

EL9343 Homework 4

(Due Feb 25th, 2022)

No late assignments accepted

All problem/exercise numbers are for the third edition of CLRS text book

1. Demonstrate the operation of HOARE-PARTITION on the array $A = \langle 13, 19, 9, 5, 12, 8, 7, 4, 11, 2, 6, 21 \rangle$. Show the values of the array after each iteration of the while loop in the lines of 4 to 11 in the code of lecture notes.

2. For the following array:

$A = \langle 20, 13, 5, 10, 12, 8, 1, 9, 3, 11, 2, 6, 21 \rangle$

- (a) Create a max heap using the algorithm BUILD-MAX-HEAP.
 - (b) Remove the largest item from the max heap you created in 3(a), using the HEAP-EXTRACT-MAX function. Show the array after you have removed the largest item.
 - (c) Using the algorithm HAX-HEAP-INSERT, insert 56 into the heap that resulted from question 3(b). Show the array after insertion.
3. Design an algorithm to merge k sorted arrays, and return it as a new array. The new array should be made by splicing together the nodes of the k arrays. Additionally, the total number of elements of all arrays is kn . (Notice that the number of elements of each array is not necessary the same). Ideally, your algorithm should run in $O(kn \log k)$ time, lower algorithm will lose some points. Please give the procedure of your algorithm and analyze the running time. (Description is enough, you do not need to provide any pseudocode)

For example:

Input: A: $\langle 1, 5, 18 \rangle$, B: $\langle 3, 6, 7, 11 \rangle$, C: $\langle 2, 4, 9, 12, 13 \rangle$

Output: $\langle 1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 13, 18 \rangle$

4. Let T be a min heap storing n keys. Given an efficient algorithm for reporting all the keys in T that are smaller than or equal to a given query key x (which is not necessarily in T). Note that the keys do not need to be reported in sorted order. Ideally, your algorithm should run in $O(k)$ time, where k is the number of keys reported that is smaller than x .