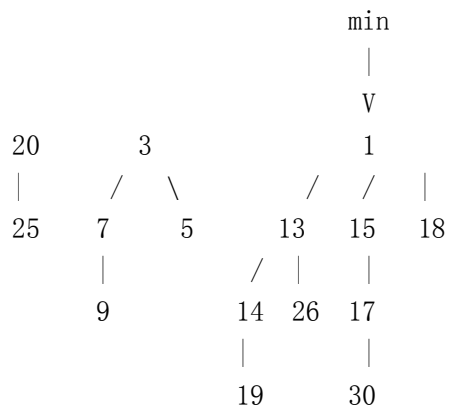
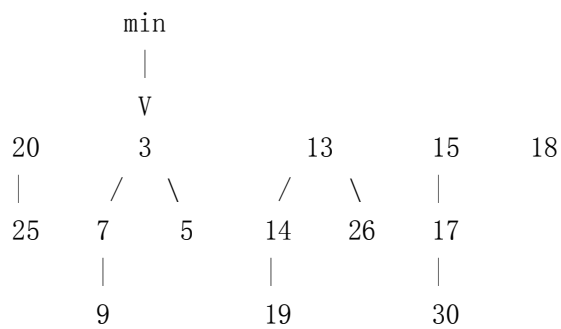


question 1.

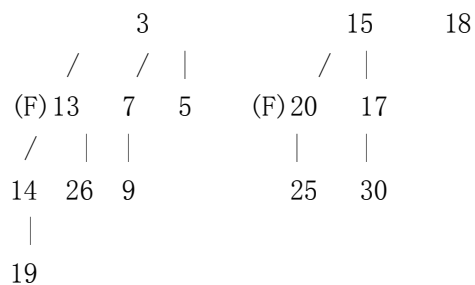


(a)

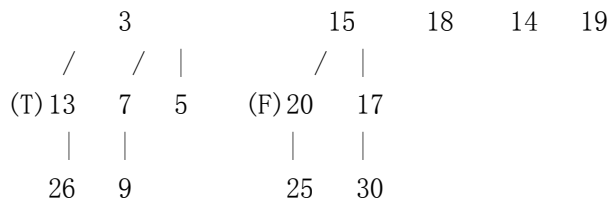
delete (1) = min



joins two min F-heaps with same degree 2 and degree 1



(b) DecreaseKey



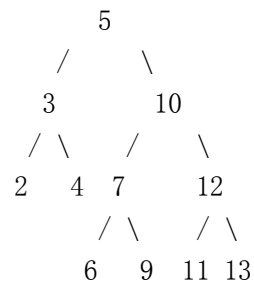
- (2) There was a typo in part(a). The balance factor of the root should be -1 instead of +1. I am very sorry for the problem.

Thus, I provide sample solutions for the two versions.

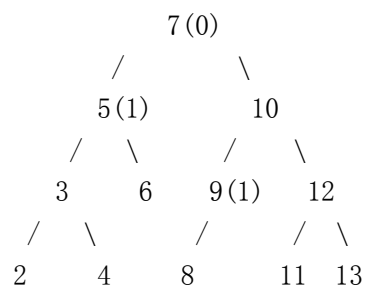
Remember that you need to identify imbalance type from the node whose balance factor becomes either +2 or -2 when a node is inserted.

Version 1: The balance factor of the root is -1.

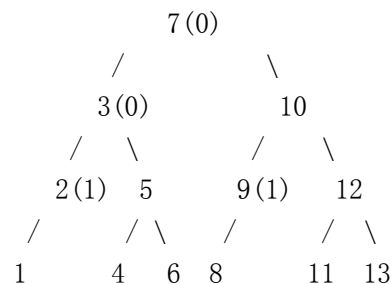
(a)



(b) insert 8 (RL)

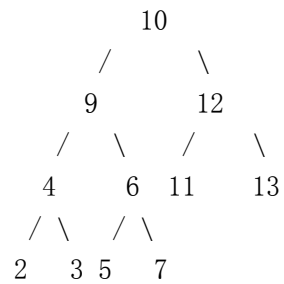


insert 1 (LL)

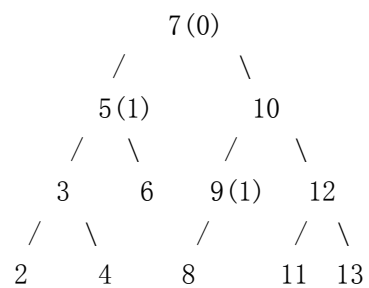
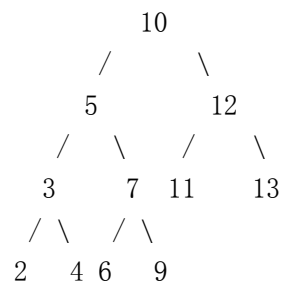


Version 2: The root is "10" and has balance factor +1.

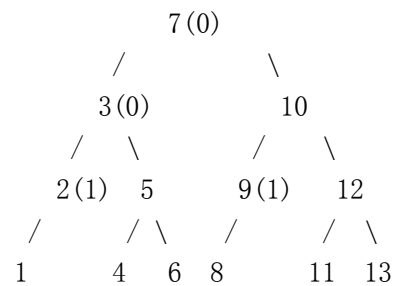
(a)



(b) insert 8 (LR)

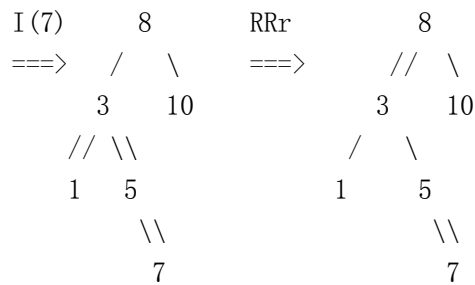
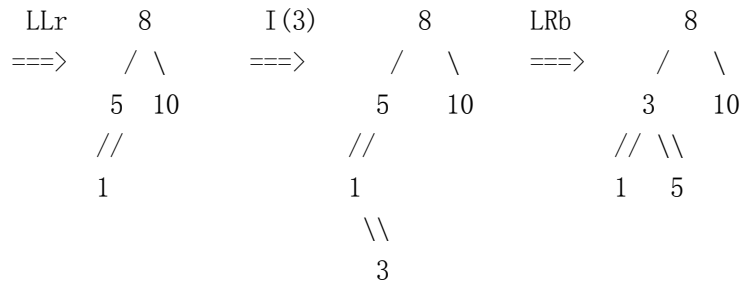
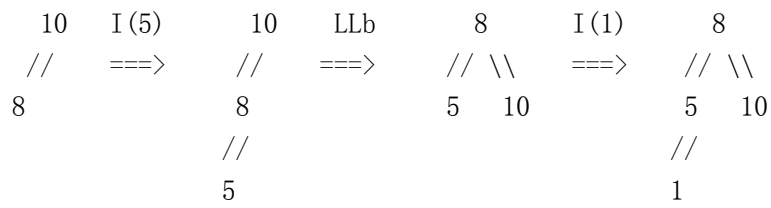


insert 1 (LL)

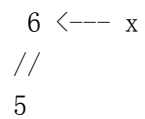


(3)

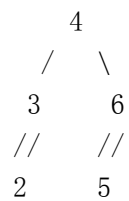
(a)



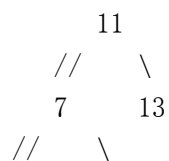
- (b) Step 1. Follow the left child pointers from the root of B to first node x whose rank equals  $\text{rank}(S) = 1$ .

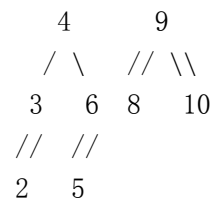


Step 2. Combine S, 4, and subtree rooted at 6.



Step 3. Combine the result of Step 2 to node "7" through a red pointer.





Step 4. Imbalance (LLb  $\rightarrow$  rotate)

