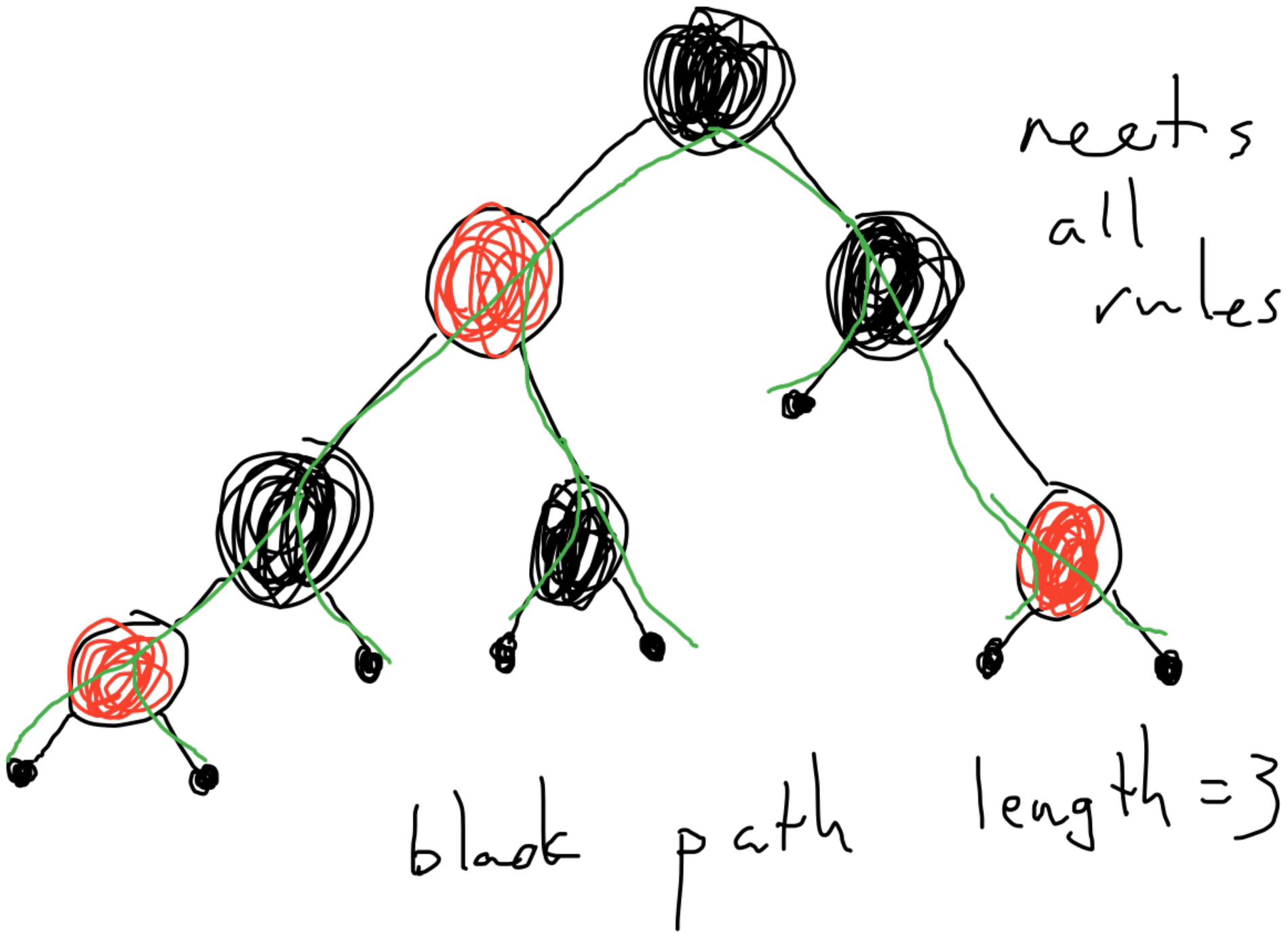
Red-Black Trees

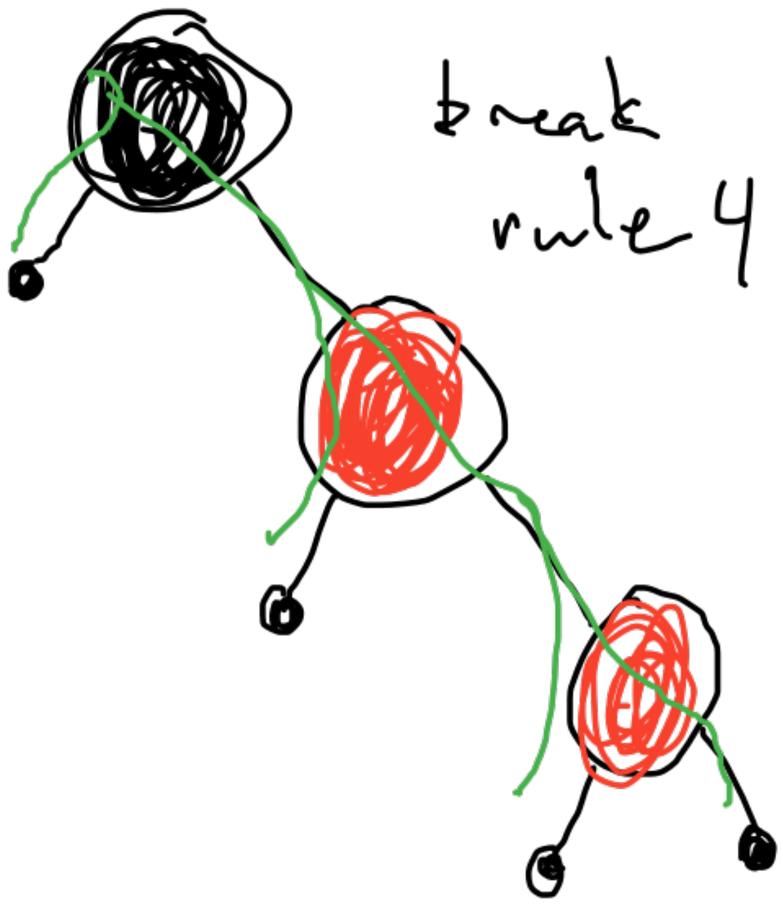
1. every node is red or black
2. root node is black
3. the non-existant null children of a node are black
4. if a node is red, the children must be black
5. the path from the root to any null child must contain the same number of black nodes

Example Trees

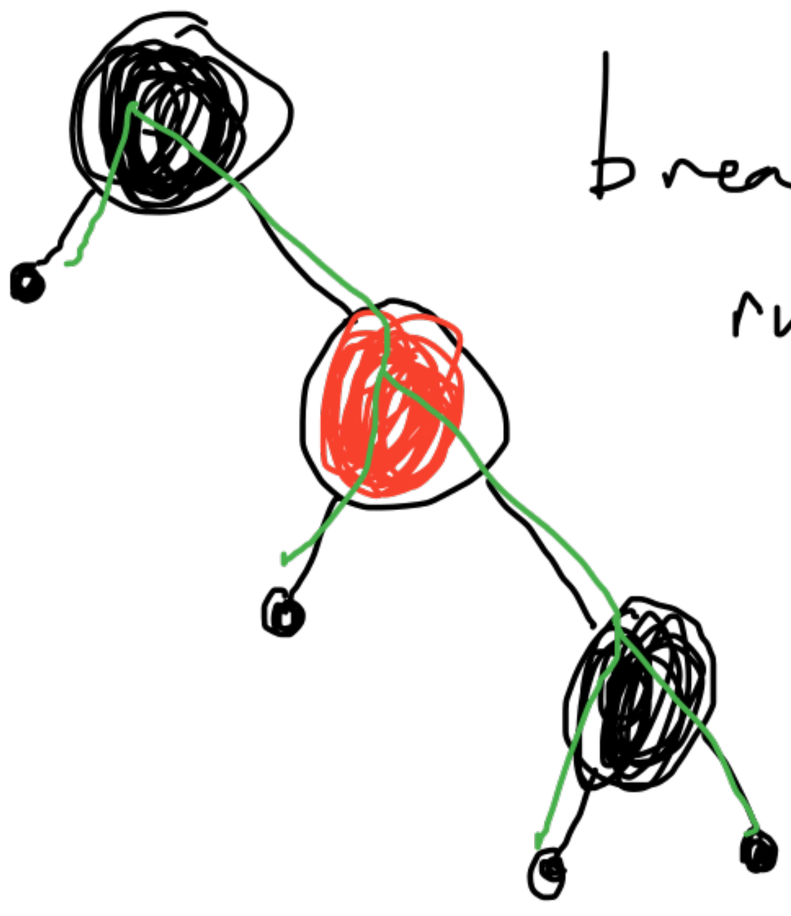


meets all rules

black path length = 3



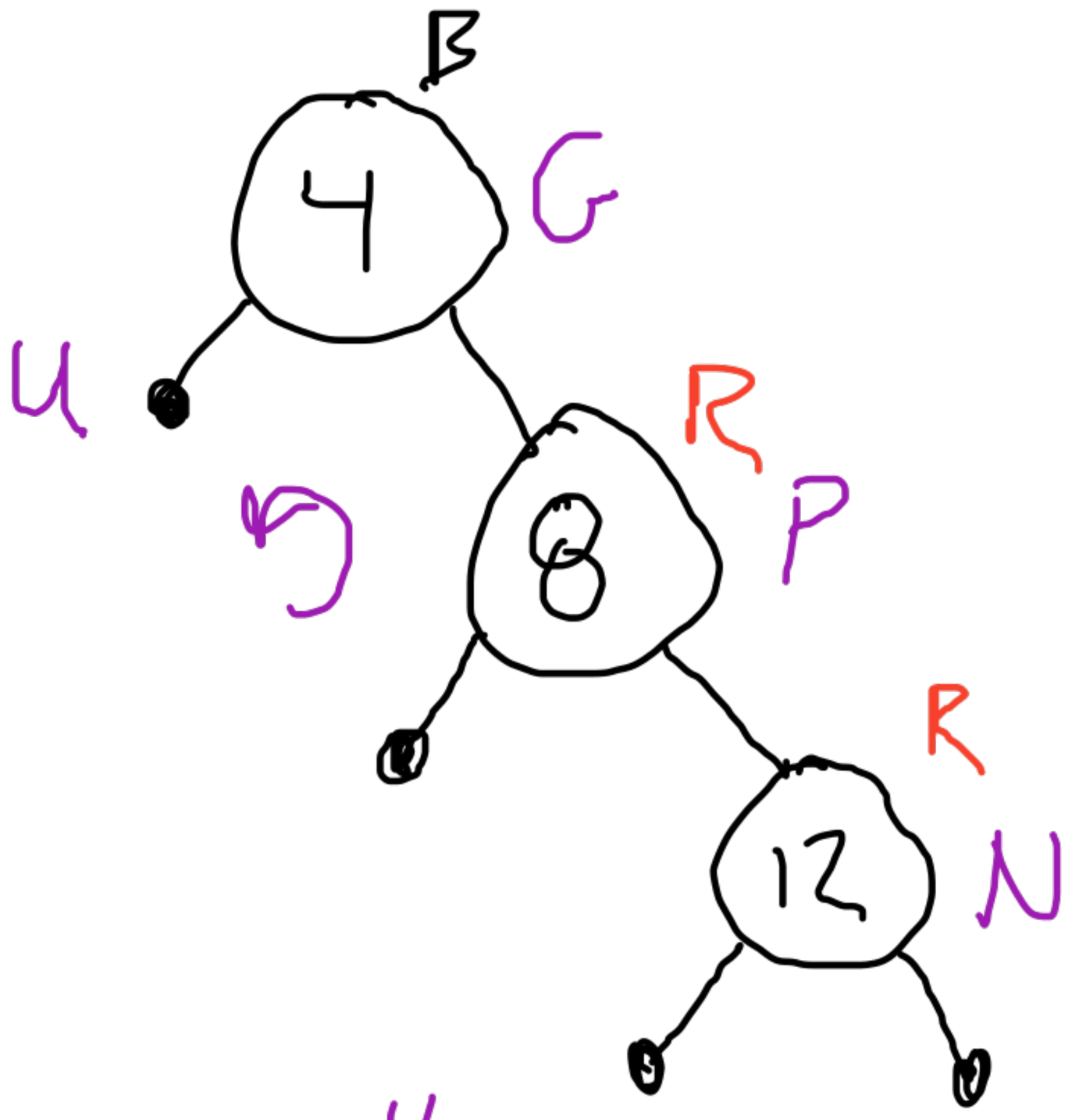
break rule 4



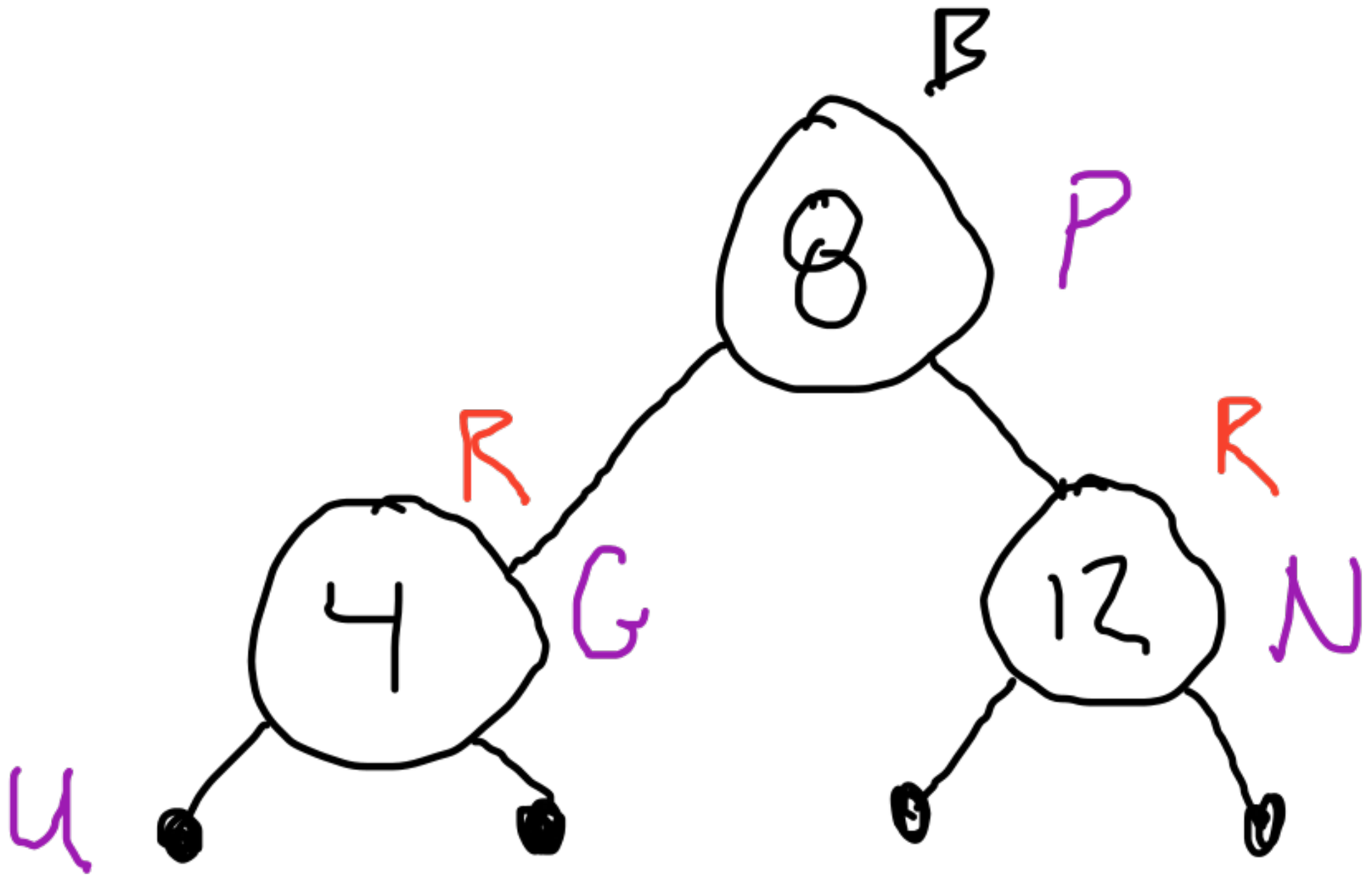
break rule 5

Add 4, 8, 12

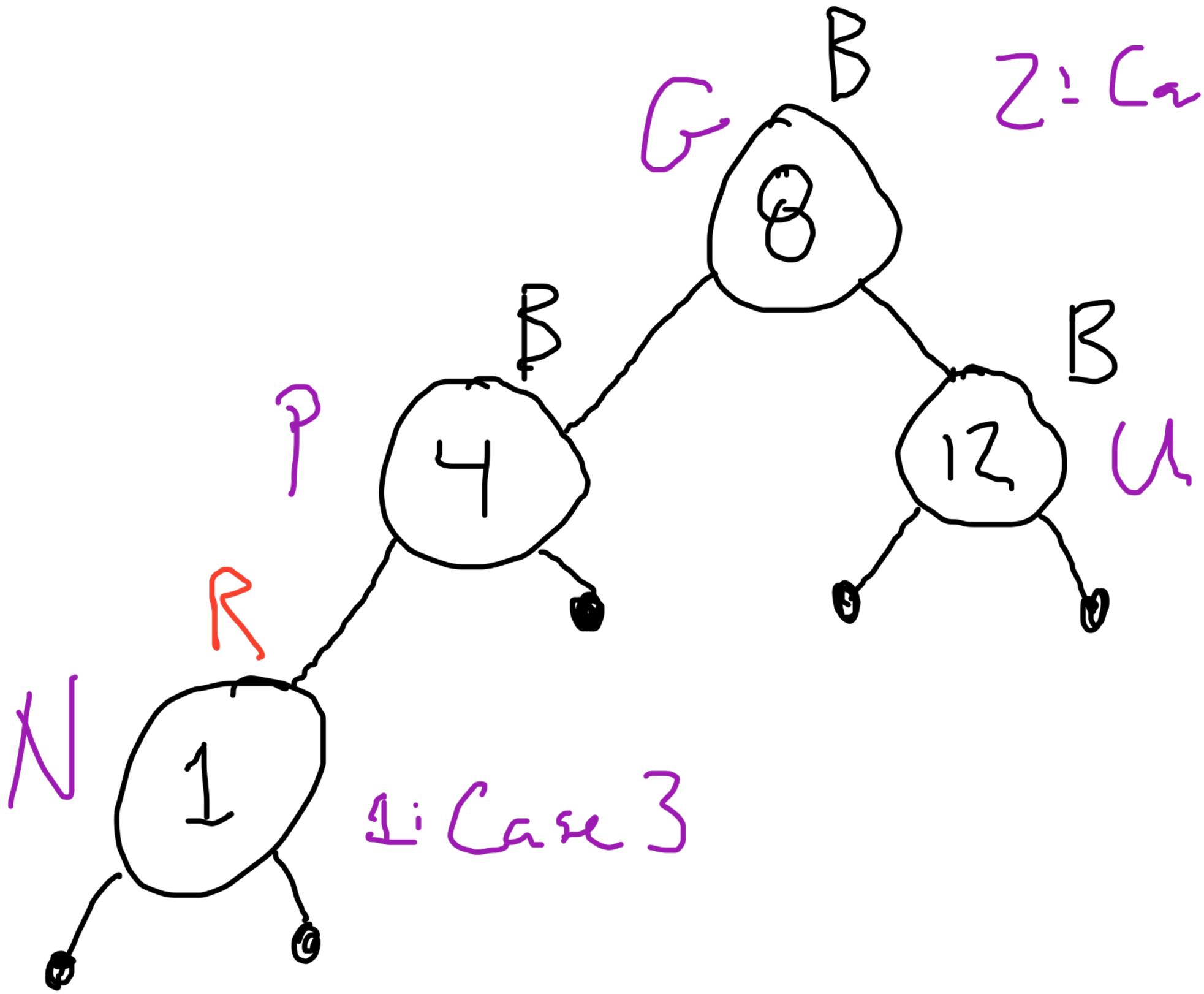
case1 case2



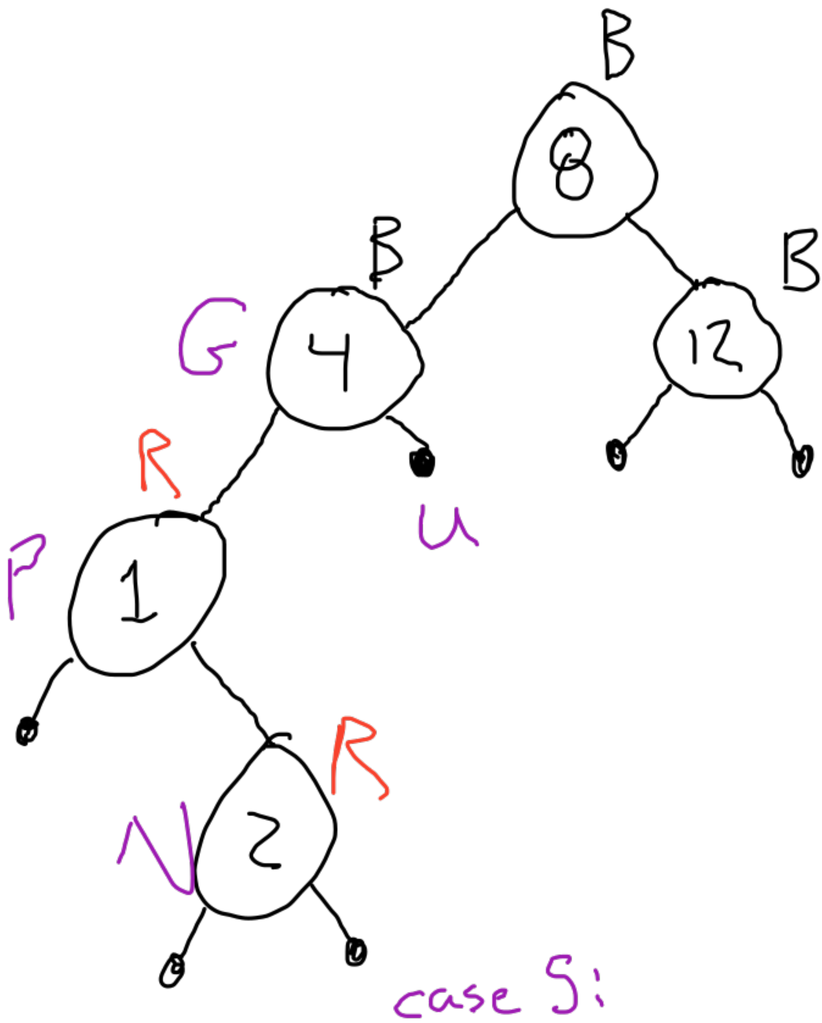
case 4:
rotation



Add 1



Add 2



case 5:

↓zig-zag