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CPSC 331 Assignment 3

Question 1: • Loop invariant:
- If T is a BST, then cursor is a BST as well
- if key > cursor.key then key is not in cursor.left (if key exists)
- if key < cursor.key then key is not in cursor.right (if key exists)

Before the first loop, it is a precondition that T is a BST, Cursor is assigned T.root, therefore cursor is a BST. If key is < cursor.key then ~~&~~ cursor.right is eliminated and we search cursor.left ~~after~~ in the next iteration. Since cursor was a BST cursor.left is a BST as well.

The loop ~~guard~~ variant is the height of cursor. Each iteration the height decreases by one since it searches the BST of one of its children. Thus it gives us an upperbounds of iterations of cursor.height. When height = ~~0~~ -1 the cursor will be pointing to null, thus exiting the loop. Therefore the loop terminates

Question 2

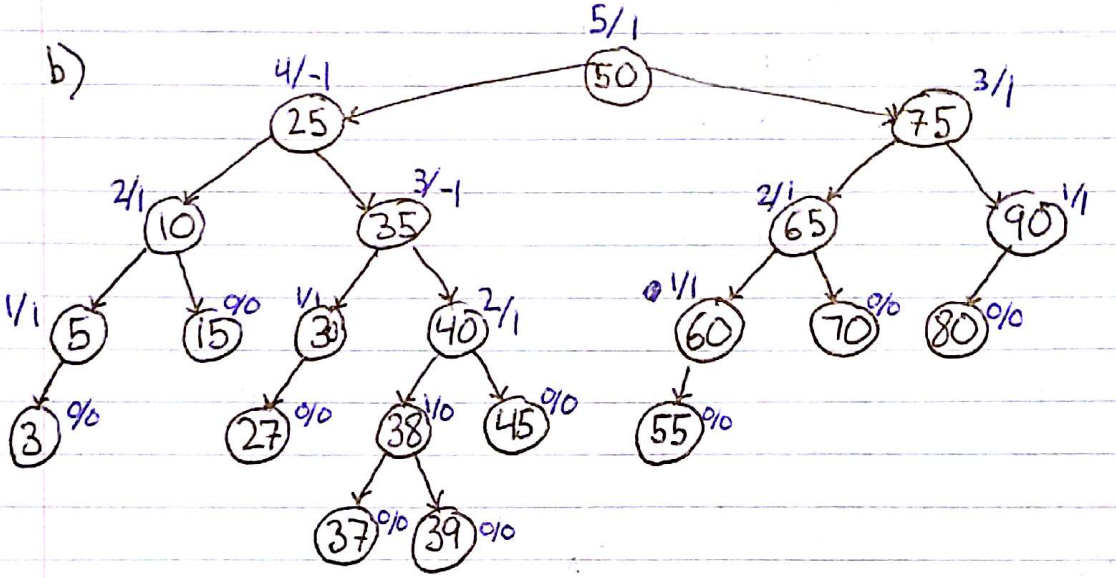
a)
```
while (cursor != null
    if (element == cursor) throw FoundException;
    if (element < cursor) then
        cursor = cursor.left;
    else
        cursor = cursor.right;
end
if (cursor == null) then
    cursor = element;
```

b)
```
modify (T, key, value)
    cursor = T.root;
    while ((cursor != null) || ( key != cursor.key && value != cursor.value))
        if (key == cursor.key) then
            cursor.value = value;
        else if ( key > cursor.key) then
            cursor = cursor.right;
        else
            cursor = cursor.left;
    end
    if (cursor == null) then
        throw KeyNotFoundException;
end
```

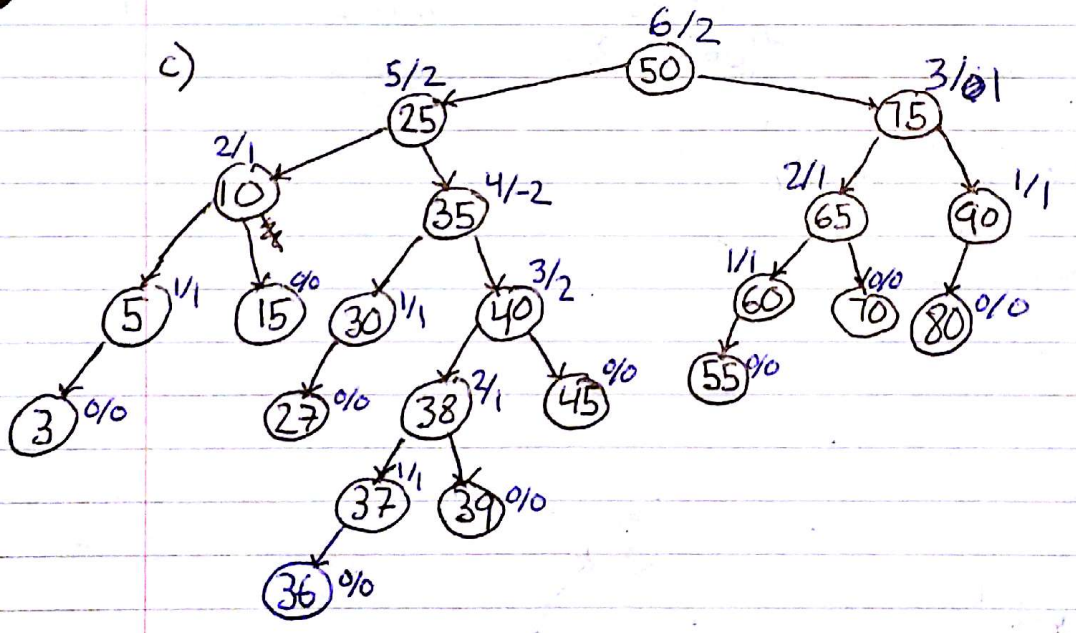
Question 5

a) Student ID: 10017168
Group: O

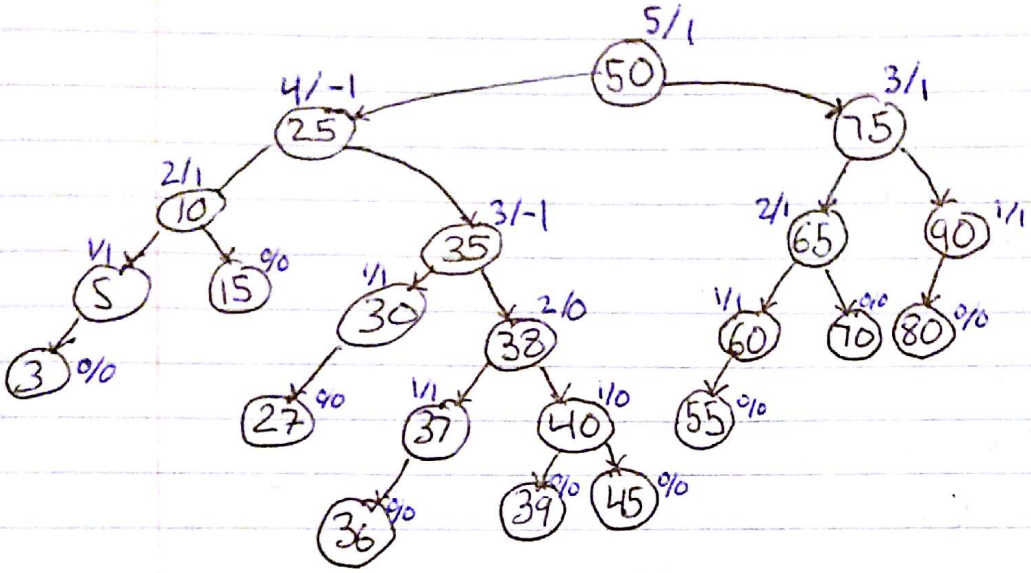
b)



c)

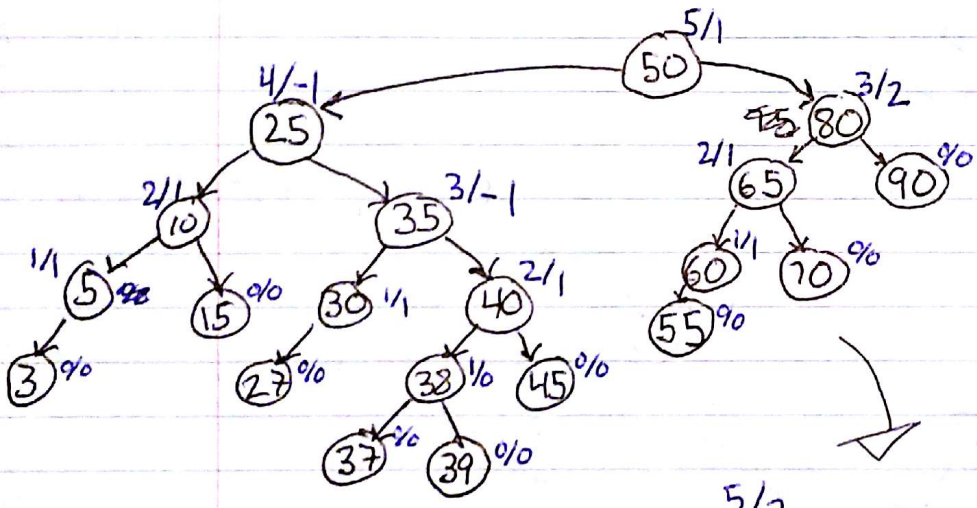


Insert 36

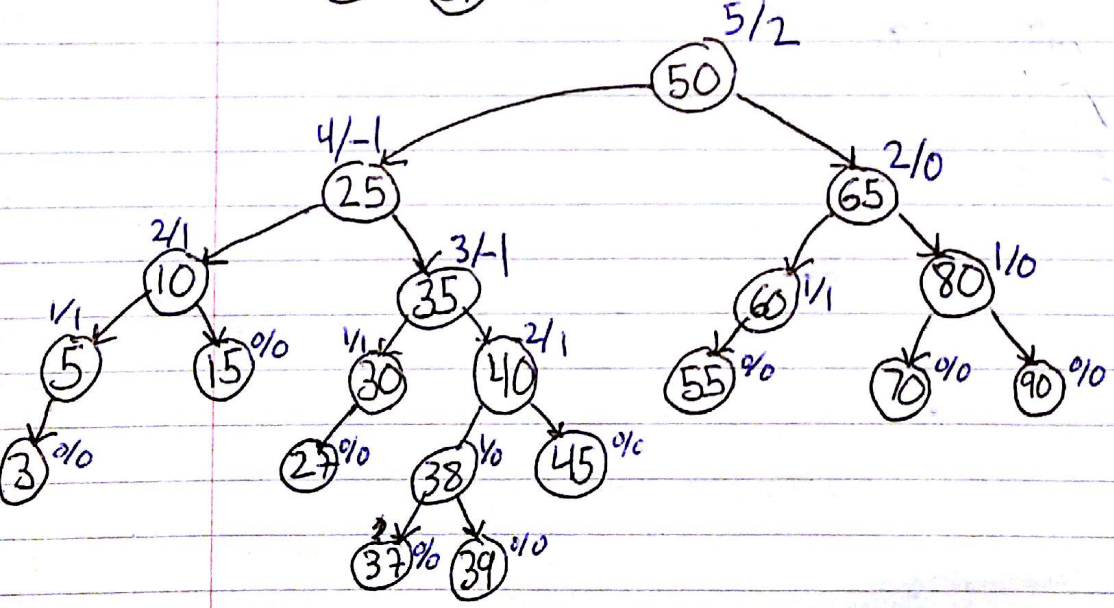


performed a right rotation on 40

d) delete 75 we take the MIN of the right subtree which is 80 to replace it.

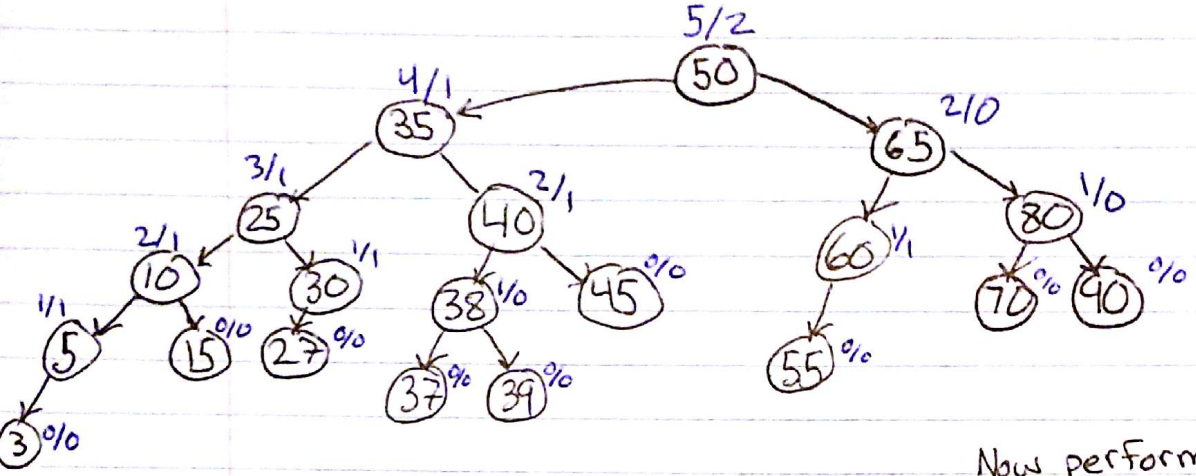


It is a left outer case so we will perform a right rotation

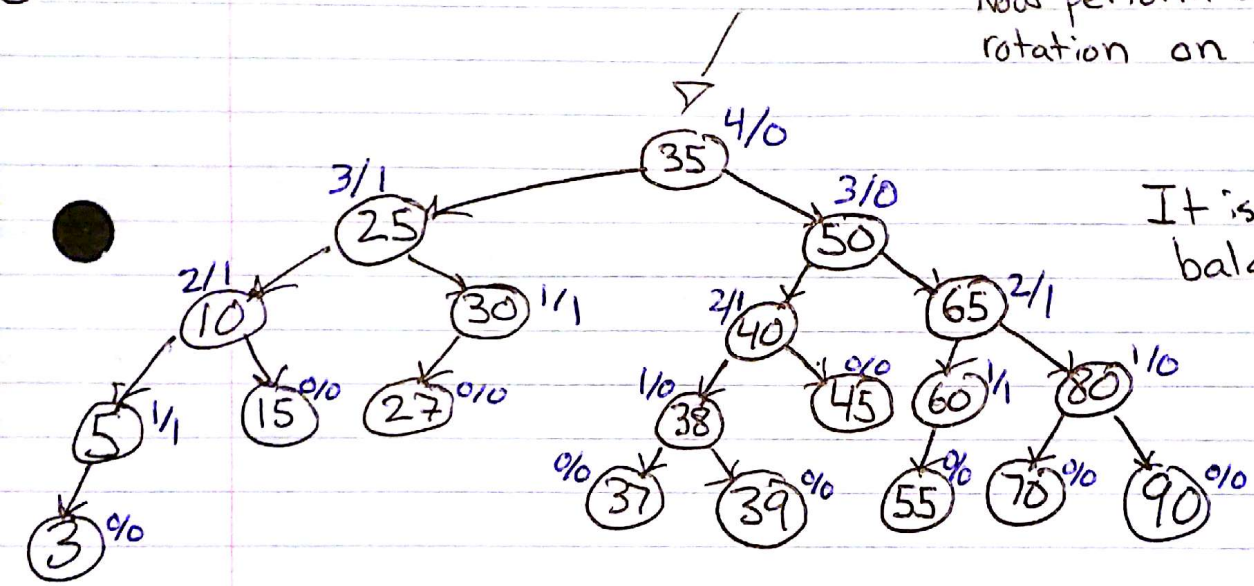


We now have an unbalance at the root. It is an inner left case, so we must perform a left right double rotation.

we will perform a left rotation on v.left, which is node 25.



Now perform a right rotation on v(50)



It is now a balanced AVL