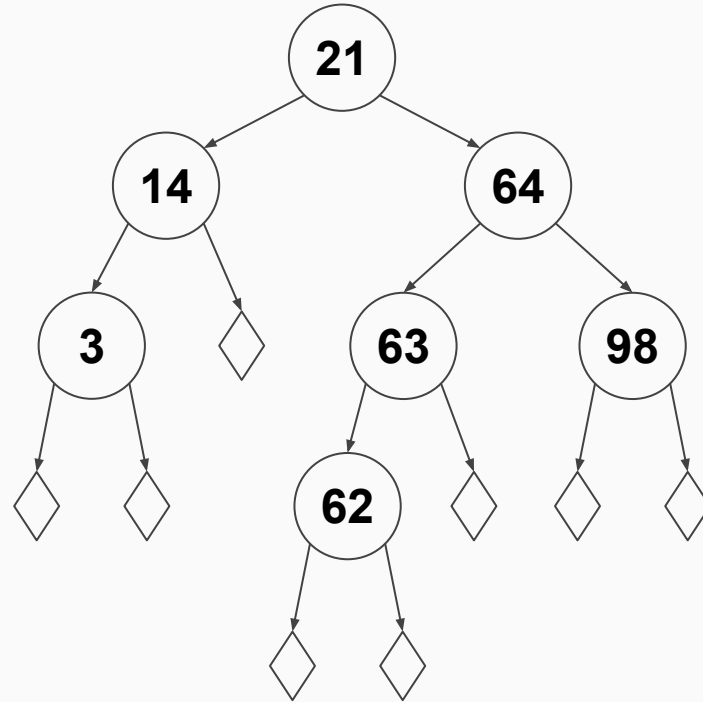# CSE 250 Recitation

April 17 - 21: Balanced BSTs

Balanced Trees

For the tree to the right, label each node with it's balance factor, and label each EmptyTree node with it's depth
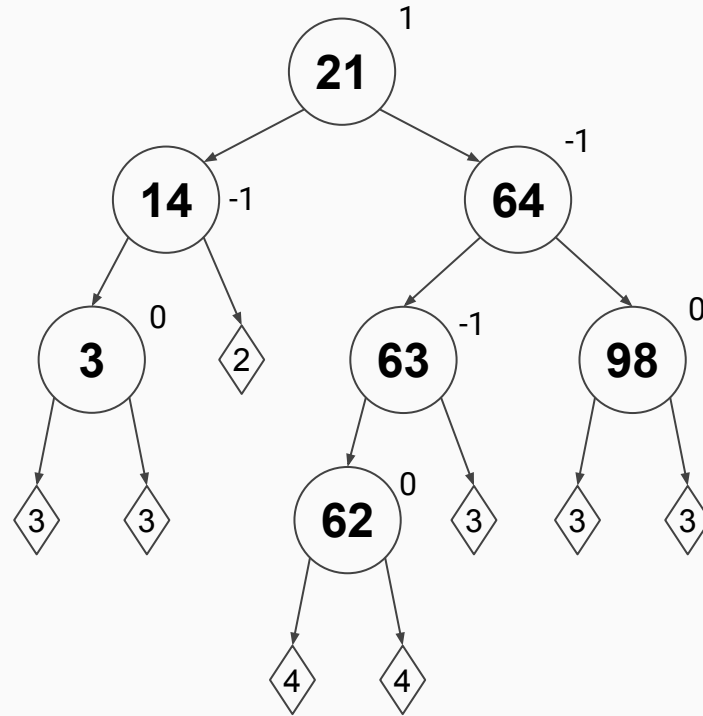
Balanced Trees

For the tree to the right, label each node with it's balance factor, and label each EmptyTree node with it's depth

Does this tree meet the structural constraints for AVL trees?

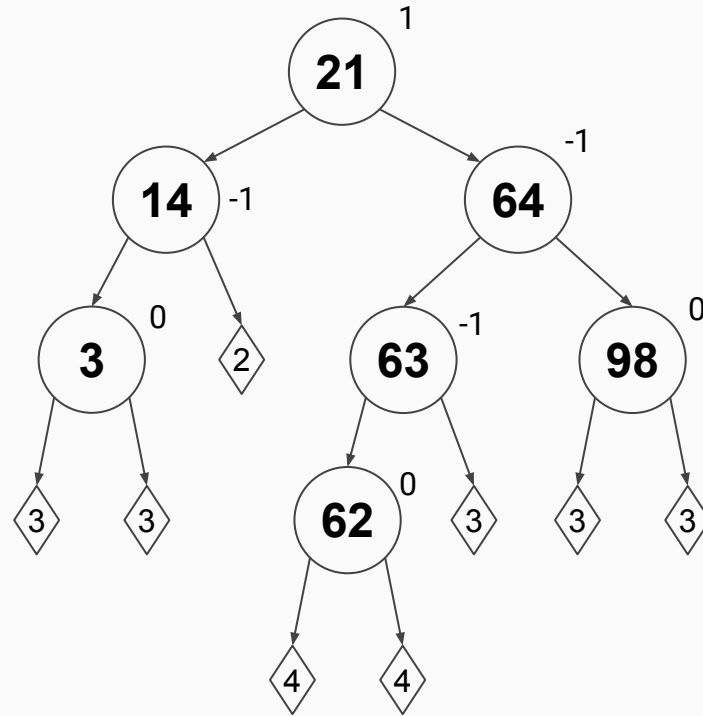Does it meet the structural constraints for Red-Black trees?

Balanced Trees

For the tree to the right, label each node with it's balance factor, and label each EmptyTree node with it's depth

Does this tree meet the structural constraints for AVL trees? YES, all balance factors are in {-1, 0, 1}

Does it meet the structural constraints for Red-Black trees? YES, shallowest EmptyTree depth ≥ deepest EmptyTree depth / 2 (2 ≥ 4/2)
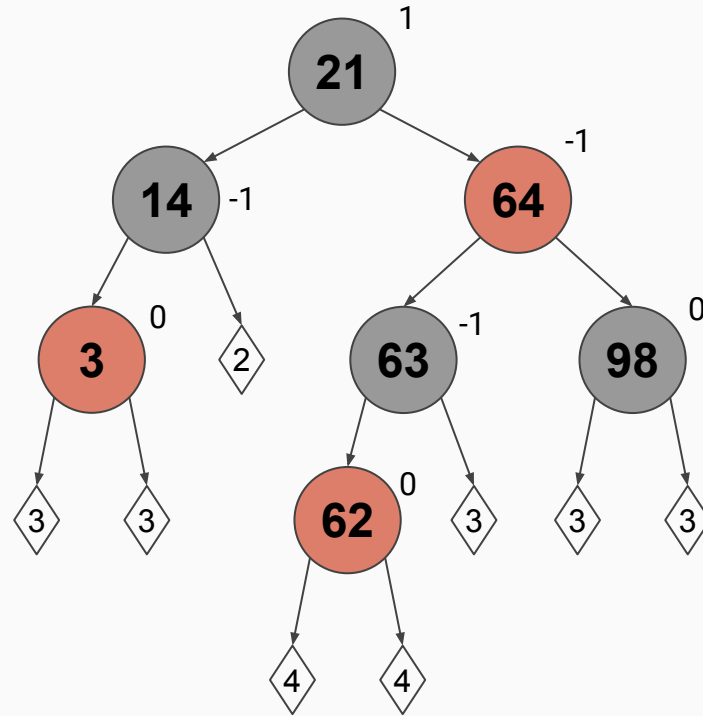
Give a valid red-black coloring

Balanced Trees

For the tree to the right, label each node with it's balance factor, and label each EmptyTree node with it's depth

Does this tree meet the structural constraints for AVL trees? YES, all balance factors are in {-1, 0, 1}

Does it meet the structural constraints for Red-Black trees? YES, shallowest EmptyTree depth ≥ deepest EmptyTree depth / 2 (2 ≥ 4/2)

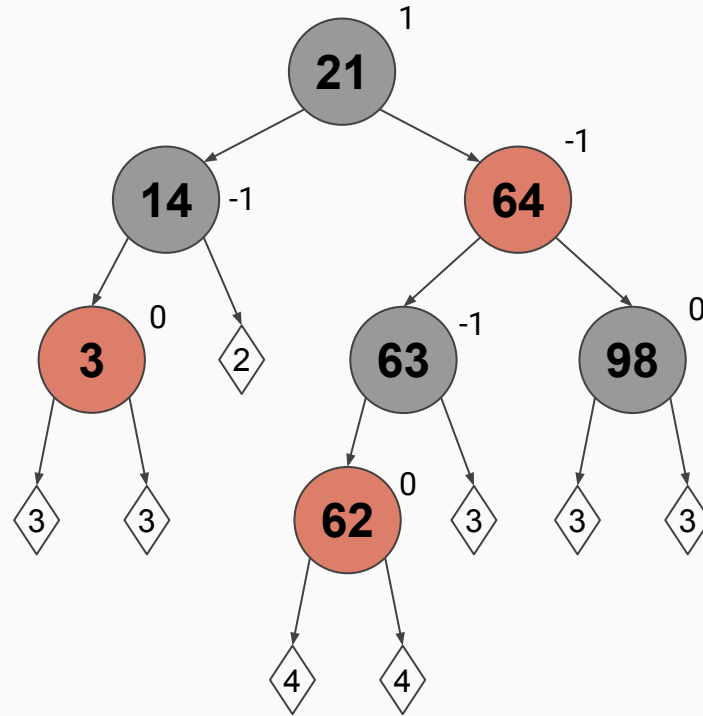Give a valid red-black coloring

Balanced Trees

What values could we insert that would break the AVL Tree constraint?

What values could we insert that would break Red-Black Tree constraints?

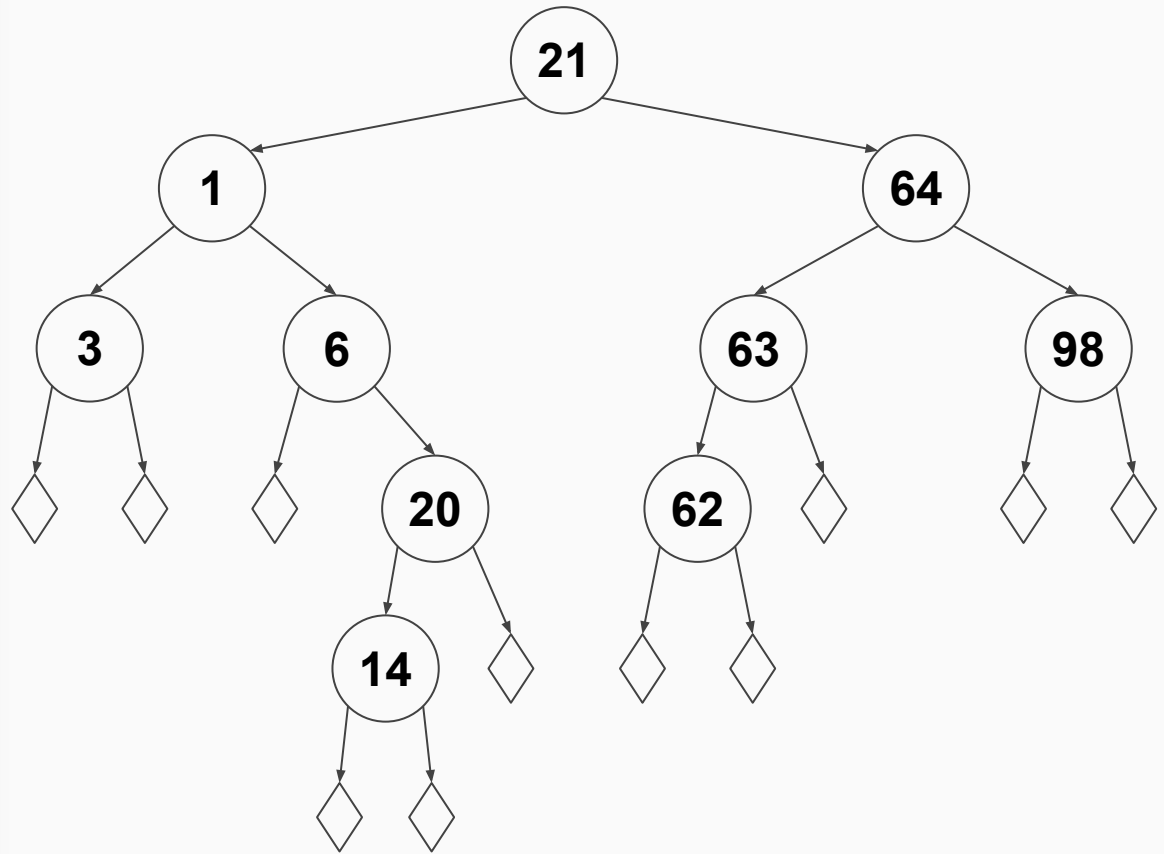Could we insert values that would break AVL but not Red-Black? Break Red-Black but not AVL?

Balanced Trees

Verify that this is a valid red-black tree, but not a valid AVL Tree.

What is the lowest node in the tree that breaks the AVL constraint?

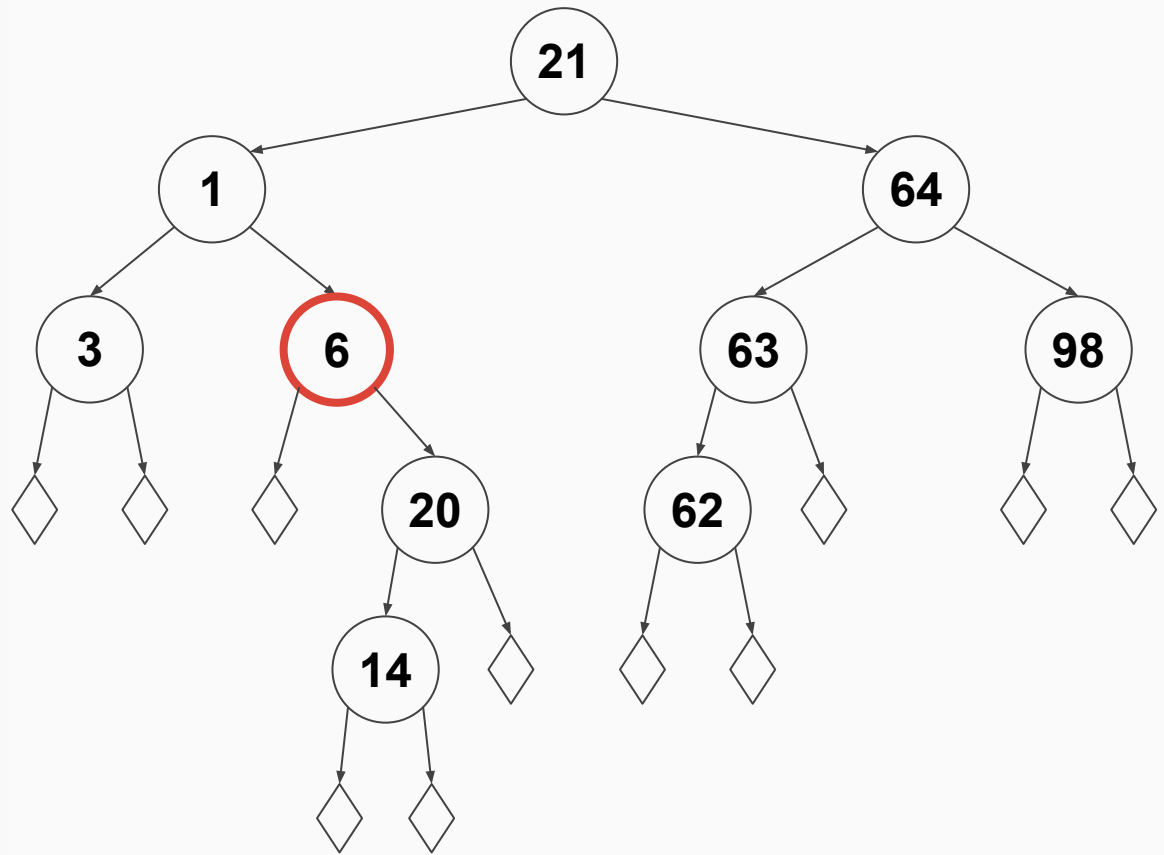What operations need to be performed to fix the AVL tree constraint?

Balanced Trees

Verify that this is a valid red-black tree, but not a valid AVL Tree.

What is the lowest node in the tree that breaks the AVL constraint?

6 has a balance factor of 2 (so does 1 but 6 is lower)

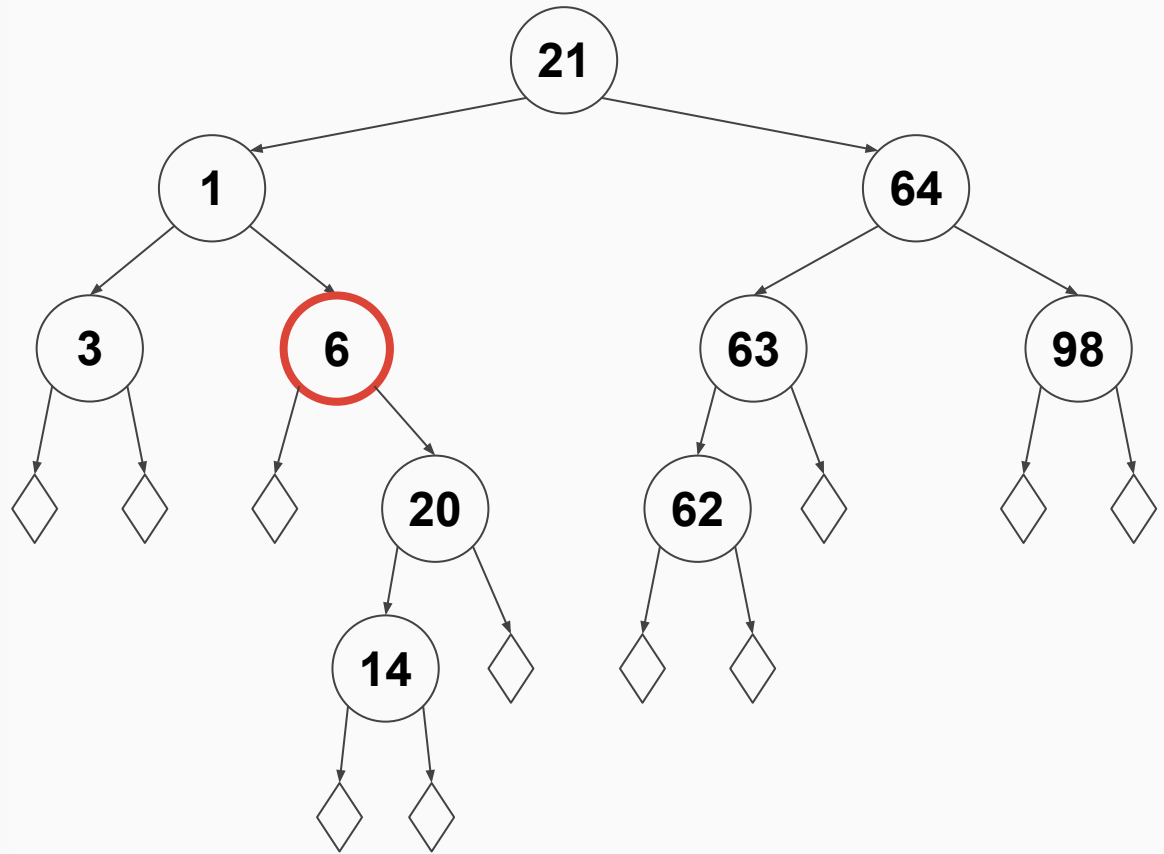What operations need to be performed to fix the AVL tree constraint?

Balanced Trees

Verify that this is a valid red-black tree, but not a valid AVL Tree.

What is the lowest node in the tree that breaks the AVL constraint?

6 has a balance factor of 2 (so does 1 but 6 is lower)

What operations need to be performed to fix the AVL tree constraint?

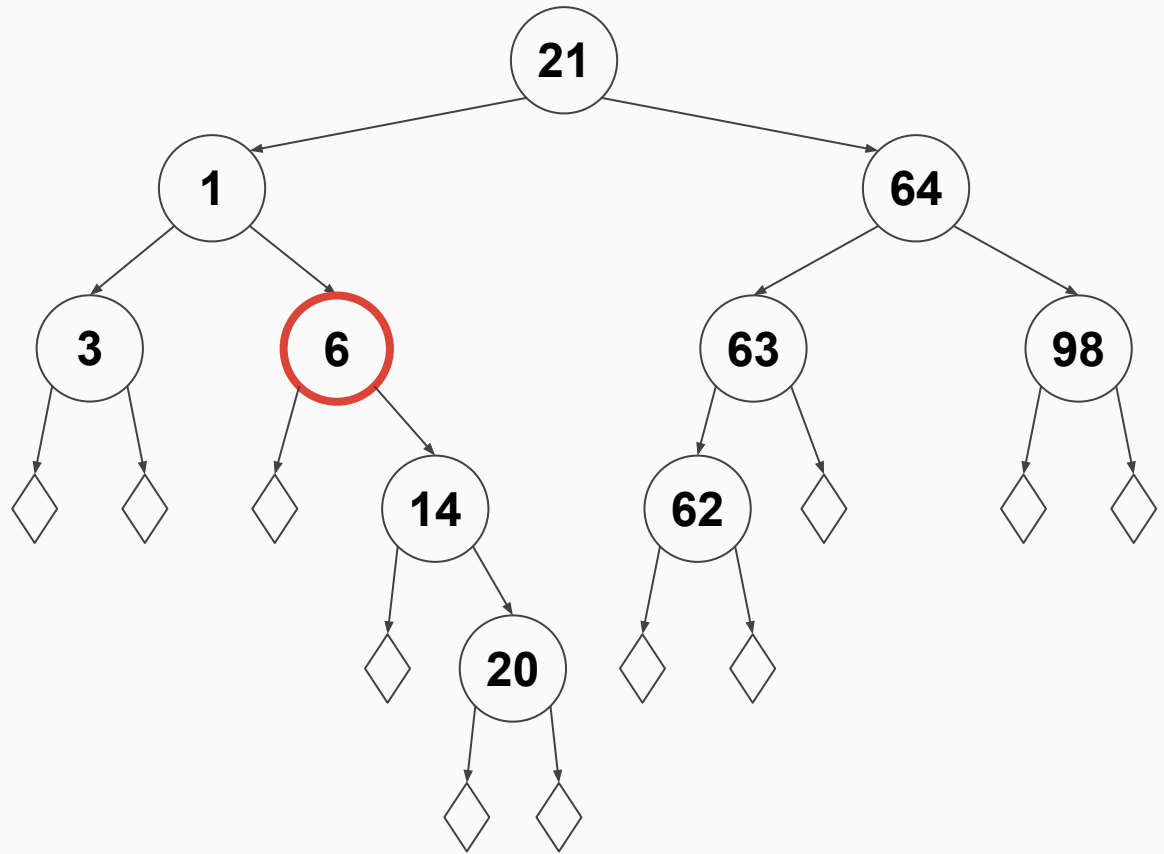Rotate right around 20, then left around 6

Balanced Trees

Verify that this is a valid red-black tree, but not a valid AVL Tree.

What is the lowest node in the tree that breaks the AVL constraint?

6 has a balance factor of 2 (so does 1 but 6 is lower)

What operations need to be performed to fix the AVL tree constraint?

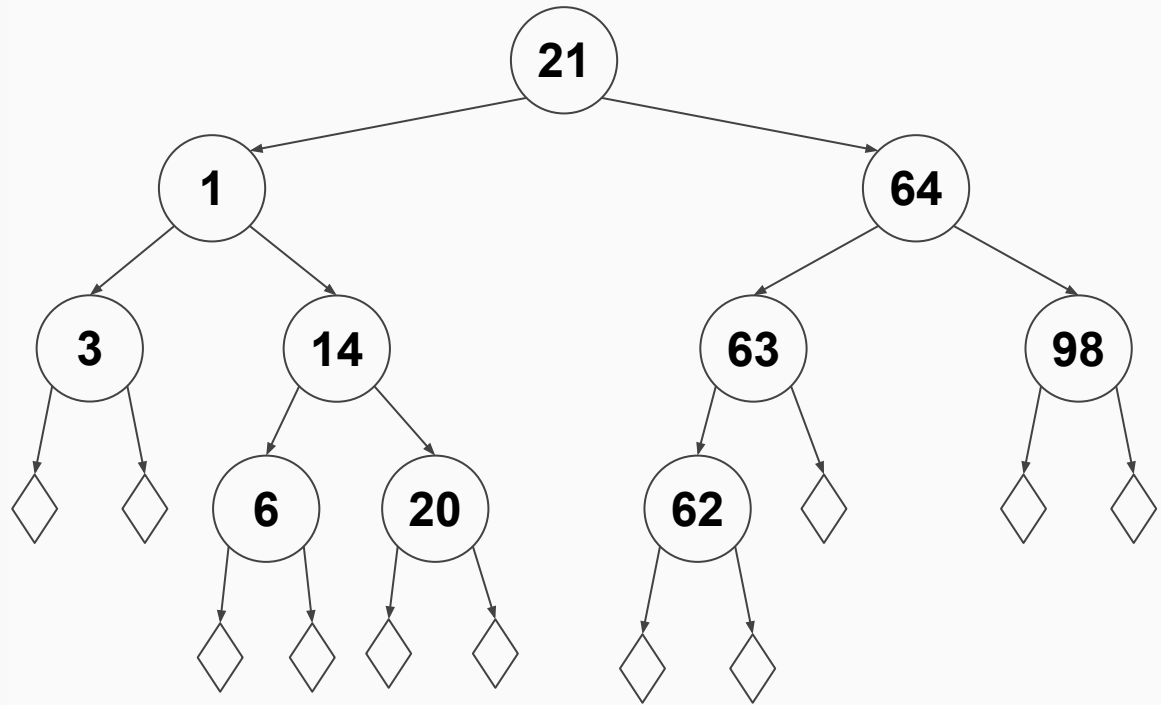Rotate right around 20, then left around 6

Balanced Trees

Verify that this is a valid red-black tree, but not a valid AVL Tree.

What is the lowest node in the tree that breaks the AVL constraint?

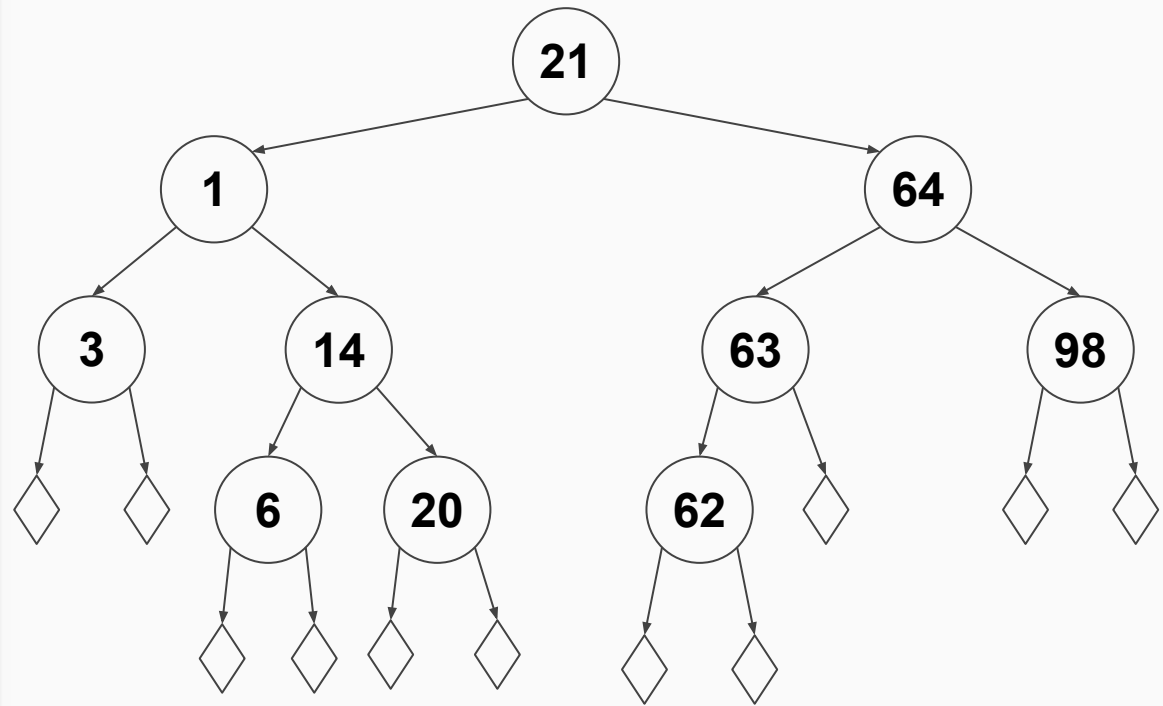6 has a balance factor of 2 (so does 1 but 6 is lower)

What operations need to be performed to fix the AVL tree constraint?

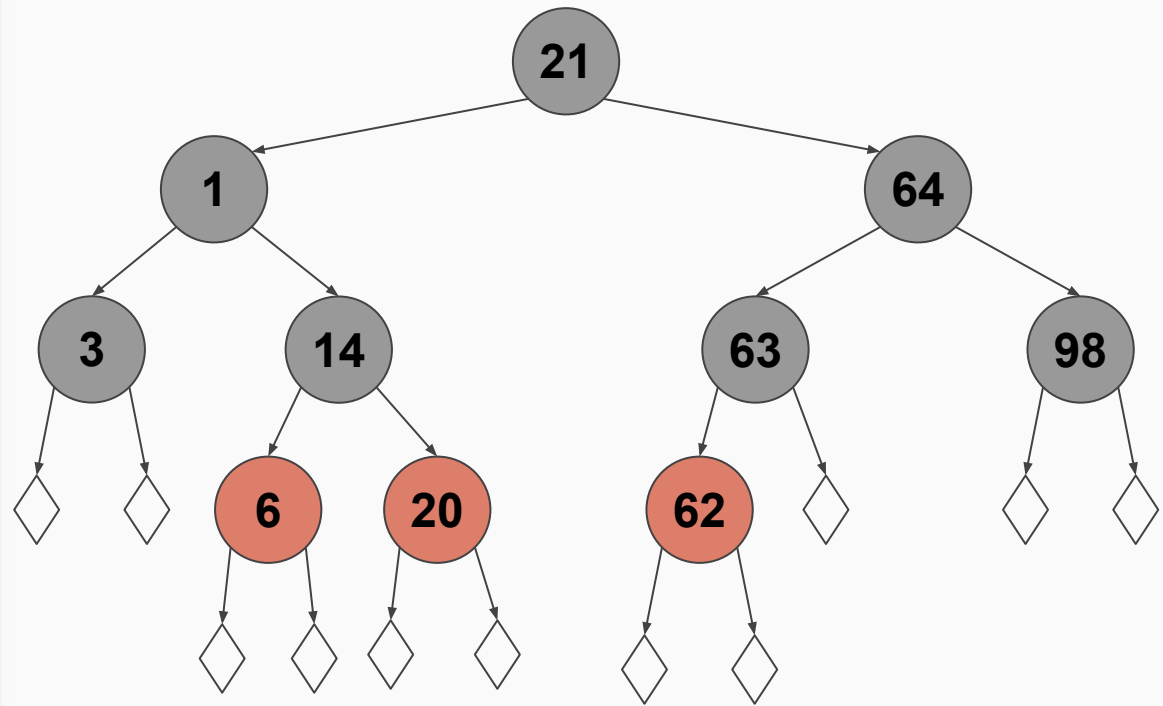Rotate right around 20, then left around 6

Balanced Trees

Now verify that it IS an AVL tree AND a Red-Black tree. Color the Red-Black Tree.

Balanced Trees

Now verify that it IS an AVL tree AND a Red-Black tree. Color the Red-Black Tree.

...OR

Balanced Trees

Now verify that it IS an AVL tree AND a Red-Black tree. Color the Red-Black Tree.

What's the fewest number of nodes you would need to insert to break AVL for this tree? What about Red-Black?

What's the maximum number of nodes you could insert before you need to fix the AVL tree? The Red-Black Tree?