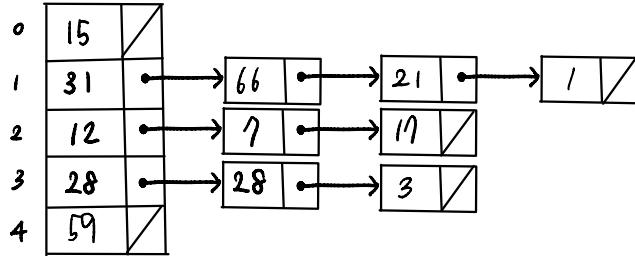


# Report 2 20163/4364 4월 7일

## I) Problem Solving manually

1)  $T(m=5)$



2) a) Linear probing

$$h(k, i) = ((K \bmod m) + i) \bmod m$$

$T(m=11)$

0	21	$h(21, 1) = 0$
1	12	$h(12, 0) = 1$
2	2	$h(2, 0) = 2$
3	11	$h(11, 0) = 3$
4	8	$h(8, 0) = 4$
5		
6		
7	18	$h(18, 0) = 7$
8	7	$h(7, 0) = 8$
9	9	$h(9, 0) = 9$
10	10	$h(10, 0) = 10$

b) Quadratic probing

$$h(k, i) = ((K \bmod m) + i + 3i^2) \bmod m$$

$T(m=11)$

0	7	$h(7, 1) = 0$
1	12	$h(12, 0) = 1$
2	2	$h(2, 0) = 2$
3	21	$h(21, 1) = 3$
4	11	$h(11, 0) = 4$
5		
6		
7	18	$h(18, 0) = 7$
8	8	$h(8, 0) = 8$
9	9	$h(9, 0) = 9$
10	10	$h(10, 0) = 10$

c) Double hashing

$$h(k, i) = ((K \bmod m) + i (1 + (K \bmod (m-1))^2) \bmod m$$

$T(m=11)$

0	11	$h(11, 0) = 0$
1	12	$h(12, 0) = 1$
2	2	$h(2, 0) = 2$
3	21	$h(21, 0) = 3$
4	7	$h(7, 0) = 4$
5		
6		
7	18	$h(18, 0) = 7$
8	8	$h(8, 0) = 8$
9	9	$h(9, 0) = 9$
10	10	$h(10, 0) = 10$

3)

p	i	j	r
11	8	13	9

p	i	j	r
11	8	13	9

p	i	j	r
11	8	13	9

 $\rightarrow$ 

p	i	j	r
11	8	9	13

p	i	j	r
11	8	9	13

p	i	j	r
11	8	9	13

 $\rightarrow$ 

p	i	j	r
11	8	9	5

p	i	j	r
11	8	9	5

p	i	j	r
11	8	9	5

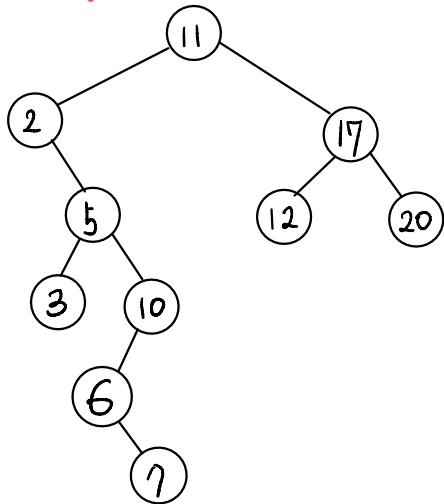
 $\rightarrow$ 

p	i	j	r
11	8	9	5

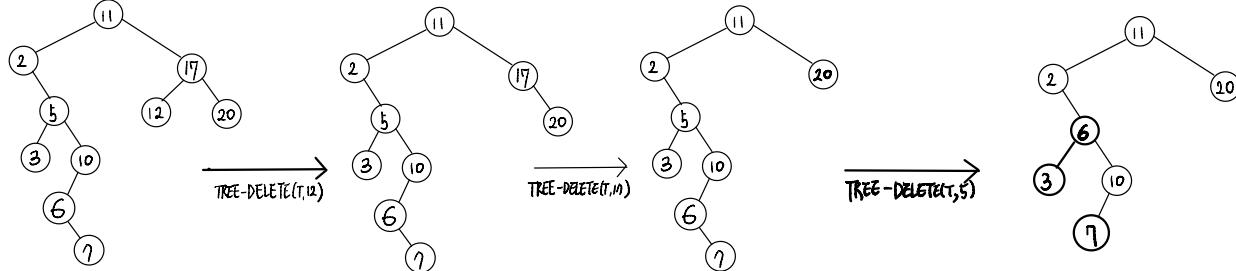
p	i	j	r
11	8	9	5

p	i	j	r
11	8	9	5

4) a)



b)



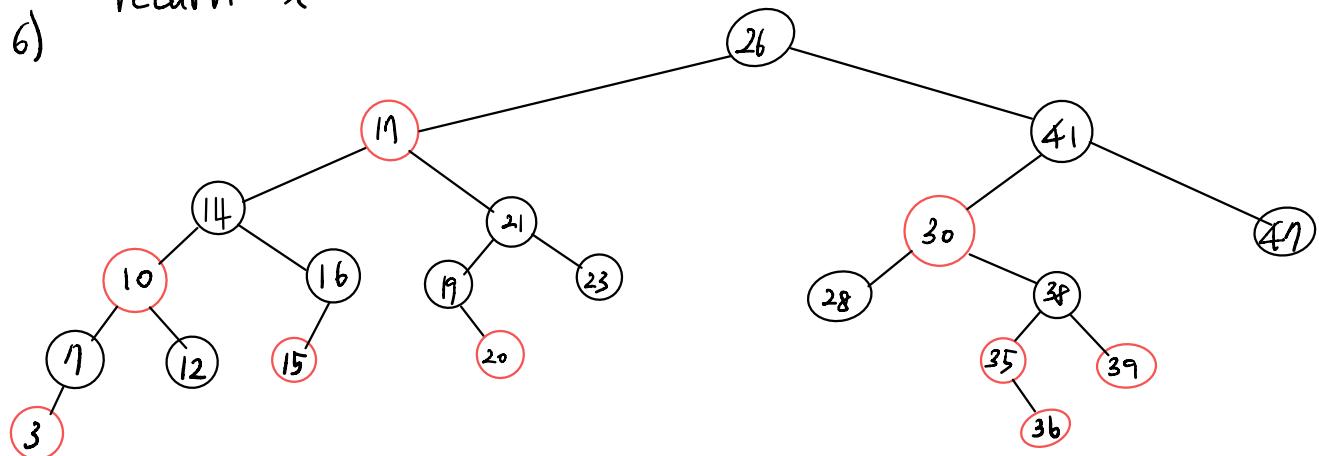
5)

MAX(T)

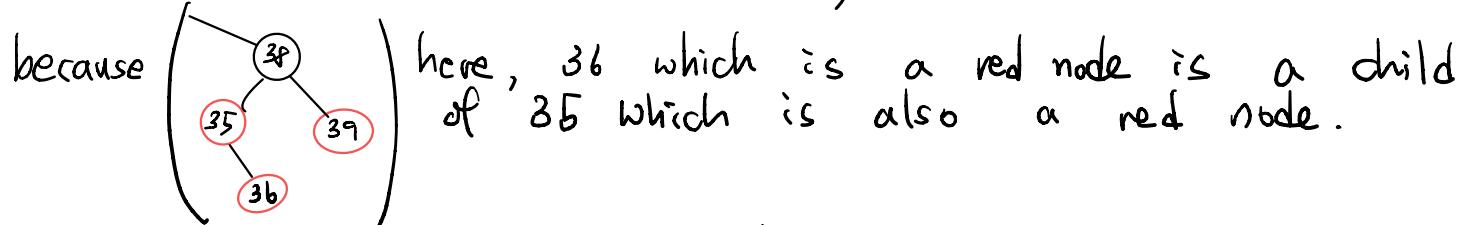
while T.right ≠ NIL  
x = x.right

return x

6)



If inserted node is colored red, resulting tree is not a red-black tree.



This violates red-black property (4).

Property 4: If a node is red, then both its children are black.

Even if an inserted node was black, it still is not a red-black tree.

This time, red-black property(5) is violated.

All paths from the root node to leaf nodes except for (36) contain 3 black nodes, while path to leaf node of (36) contains 4 black nodes.

(7)  $\xrightarrow{\text{insert } 1}$   
NULL  
(empty)  
 $\# \text{ of color changes: } 0$   
 $\# \text{ of left rotations: } 0$   
 $\# \text{ of right rotations: } 0$   
Sum : 0

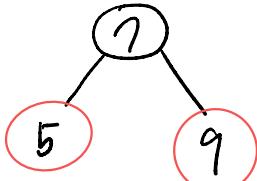
(7)  $\xrightarrow{\text{insert } 5}$   
 $\# \text{ of color changes: } 0$   
 $\# \text{ of left rotations: } 0$   
 $\# \text{ of right rotations: } 0$   
Sum : 0

5

insert 9

# of color changes: 0  
# of left rotations: 0  
# of right rotations: 0

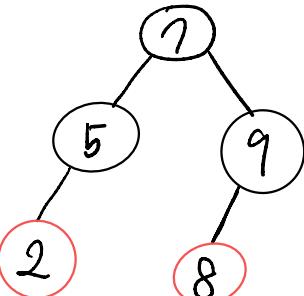
Sum : 0



insert 8

# of color changes: 0  
# of left rotations: 0  
# of right rotations: 0

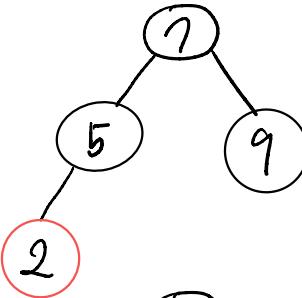
Sum : 0



insert 2

# of color changes: 4  
# of left rotations: 0  
# of right rotations: 0

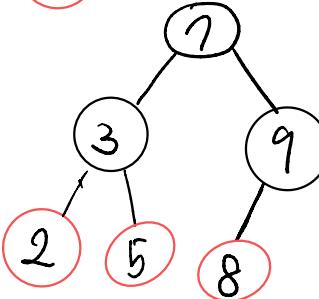
Sum : 4



insert 3

# of color changes: 2  
# of left rotations: 1  
# of right rotations: 1

Sum : 4



insert 13

# of color changes: 0  
# of left rotations: 0  
# of right rotations: 0

Sum : 0

