# BST

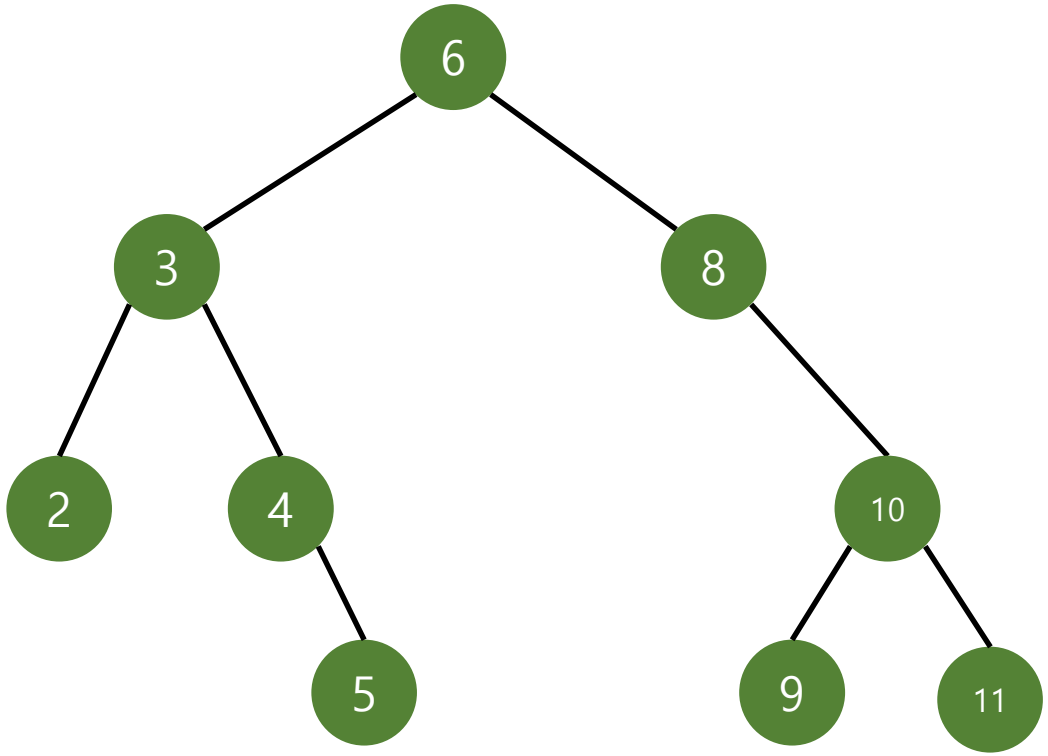
딕셔너리(Dictionary)

1. 쌍의 집합(a collection of pairs)
2. 각 쌍은 키와 아이템(원소)로 구성(pair : <key, item>)

딕셔너리 ADT

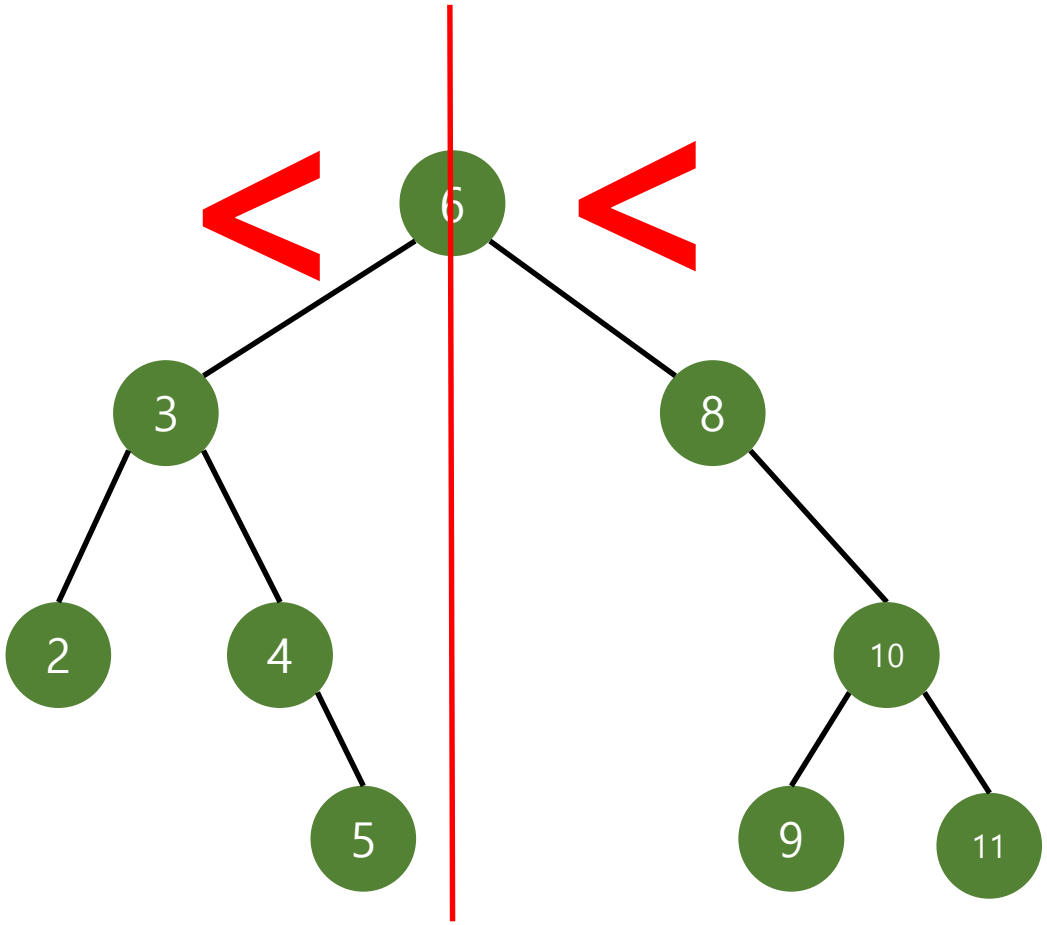
1. D.insert(key, item)->None
   : 키와 아이템을 딕셔너리에 삽입
2. D.search(key) -> pair<key, item>
   : 인자 key를 가지는 쌍을 반환
3. D.delete(key) -> pair<key, item>
   : 인자 key를 가진 쌍을 삭제한 후 반환

BST



Binary Search Tree

1. 모든 원소는 서로 다른 key를 가진다.
2. 왼쪽 서브 트리에 있는 모든 키들은 루트의 키보다 작다.
3. 오른쪽 서브 트리에 있는 모든 키들은 루트의 키보다 크다.
4. 왼쪽 서브 트리와 오른쪽 서브 트리도 이진 탐색 트리이다.


6
<
<
3
8
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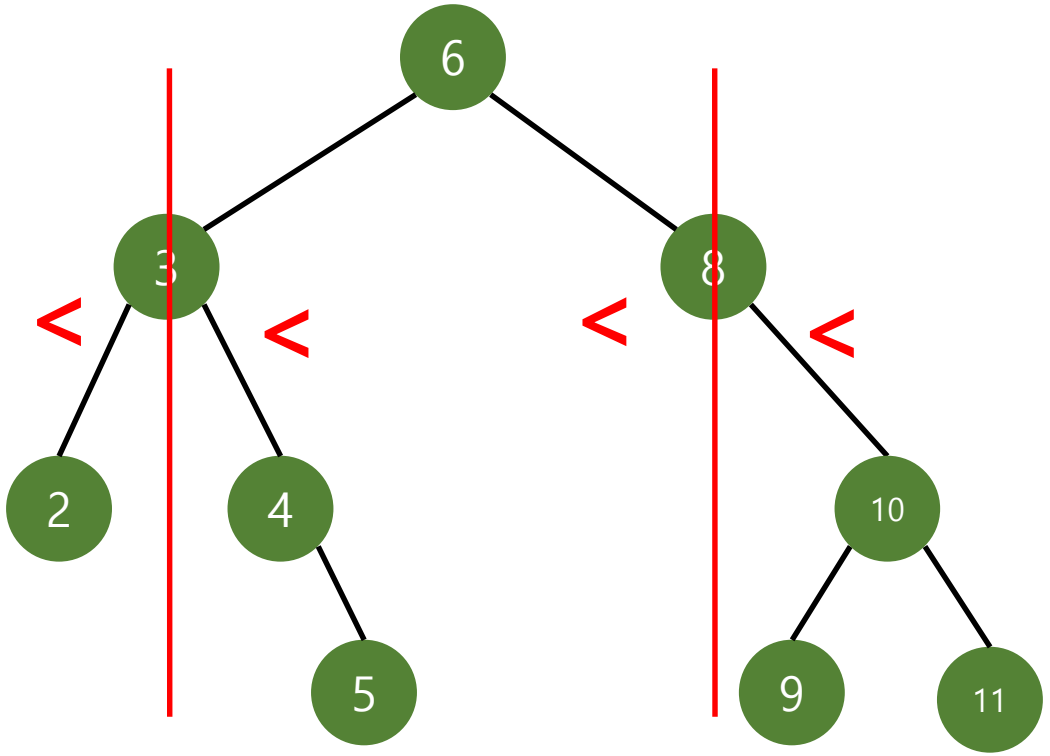
4
10
5
9
11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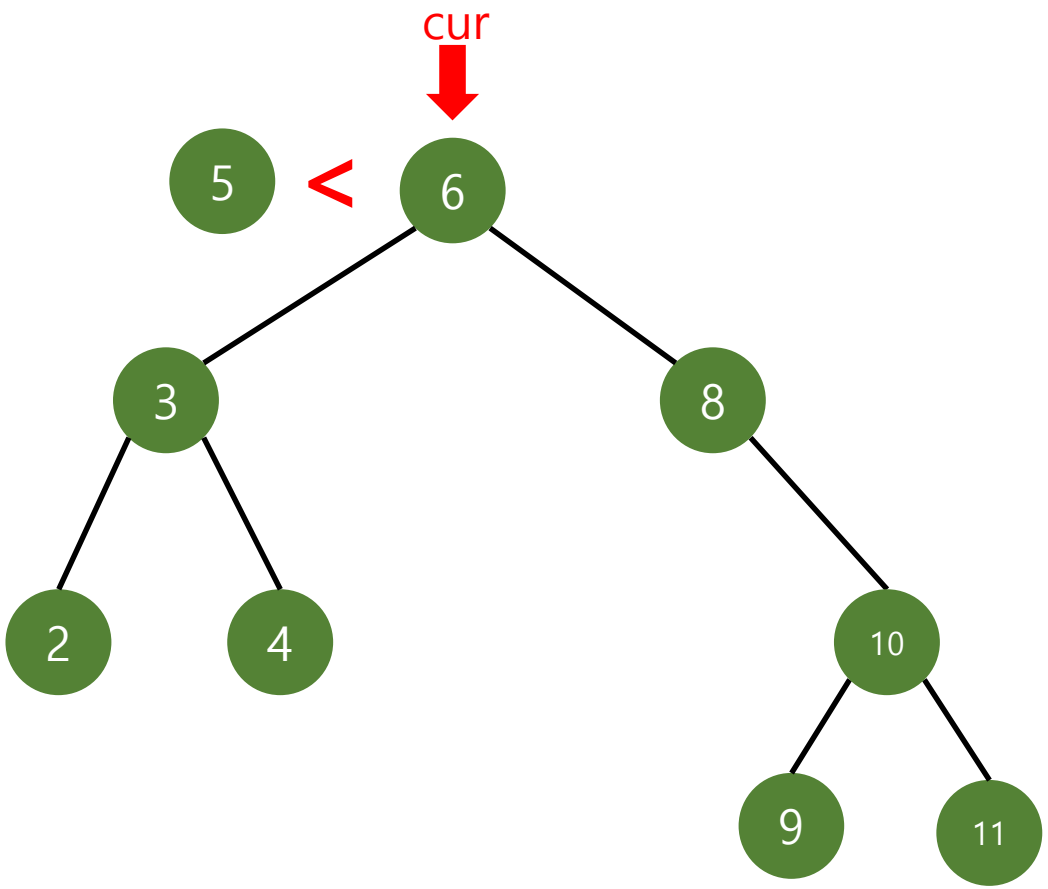
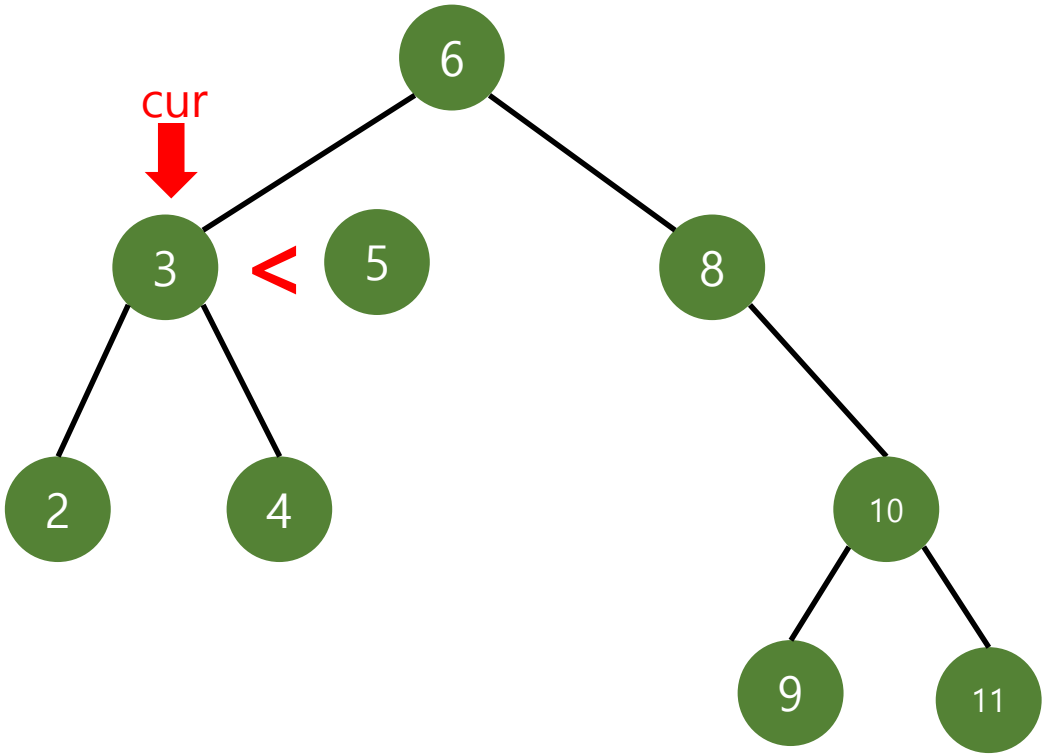
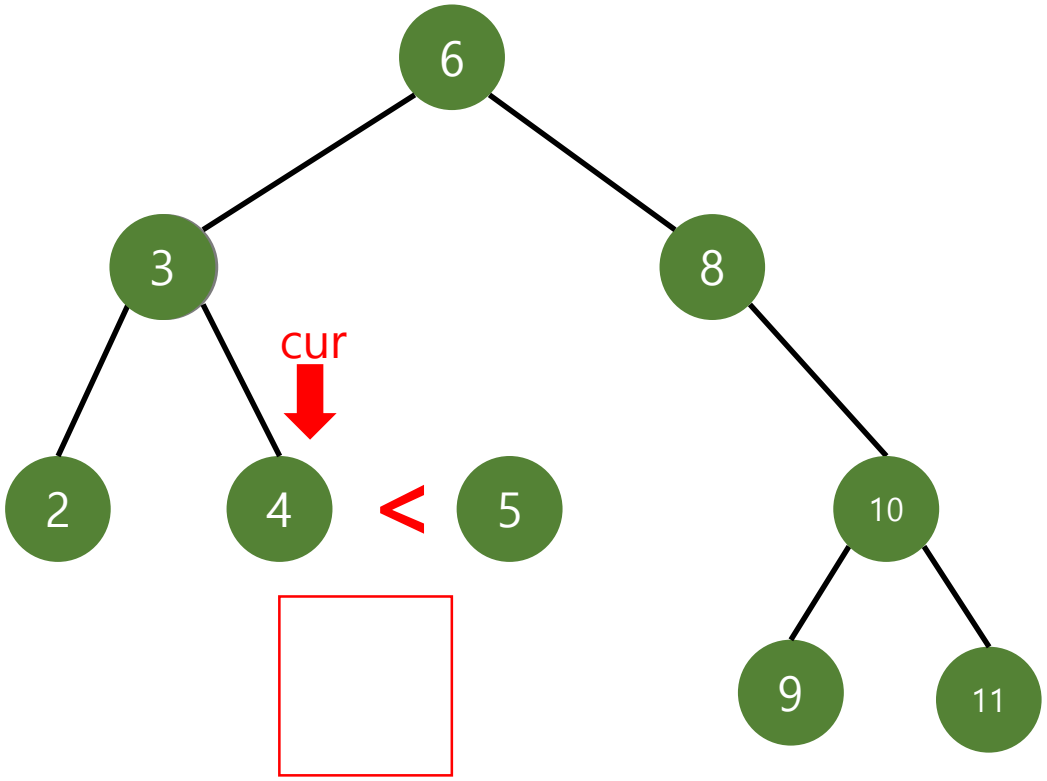
Insert - 1



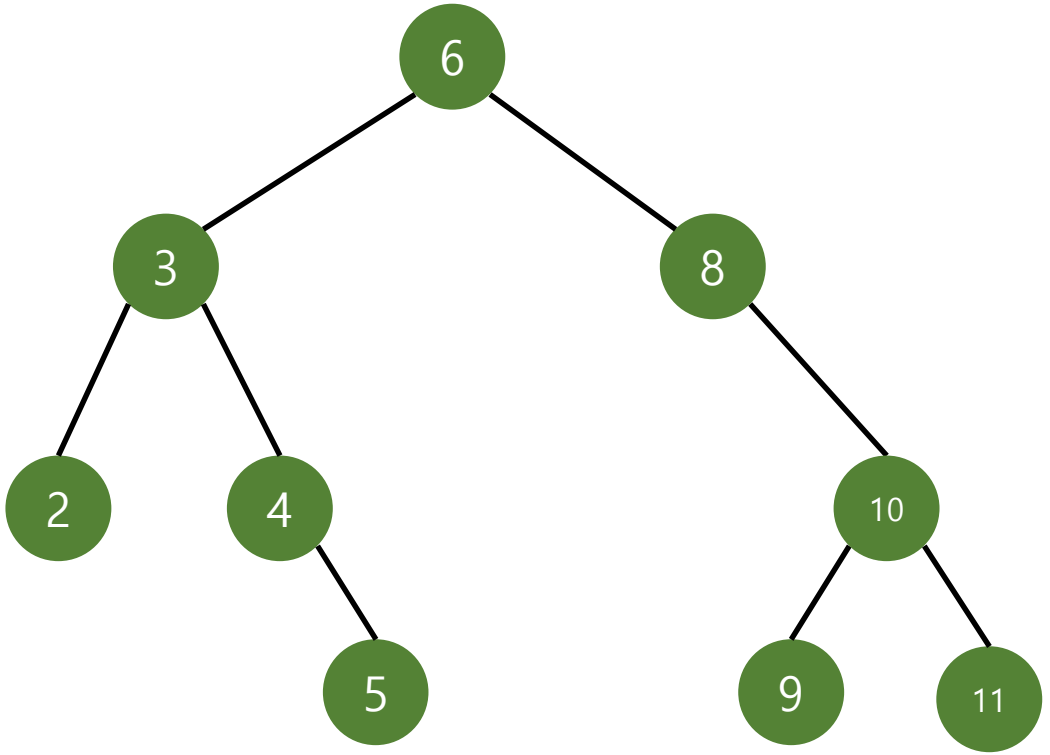
Insert - 2



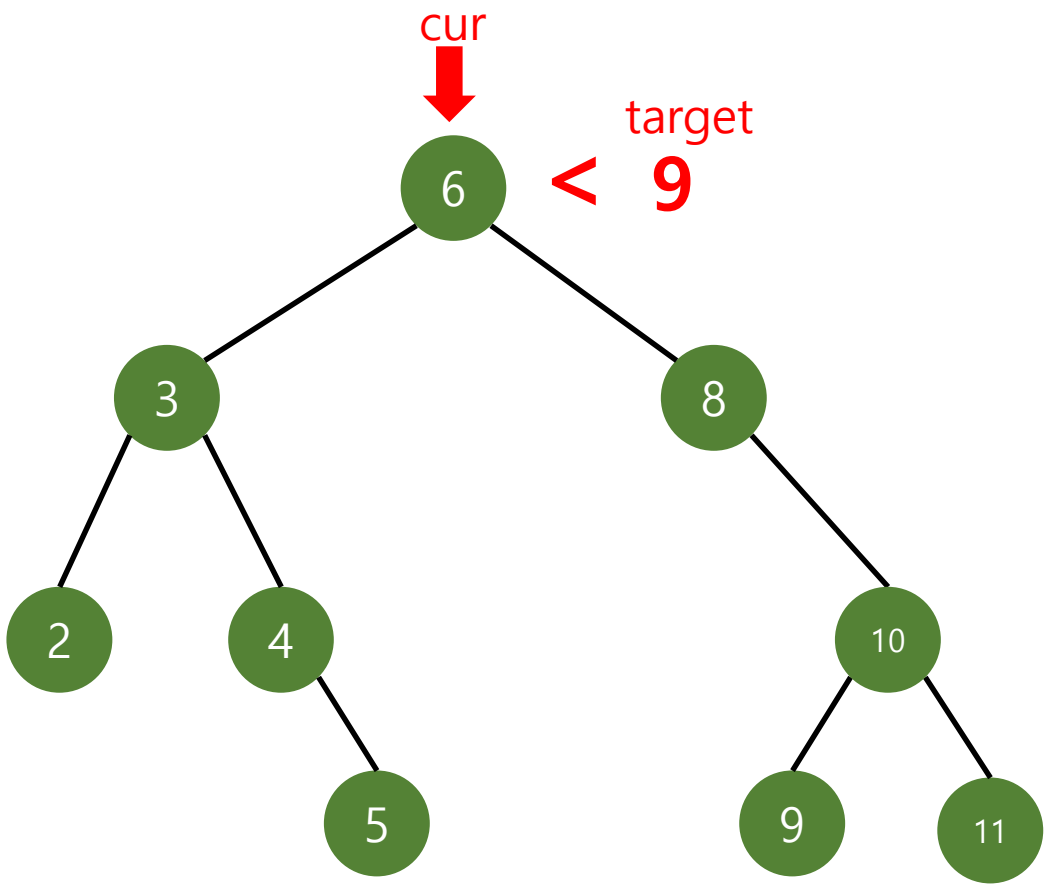
Insert - 3



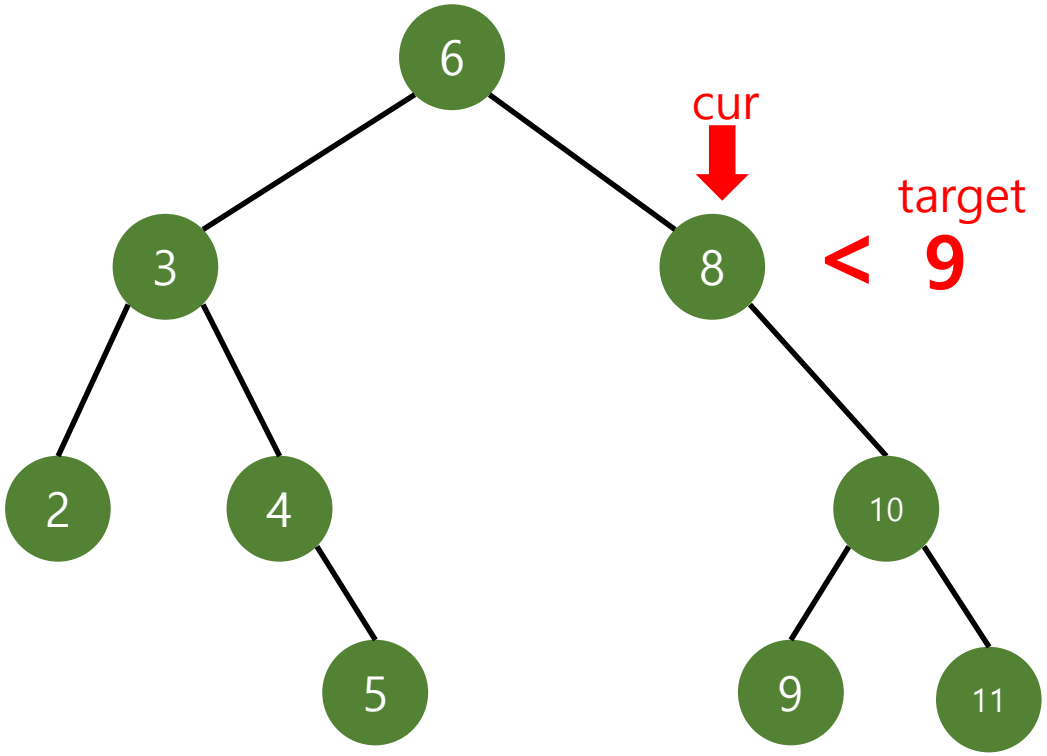
Insert - 4



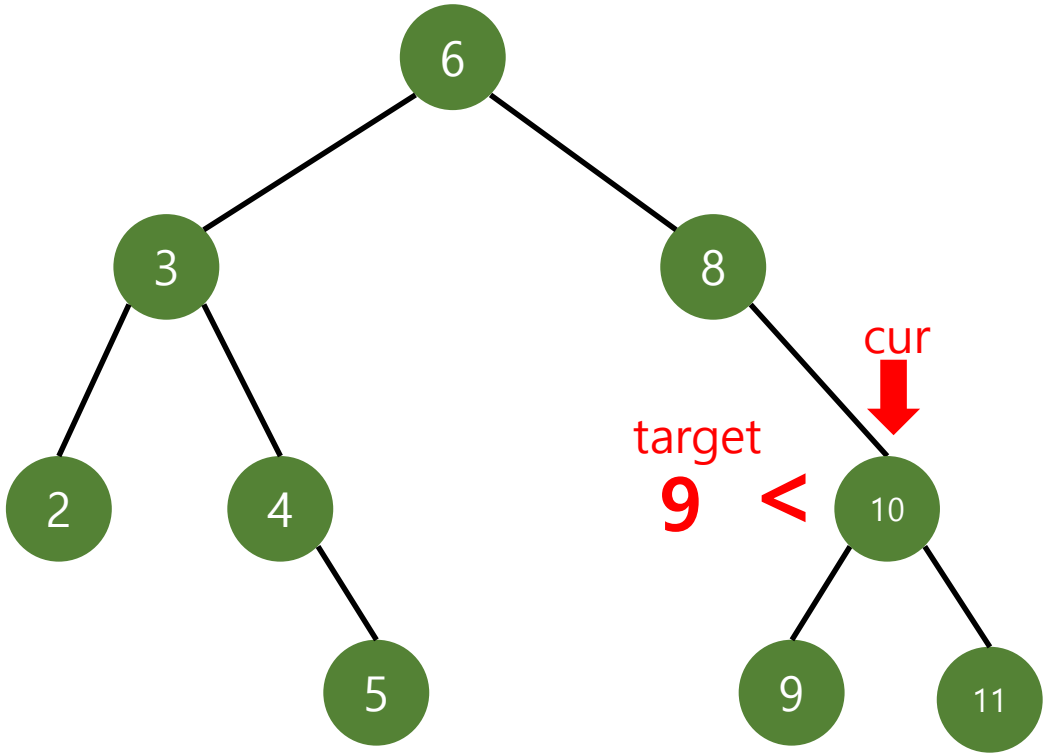
search - 1



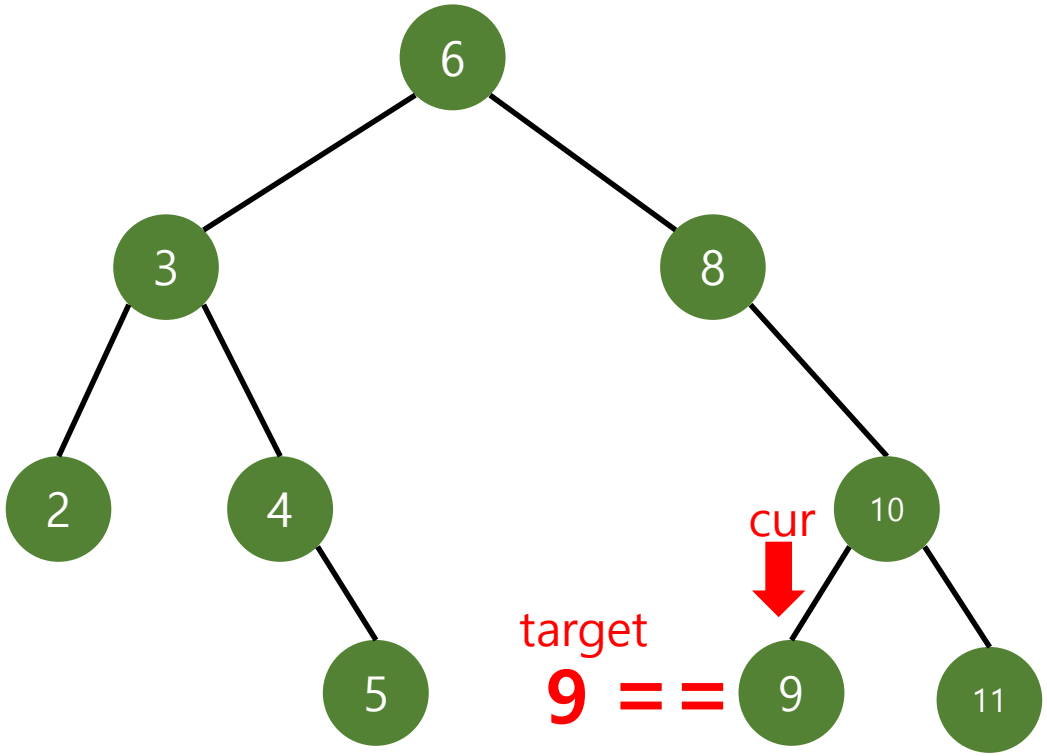
search - 2



search - 3



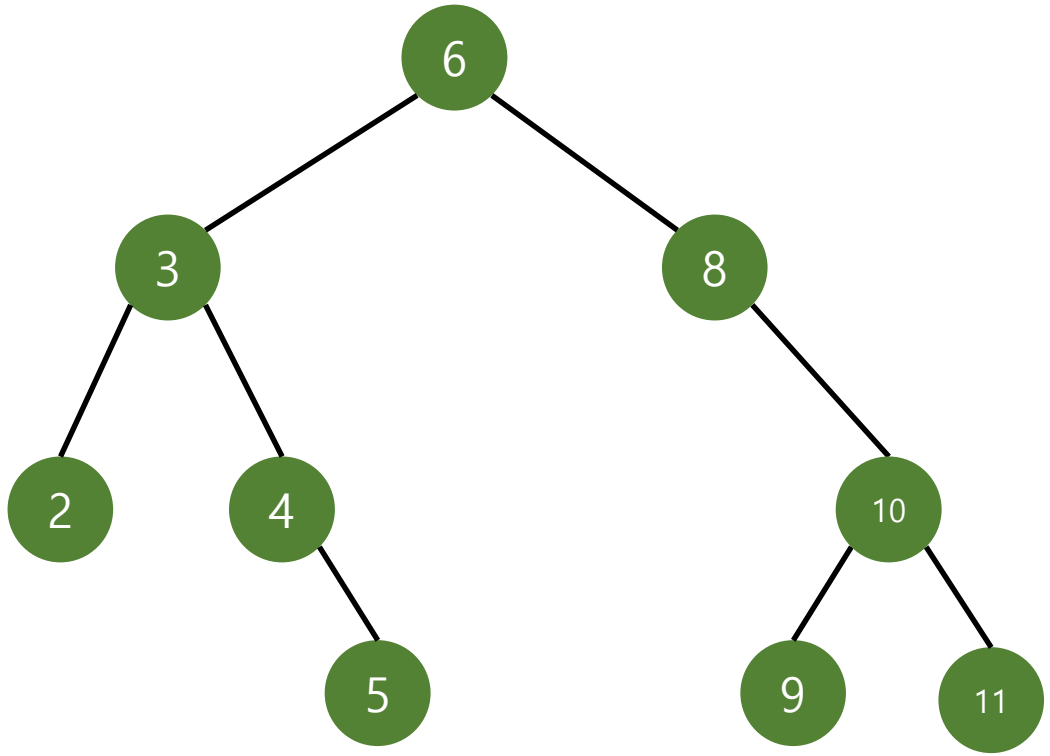
search - 4



remove

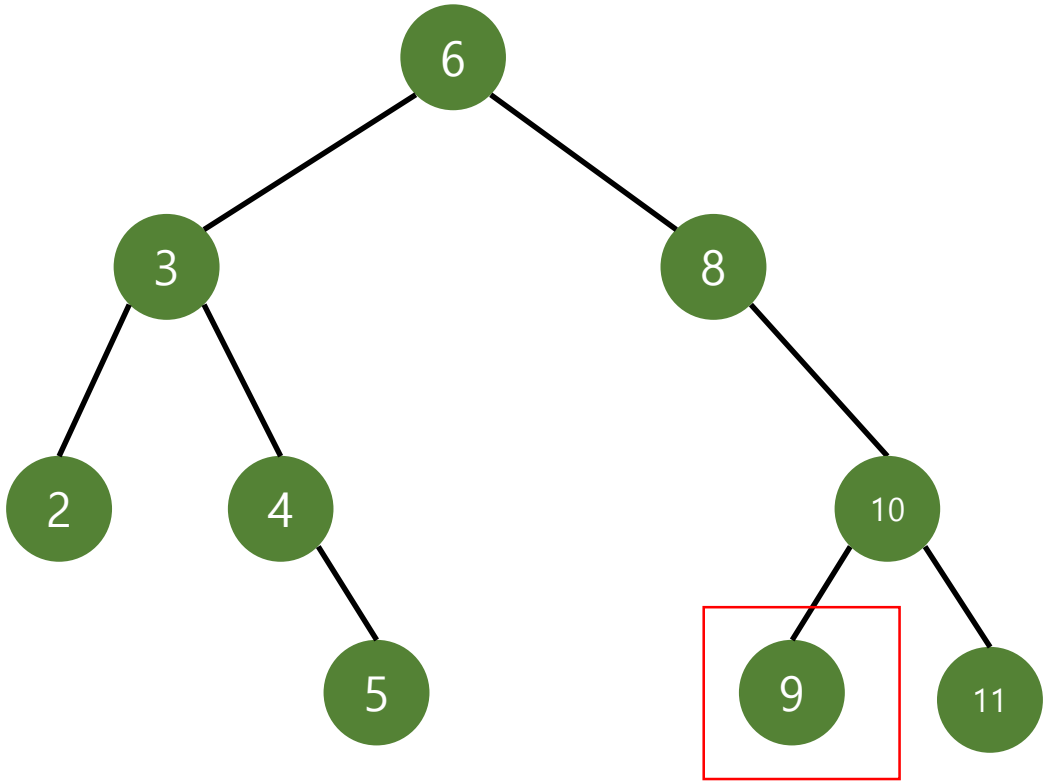
노드를 지울 때 3가지 상황

1. 지울 노드가 리프 노드
2. 자식 노드가 하나일 때
3. 자식 노드가 둘일 때

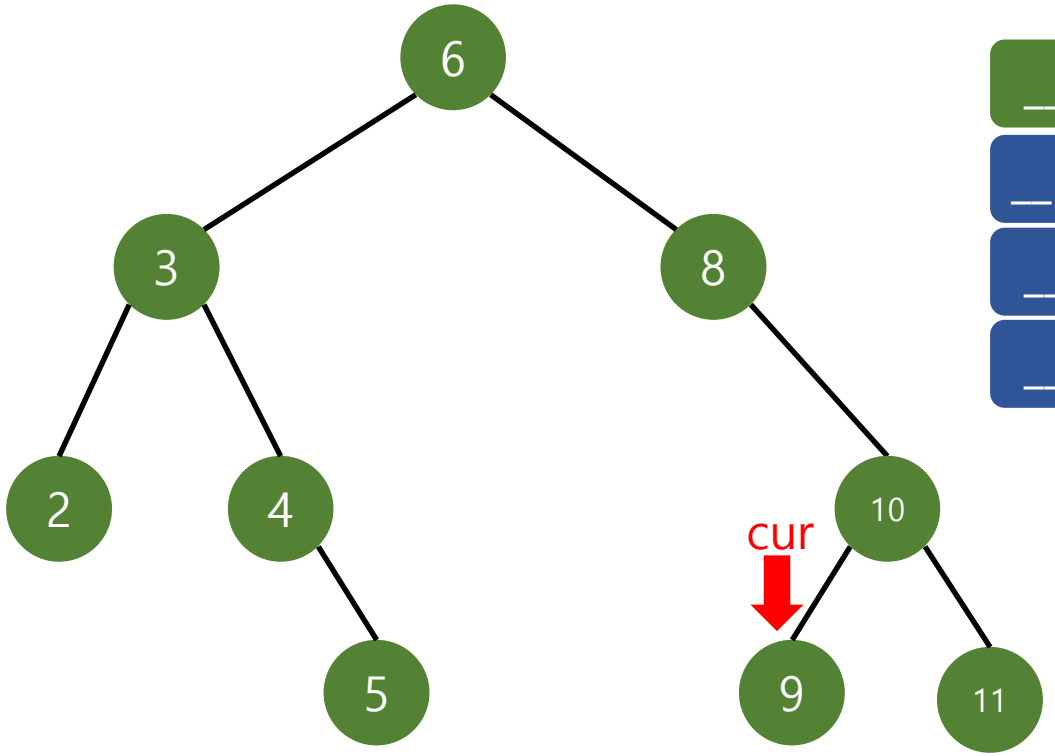


1. 지울 노드가 리프 노드

remove



# remove



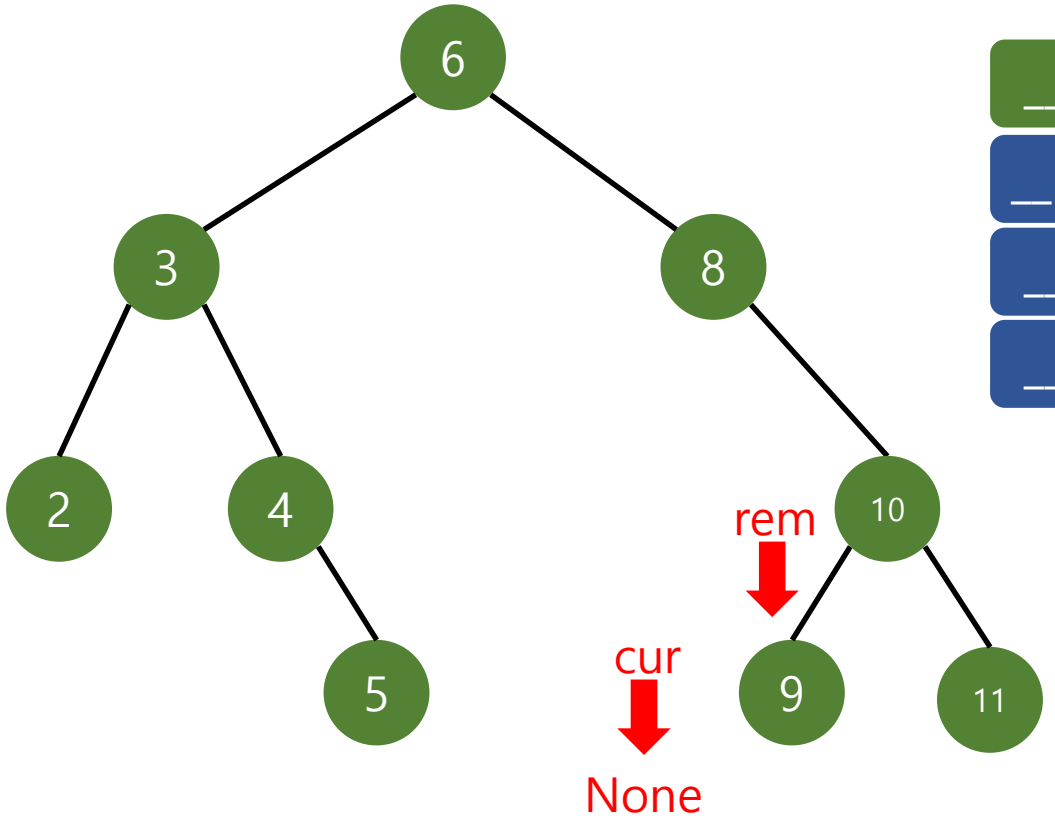

__remove_recusion(node 9, 9)

__remove_recusion(node 10, 9)

__remove_recusion(node 8, 9)

__remove_recusion(node 6, 9)

# remove



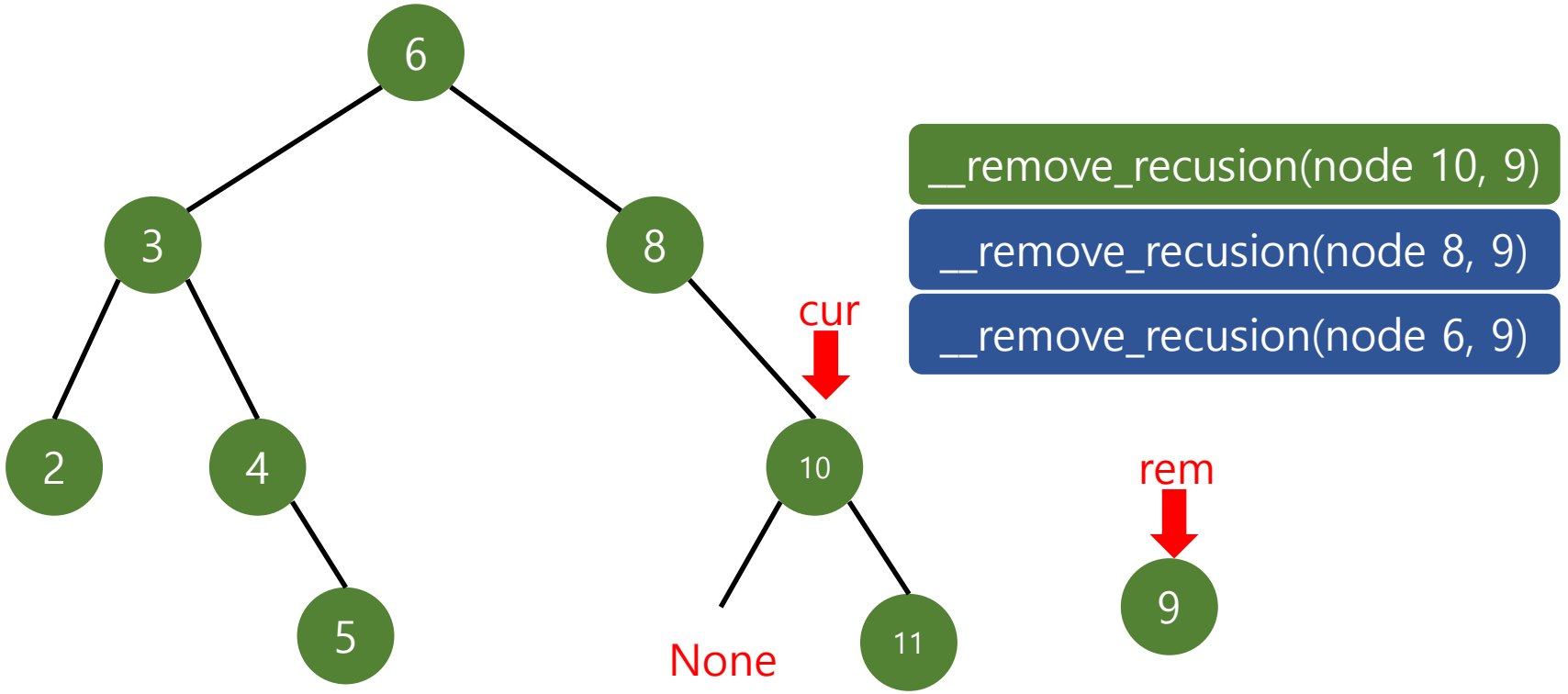

__remove_recusion(node 9, 9)

__remove_recusion(node 10, 9)

__remove_recusion(node 8, 9)

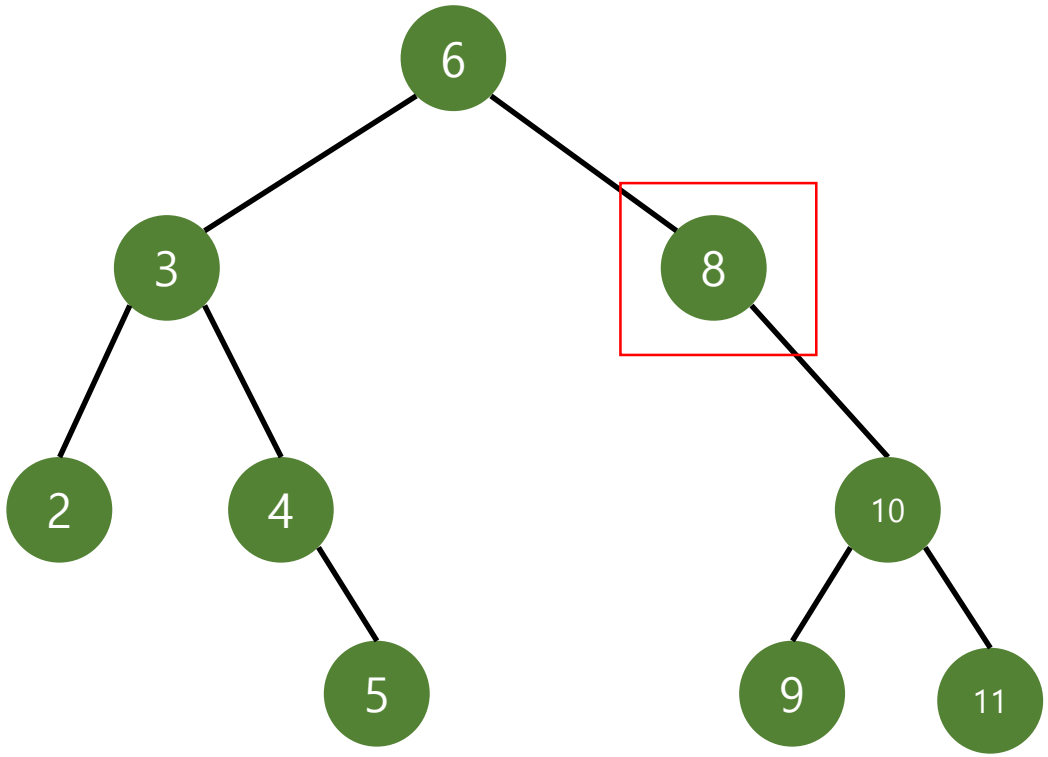
__remove_recusion(node 6, 9)

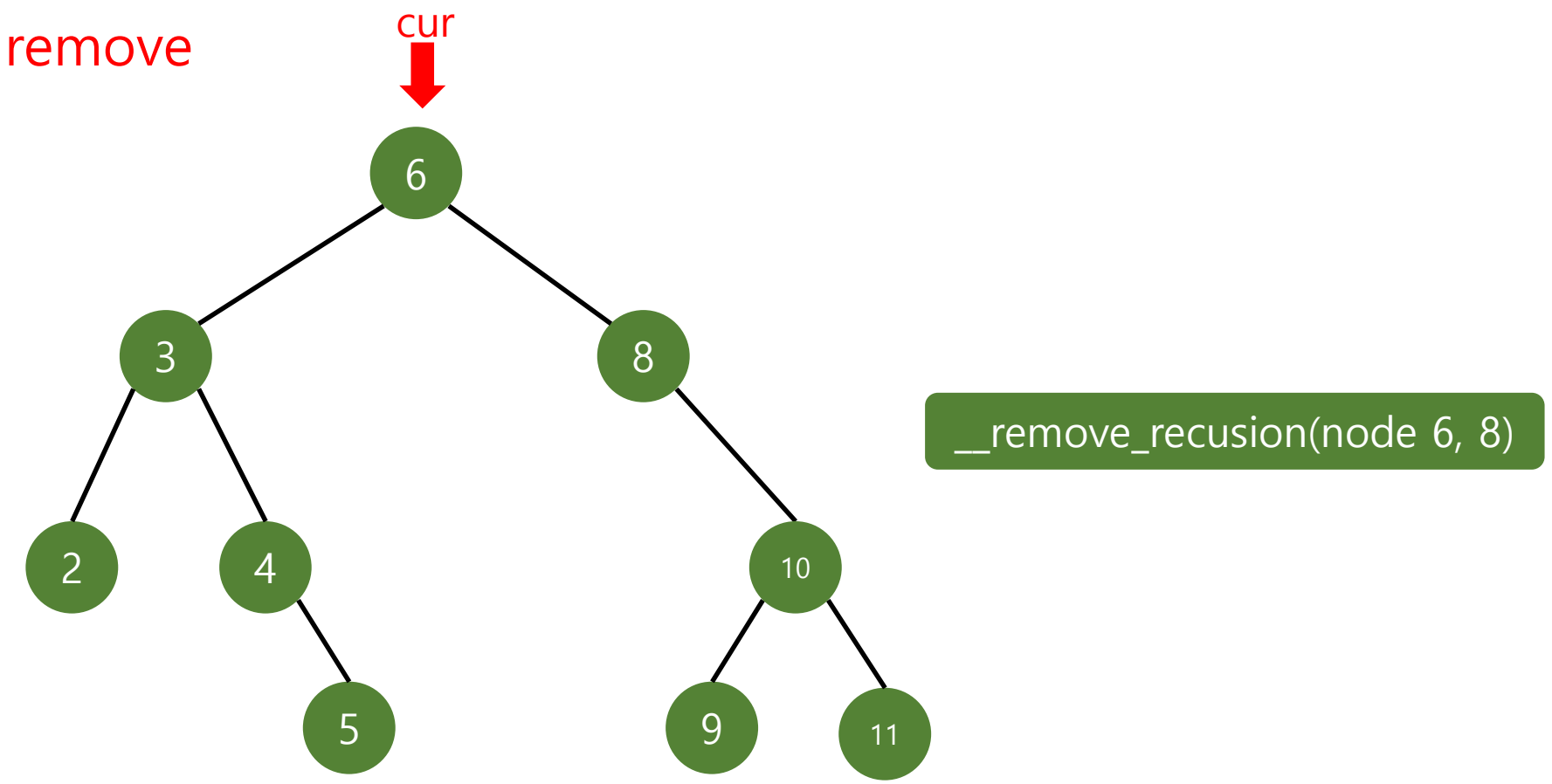
# remove


6
3
8
2
4
10
5
None
11
cur
rem
9
__remove_recusion(node 10, 9)
__remove_recusion(node 8, 9)
__remove_recusion(node 6, 9)

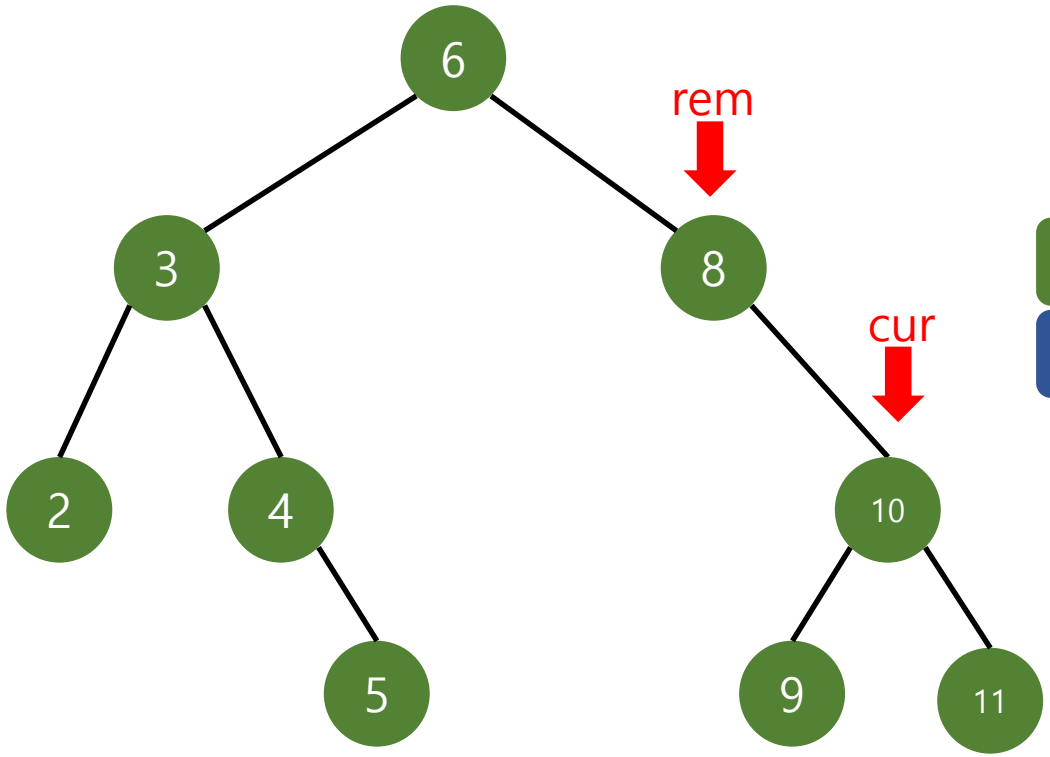
## 2. 자식 노드가 하나일 때

remove



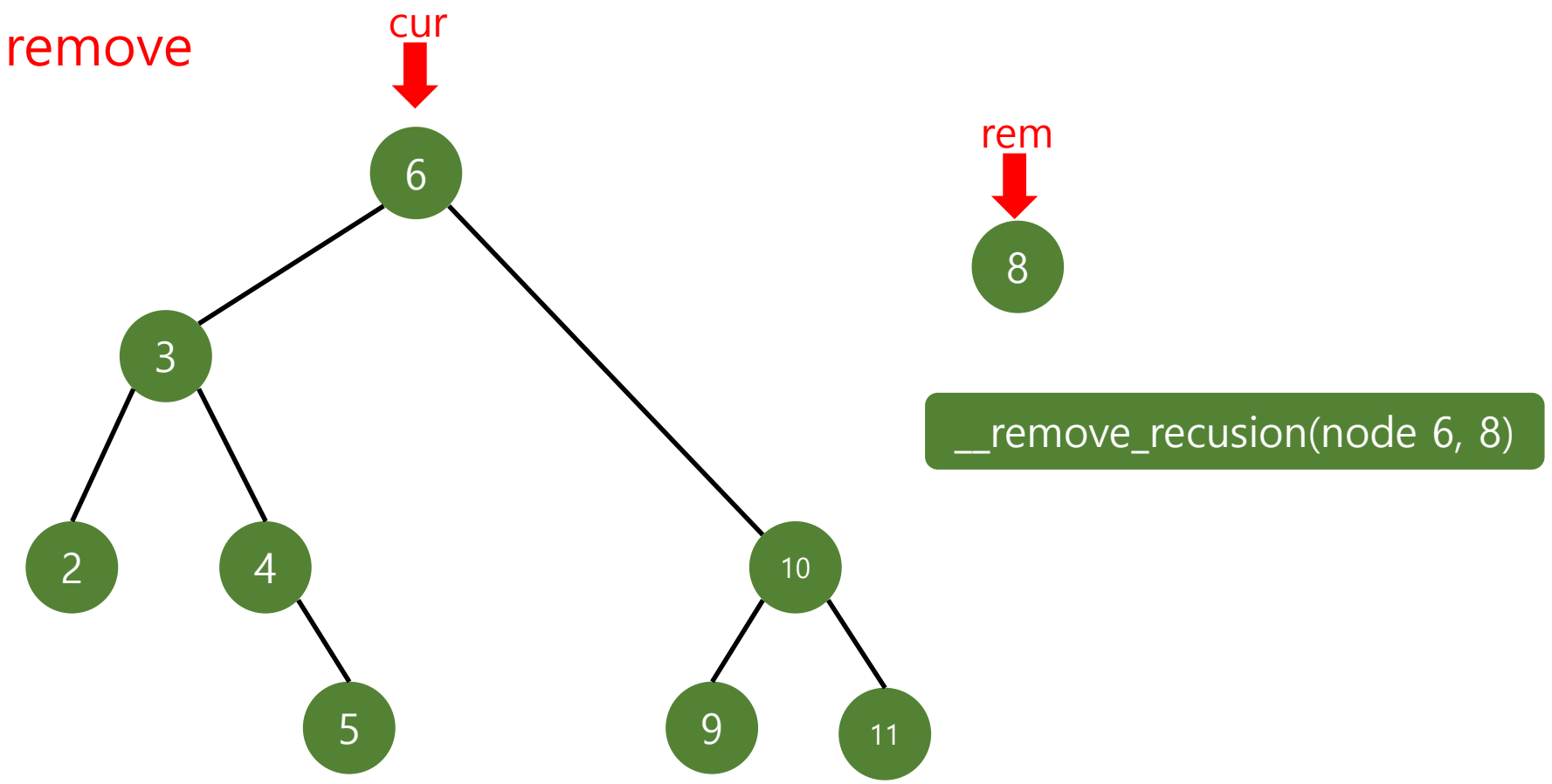

remove
cur
6
3
8
2
4
10
5
9
11
__remove_recusion(node 6, 8)

remove



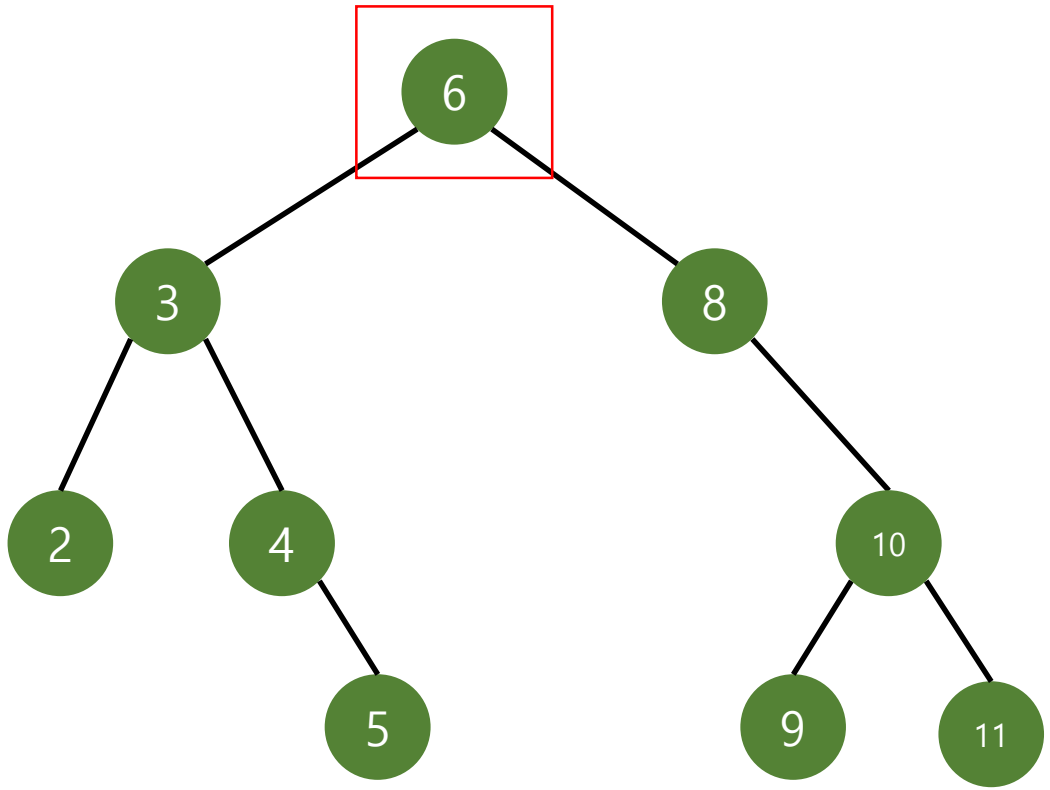

__remove_recusion(node 8, 8)

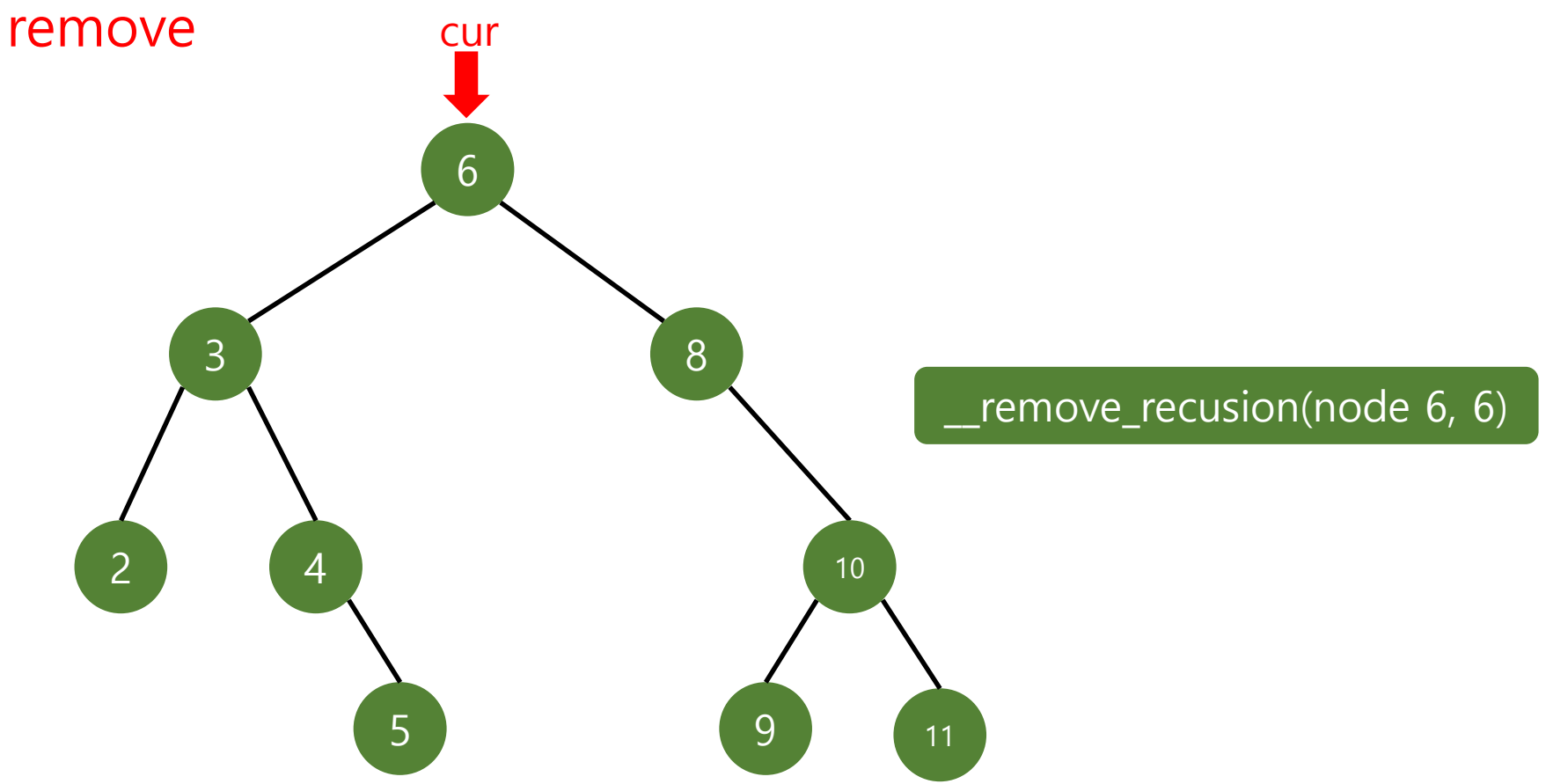
__remove_recusion(node 6, 8)


remove
cur
6
3
2
4
5
10
9
11
rem
8
__remove_recusion(node 6, 8)

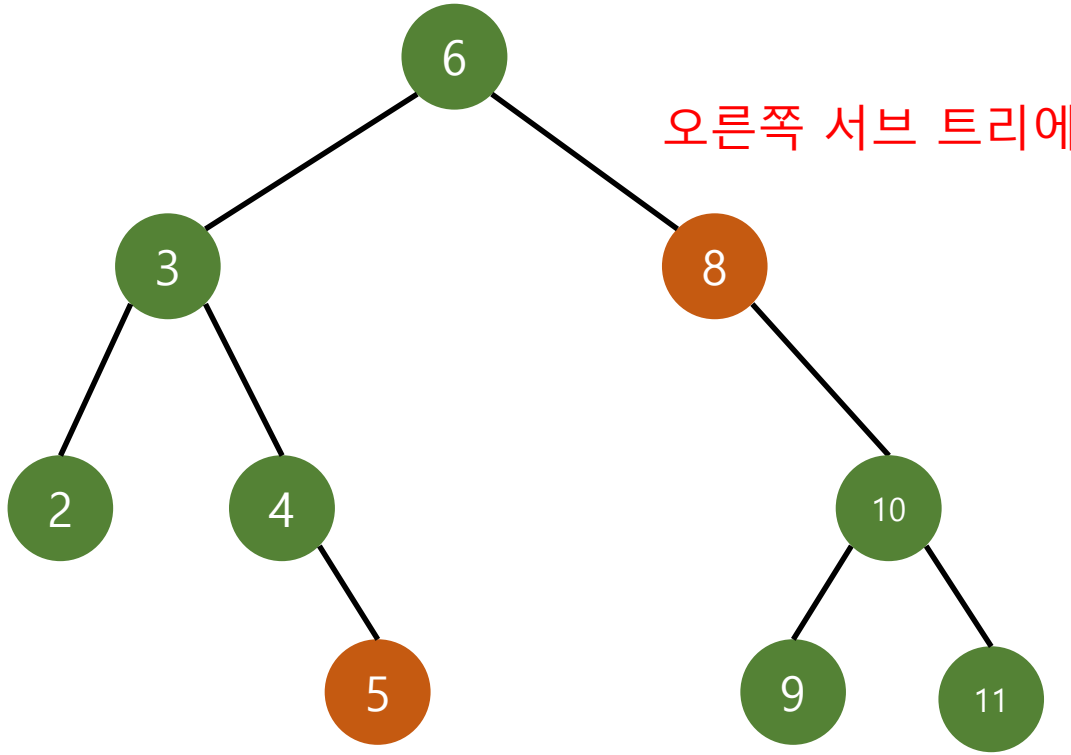
## 3. 자식 노드가 둘일 때

remove



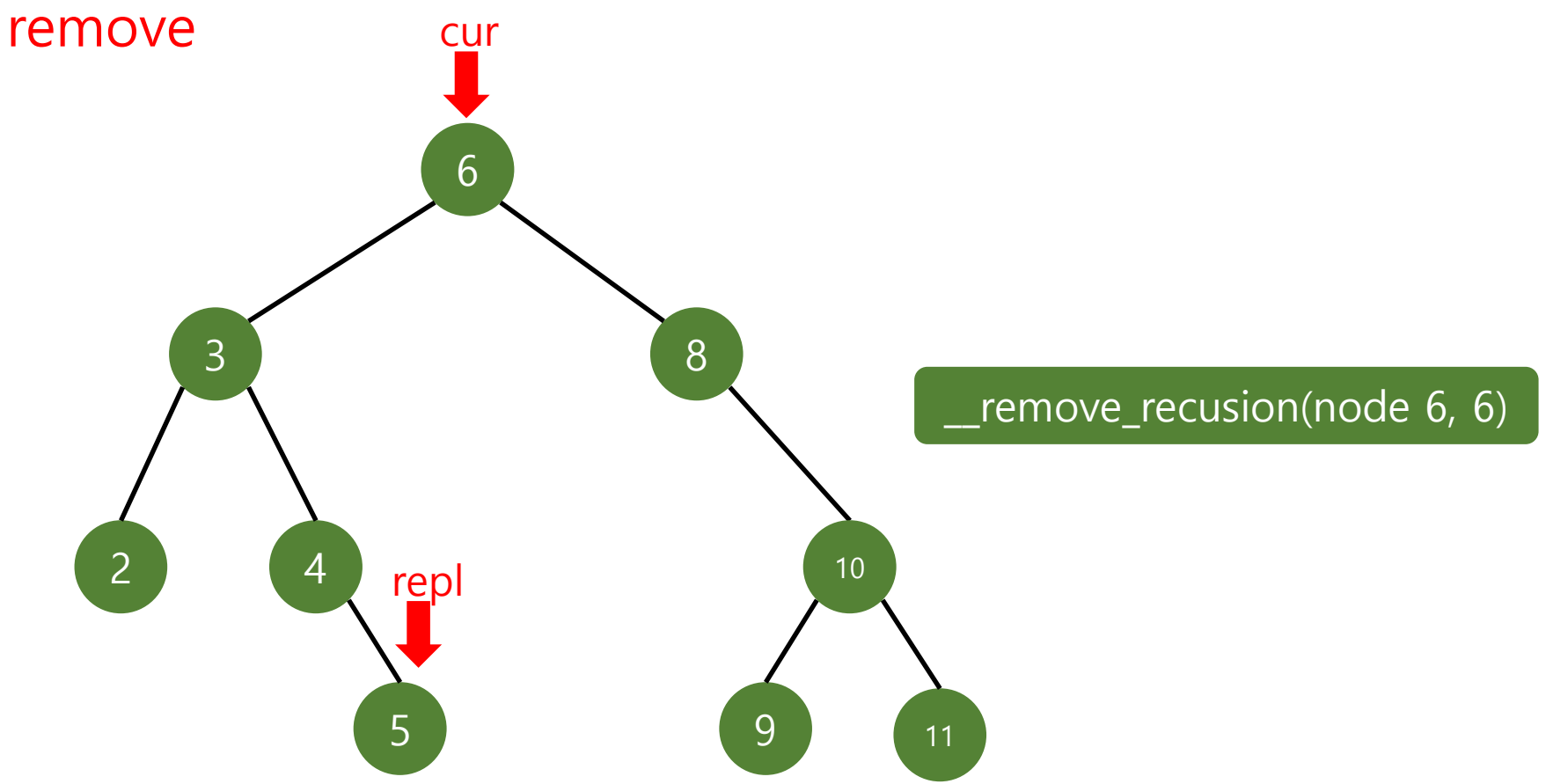

remove
cur
6
3
8
2
4
10
5
9
11
__remove_recusion(node 6, 6)

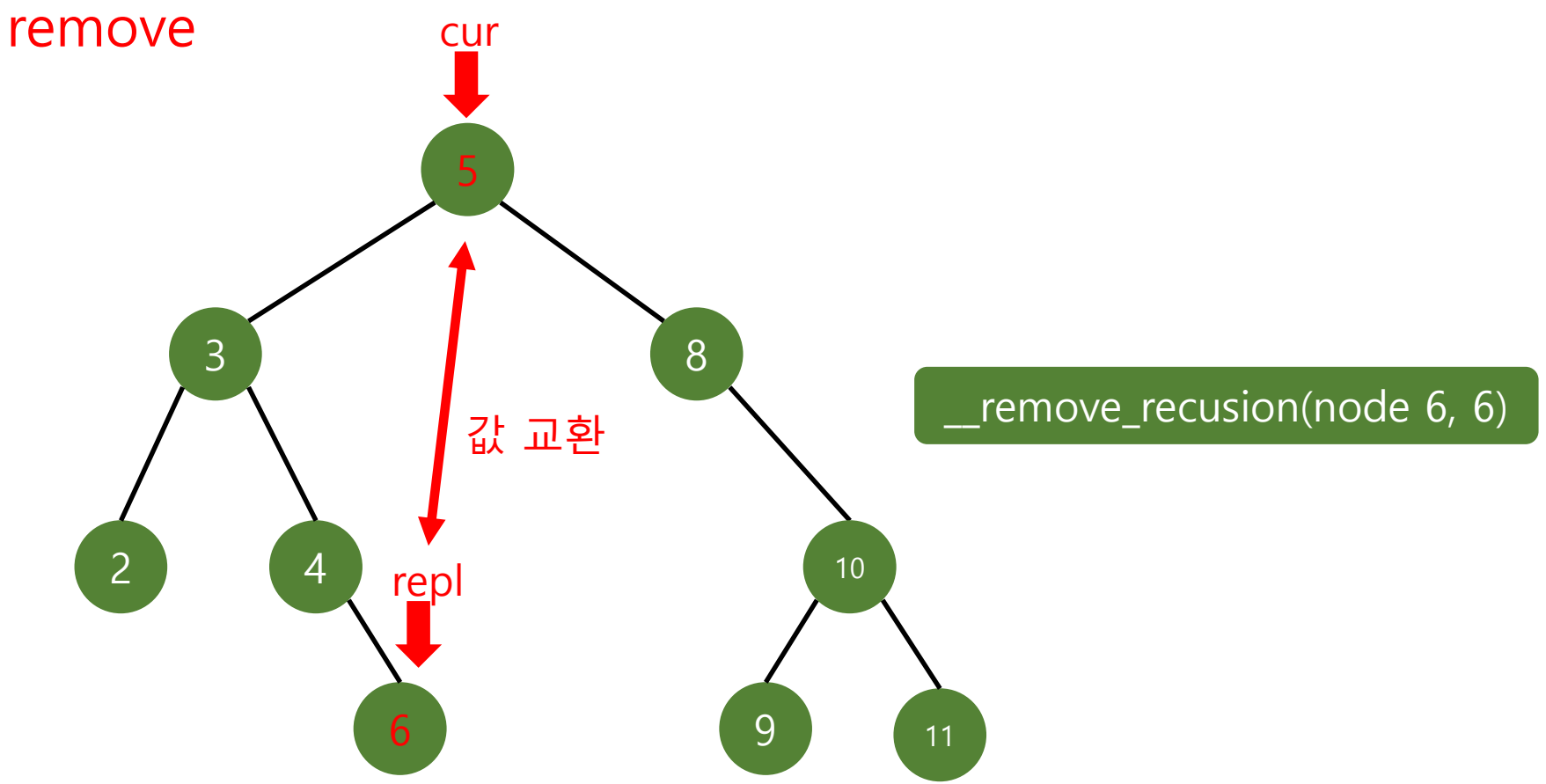
# 대체 노드



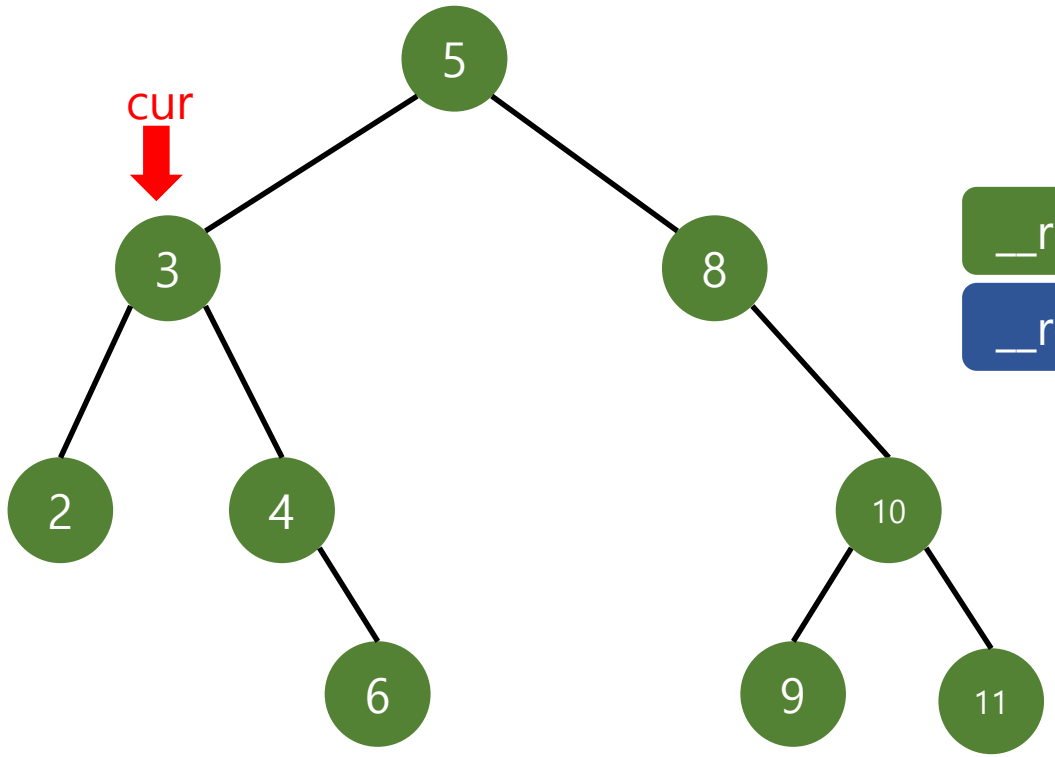

오른쪽 서브 트리에서 가장 작은 노드

왼쪽 서브 트리에서 가장 큰 노드


remove
cur
6
3
8
2
4
repl
10
5
9
11
__remove_recusion(node 6, 6)


remove
cur
5
3
8
값 교환
2
4
repl
10
6
9
11
__remove_recusion(node 6, 6)

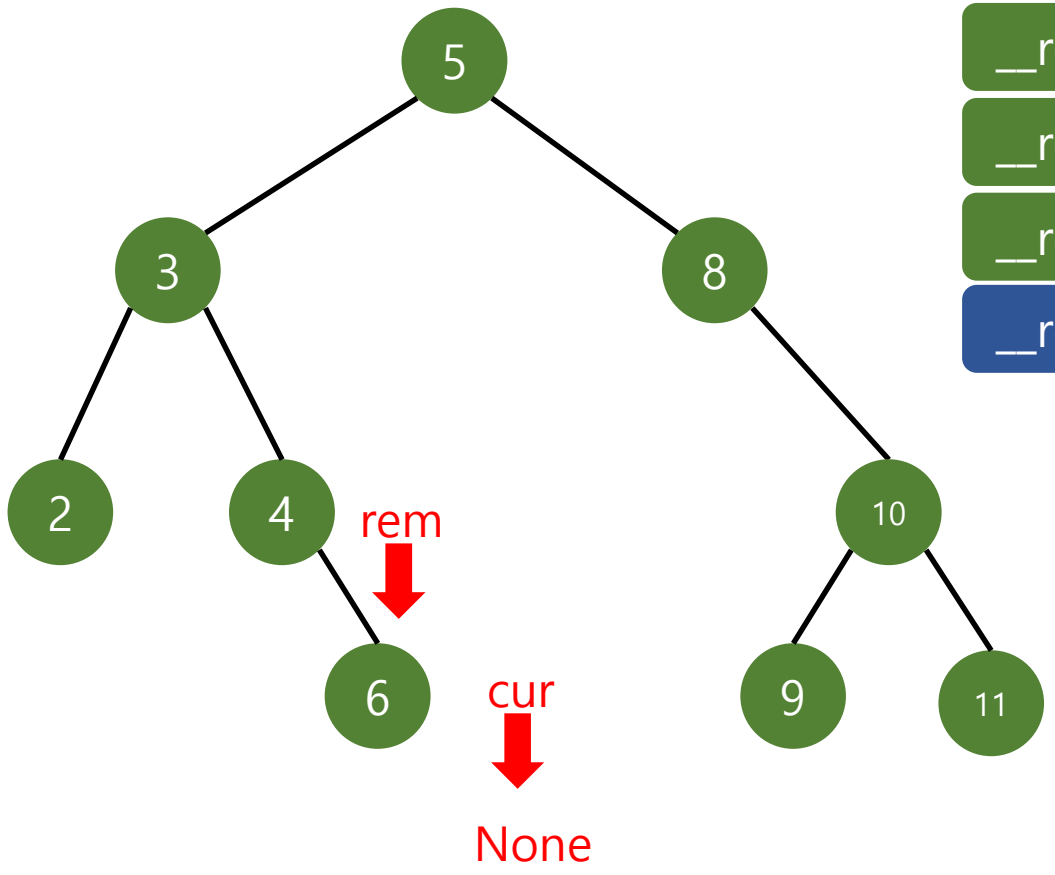
remove




__remove_recusion(node 3, 6)

__remove_recusion(node 6, 6)

remove

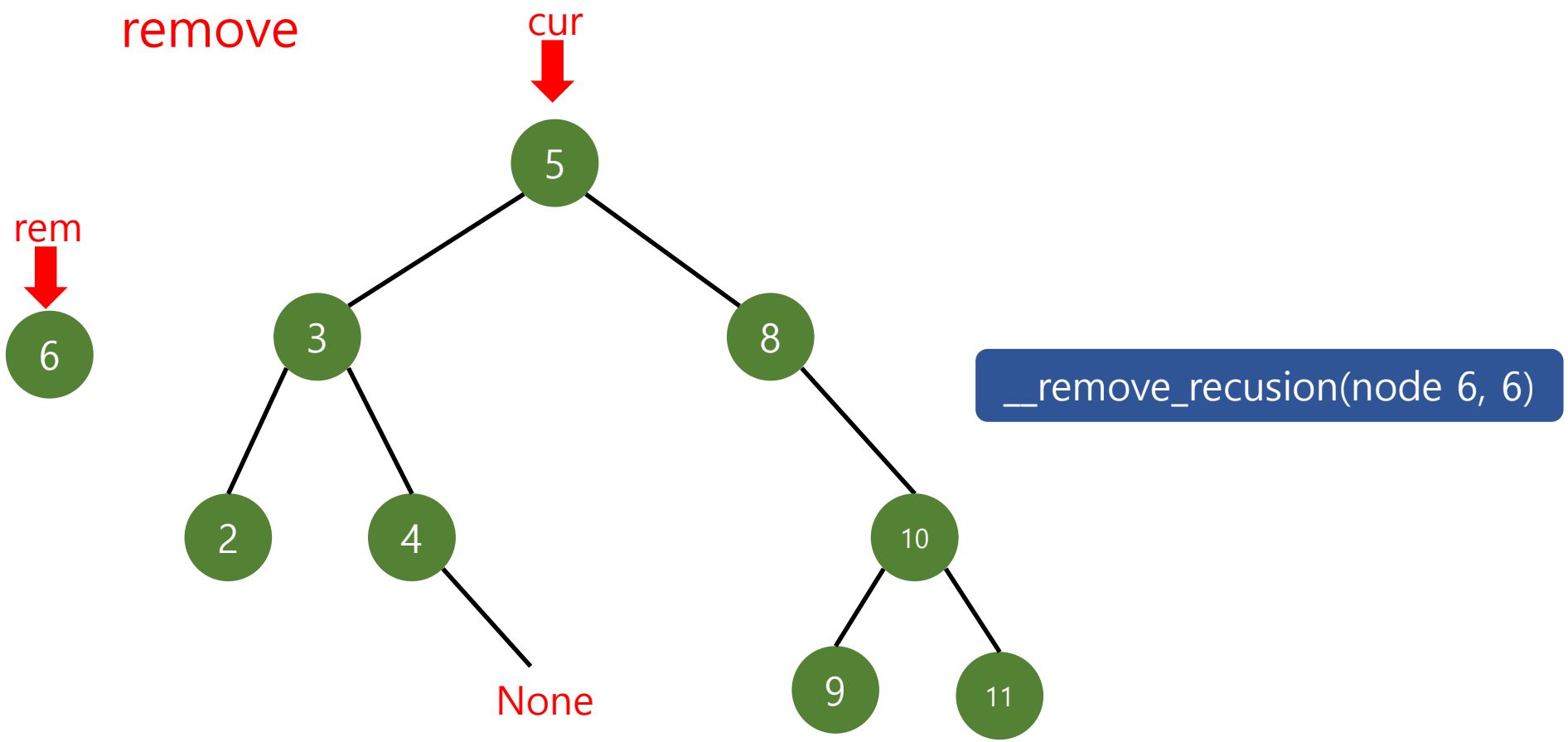



__remove_recusion(node 6, 6)

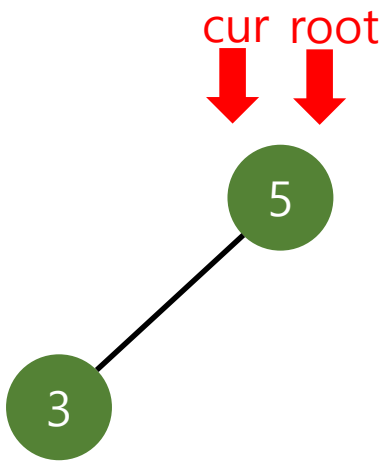
__remove_recusion(node 4, 6)

__remove_recusion(node 3, 6)

__remove_recusion(node 6, 6)

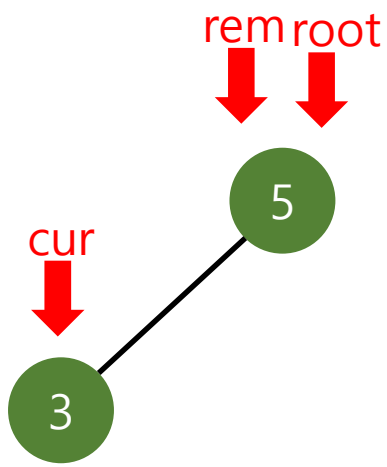

remove
cur
rem
5
6
3
8
2
4
10
None
9
11
__remove_recusion(node 6, 6)

Remove()함수에서 루트 노드를 업데이트하는 이유




__remove_recusion(node 5, 5)

Remove()함수에서 루트 노드를 업데이트하는 이유




__remove_recusion(node 5, 5)

Remove()함수에서 루트 노드를 업데이트하는 이유

루트를 업데이트 해줘야 함.