

Name: (Print) PHONG VO**Heap and its application**

1. (10 points)

(1) Consider the given heap  $\langle 35, 15, 26, 13, 10, 8, 12 \rangle$ , what is the content of the array after two delete operations?

(A) 15,13,12,10,8

(B) 15,12,13,8,10

(C) 15,13,8,12,10

☒ (D) 15,13,12,8,10

(2) A **3-ary max-heap** has the same heap-property as a binary max-heap that we have learned. The only difference is that, instead of 2 children, nodes have 3 children. A 3-ary heap can be represented by an array A as follows:

(1) The root is stored in the first location, A[1];

(2) nodes in the next level, from left to right, is stored from A[2] to A[4].

(3) The nodes from the second level of the tree from left to right are stored from A[5] location onward.

Which one of the following is a valid sequence of elements in an array representing 3-ary max-heap? Circle the correct answer.

(A) 1, 3, 5, 6, 8, 10

(B) 10, 6, 3, 1, 8, 5

(C) 10, 3, 6, 8, 5, 1

☒ (D) 10, 5, 6, 8, 3, 1

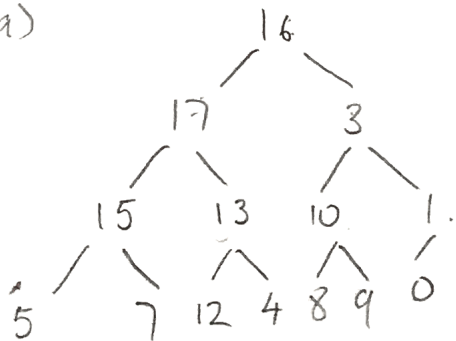
(2). (25 points) Consider the given array  $\langle 16, 17, 3, 15, 13, 10, 1, 5, 7, 12, 4, 8, 9, 0 \rangle$

(a) Is this a **binary max-heap**? Justify the answer.

(b) If your answer is yes in (1), show the heap in its **binary tree view**.

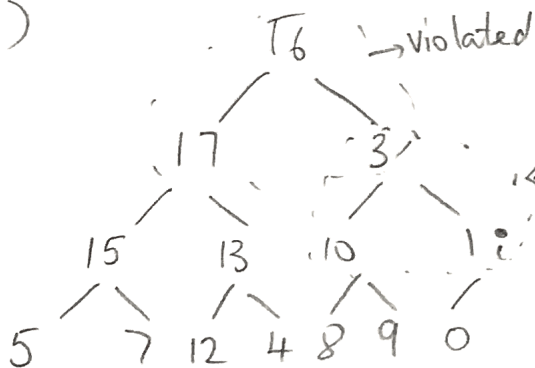
If your answer is no, make it a max-heap using the algorithm that we have learned. Show detailed steps of how to get the max-heap. You may use the tree view to show the changes. Show a tree for each change (a swap) in the array. Also, show the final answer (the max heap) in an array view.

(a)



is not a binary max-heap because root (16) is less than its child (17) ✓

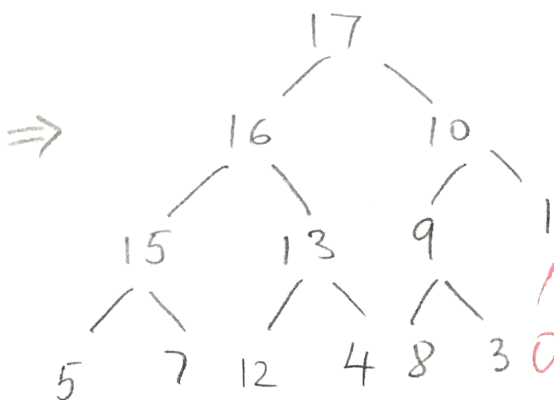
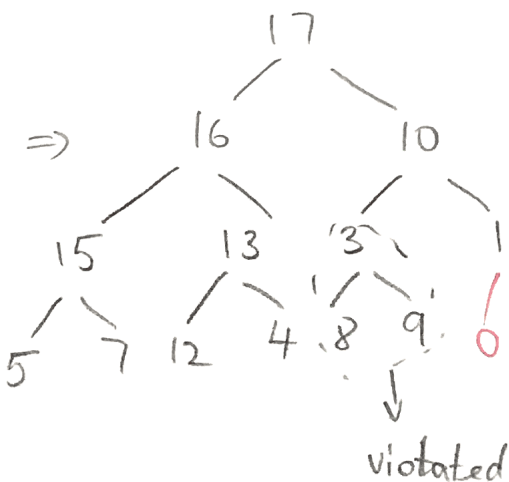
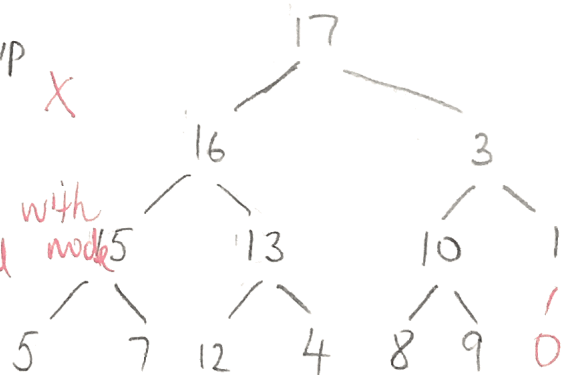
(b)



Fixup

⇒ X

should start with first internal node but not the top



⇒ array view =  $\langle 17, 16, 10, 15, 13, 9, 1, 5, 7, 12, 4, 8, 3, 0 \rangle$