

THE HEAPSORT ALGORITHM **WITH HEAPIFY.**



Consider a set of elements
{12,34,56,73,24,11,34,56,78,91,34,91,45}. Sketch
the heapsort algorithm and use it to sort this set.
Obtain a derivation for the time complexity of
heapsort, both the worst case and average case
behaviour.

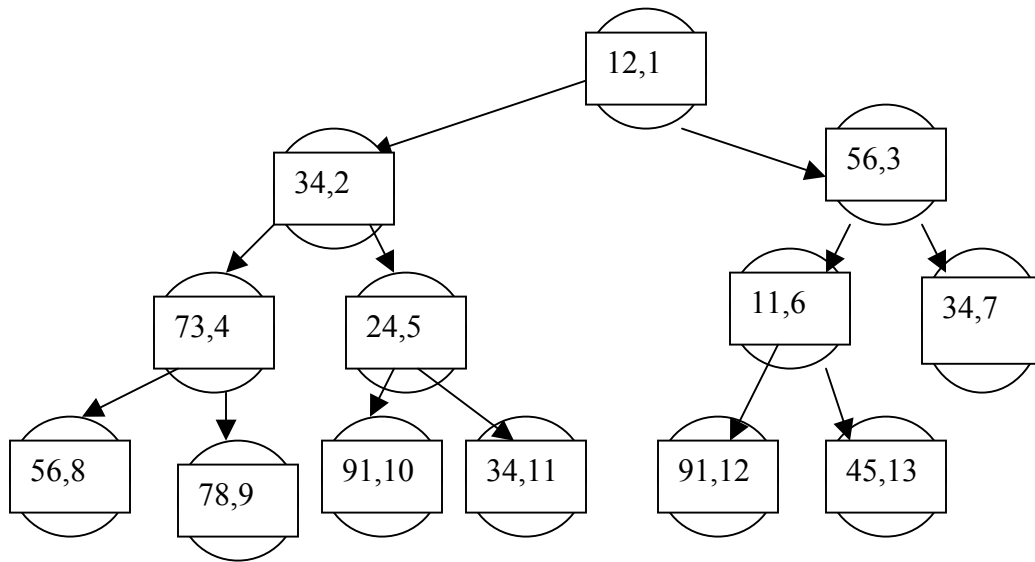
**COMPLEXITY
TO BUILD HEAP
WITH HEAPIFY
 $O(n)$**

COMPLEXITY ANALYSIS OF HEAPIFY

SIMULATION OF HEAPIFY

INITIAL

12	34	56	73	24	11	34	56	78	91	34	91	45
1	2	3	4	5	6	7	8	9	10	11	12	13

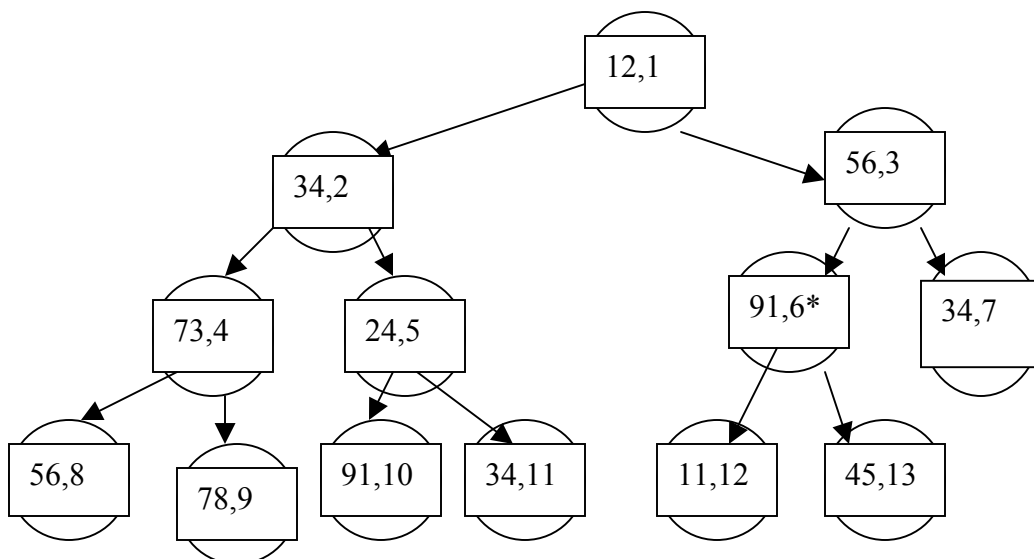


Number of elements = 13 = n; $I = \text{floor}(n/2) = 6$

So consider the heap with 6 as root, the left subtree is a one element heap, the right subtree is a one element heap, and the root may be violating the heap property.

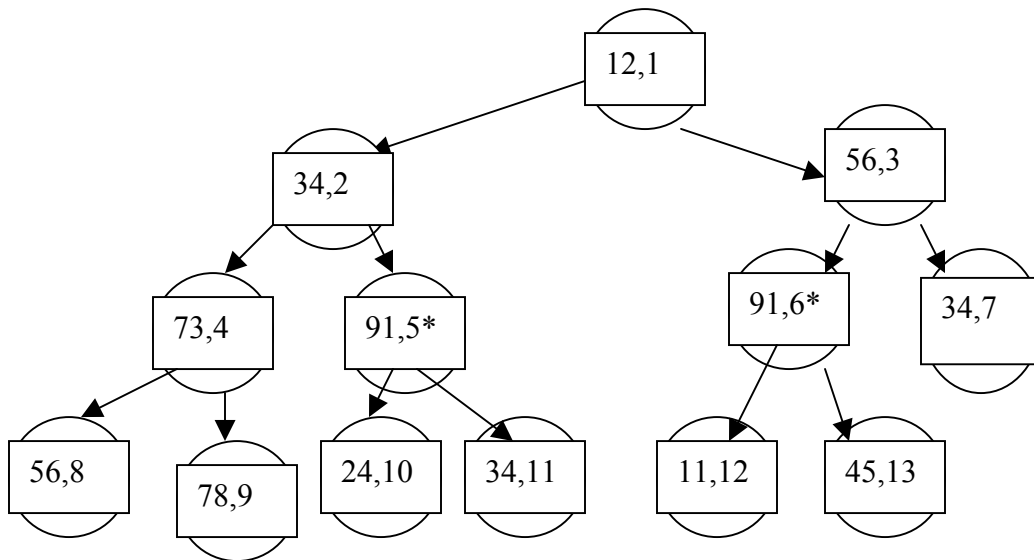
So 11 comes down and 91 becomes the 6th node.

12	34	56	73	24	91	34	56	78	91	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13



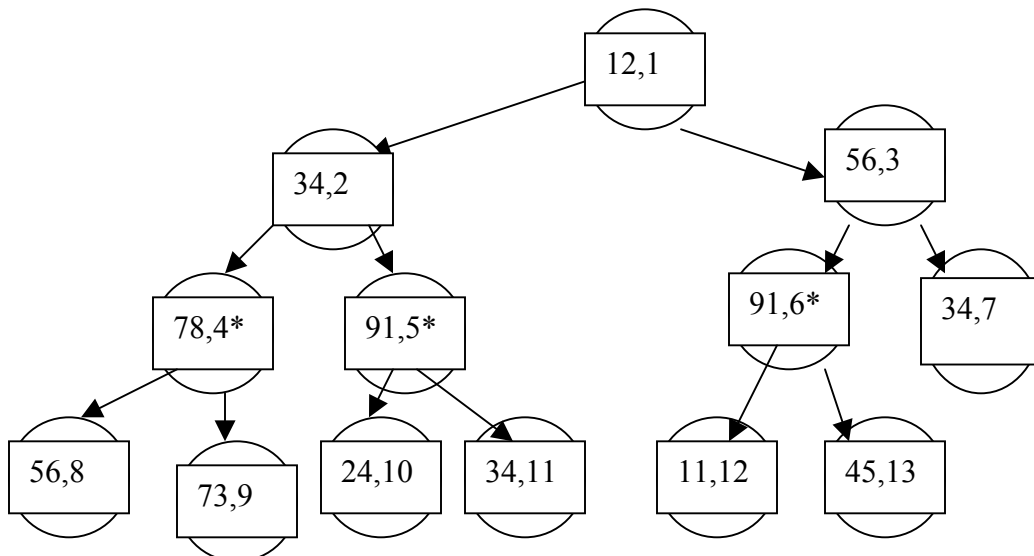
Now let $I=5$. We have the heap with 5 as root and left subtree is a one element heap and the right subtree is a one element heap. The element at 5 is violating the heap property, so let 91 come up to position 5, and 24 go down to position 10.

12	34	56	73	91	91	34	56	78	24	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13



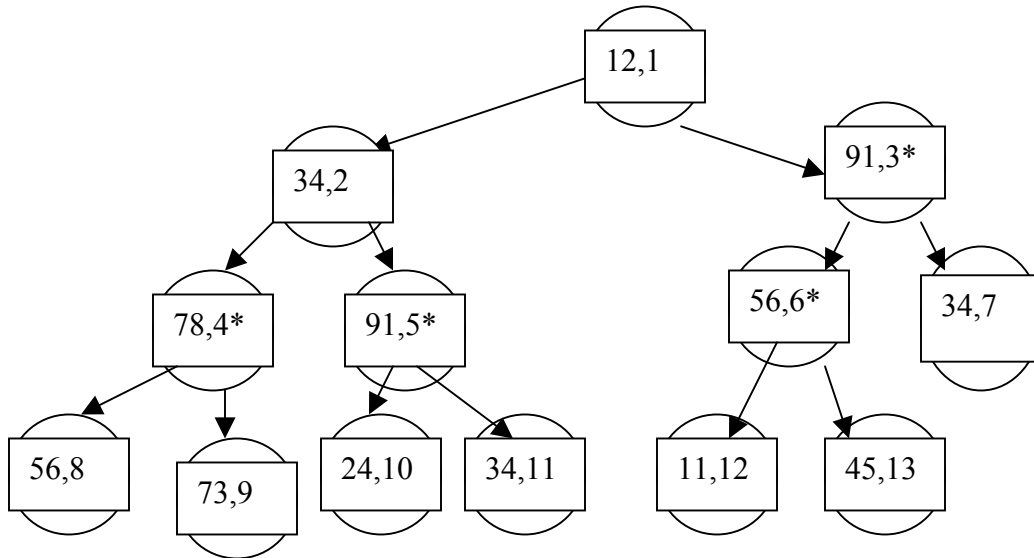
Now let $I=4$. We have the heap with 4 as root and left subtree is a one element heap and the right subtree is a one element heap. The element at 4 is violating the heap property, so let 78 come up to position 4, and 73 go down to position 9.

12	34	56	78	91	91	34	56	73	24	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13



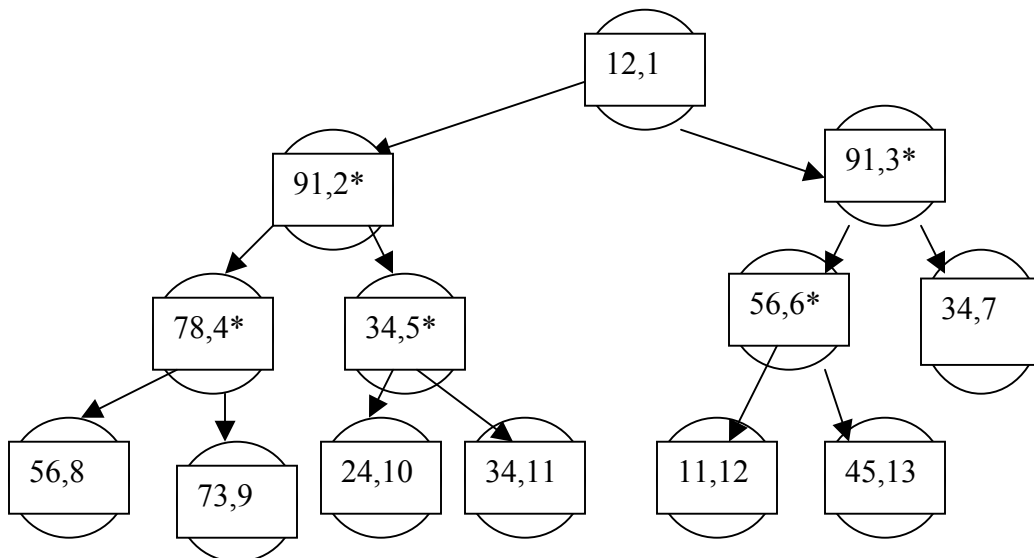
Now let $I=3$. We have the heap with 3 as root and left subtree is a heap and the right subtree is a one element heap. The element at 3 is violating the heap property, so let 91 come up to position 3, and 56 go down to position 6.

12	34	91	78	91	56	34	56	73	24	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13



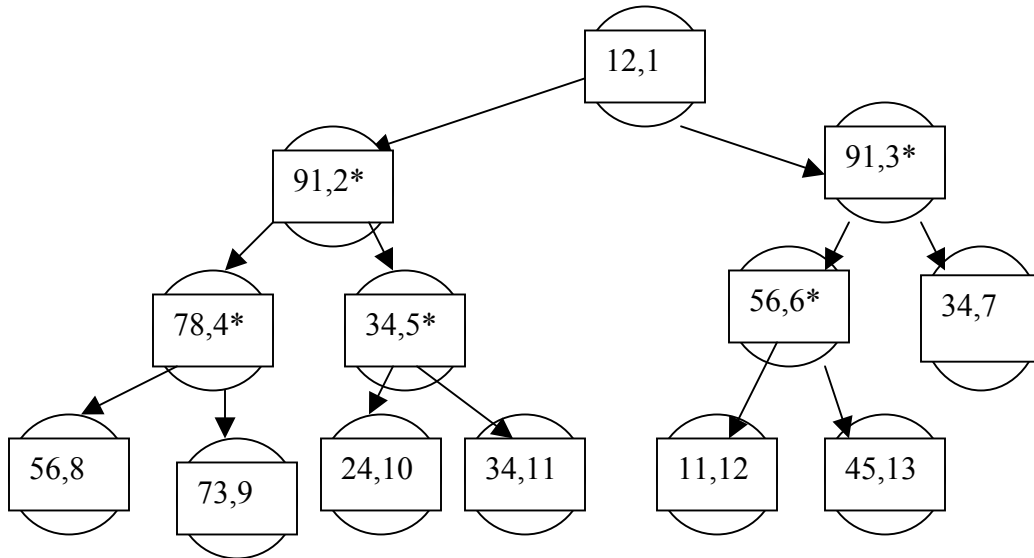
Now let $I=2$. We have the heap with 2 as root and left subtree is a heap and the right subtree is a heap. The element at 2 is violating the heap property, so let 91 come up to position 2, and 34 go down to position 5.

12	91	91	78	34	56	34	56	73	24	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13



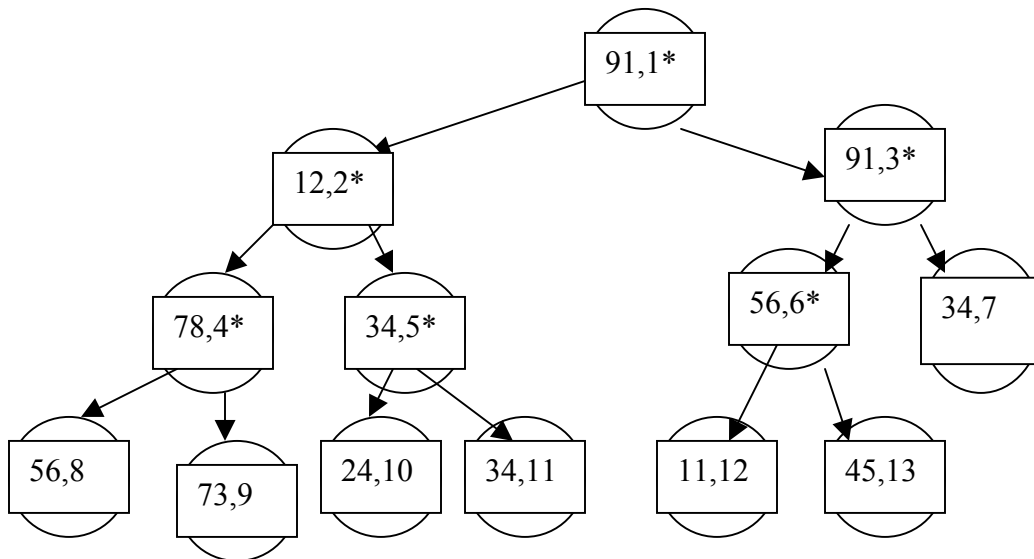
Now let $I=1$. We have the heap with 1 as root and left subtree is a heap and the right subtree is a heap. The element at 1 is violating the heap property, so let 91 come up to position 1, and 12 go down to position 2.

12	91	91	78	34	56	34	56	73	24	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13

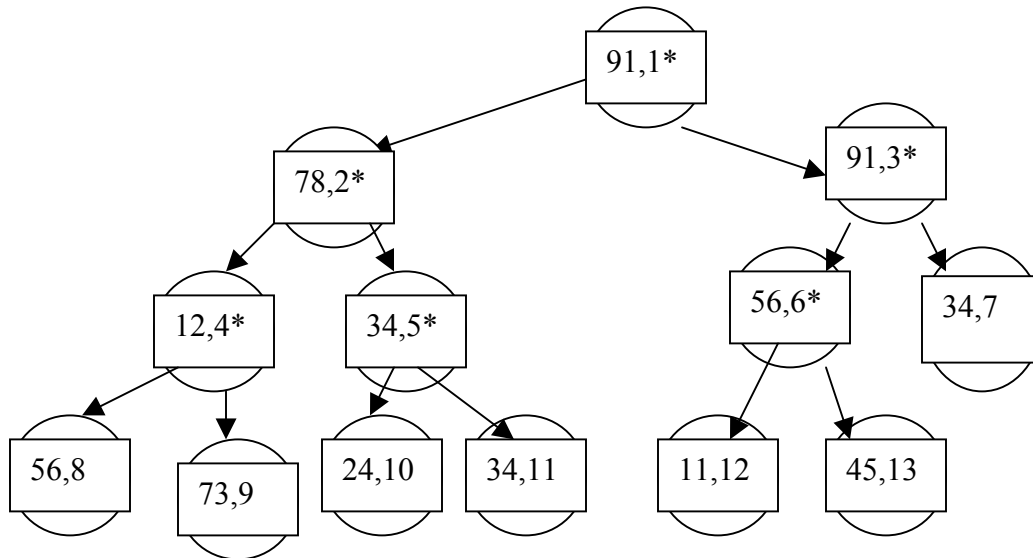


Now let $I=1$. We have the heap with 1 as root and left subtree is a heap and the right subtree is a heap. The element at 1 is violating the heap property, so let 91 come up to position 1, and 12 go down to position 2.

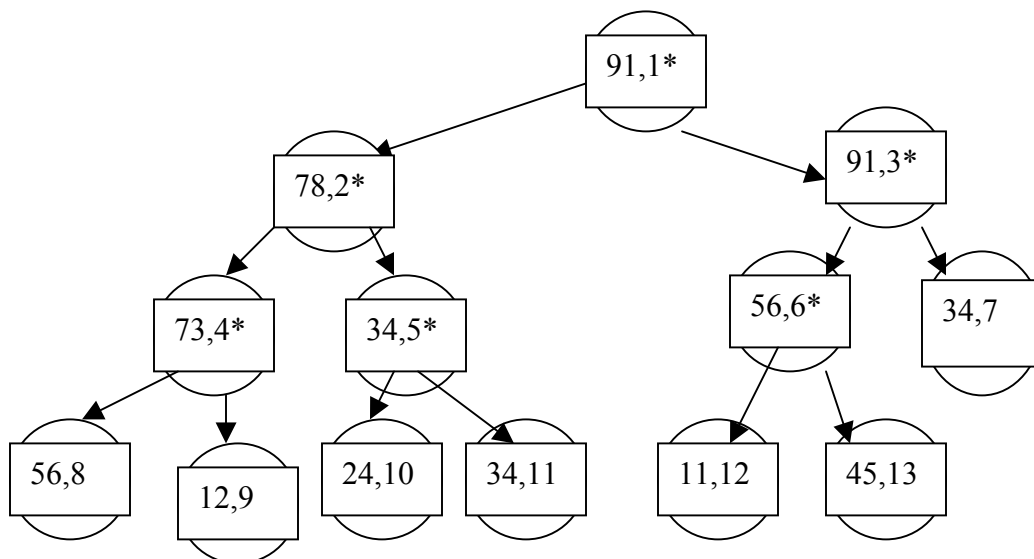
91	12	91	78	34	56	34	56	73	24	34	11	45
1	2	3	4	5	6	7	8	9	10	11	12	13



Now 12 is compared with its two children, 78 came up and 12 comes down,



Now 12 is compared with its two children, 73 moves up and 12 moves down.



**THE HEAP HAS BEEN FORMED AT LAST.
 NOW HEAPSORT CAN BE IMPLEMENTED, THE SIMULATION IS AS IN
<http://www.gateguru.com/algorithms/heapsort.pdf>**