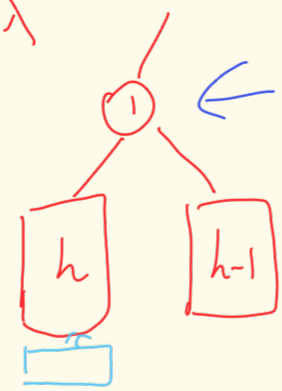
对于插入

(1)

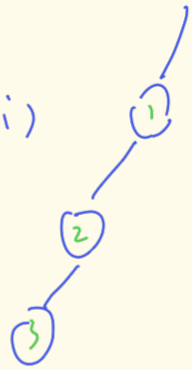


← 从下往上第一个失去平衡的点

插入前对于以1为根的树 深度为h+1

① $h=1$

(i)

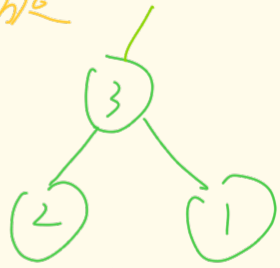


(ii)

右旋

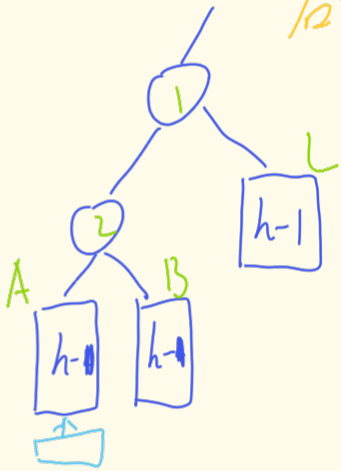
$h'=2$ ✓

左旋+右旋

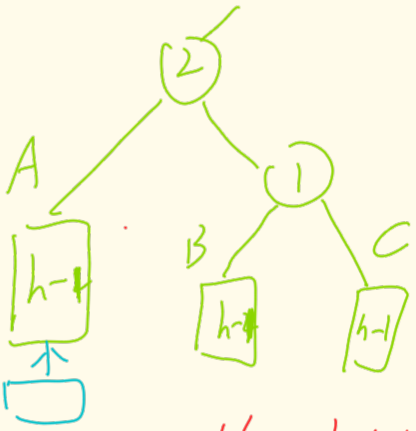


② $h\geq 2$

(i)

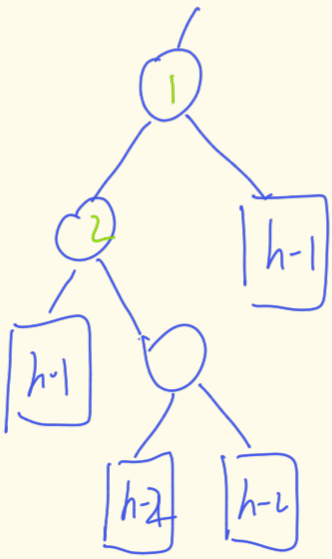


右旋

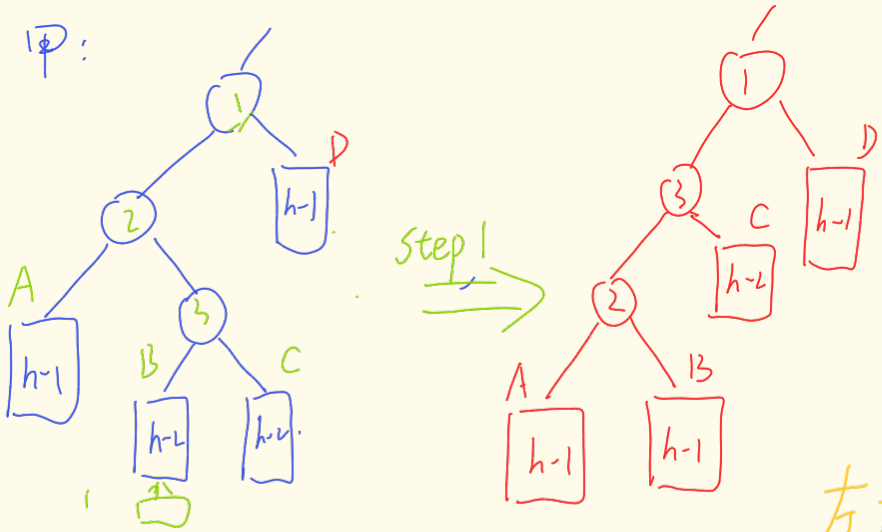


$h'=h+1$ ✓

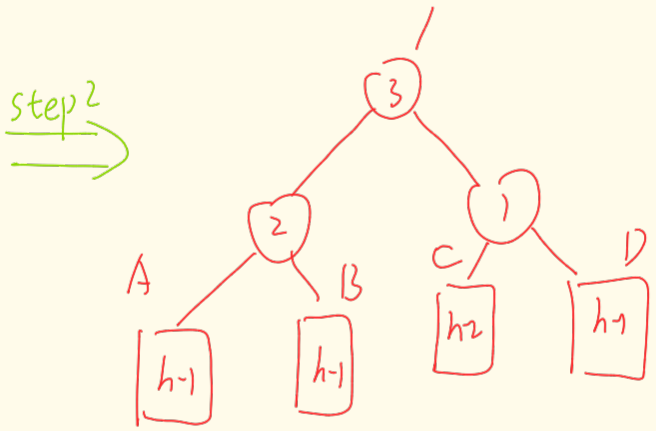
(ii)



甲：

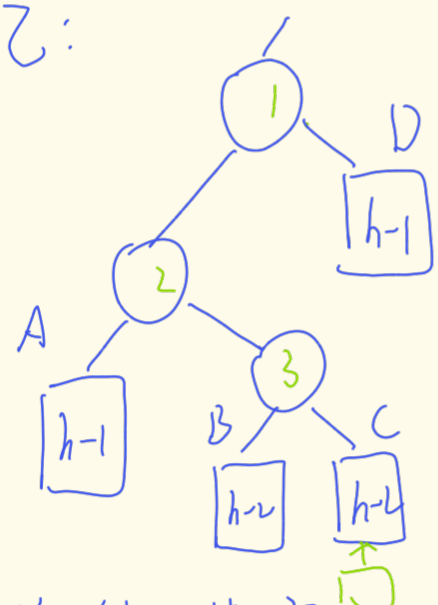


左旋 + 右旋.



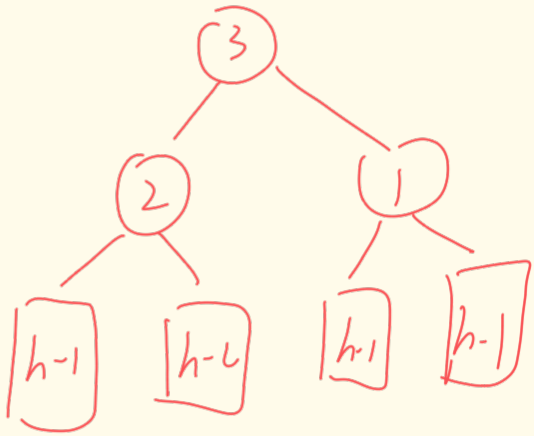
$h' = h+1$ ✓

乙：



⇒

同上.



总结：其实只有两个基本操作，左旋，右旋）

若插入为破坏平衡点左子树左子树 → 右旋

右子树 → 左旋 + 右旋

上述对应 LeftBalance 中

① (i) & ② (i) → $bf = 1$

③ (ii) → $bf = -1$ $rc \to bf = 0$

②(iii)甲 → $bf = -1$ $rc \to bf = 1$

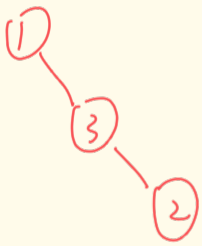
②(iii)乙 → $bf = -1$ $rc \to bf = -1$

同理可画出 RightBalance 对应情况

① $h=1$

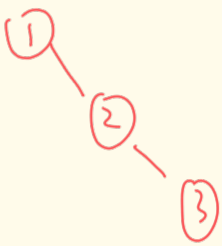
(i)

右⇒



左⇒

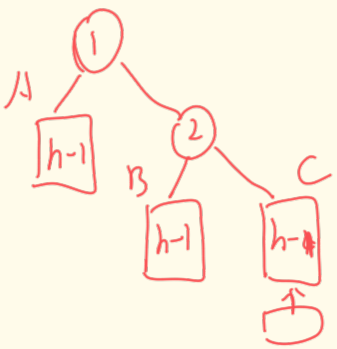
(ii)



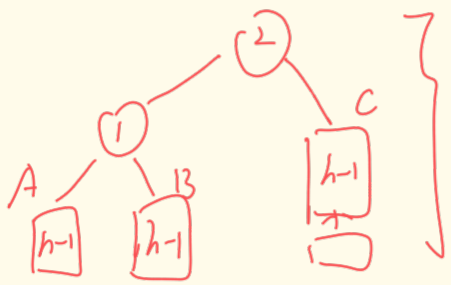
左⇒

② $h \geq 2$

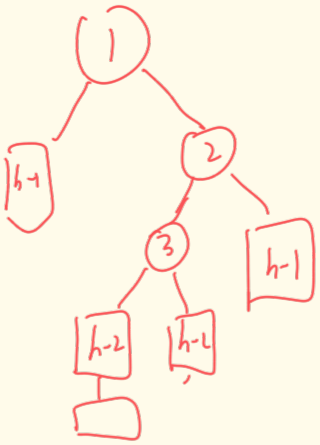
(i)



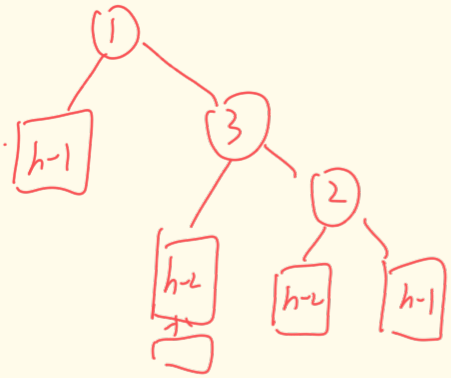
左⇒



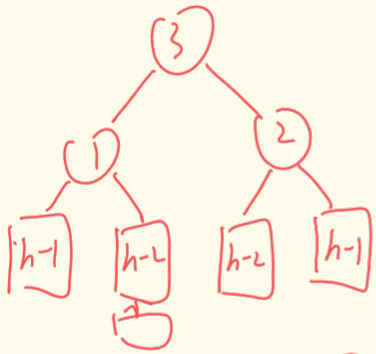
(ii) 甲



右⇒

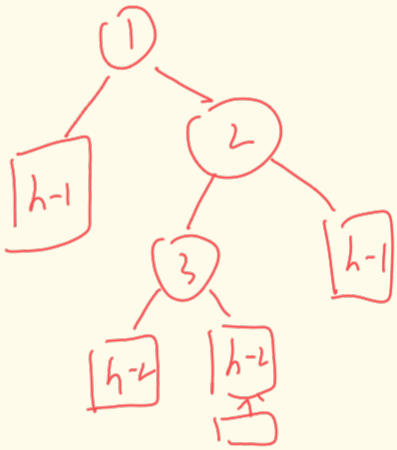


左⇒

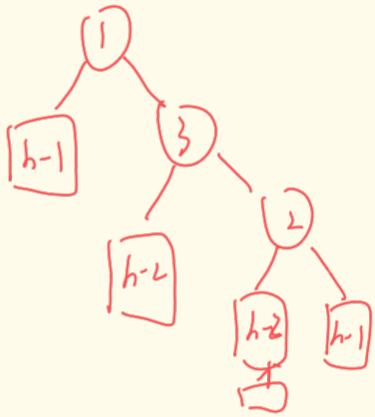


h+1 ✓

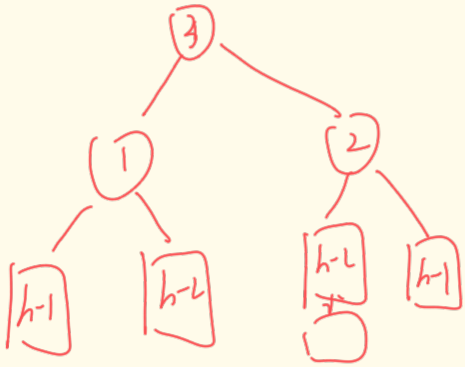
乙.



右⇒



左⇒



h+1 ✓

同理有 ①(ii) & ②(i) → bf = -1

① (i) → bf = 1, lc → bf = 0

② (ii) 甲 → bf = 1, lf → bf = 1

② (ii) 乙 → bf = 1, lc → bf = -1