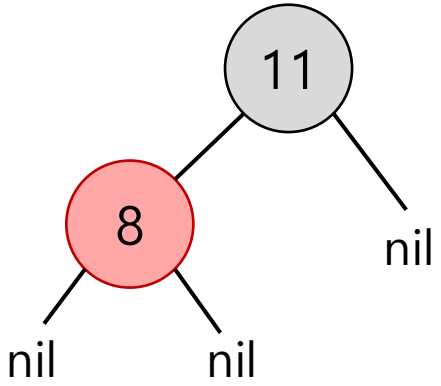
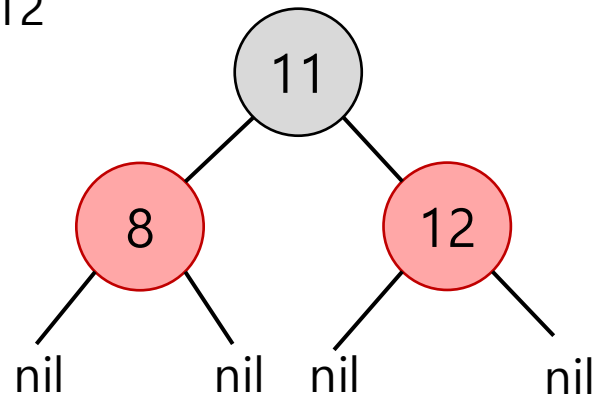
7. Draw the red-black trees that result from successive insertions of the keys in the order 11, 8, 12, 5, 13, 2, 10, 17, 26, 9 into an initially empty red-black tree. For each insertion, count the number of color changes, left rotations, and right rotations. Also, count the sum of each of these three operations, respectively.

1) Insert 11

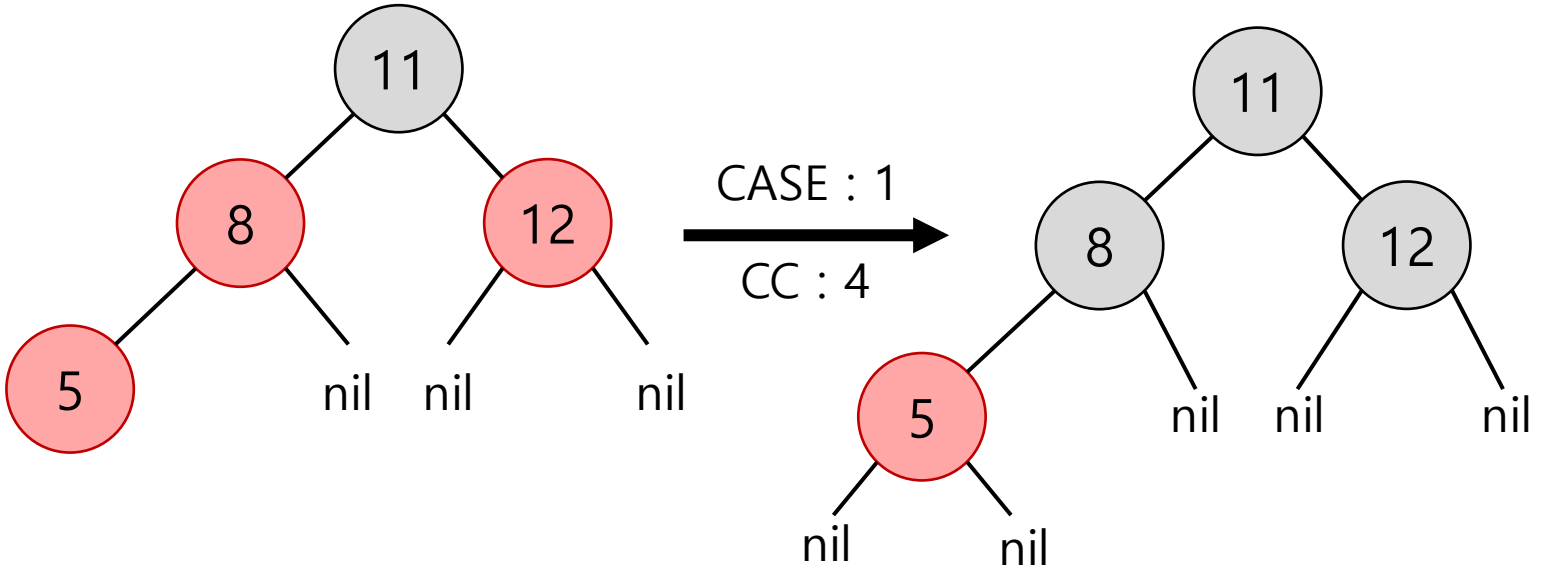
2) Insert 8



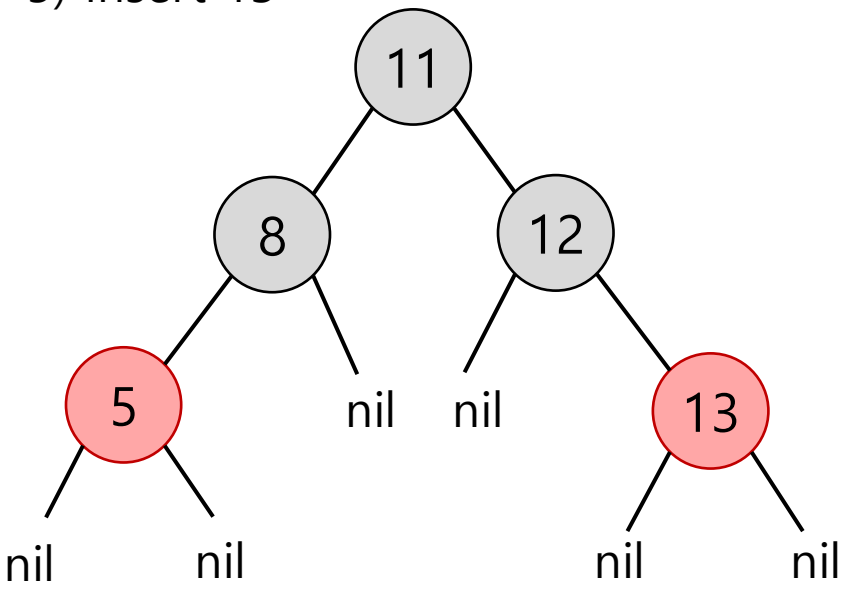
3) Insert 12



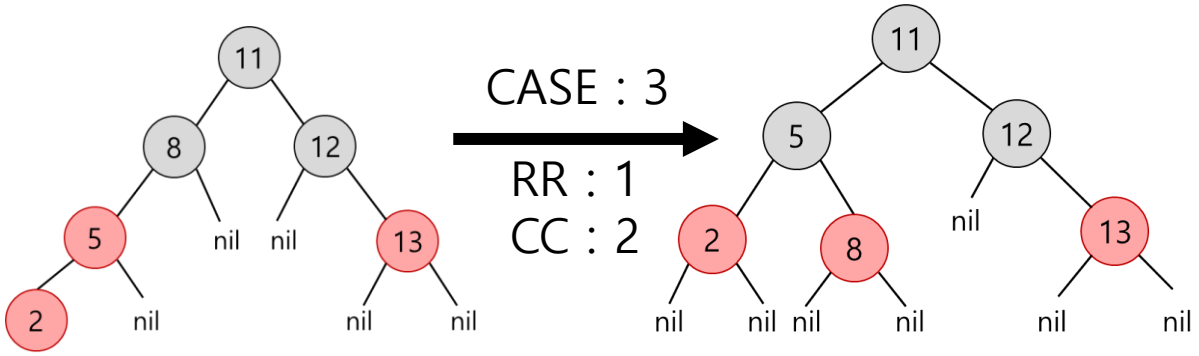
4) Insert 5



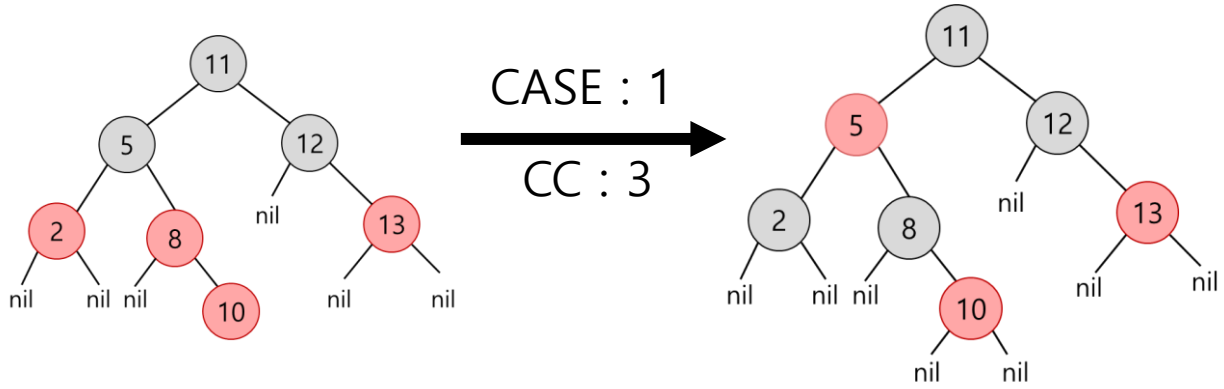
5) Insert 13



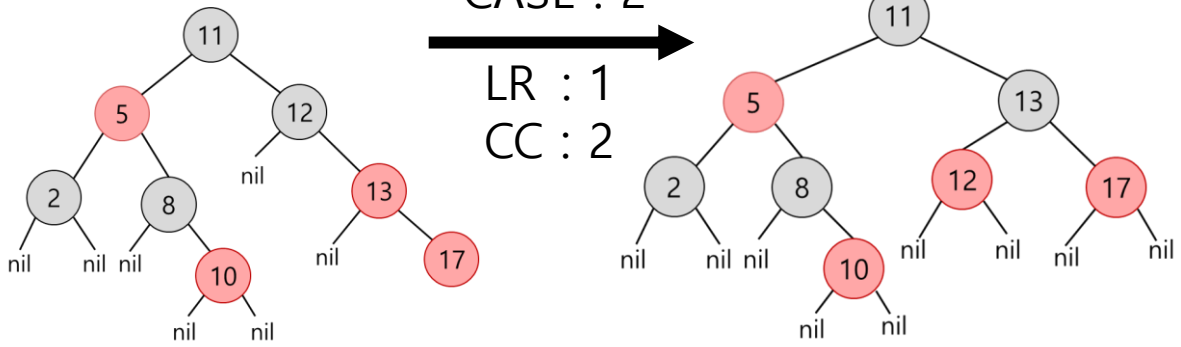
6) Insert 2



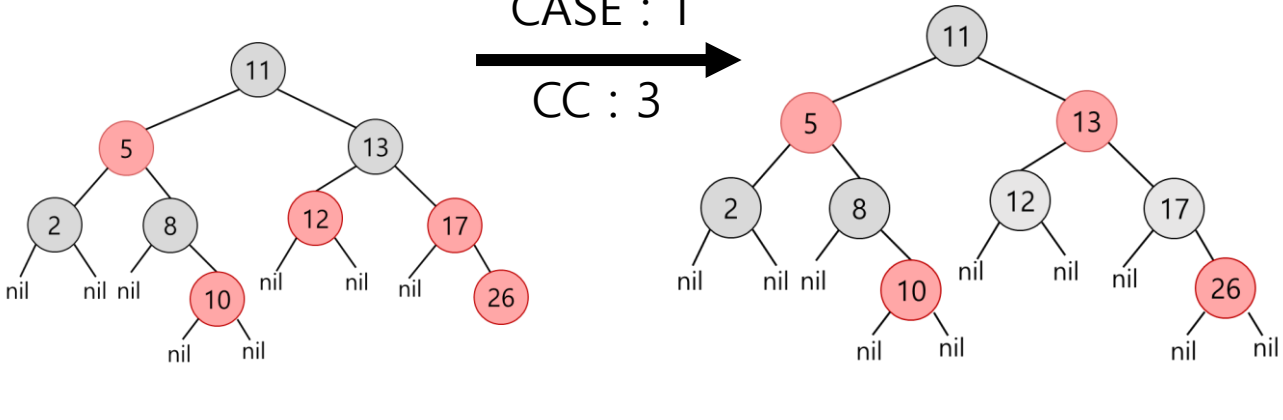
7) Insert 10



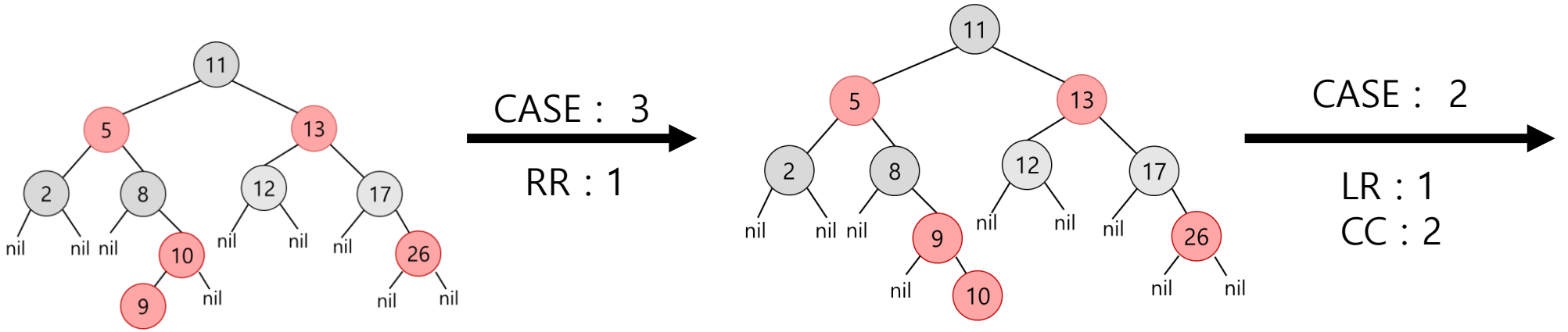
8) Insert 17

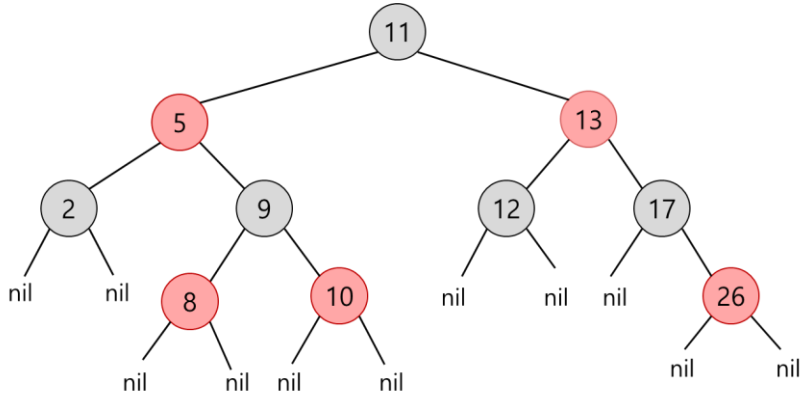


9) Insert 26



10) Insert 9

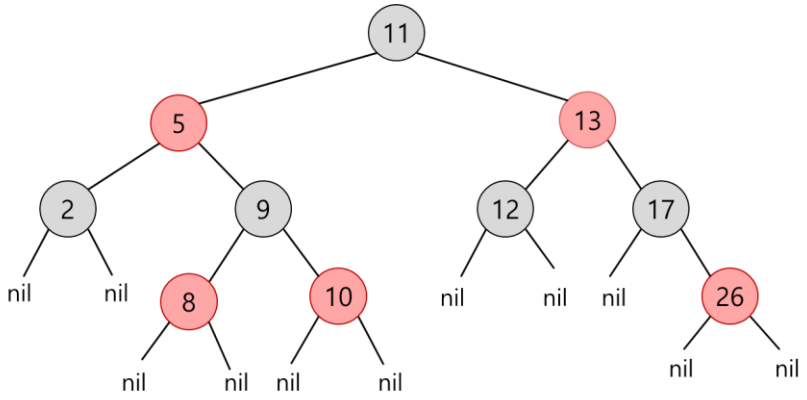




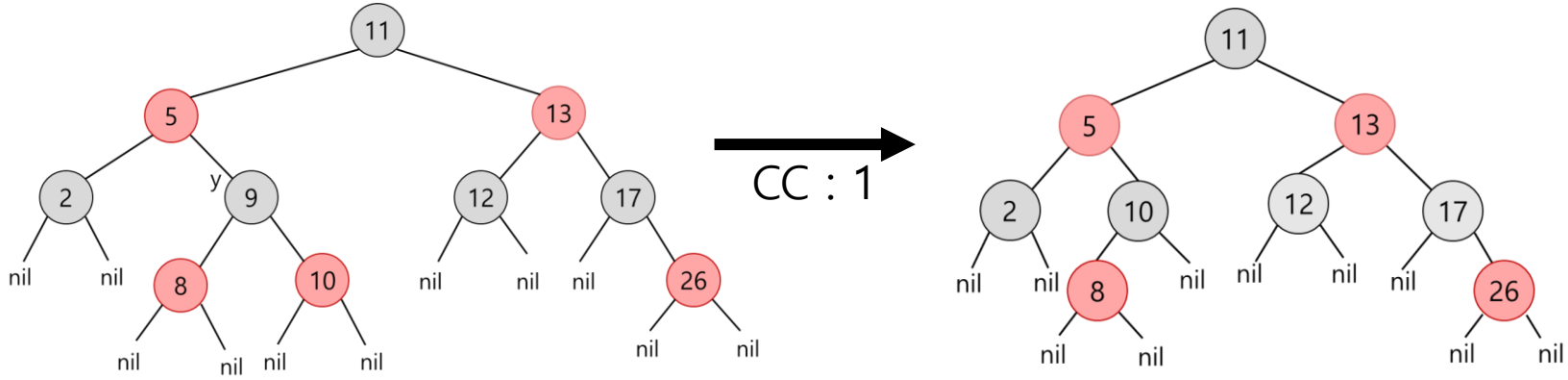
Total
CC(color change): 17
RR(right rotation): 2
LR(Left rotation): 2

8. Draw the red-black trees that result from the successive deletions of the keys in the order 9, 12, 10, 8, 11, 5, 17 on the tree generated in exercise 7. For each deletion, count the number of color changes, left rotations, and right rotations. Also, count the sum of each of these three operations, respectively.

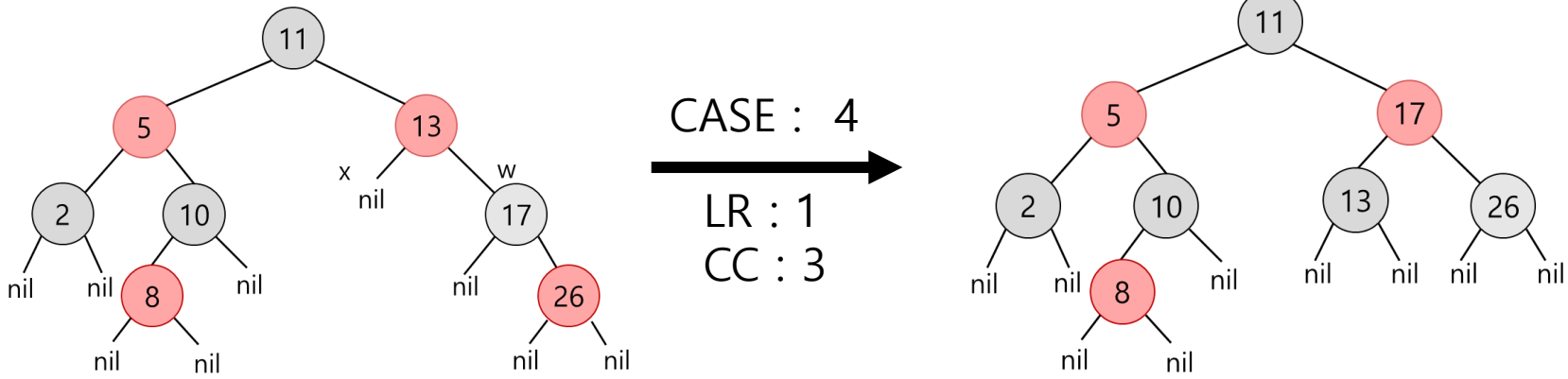
0) initial



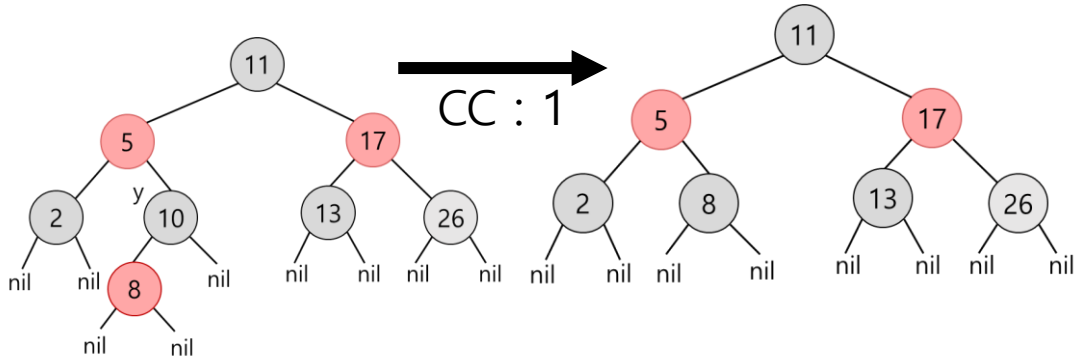
1) Delete 9



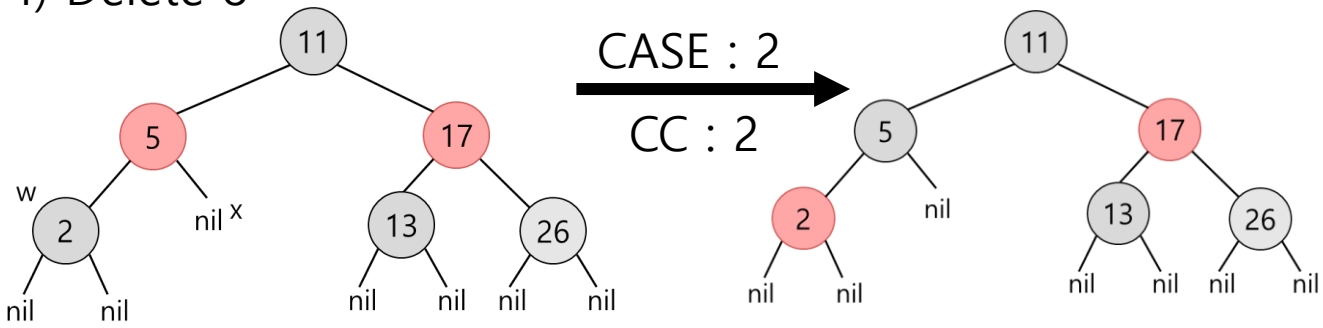
2) Delete 12



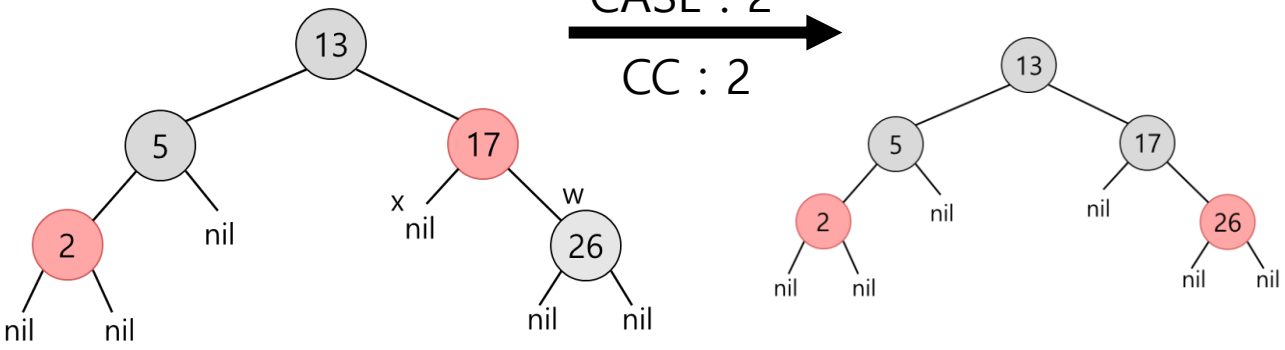
3) Delete 10



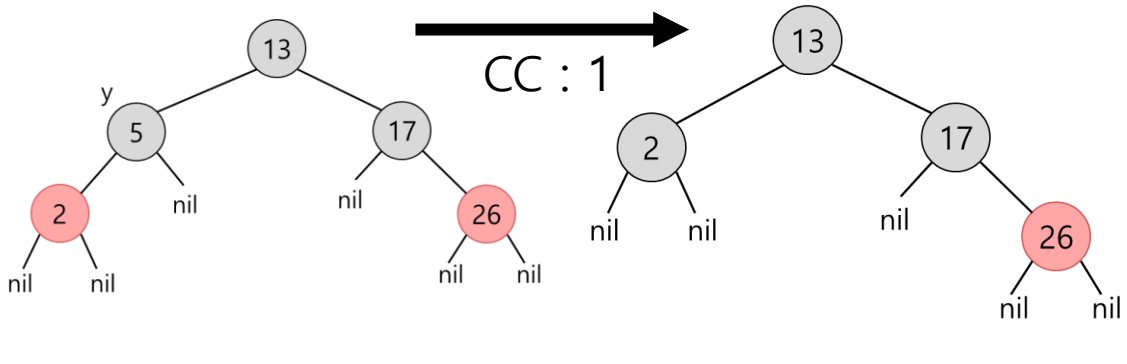
4) Delete 8



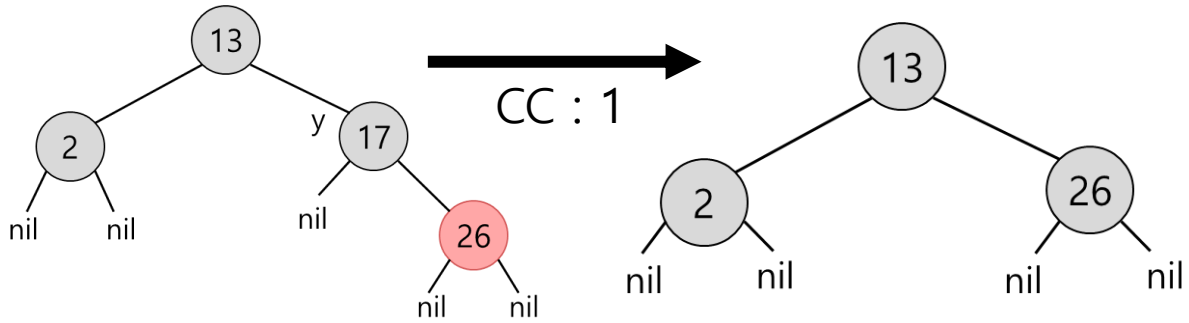
5) Delete 11



6) Delete 5



7) Delete 17



Total
CC(color change): 11
RR(right rotation): 0
LR(Left rotation): 1