DATA STRUCTURES & ALGORITHMS

Heap

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Heap

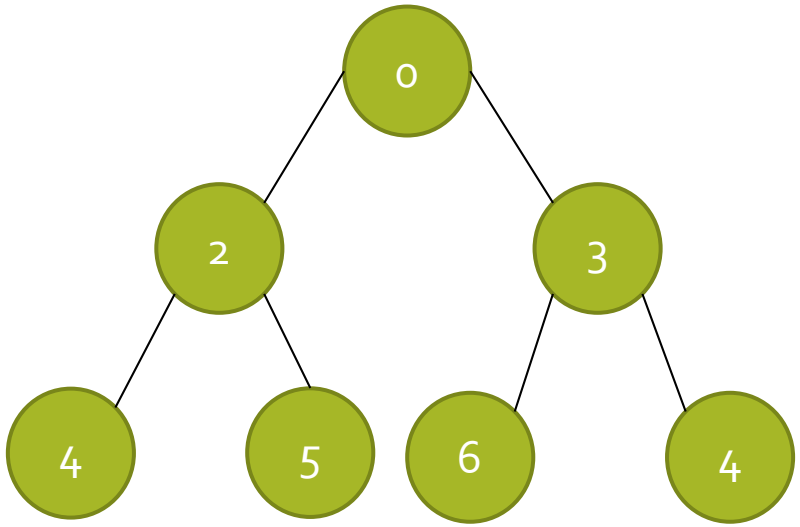
A Heap is a special Tree-based data structure in which the tree is a complete binary tree.

Generally, Heaps can be of two types:

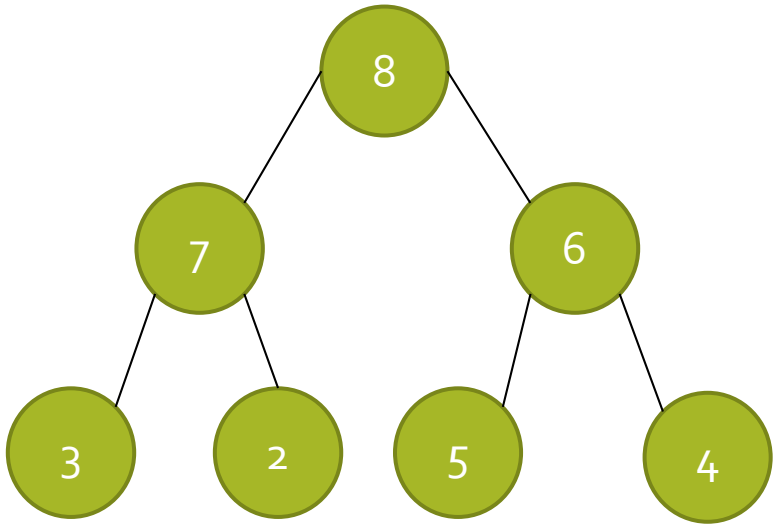
Min-Heap – root node is less than or equal to either of its children.

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

Min/ Max Heap



Min Heap



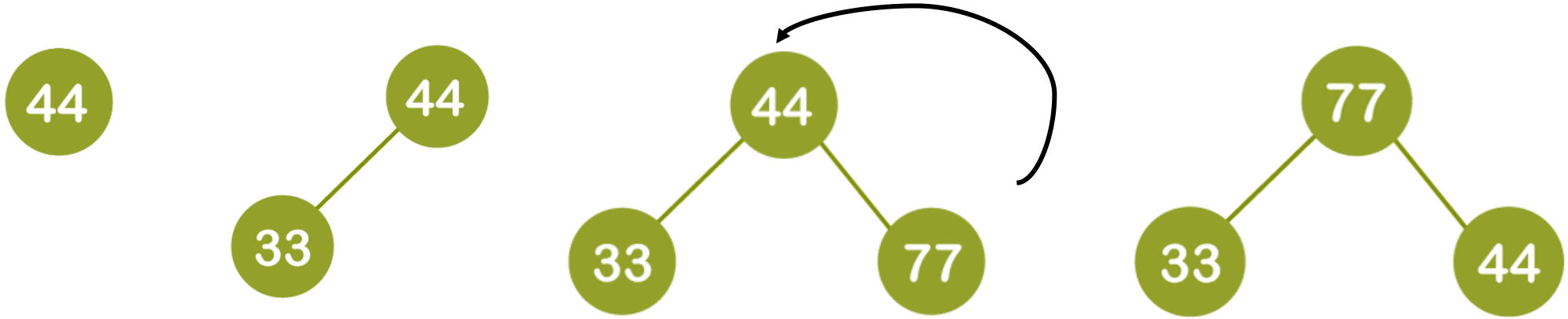
Max Heap

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

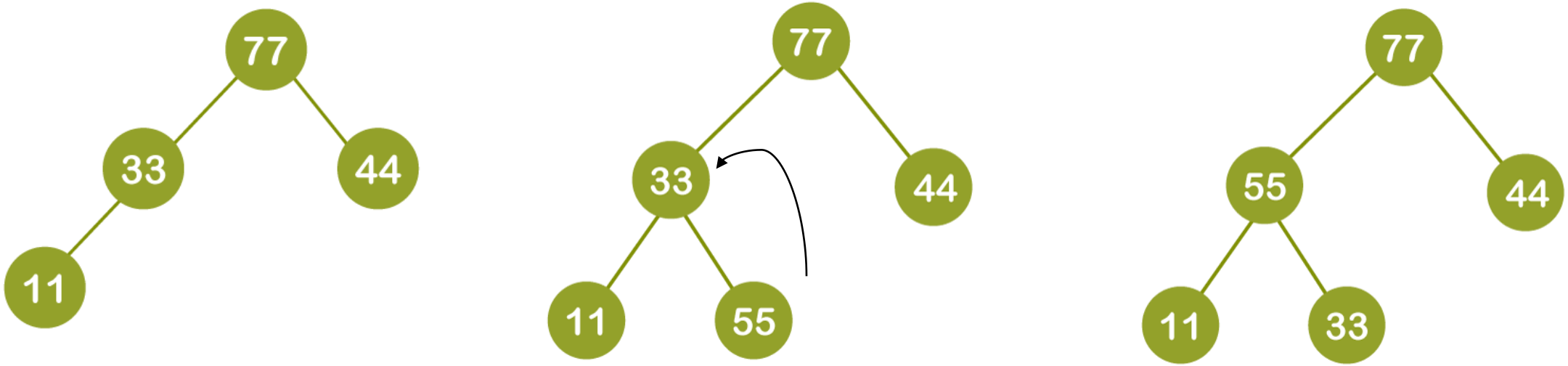
44, 33, 77



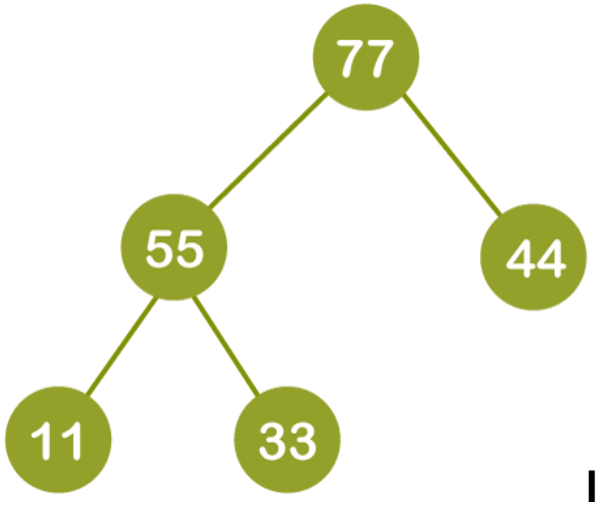
Violates max heap property: swap

Insertion – Max Heap

11, 55

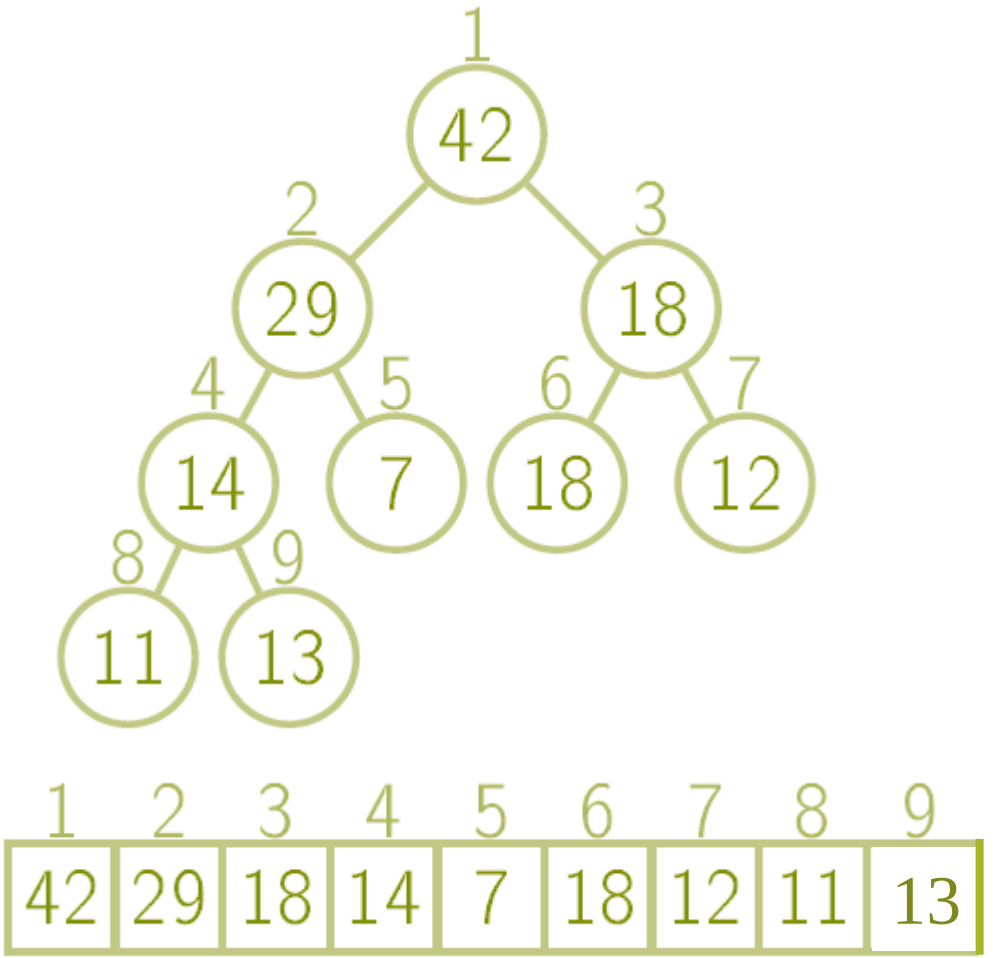


Insertion – Max Heap



Insert 88, 66 ?

Store as Array



parent(i) = ⌊i/2⌋
leftchild(i) = 2i
rightchild(i) = 2i + 1

Max/Min Heap Deletion Algorithm

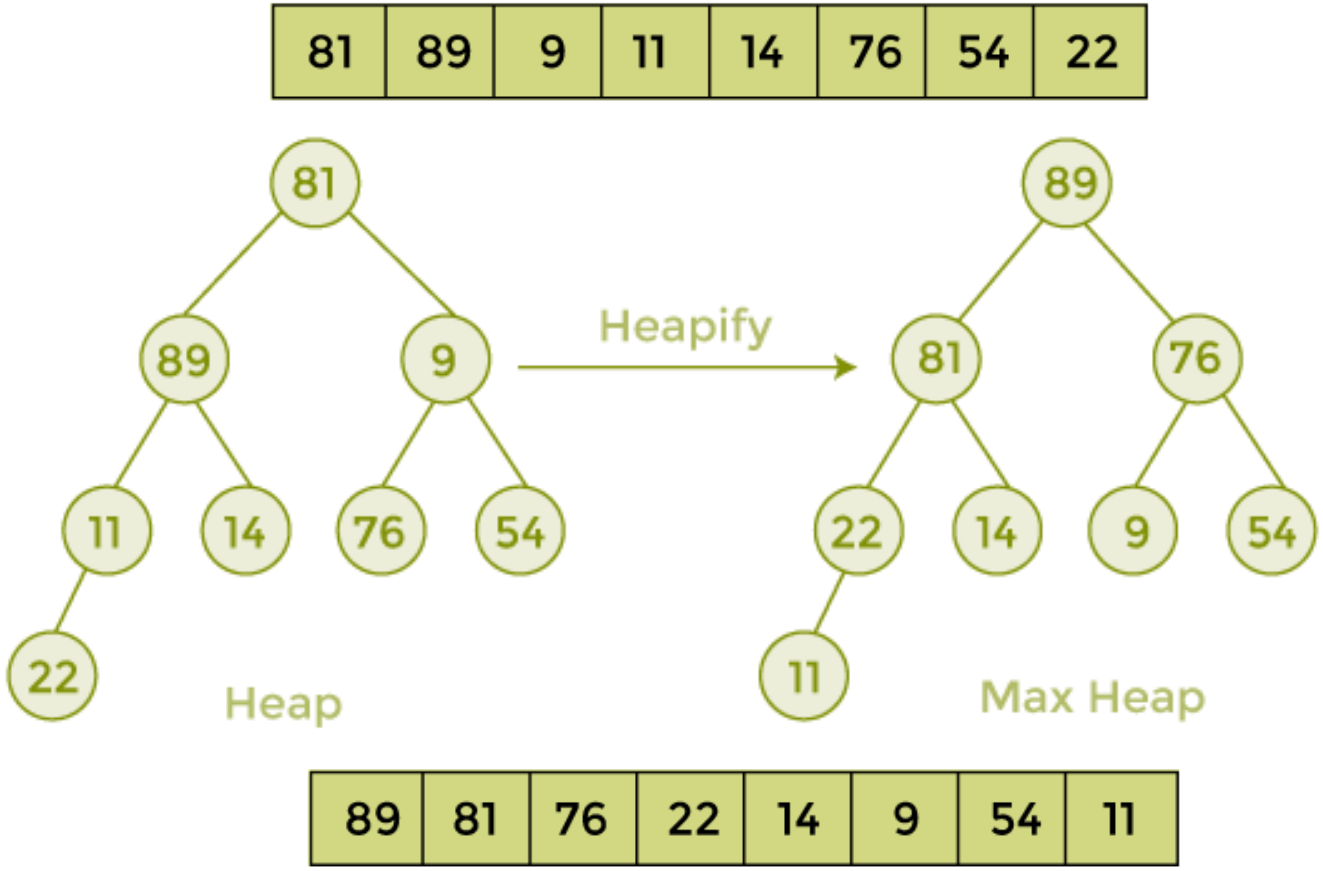
1. Remove root node.
2. Move the last element of last level to root.
3. Compare the value of this child node with its parent.
4. If value of parent is less than child, then swap them.
5. Repeat step 3 & 4 until Heap property.

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.

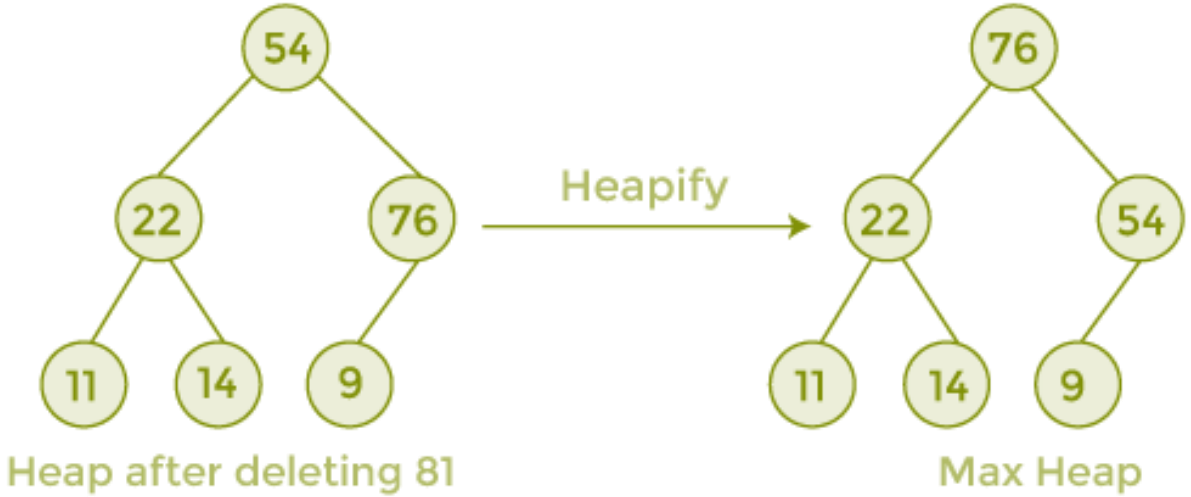
Heap Sort


81 89 9 11 14 76 54 22
81
89
9
11
14
76
54
22
Heap
Heapify
89
81
76
22
14
9
54
11
Max Heap
89 81 76 22 14 9 54 11

Heap Sort

81	22	76	11	14	9	54	89

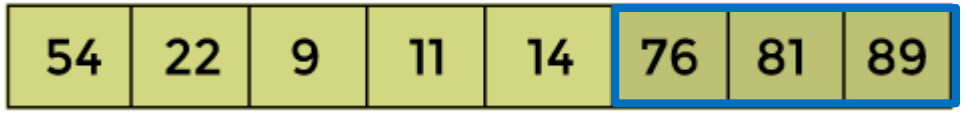
Heap Sort



76	22	54	11	14	9	81	89

Heap Sort


9
22
54
11
14
Heapify
54
22
9
11
14
Heap after deleting 76
Max Heap


54
22
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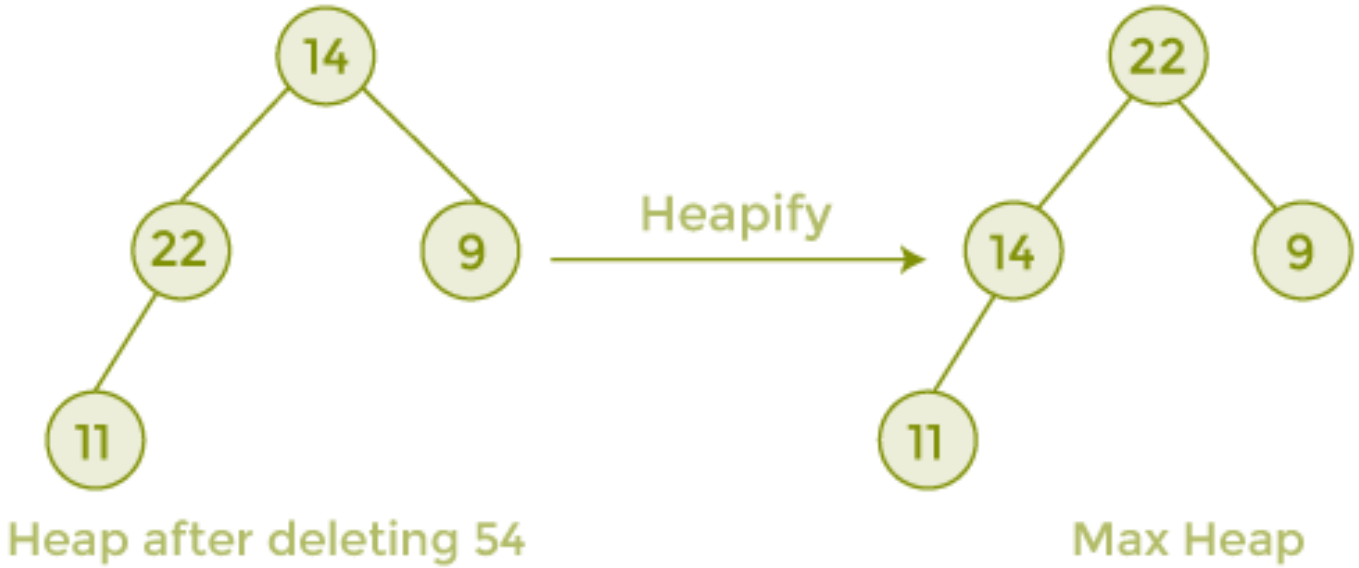
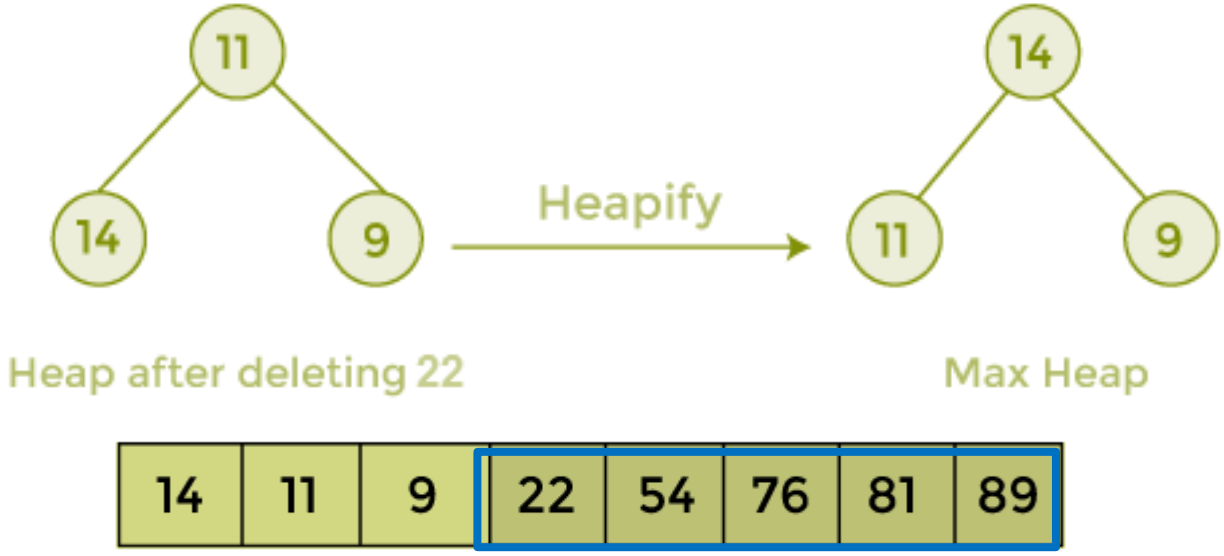
89

Heap Sort


14
22
9
11
Heapify
22
14
9
11
Heap after deleting 54
Max Heap


22
14
9
11
54
76
81
89

Heap Sort


11
14
9
Heapify
14
11
9
Heap after deleting 22
Max Heap
14
11
9
22
54
76
81
89

Heap Sort

11	9	14	22	54	76	81	89

Heap Sort

Complexity???