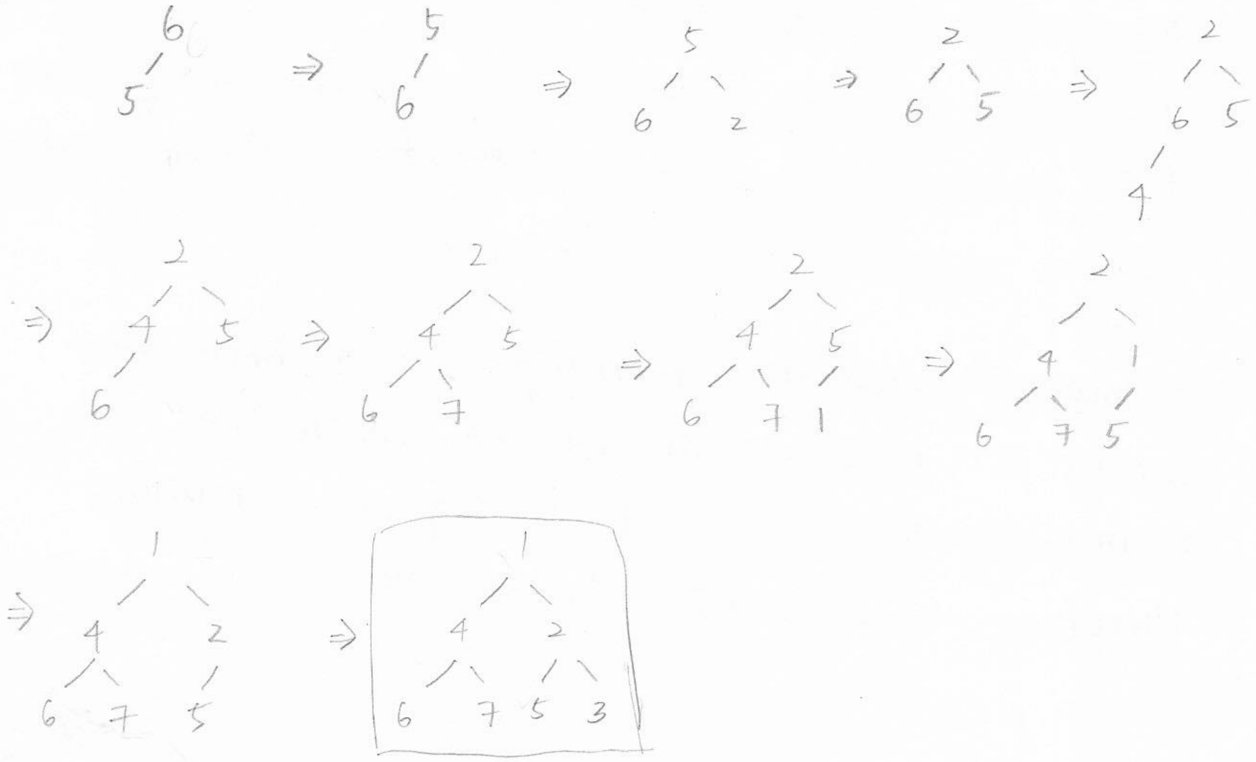
4.1

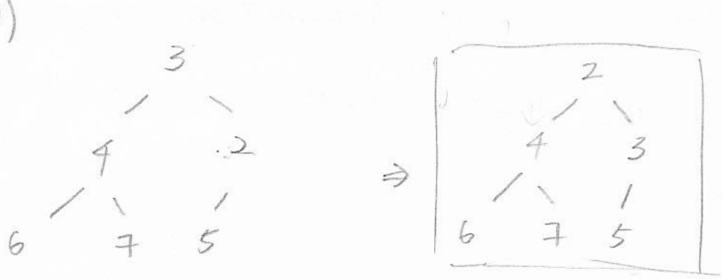
Range(s, k_1, k_2) will need the amortized cost of operation which is $O(\log n)$, and all the other operation required a constant time, therefore the running time of this implementation is $O(\log n)$.

4.2

a)



b)



4.3

In Linked list, the node can be deleted or inserted from any position. The pointer will used to traverse to the node and delete the node. When two have same priority, the first inserted node will be deleted first. Therefore Linked list is stable.

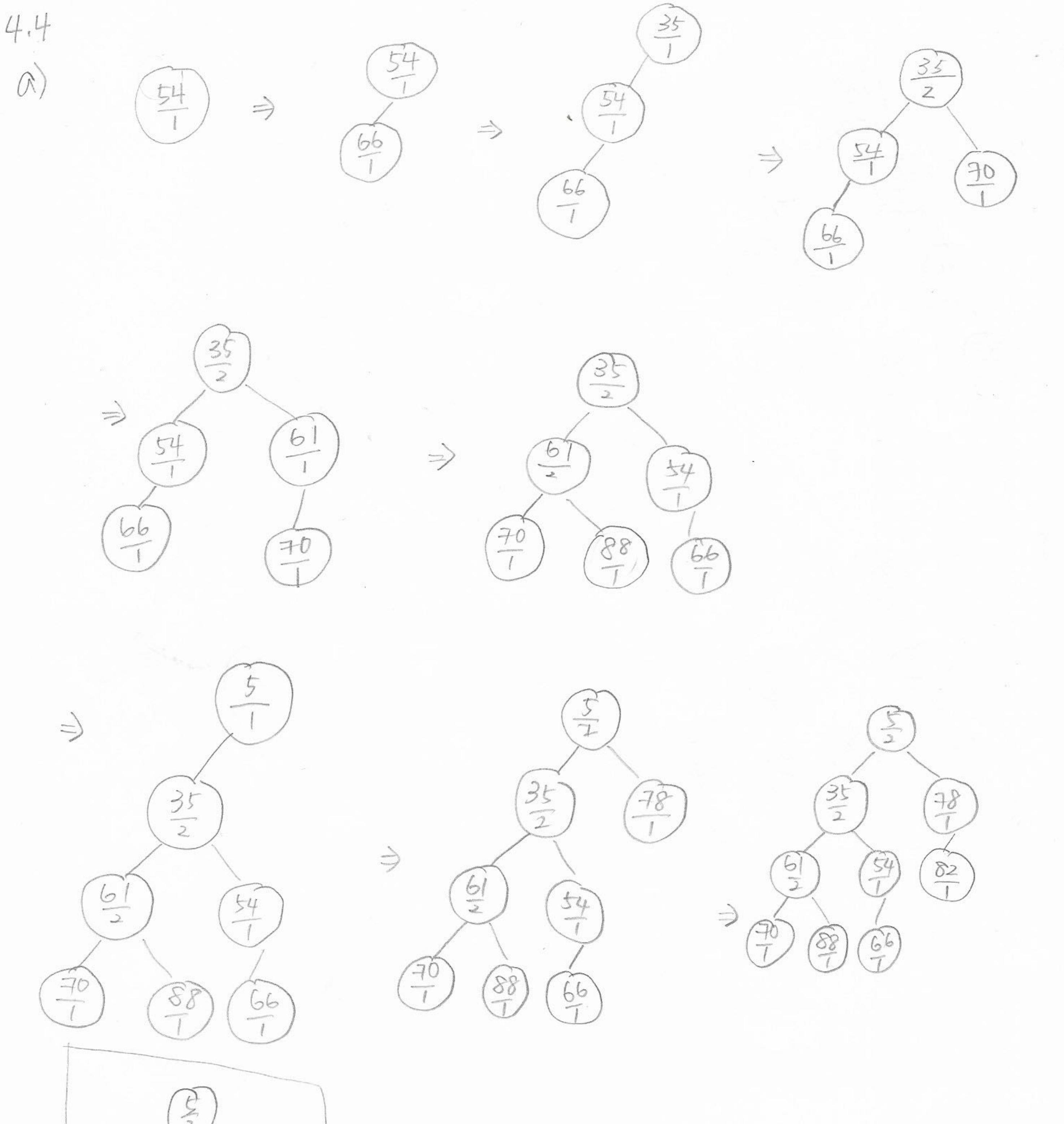
A balanced search tree rearranged itself when new element is inserted or deleted, which has no information about the original sequence remain. Therefore, a balanced search tree is unstable.

During the creation of heap tree, the heap is reconstructed after each insertion or removal, so the information about the ordering of the items in the original sequence was lost therefore, heap is unstable

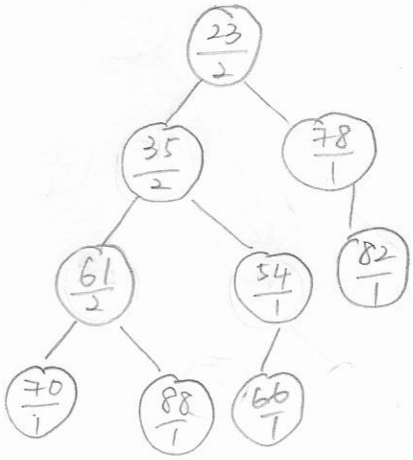
A leftist tree is similar to the heap tree with a little difference with the continuously merging operation when insert or deleting elements. The leftist tree does not have the information about the original sequence, Therefore, Leftist tree is unstable

4.4

a)

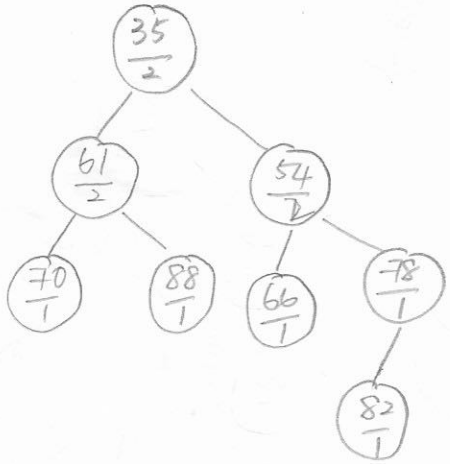


b)



23
2
35
2
78
1
61
2
54
1
82
1
70
1
88
1
66
1

c)



35
2
61
2
54
2
70
1
88
1
66
1
78
1
82
1

4.5

A

B.

(S_4, B)

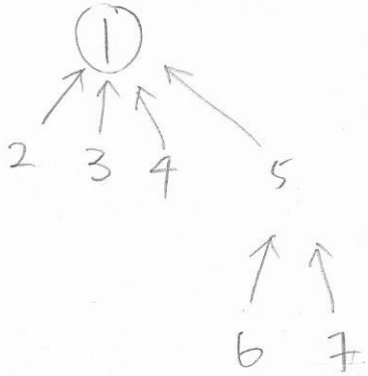
C

D.

E

D, S_7

F



4.7

A graph with all possible edges connected for n vertices will have a total of

${}^{n}C_2$ possible edges. If a graph is directed, the there will be 4 possibilities :

1) no edge between u and v
2) an edge from u to v
3) an edge from v to u
4) two edge between 2 given vertices

Therefore there will be $4^{{}^{n}C_2}$ possible number of edges

The undirected graph will only posibilities, which is whether the two vertices is connected or not, therefore; the possible edges will be $2^{{}^{n}C_2}$

4.6.

Lemma: if h is the height of an up-tree with n nodes, then:

$$h \leq \log n \Rightarrow n \geq 2^h$$

Since the height will be the the height of greater tree

greater $= h+1 \Rightarrow n \geq 2^{h+1}$

smaller $= h \Rightarrow n \geq 2^{h+1}$

differece $\Rightarrow 2^h$