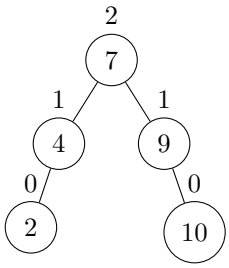
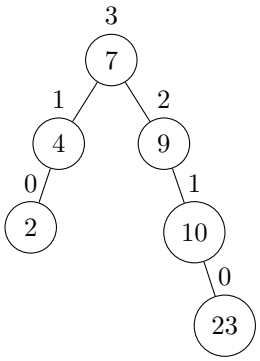
Exercise 1.

a) Valid.

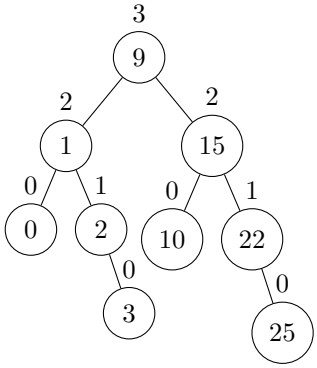


b) Invalid, 9 is unbalanced.



c) Invalid, not a binary tree ($9 < 23$).

d) Valid.



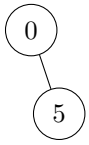
e) Invalid. Node 4 is unbalanced.

f) Valid.

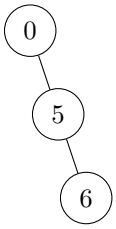
Exercise 2.

1. Insert 0.

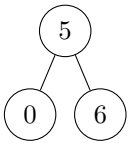
2. Insert 5.



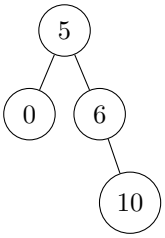
3. Insert 6.



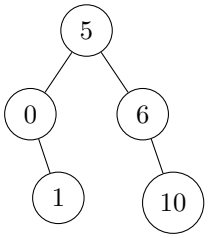
   Rebalance.



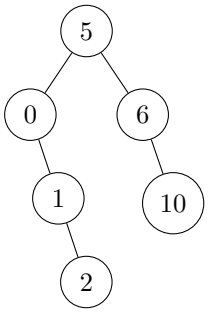
4. Insert 10.



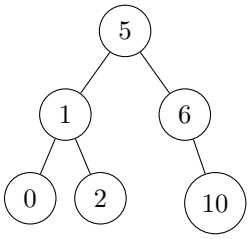
5. Insert 1.



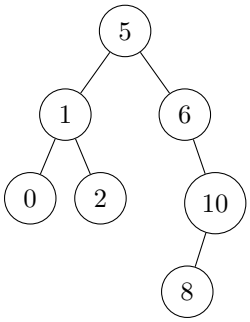
6. Insert 2.



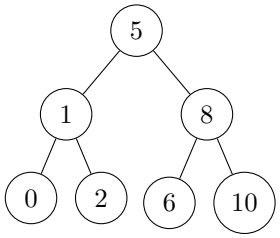
Rebalance.



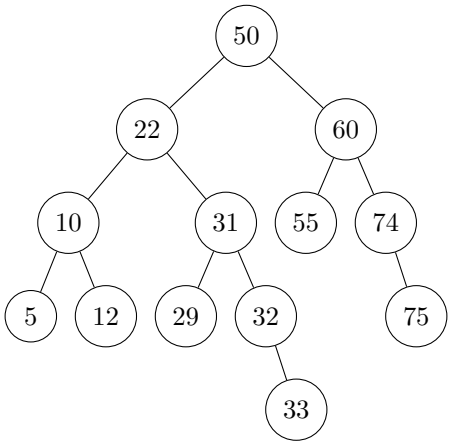
7. Insert 8.



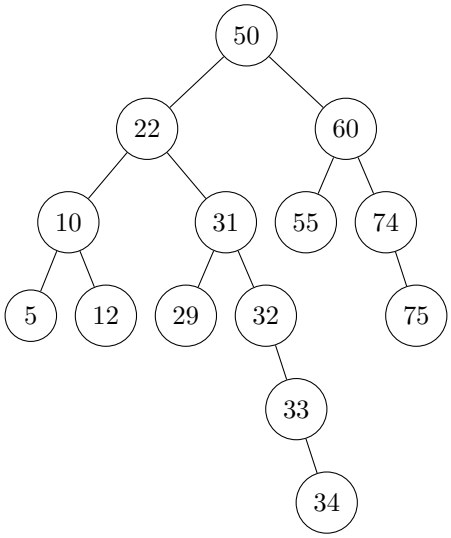
Rebalance.



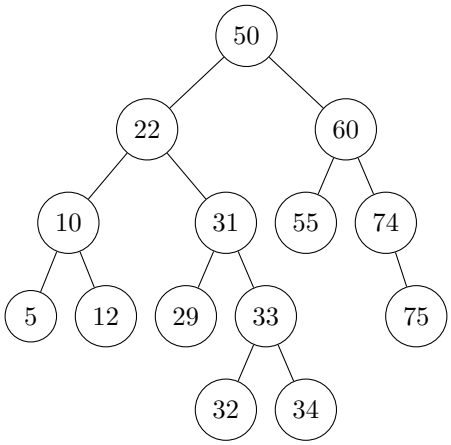
Exercise 3. Insert 33.



Insert 34.

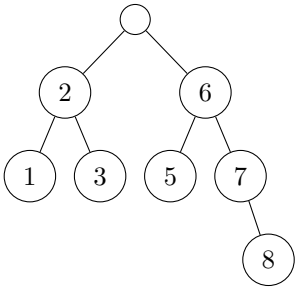


Rebalance.

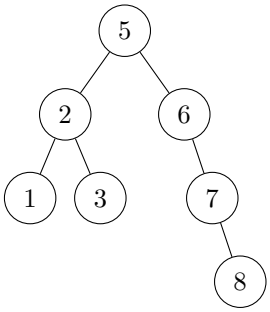


Exercise 4.

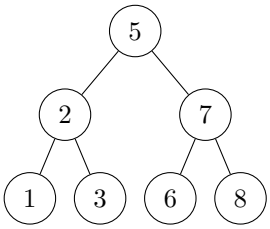
a) Remove 4.



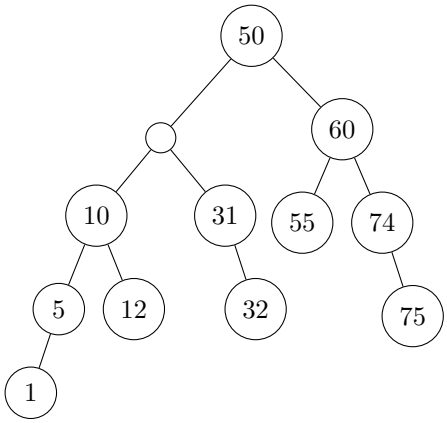
5 is the inorder successor.



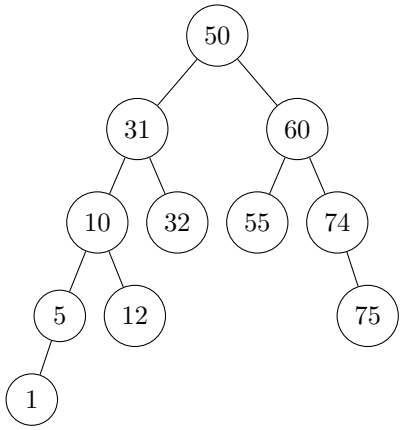
Rebalance starting from parent of (now removed) successor, 6.



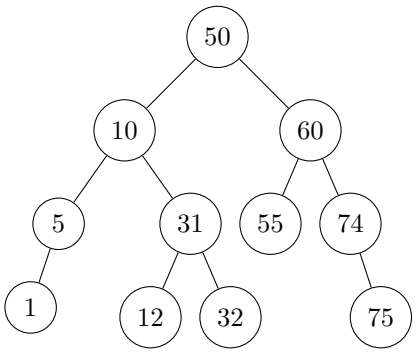
b) Remove 22.



31 is the inorder successor.



Rebalance starting from 50, which is balanced. First unbalanced node is 31; rebalance.


50
10
60
5
31
55
74
1
12
32
75