Student Information

Name: _____   Student ID: _____

Due Date: 02 Oct 11:59pm.

Submit answers on eDimension in pdf format. Submission without student information will **NOT** be marked! Any questions regarding the homework can be directed to the TA through email (contact information on eDimension).

Week 3

Note: Please read and understand the Heap operations before doing the following questions.

1. The array [80, 77, 76, 50, 45, 70, 52, 30, 29, 22] forms a heap [True/False].
   Show explanation by drawing. ***Only half of the full marks will be awarded if answer is correct without explanation.***

   Solution: True.
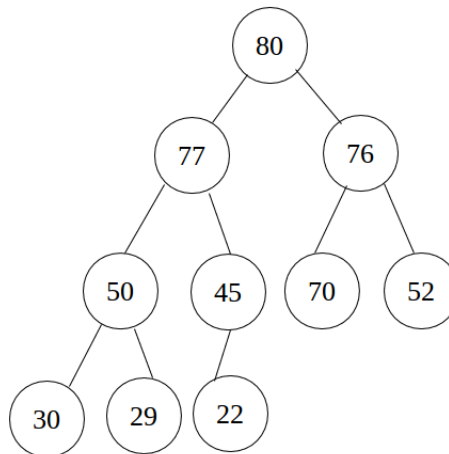
   Figure 1: q1 ans

2. We have a max heap of n elements and we want to insert m more elements to this heap. Assume that all the m elements are inserted at the same time and the end result must also be a max heap. The entire operation takes O(m + n) total time [True/False].
   Will the time complexity change if the m elements are inserted one by one to a max heap

containing n elements? If it changes, what would be the time complexity? ***Only half of the full marks will be awarded if answer is correct without explanation.***

Solution: True. Building a heap given n elements all at once takes a linear time : O(n) (see lecture notes). So we can think of it as: we are building a heap out of m+n elements, instead of inserting the elements 1 by 1. Thus, the time complexity is O(m+n).

The complexity changes if we insert the m elements one by one. Recall from lecture notes that inserting a new element to a heap size of n is O(logn). Note that that the height of the heap changes as more and more elements are inserted into the heap. Therefore, given that the heap already has n elements and we insert m elements one by one, it would take O(m log(n+m)) total time.

3. Consider the heap created from the array [80, 77, 76, 50, 45, 70, 52, 30, 29, 22]. If the node with value 29 has its value increased to 79, how many swaps must occur to convert the heap into a max heap? Provide answer and show explanation by drawing. ***Only half of the full marks will be awarded if answer is correct without explanation.***
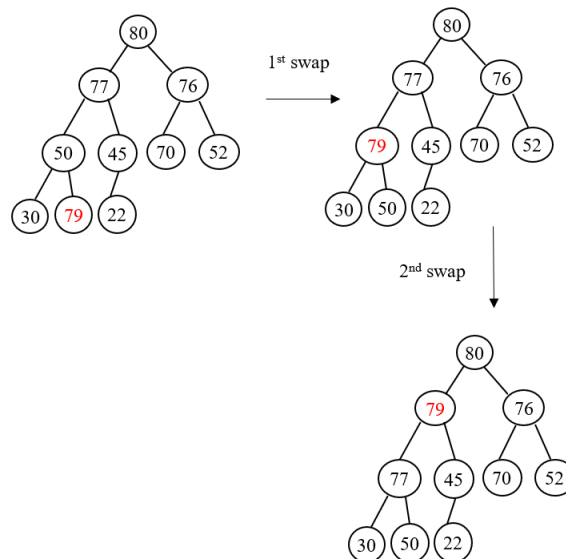
Solution: Two swaps.

Figure 2: q3 ans

4. In the worst case scenario, what is the time complexity of finding the smallest item from a max heap?

A. O(1)

B. O(n)

C. O(log n)

D. O(n log n)

Solution: B.

5. What is the number of swaps needed to construct a max heap from the array [9, 19, 50, 7, 8, 10, 25, 2, 5, 17, 12, 8]?

A. 6 swaps

B. 3 swaps

C. 1 swap

D. 4 swaps

Solution: B.