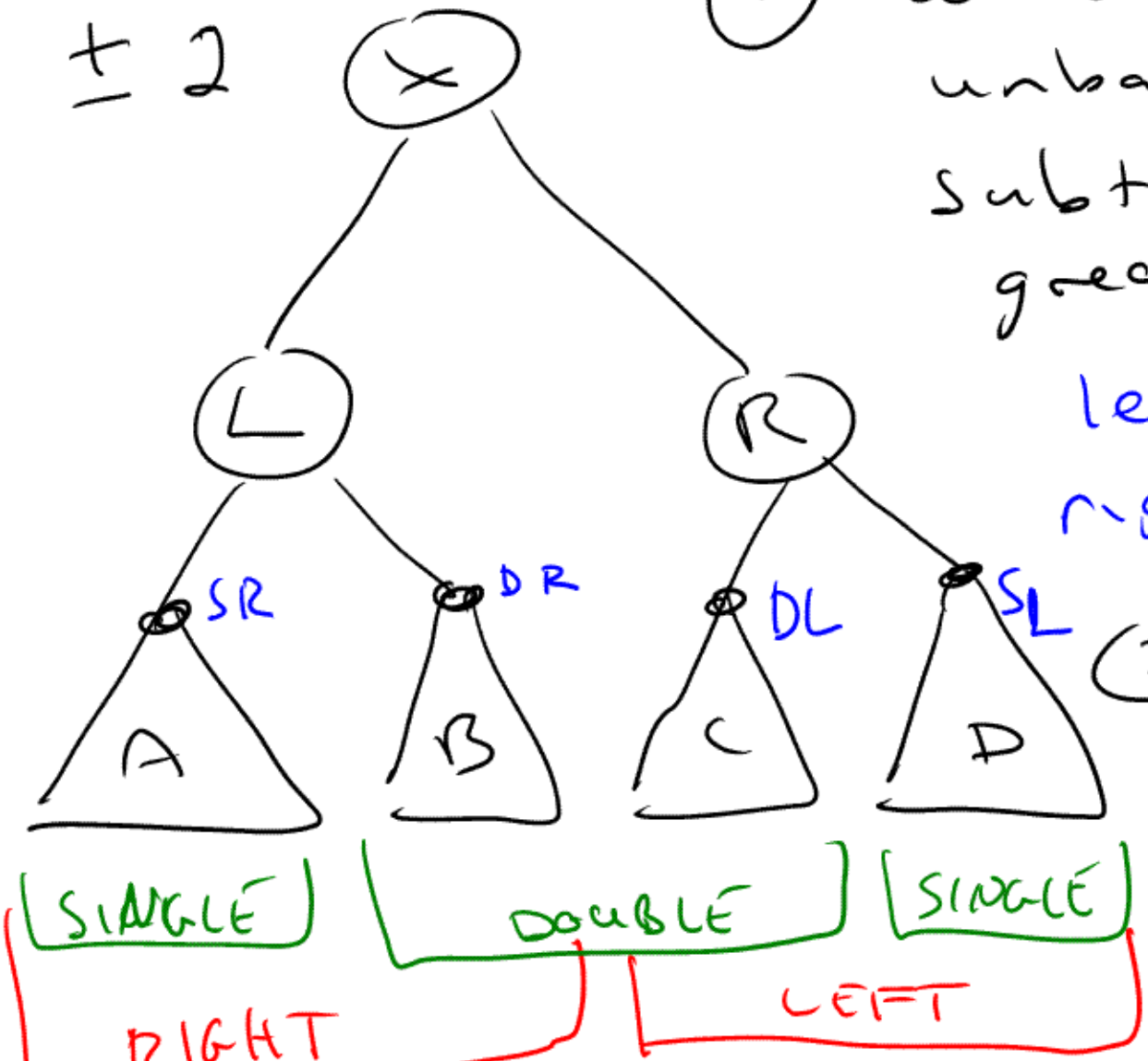


(1) which of the unbalanced node's subtrees has greater height?

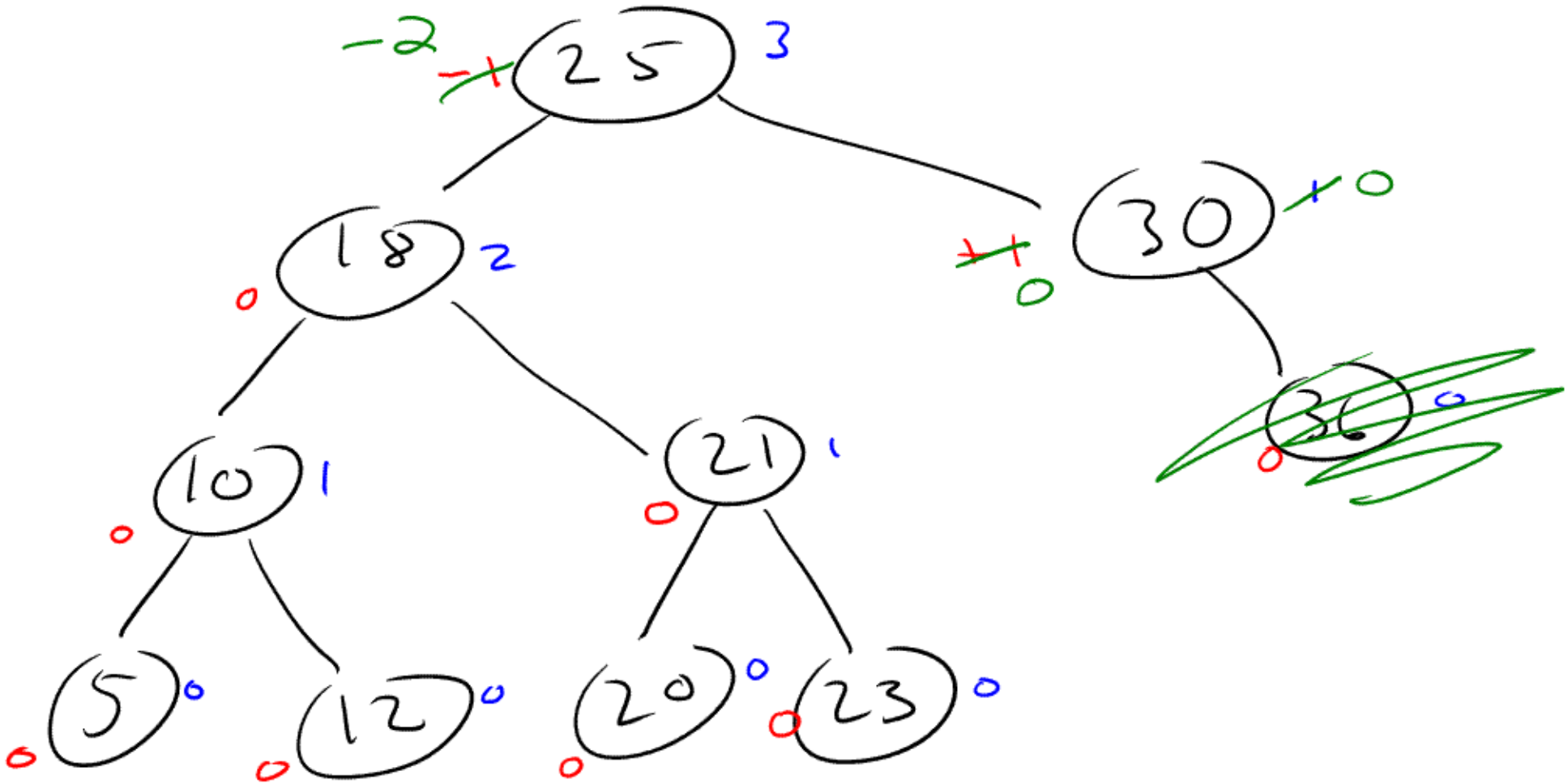
left → RIGHT rot

right → LEFT rot

(2) given your answer to Q1, which of its subtrees has greater height?

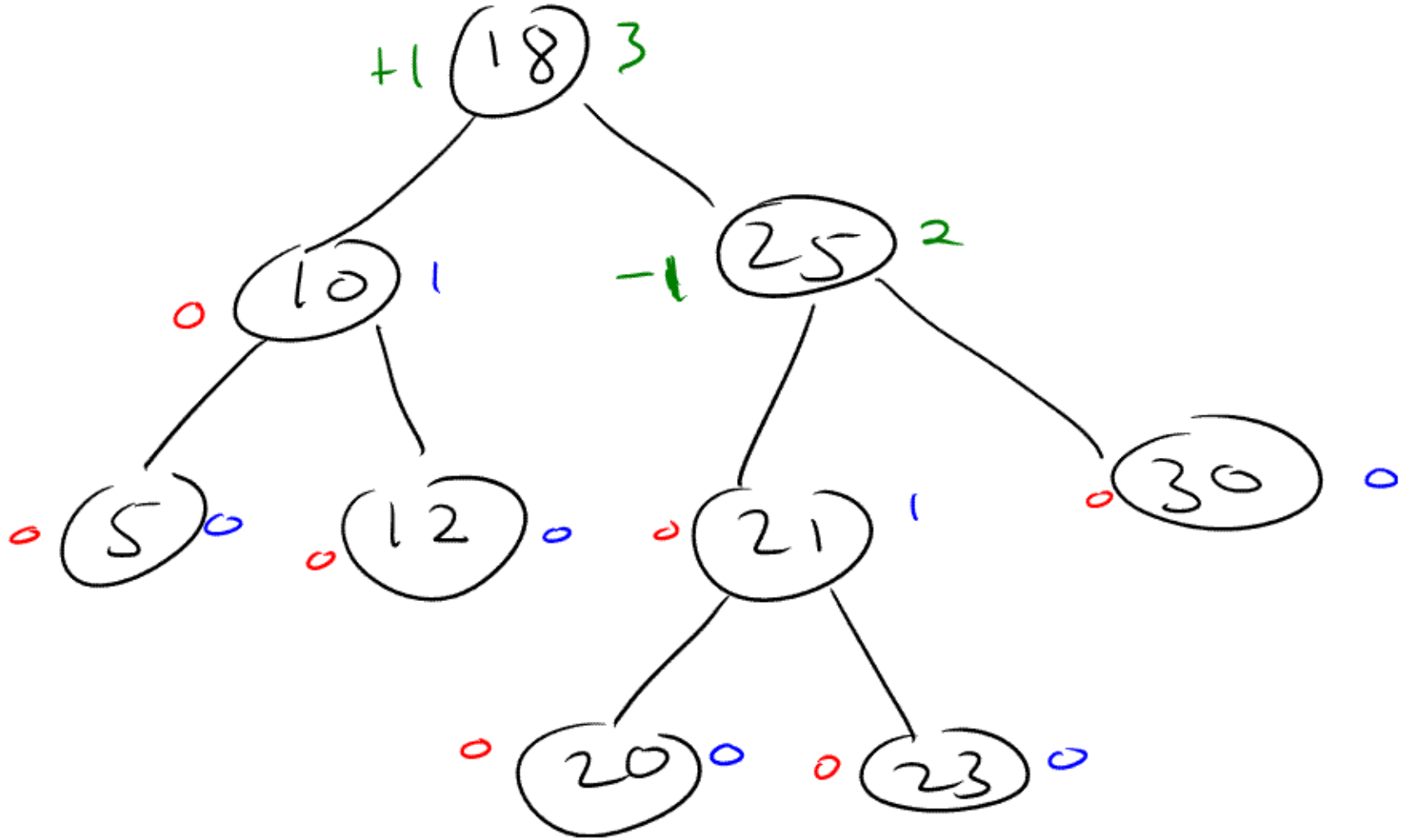
inner (left → right or right → left) ⇒ DOUBLE

outer (left → left or right → right) ⇒ SINGLE

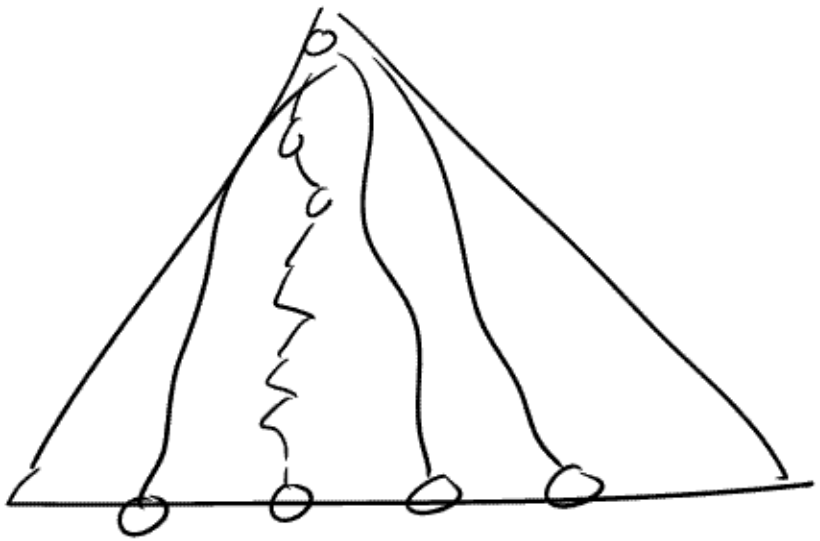


Q 2 ends in tie → SINGLE

1) "left" → RIGHT
2) "tie" → SINGLE

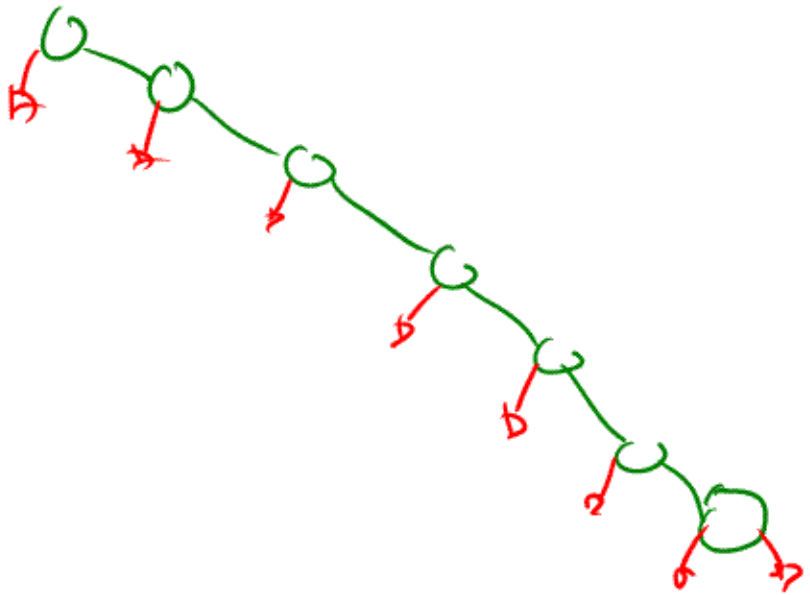

+1
18
3
10
1
0
-1
25
2
5
0
0
12
0
0
0
21
1
0
30
0
0
20
0
0
0
23
0

Red-Black Trees



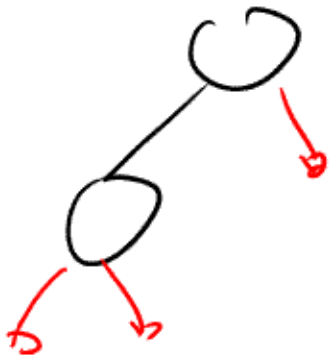
attempt #1

every path from root to leaf is same length



attempt #2

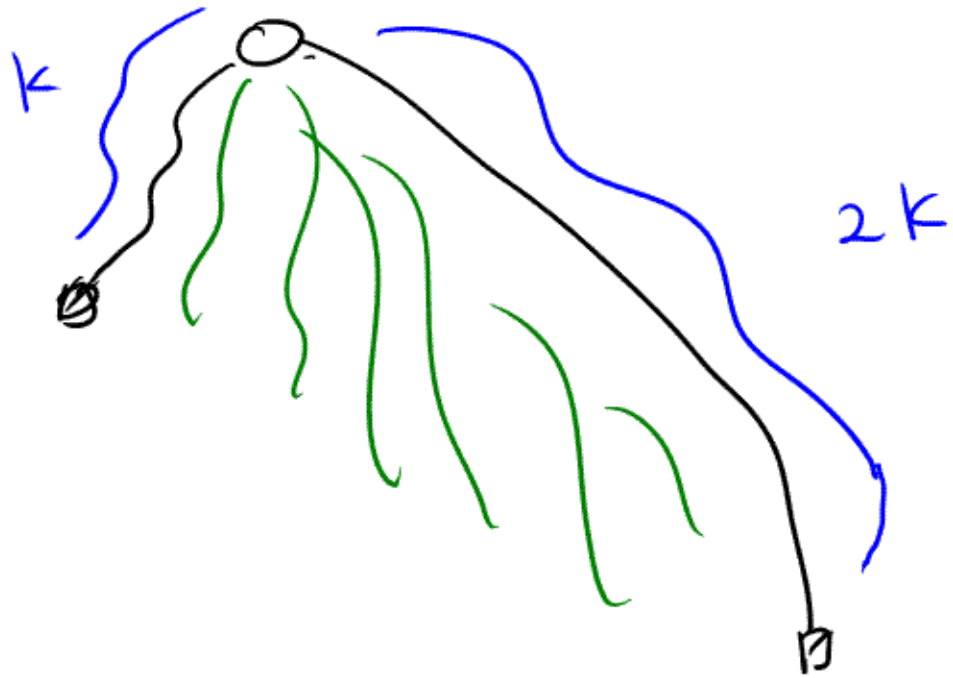
every path from root to a NULL is same length

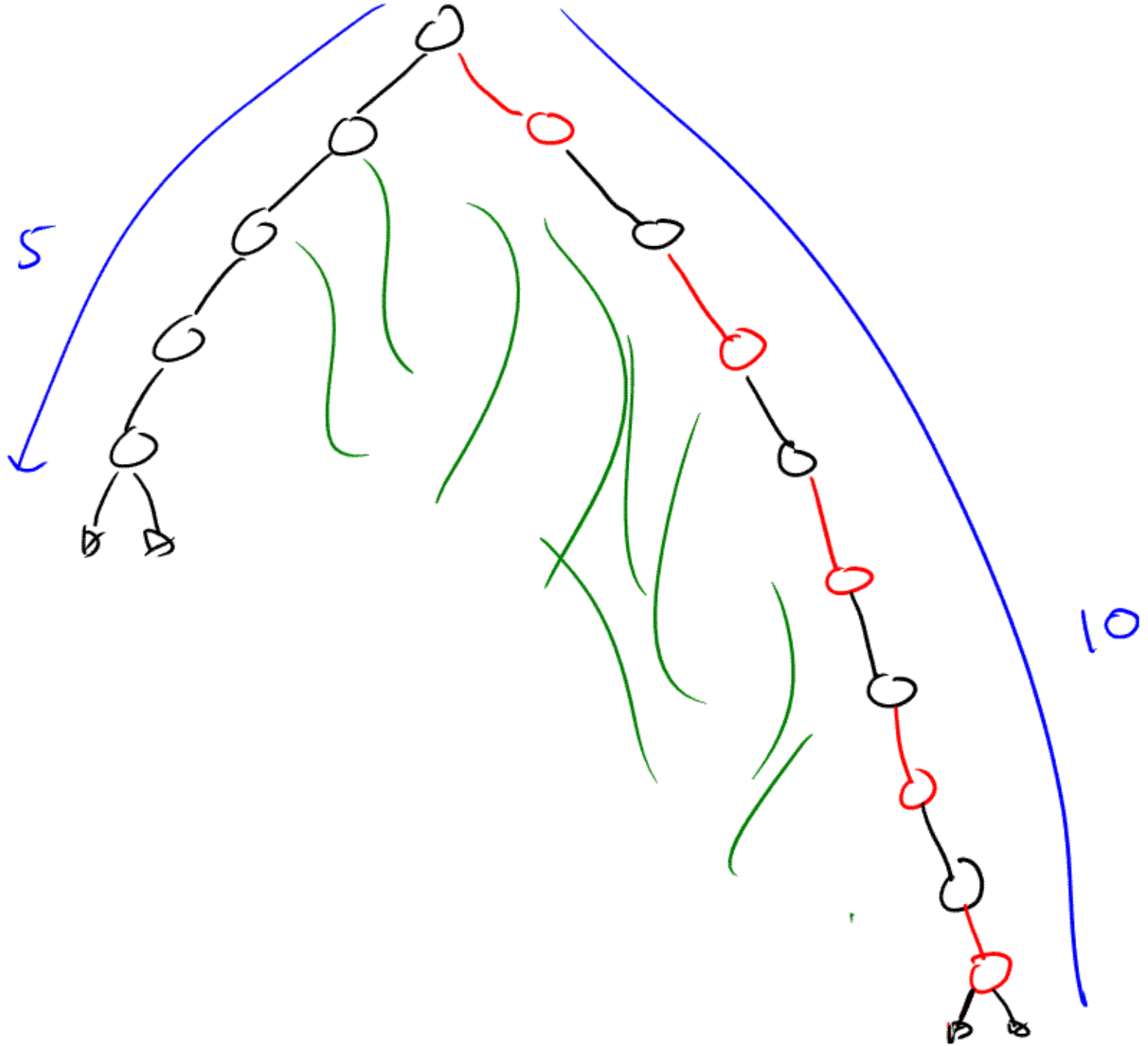


No!

attempt #3

Largest path from root to NULL is no more than twice length of shortest path from root to NULL




5
10

Red - Black tree (BST where:)

definition

1) every node colored red or black

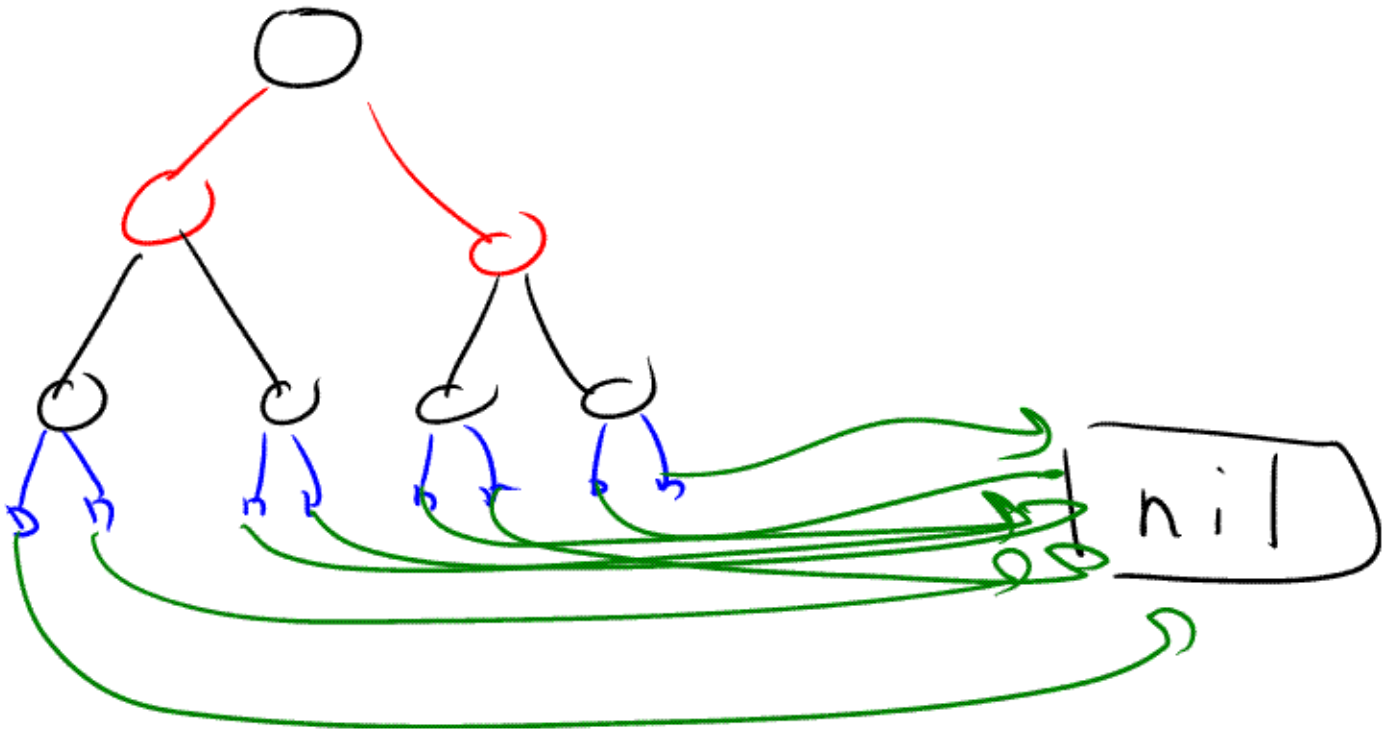
2) ptrs to NULL treated like ptrs to black nodes

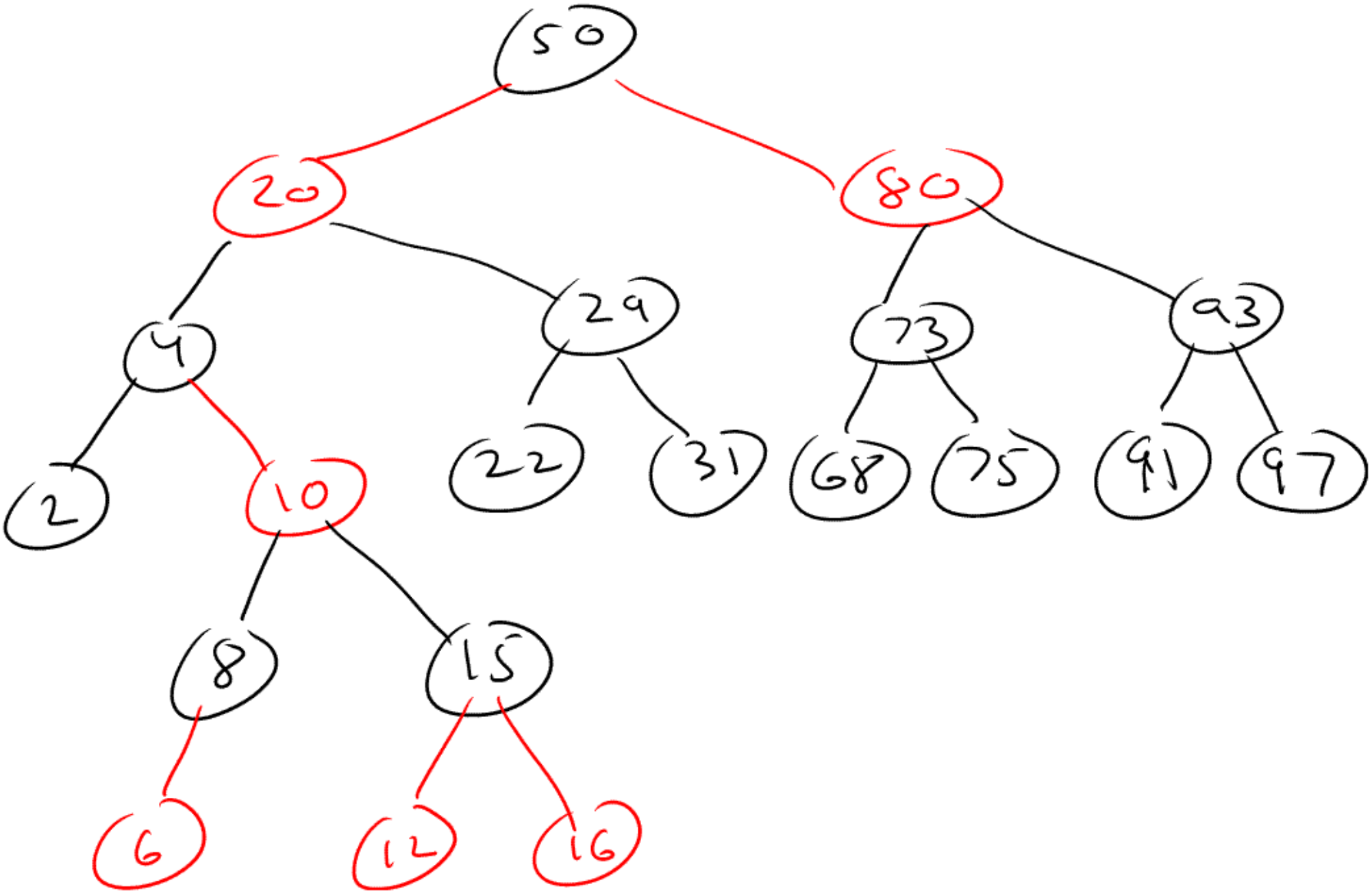
balance properties

3) every path from root to NULL has same # of black nodes (black height)

4) no red node has red parent

5) root is black


nil


50
20
80
4
29
73
93
2
10
22
31
68
75
91
97
8
15
6
12
16