CSI2110-D – Written Assignment #4

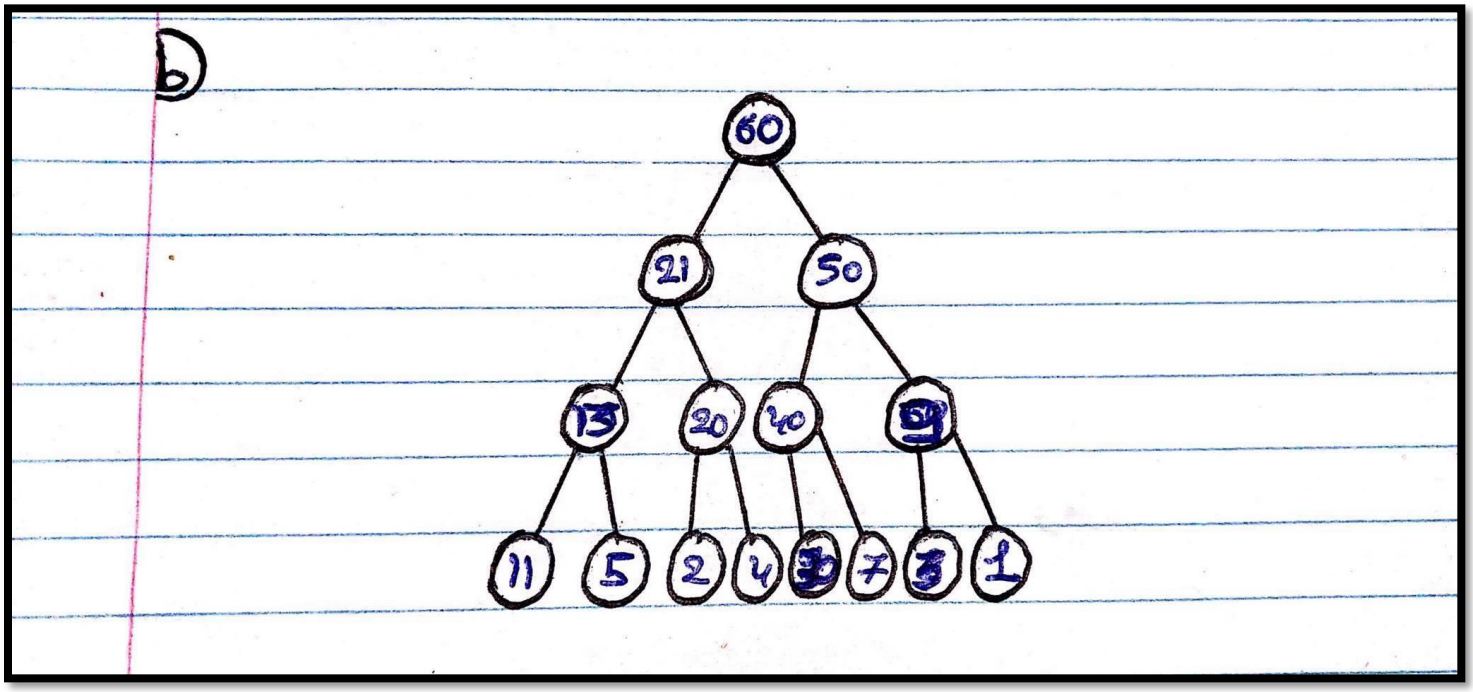
Alae Boufarrachene (300188539)

Question 1 :

a)

index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Keys of A (before the loop)	1	2	3	5	4	7	9	11	13	20	21	30	40	50	60
Keys of A	1	2	3	5	4	7	60	11	13	20	21	30	40	50	9
Keys of A	1	2	3	5	4	40	60	11	13	20	21	30	7	50	9
Keys of A	1	2	5	5	21	40	60	11	13	20	4	30	7	50	9
Keys of A	1	2	3	13	21	40	60	11	5	20	4	30	7	50	9
Keys of A	1	2	60	13	21	40	50	11	5	20	4	30	7	3	9
Keys of A	1	21	60	13	20	40	50	11	5	2	4	30	7	3	9
Keys of A	60	21	50	13	20	40	9	11	5	2	4	30	7	3	1

b)



c)

index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Keys of A	1	2	3	3	4	7	9	5	13	20	21	30	40	50	60	11

d)

i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Keys of A	2	4	3	5	20	7	9	11	13	60	21	30	40	50	null

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Question 2:

i) Finding K^{th} smallest Key element in a given array, where $K \leq n$:

↳ Min Heap Algorithm - Problem-solving process:

- We use the array to construct a minheap (which sorts the elements)
- We remove the root (must be repeated K-1 times)
- The K^{th} smallest element should be the root now
- We simply return the root

My solution achieves a complexity of $O(n + K\log(n))$ because the number of operations is directly proportional to the K input, in addition, my solution only requires one loop (the one used to remove and swap the root K-1 times)

ii)

↳ Max Heap Algorithm | Problem-solving process:

- We use the array to implement a Max Heap of the same size.
- We insert the first K elements of the array into the Max Heap.
- Once we reach the K^{th} element, we use it to compare with the remaining elements of the array, if they are inferior to the root, the element replaces the root (repeated until there are no more elements left).
- We will obtain a heap that only contains the K smallest elements.
- We return the root of the Max Heap.

My solution achieves a complexity of $O(n\log(K))$ because only one loop is required to create a Max Heap and to insert the first K elements of the array into the newly-created Max Heap.