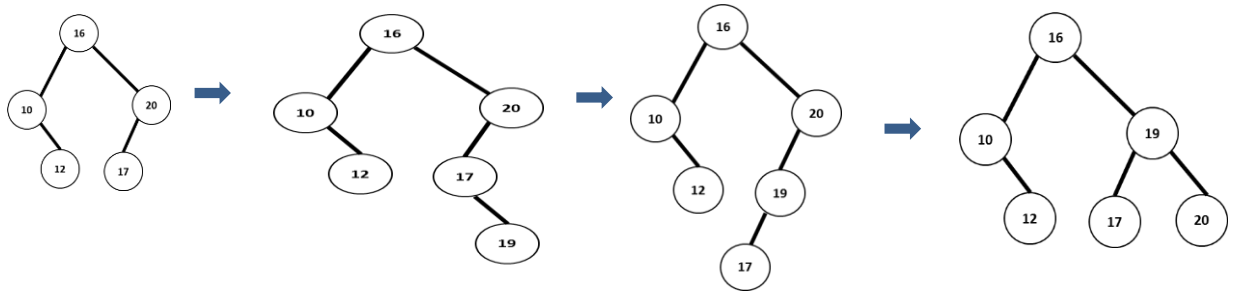
4) (10 pts) ALG (Binary Search Trees and Hash Tables)

a) (5 pts) Show the AVL tree created when 19 is added to the AVL tree below



Grading: 5 pts total - GIVE FULL CREDIT IF FINAL TREE IS CORRECT
1 for inserting 19 in the correct position
2 pt for left rotation
2 pt for right rotation (for rotation trace)

b) (5 pts) In a binary heap of 100 elements, how many elements are at a depth of 6 (lowest level) from the root of the heap? (Note: the depth of an element is the number of links that have to be traversed from the root of the tree to reach it.)

A binary heap fills in each row before moving onto the next, since its structure is always a complete binary tree. Thus, the number of nodes at depths 0 through 5 are 1, 2, 4, 8, 16, and 32, respectively. This sums to 63. Thus, the next **37 nodes** will all be at a depth of 6 from the root.

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Grading: 2 pts for observation of heap structure, 2 pts for counting up the nodes at all the previous levels, 1 pt for calculating the final answer.