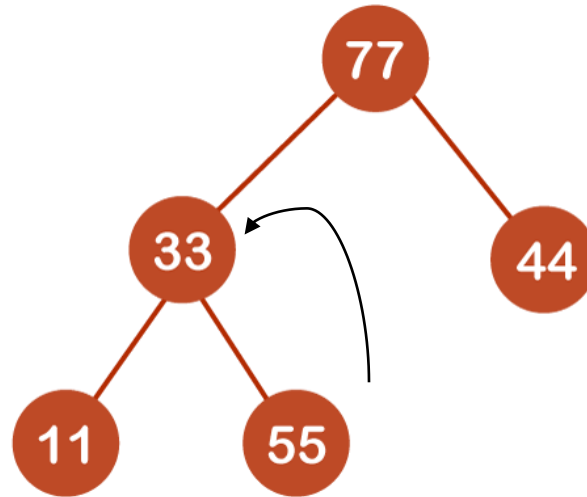
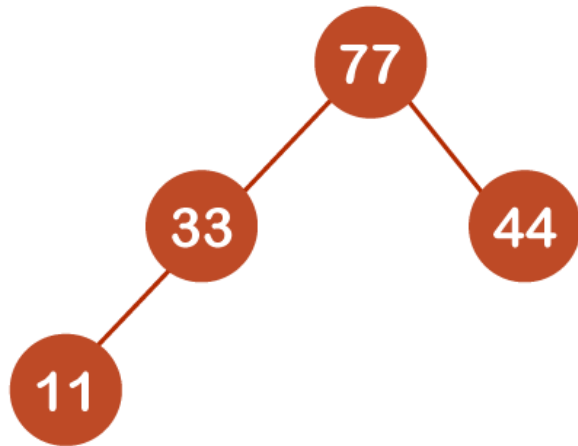
44, 33, 77



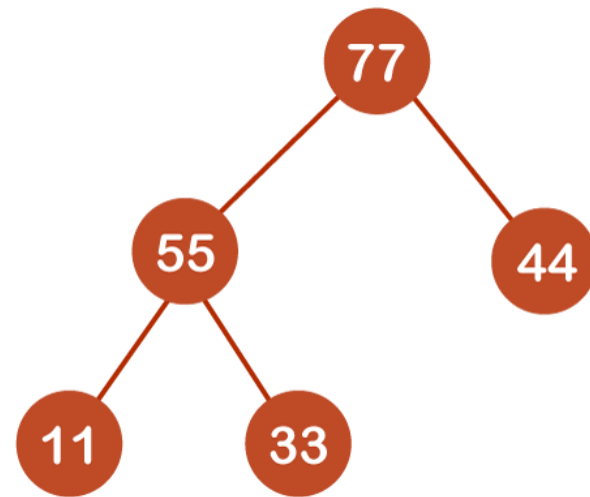
Violates max heap property: swap

# Insertion – Max Heap

11, 55



# Insertion – Max Heap



Insert 88, 66 ?

# Max/Min Heap Deletion Algorithm

1. Remove root node.
2. Move the last element of last level to root.
3. Compare the value of this child node with its parent.
4. If value of parent is less than child, then swap them.
5. Repeat step 3 & 4 until Heap property.

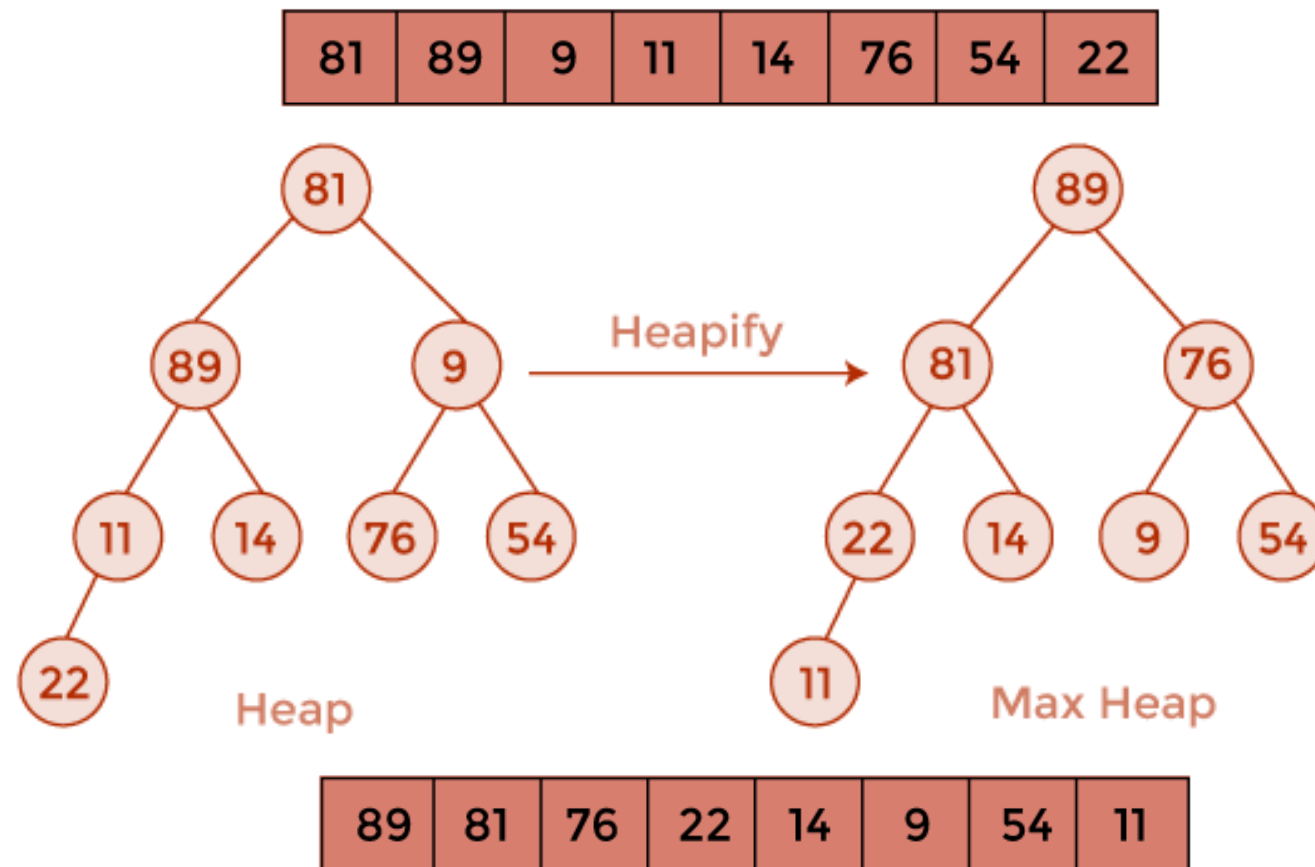


# Heap Sort

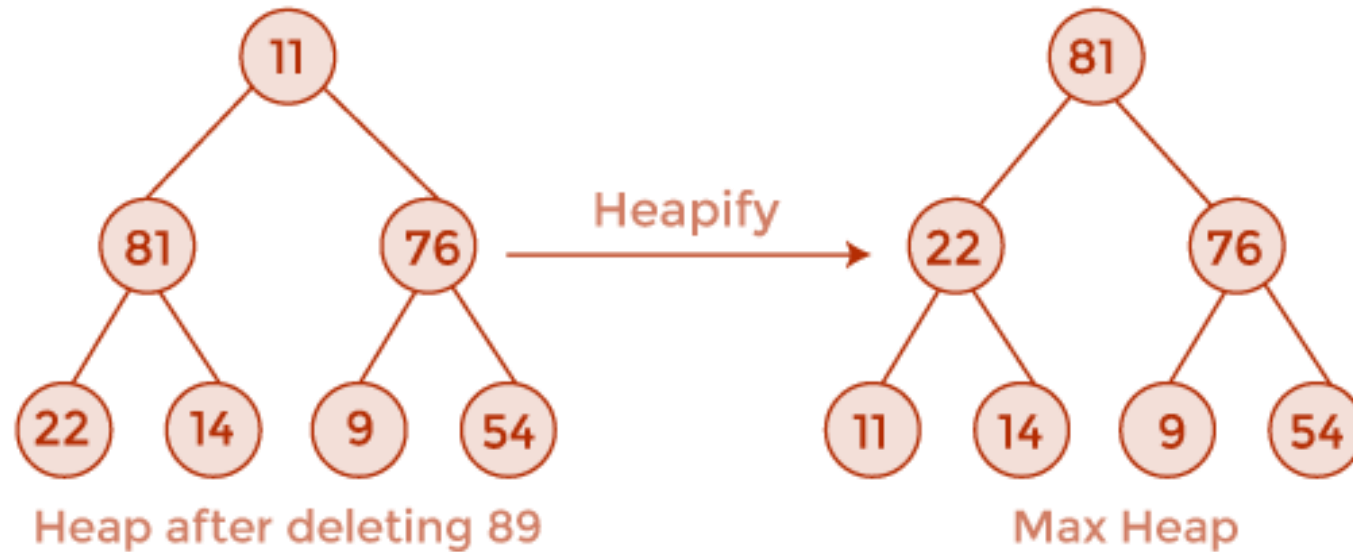
In heap sort, basically, there are two phases involved in the sorting of elements. By using the heap sort algorithm, they are as follows -

- The first step includes the creation of a heap by adjusting the elements of the array.
- After the creation of heap, now remove the root element of the heap repeatedly by shifting it to the end of the array, and then store the heap structure with the remaining elements.

# Heap Sort

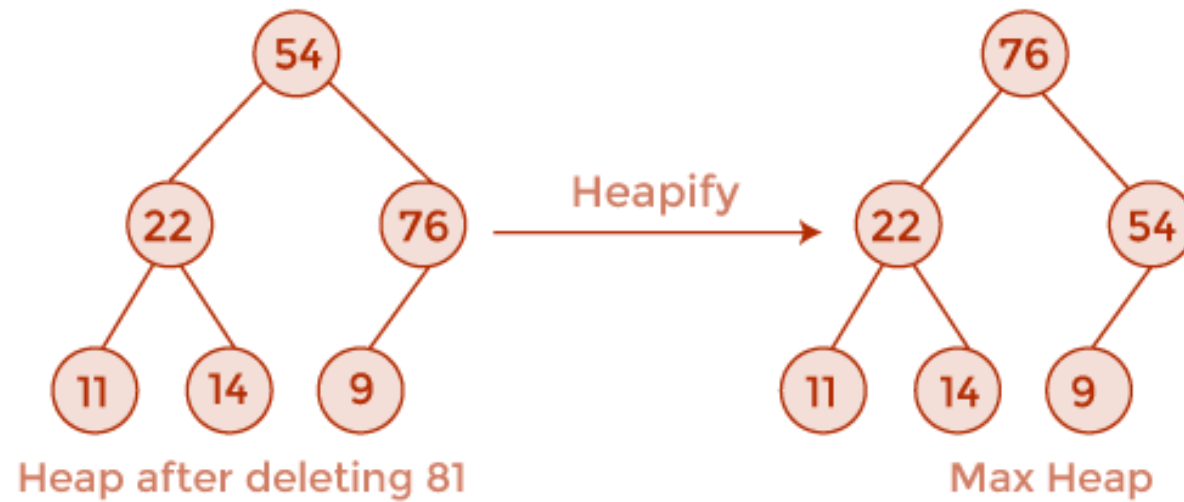


# Heap Sort



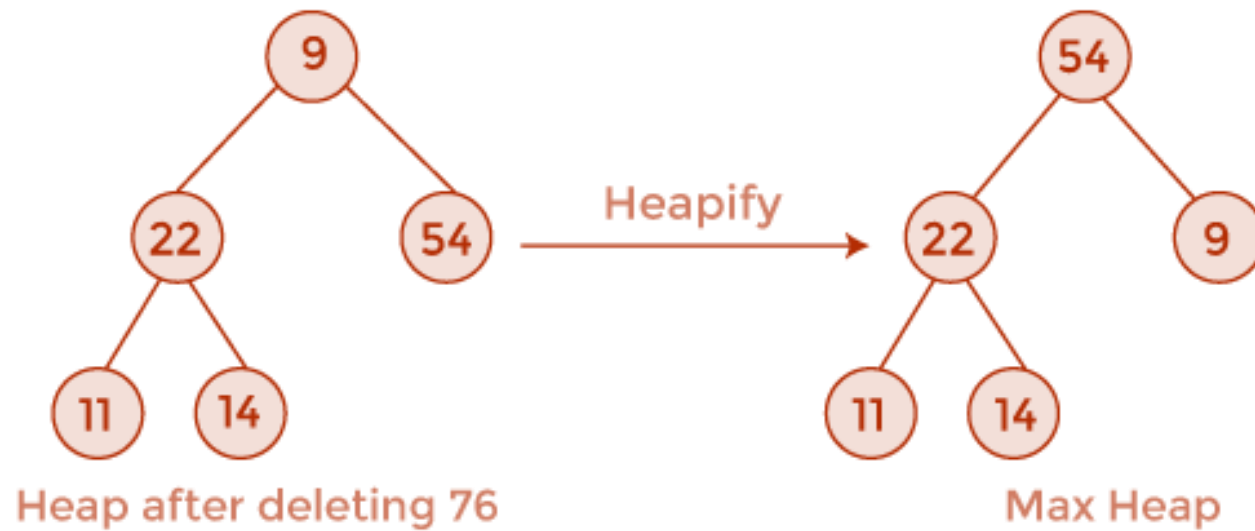
81	22	76	11	14	9	54	89
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# Heap Sort



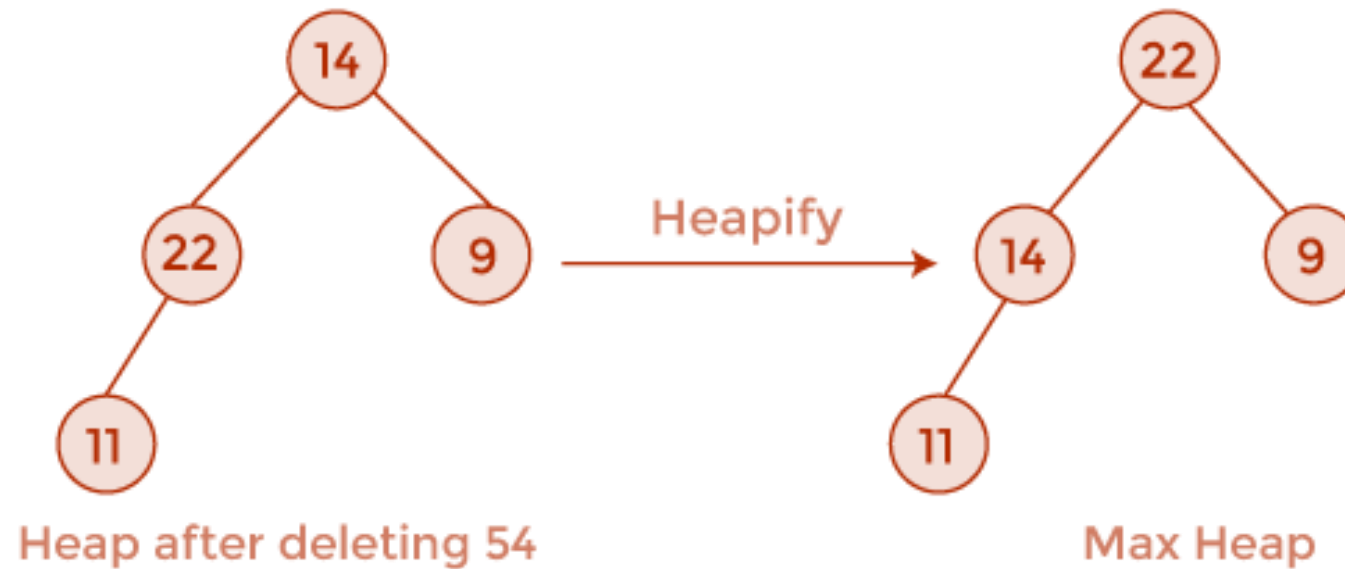
76	22	54	11	14	9	81	89
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# Heap Sort



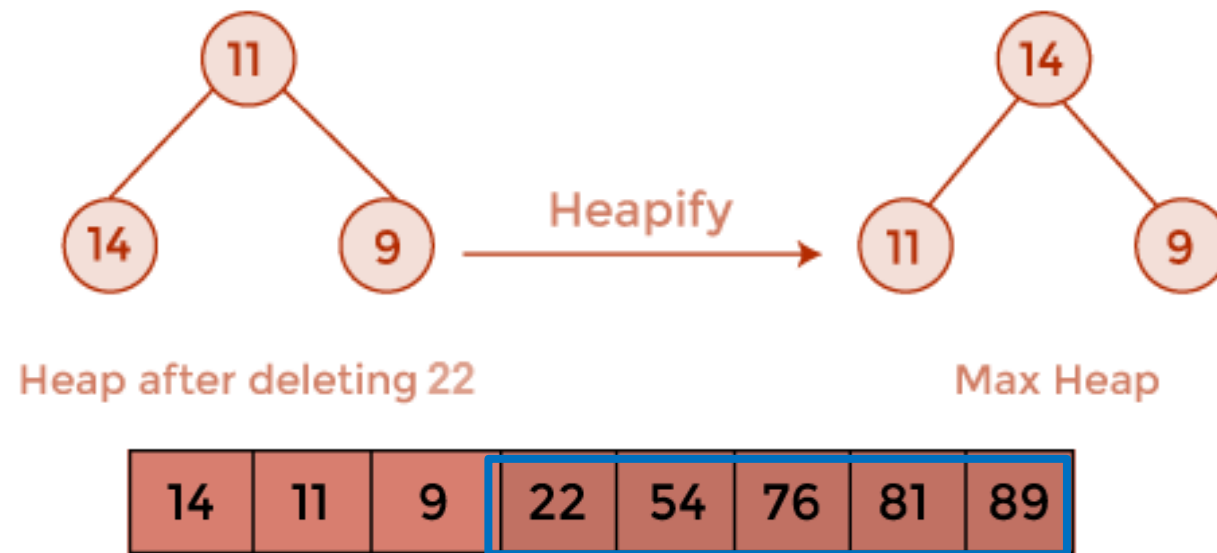
54	22	9	11	14	76	81	89
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# Heap Sort



22	14	9	11	54	76	81	89
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# Heap Sort



# Heap Sort



11	9	14	22	54	76	81	89
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# Heap Sort



9	11	14	22	54	76	81	89
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*Complexity???*