CSCI 532 – Algorithm Design
Assignment 2

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Question 1: What are the minimum and maximum number of elements in a heap of height h?

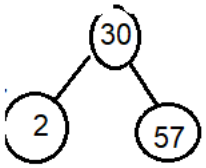
Solution:
The no. of edges in the longest possible path from the parent node to the last leaf node is the height of the node.
For given height h, the maximum number of elements in the heap is $\mathbf{2^{h+1}-1.}$
The minimum number of elements in the heap is $\mathbf{2^{h}}$.

Question 2: Show that an n-element heap has height (lg n).

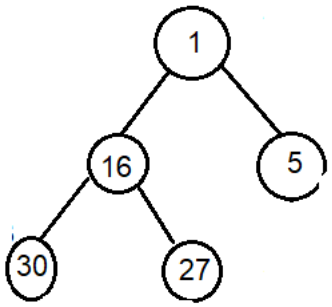
Solution:

Let's consider a binary tree

1) In the case of 3 nodes, the height of the node is 1. [The no. of edges from the parent node to the leaf node]



2) In the case of 5 nodes, the height of the node is 2



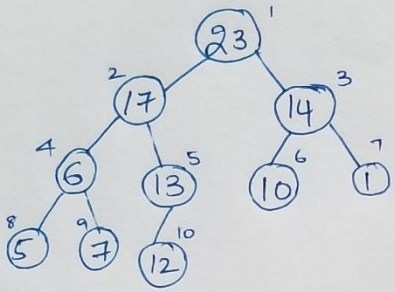
Likewise, in the case of 7 nodes the height is 2, for 15 nodes the height is 3 and for 31 nodes the height is 4.
Hence, for the n nodes the height is **(log n)**

Question 3: Is the array with values {23,17,14,6,13,10,1,5,7,12} a max-heap?

Solution:

3) Given array is {23, 17, 14, 6, 13, 10, 1, 5, 7, 12}

It can be written in tree as



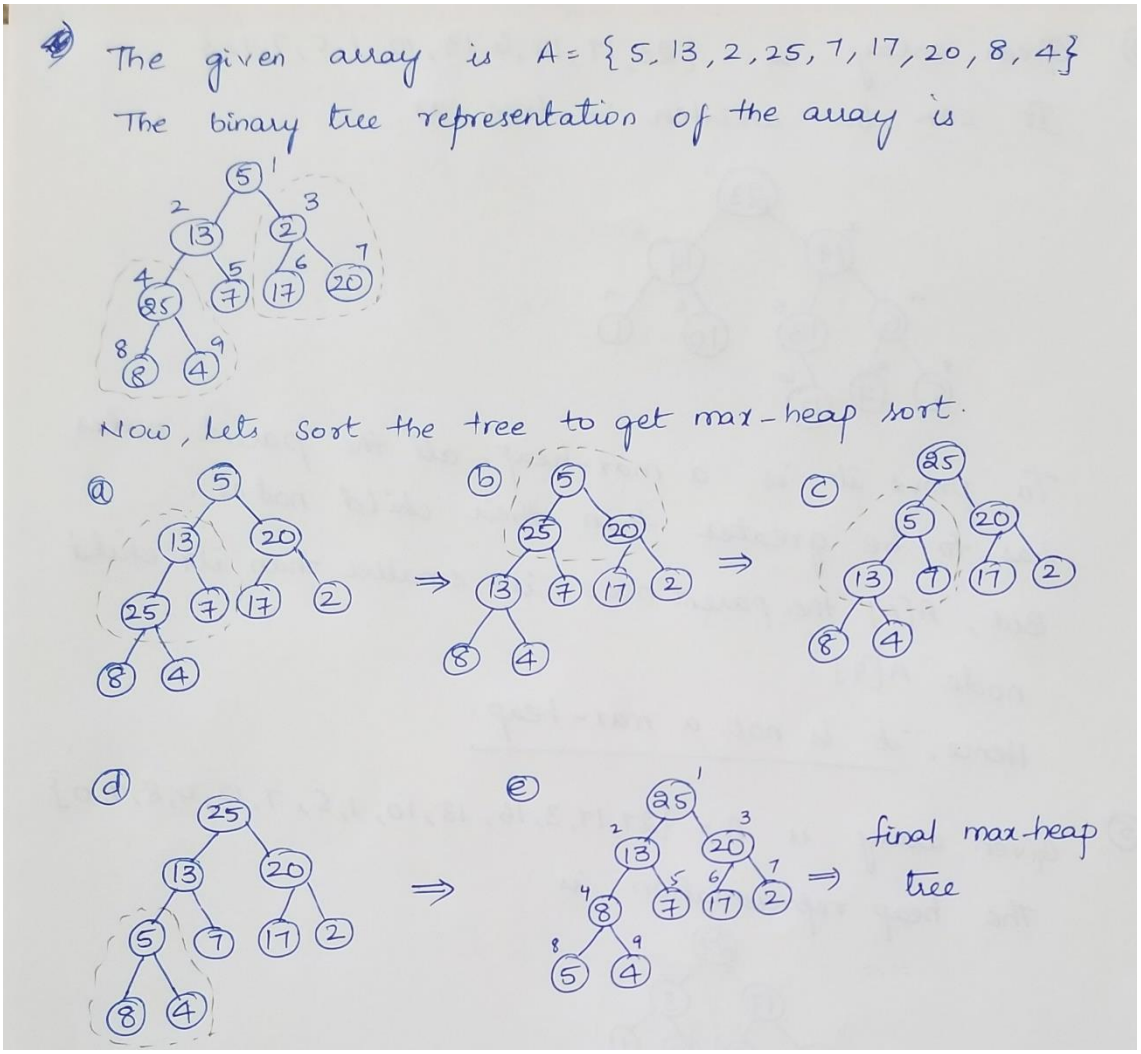
To prove it is a max-heap, all the parent nodes has to be greater than their child nodes.

But, A[6] the parent node is smaller than its child node A[9].

Hence, it is not a max-heap.

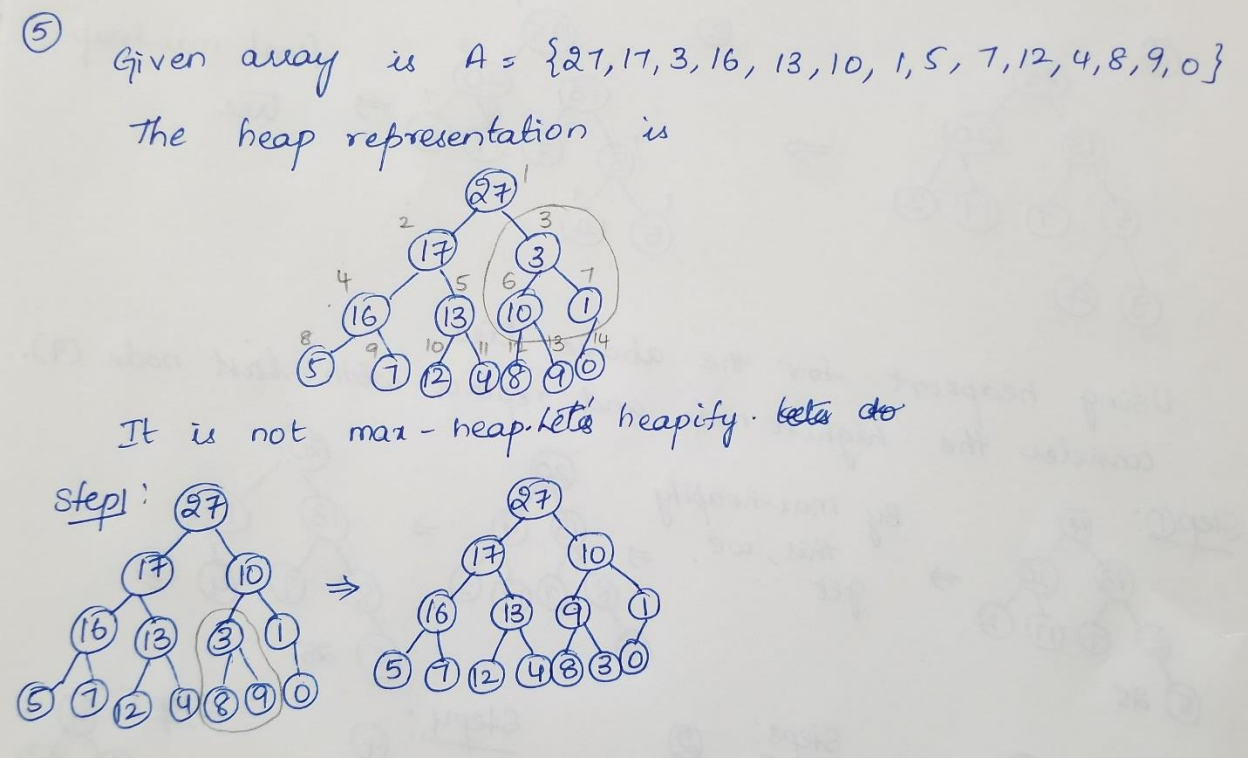
Question 4: Illustrate the operation of heapsort on the array A = {5,13,2,25,7,17,20,8,4}.

Solution:



Question 5: Illustrate the operation of Max-Heapify(A,3) on the array A = {27,17,3,16,13,10,1,5,7,12,4,8,9,0}

Solution:



Question 6: Using Figure 6.4 as a model, illustrate the operation of HEAPSORT on the array A = [5, 13, 2, 25, 7, 17, 20, 8, 4].

Solution: