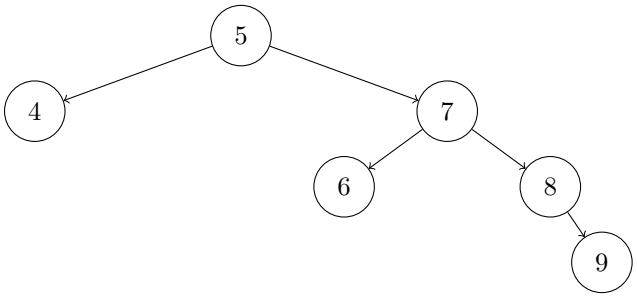
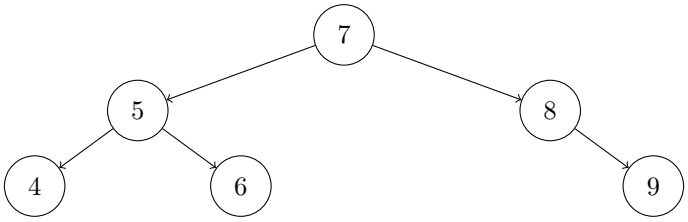
1 AVL Trees

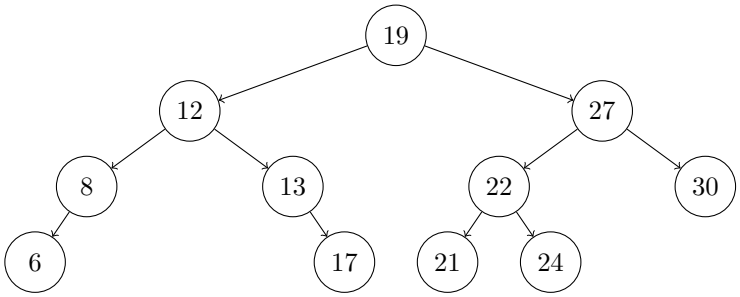
Problem 1. Perform a left rotation on the root of the following tree. Be sure to specify the X, Y, and Z subtrees used in the rotation.



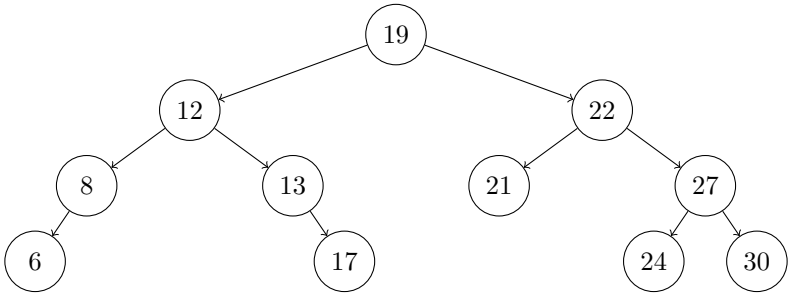
X subtree—rooted at 4
Y subtree—rooted at 6
Z subtree—rooted at 8



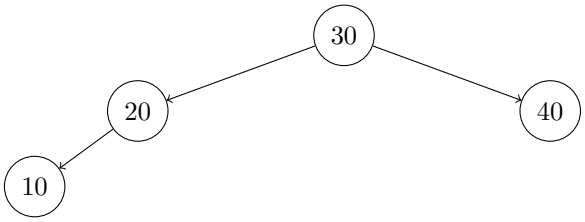
Problem 2. Show the right rotation of the subtree rooted at 27. Be sure to specify the X, Y, and Z subtrees used in the rotation.



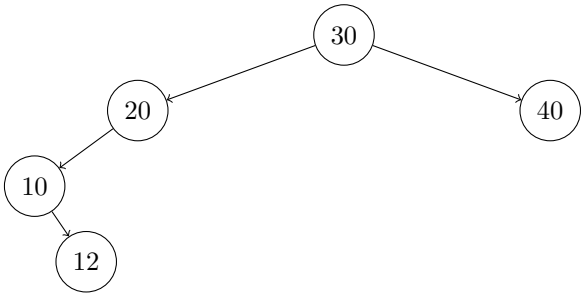
X subtree—rooted at 21
Y subtree—rooted at 24
X subtree—rooted at 30



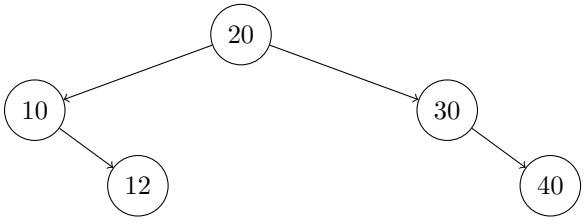
Problem 3. Using the appropriate AVL tree algorithm, insert the value 12 into the following tree. Show the tree before and after rebalancing.



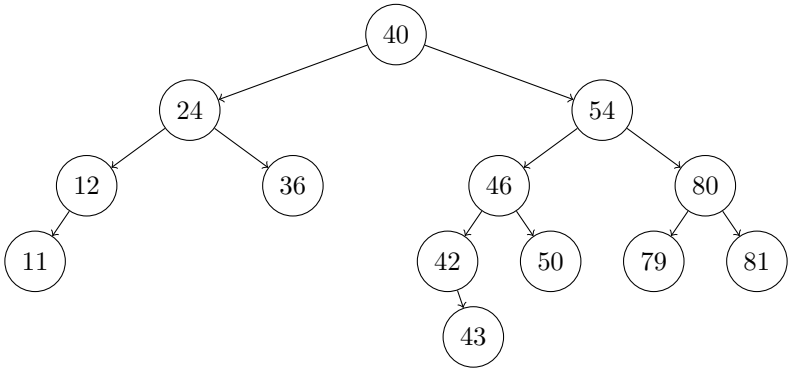
Before rebalancing:



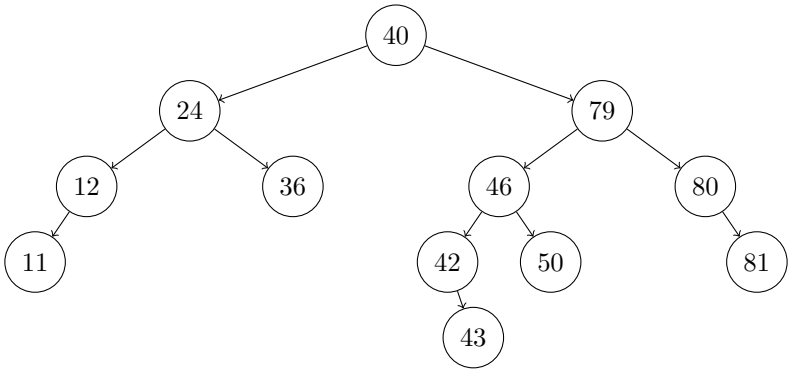
After rebalancing:



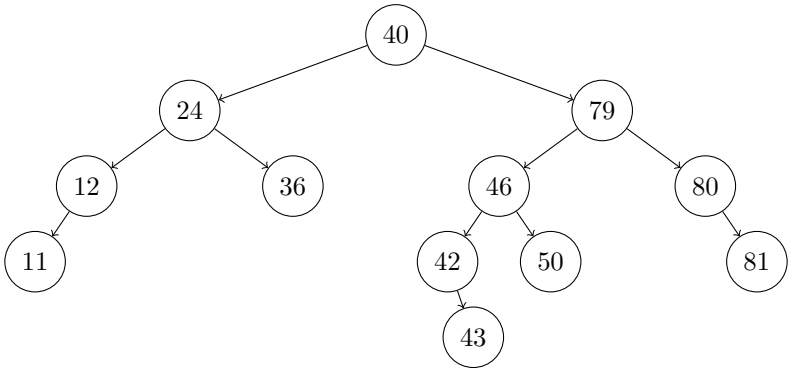
Problem 4. Using the appropriate AVL tree algorithm, remove the value 54 from the following tree. Show the tree before and after rebalancing.



Before rebalancing:

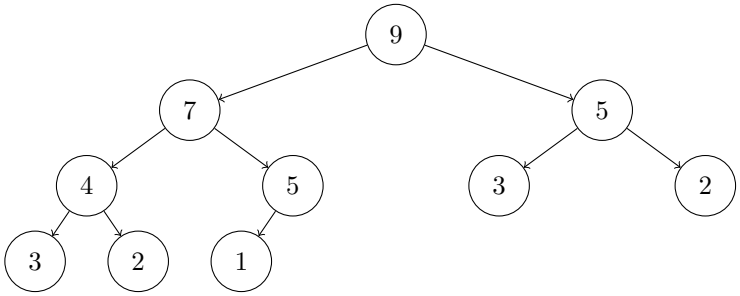


After rebalancing:

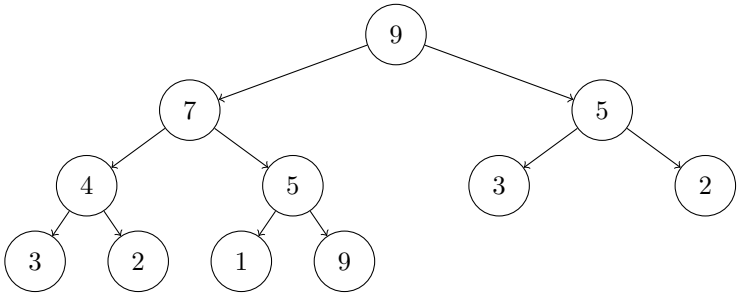


2 Heaps

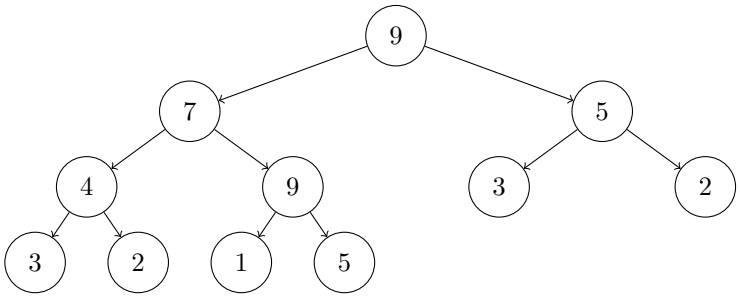
Problem 1. Show the addition of the element 9 to the max-heap below. First, show the addition of 9 to the tree; then, show each bubbling step.



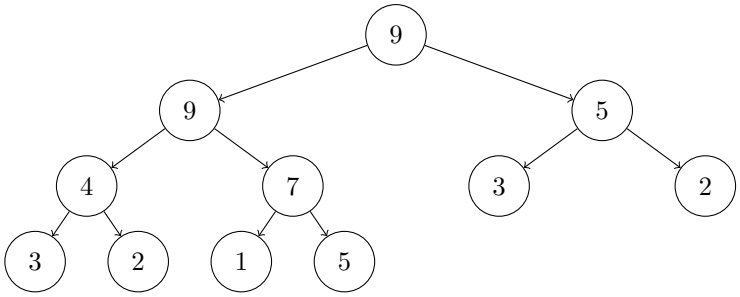
Addition of 9:



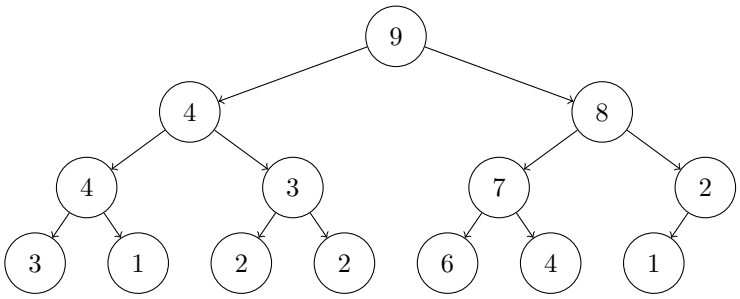
Bubbling step 1:



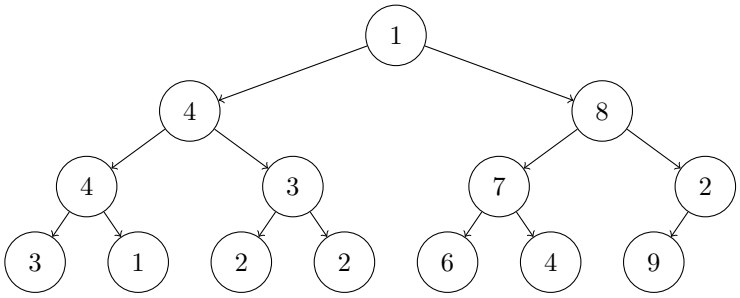
Bubbling step 2:



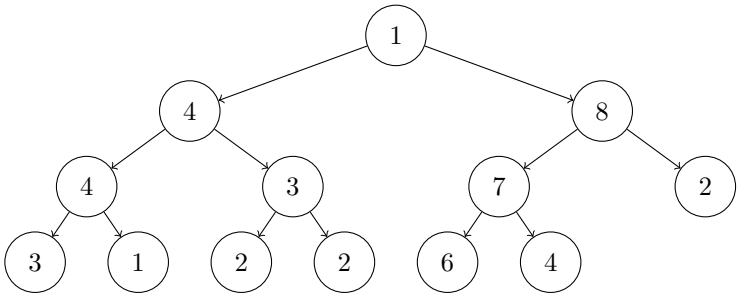
Problem 2. Show the removal of the top element of this max-heap. First, show the swap of the root node; then, show each bubbling step.



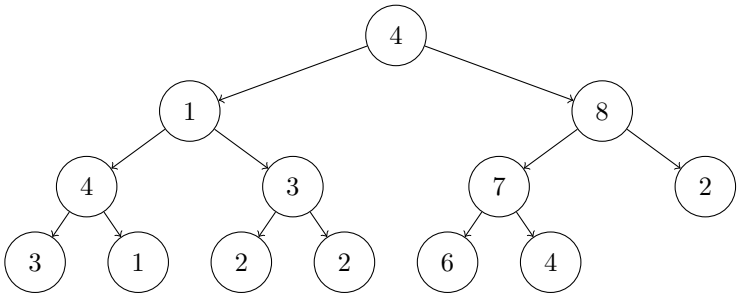
Swap:



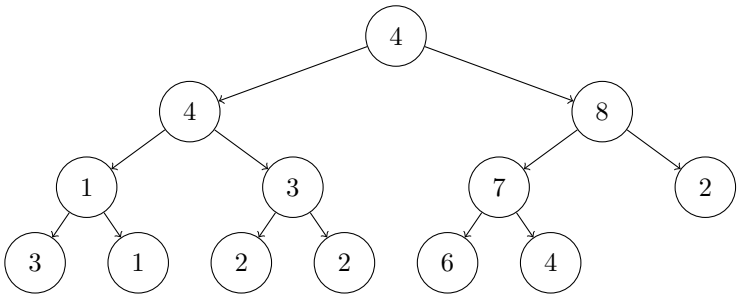
Removing right-most leaf after swap:



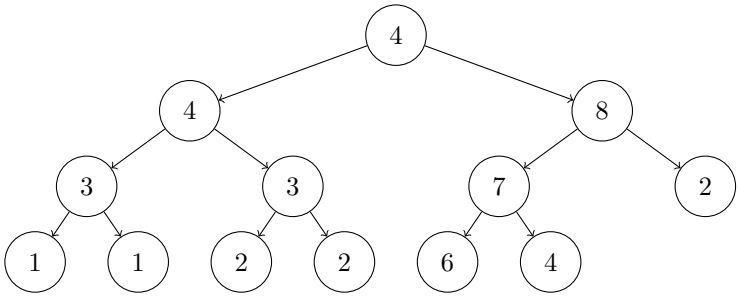
Bubbling step 1:



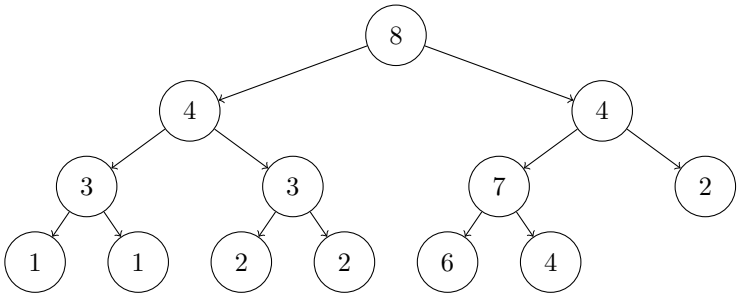
Bubbling step 2:



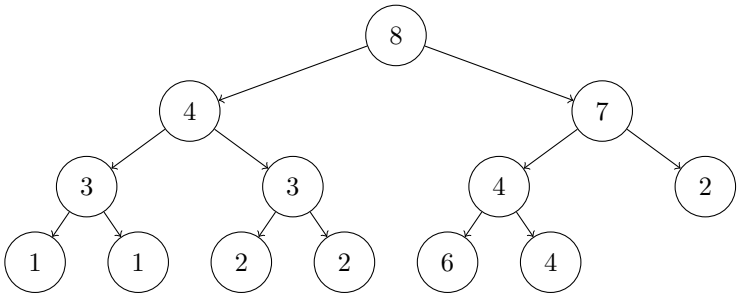
Bubbling step 3:



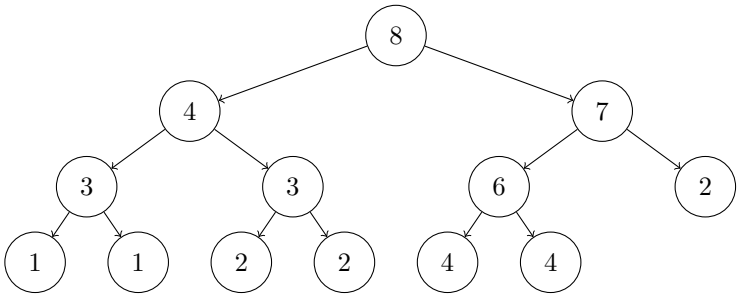
Bubbling step 4:



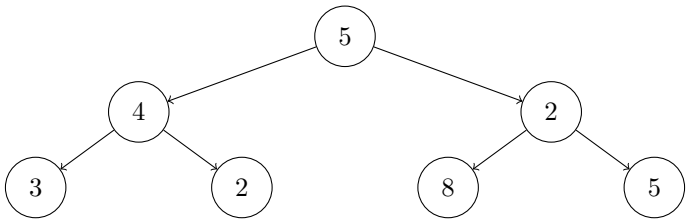
Bubbling step 5:



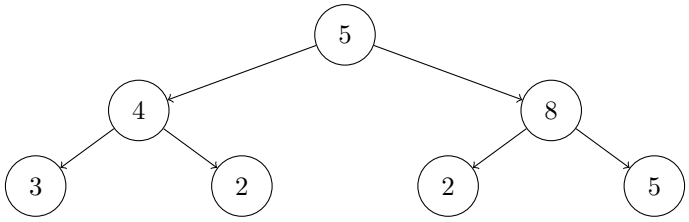
Bubbling step 6:



Problem 3. Consider the sequence of elements `[5,4,2,3,2,8,5]`. Using the representation discussed in class, show the tree to which this sequence corresponds. Then, show the *heapification* of this tree; that is, show how this tree is transformed into a heap. Demonstrate each bubbling step.



Bubbling Step 1:



Bubbling Step 2: