CSI 3334 Data Structures
Homework 3

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Do your own work for this assignment; do not work with others. Consult the book and your professor for help if you need it. Do not use any other resources. Use good grammar, correct spelling, and complete sentences.
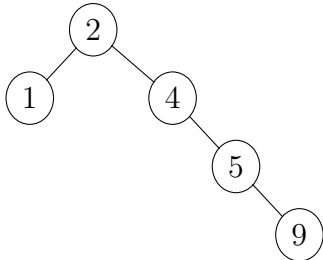
1. Show the results of inserting 2, 1, 4, 5, 9, 3, 6, and 7 into an initially empty AVL tree. Show the tree after each insertion (before rebalancing), point out each imbalance (when they occur), and show the tree after rebalancing (if it is necessary).
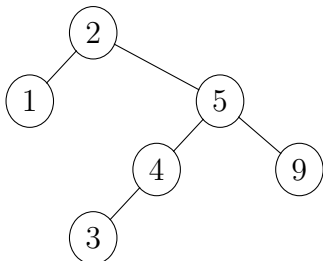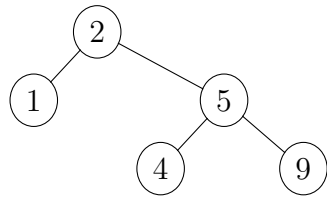
   Solution:

   Insert 2

   Insert 1, 4, 5, 9

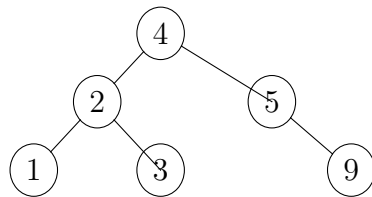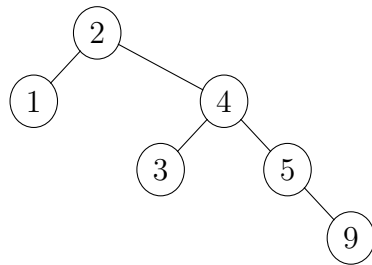   Lost balance, 4 is the α node

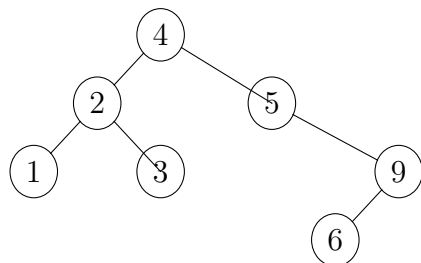   Single Left Rotation

   Insert 3
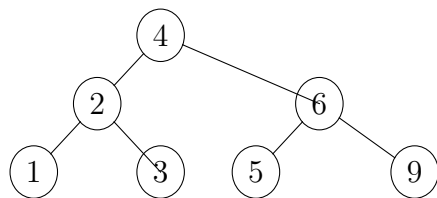
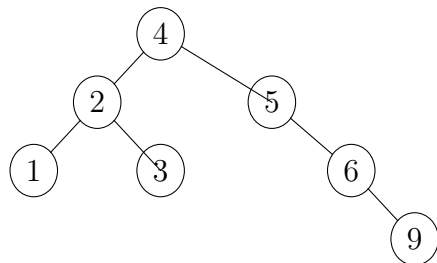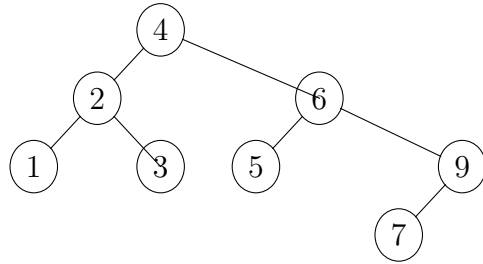Lost balance, 2 is the α node

Right-Left Rotation

Insert 6

Lost balance, 5 is the α node

Right-Left Rotation

Insert 7

4
     2   6
  1   3 5   9
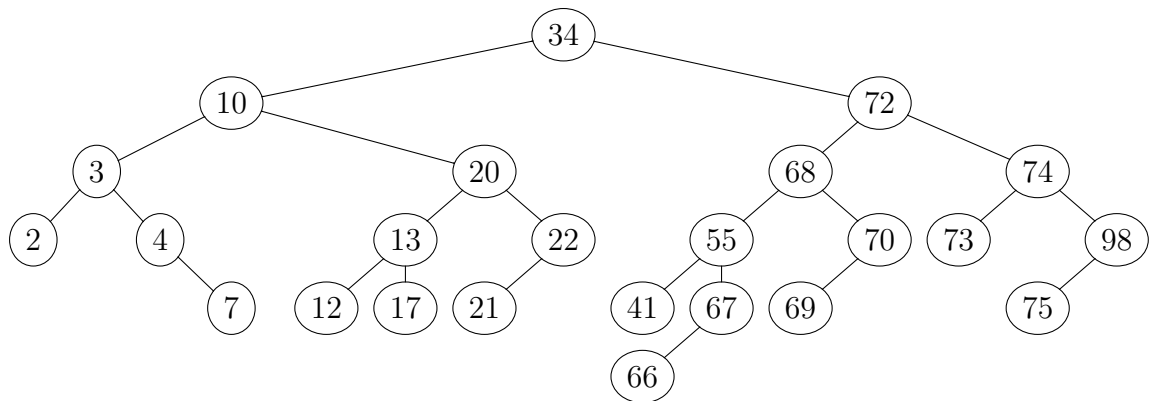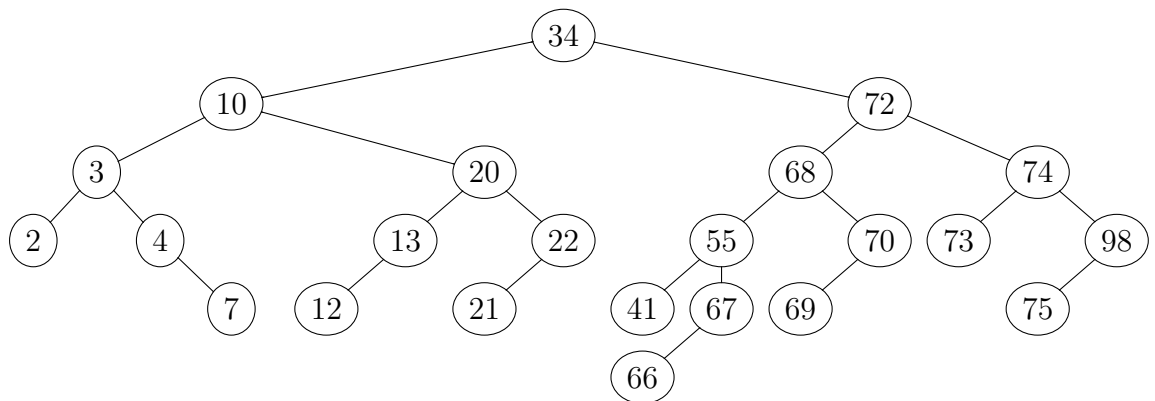   7

The above tree is the final result after all the insertions

2. Show how the following AVL-balanced tree will change after removing each of the
   following nodes: 17, 13, 20, and 2. After removing each node, it should remain removed
   for the rest of the exercise. Make sure that your changes are clear.
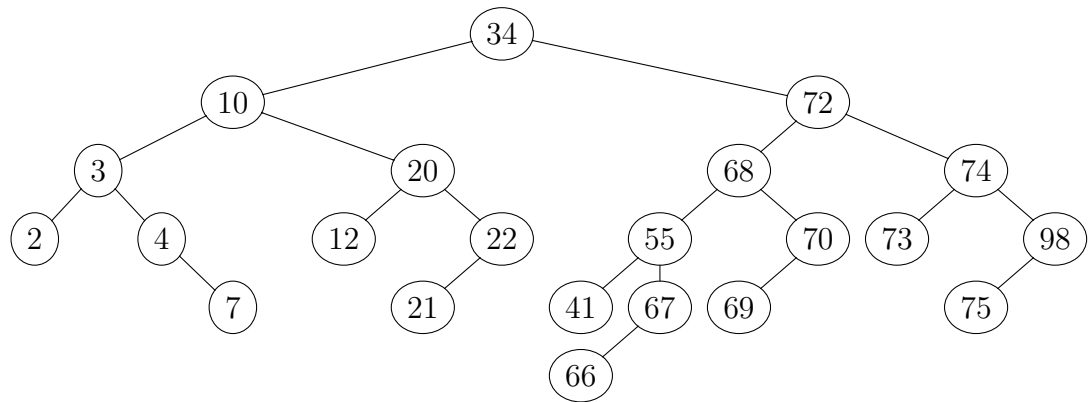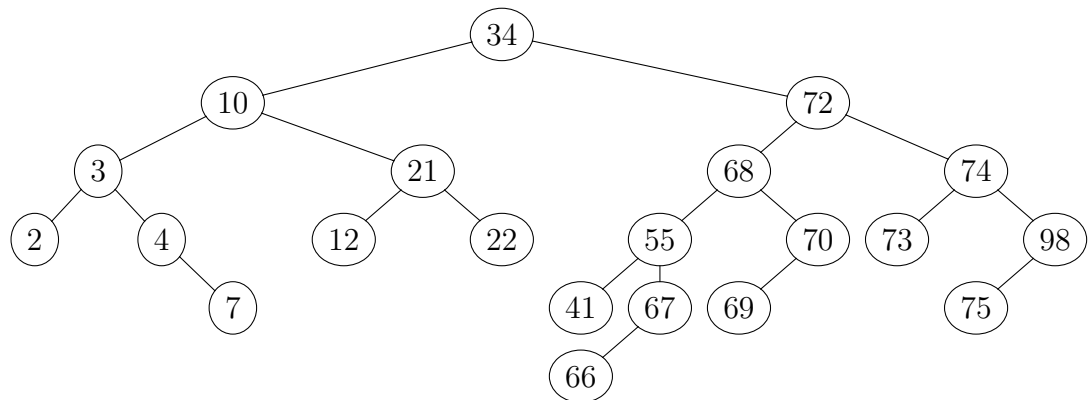
                                    34
            10   72
       3   20   68   74
   2   4   13   22   55   70   73   98
              7   12 17 21   41   67 69   75
                                          66

Solution:

Remove 17

                                    34
            10   72
       3   20   68   74
   2   4   13   22   55   70   73   98
              7   12   21   41   67 69   75
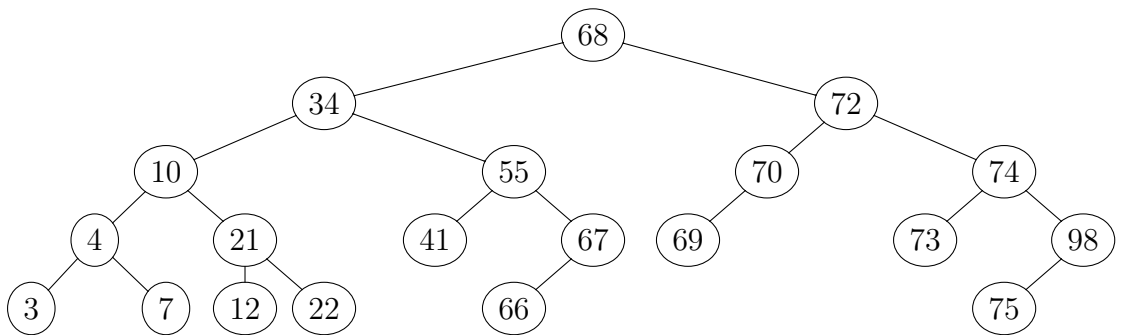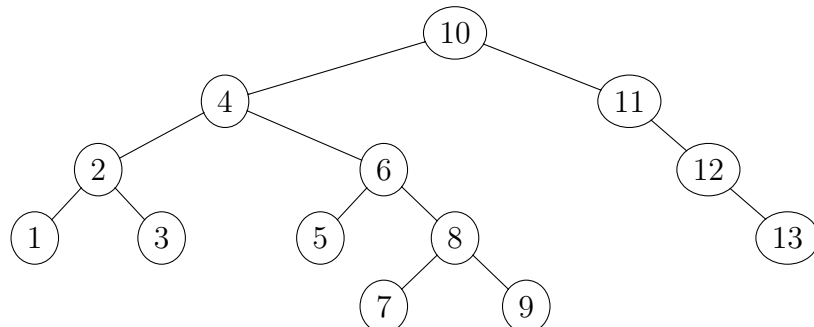   66
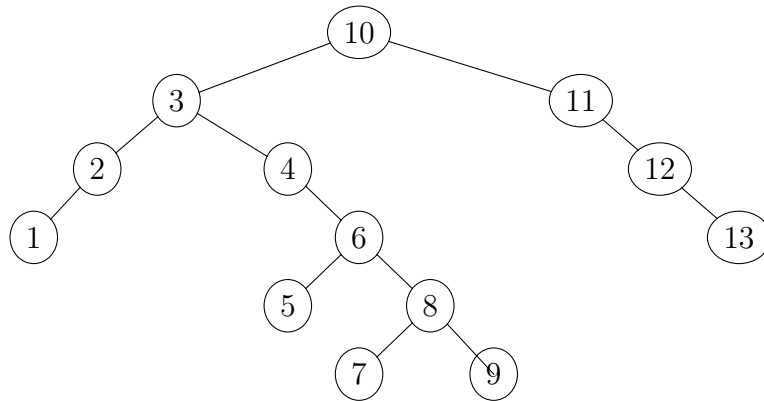
Remove 13

Remove 20

Remove 2

3. Show the results of accessing the keys 3, 9, 1, 5 in order in the following splay tree. Like the previous problem, show the tree after each access. For each rotation, clearly indicate its type, location in the tree, and direction(s) of rotation.
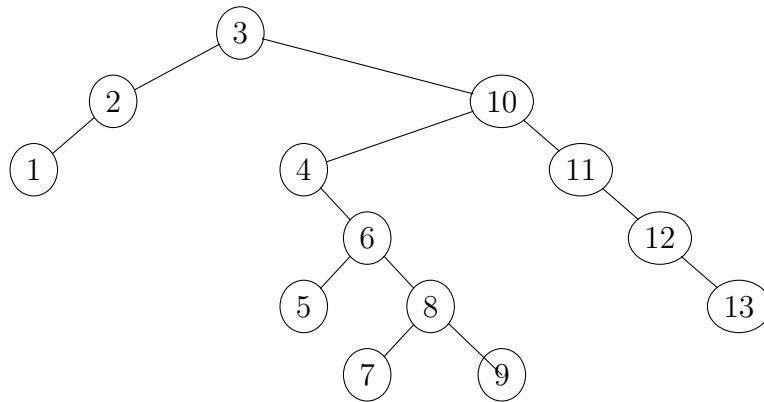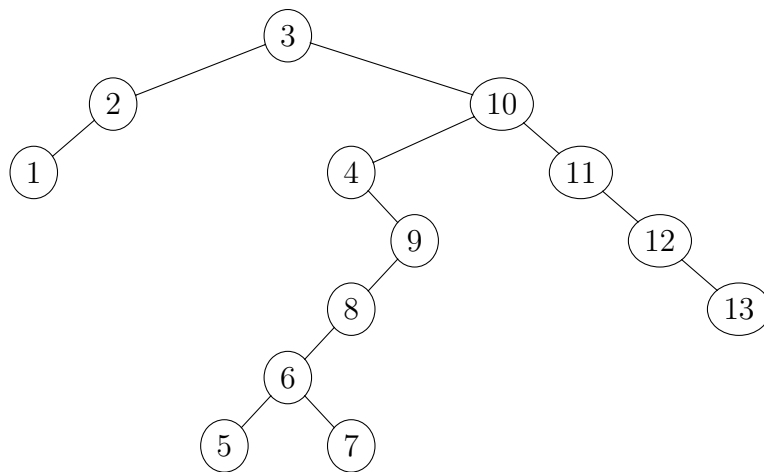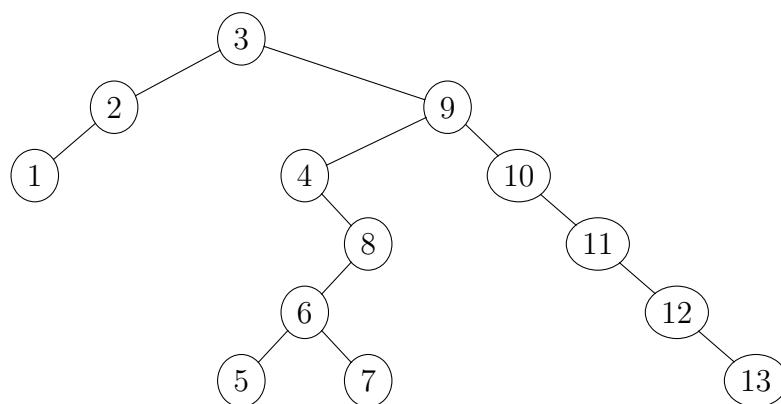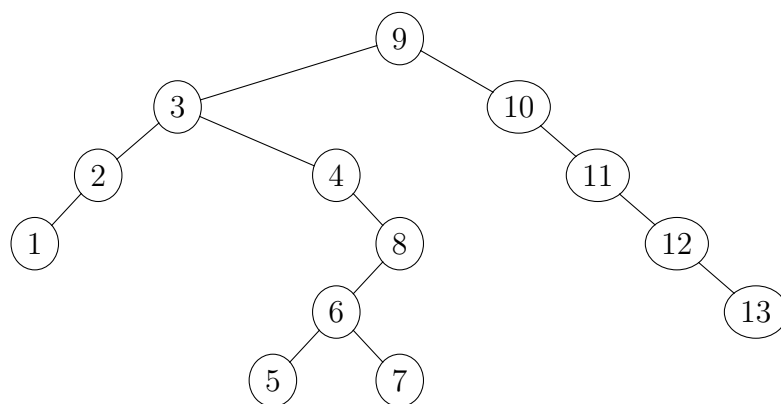
Solution:

Find 3

zig-zag (left-right)

```
                          10
                   3             11
               2       4              12
            1         6                    13
                   5     8
                      7     9
```

zig (right)

```
              3
           2       10
        1       4       11
             6              12
          5     8               13
             7     9
```

Find 9

zig-zig (left-left)

```
              3
           2       10
        1       4       11
                  9         12
                8               13
              6
            5     7
```
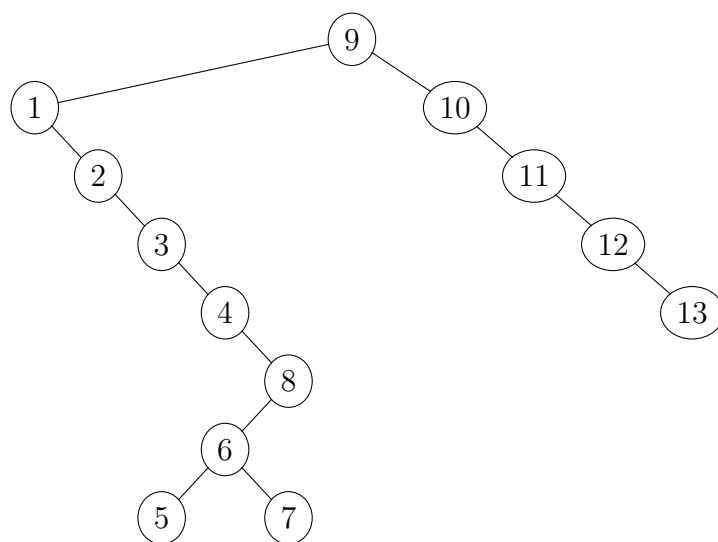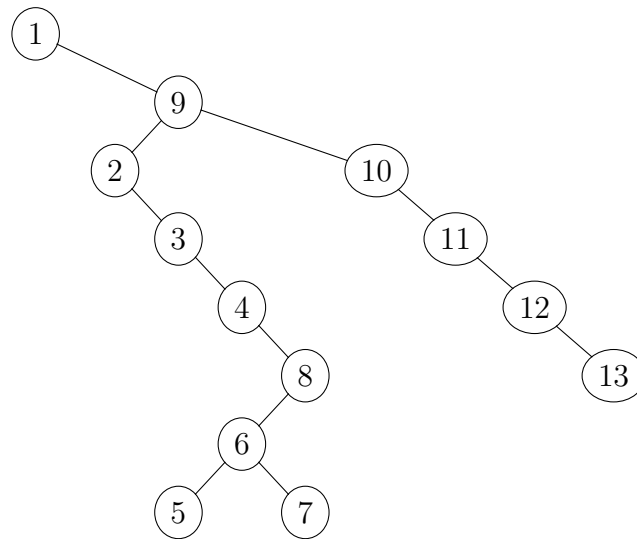
zig-zag (left-right)

zig (left)

Find 1
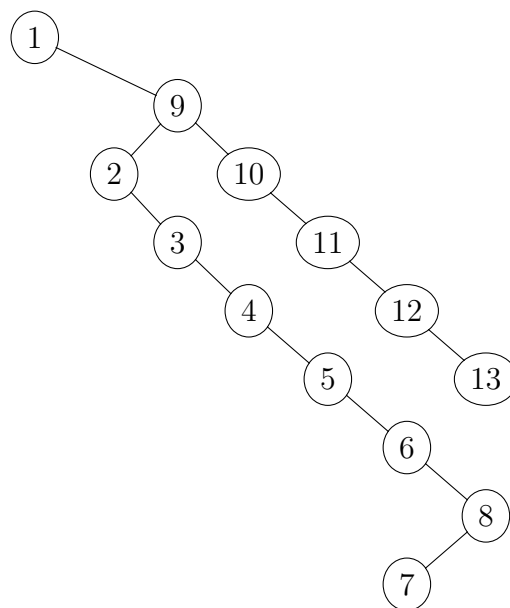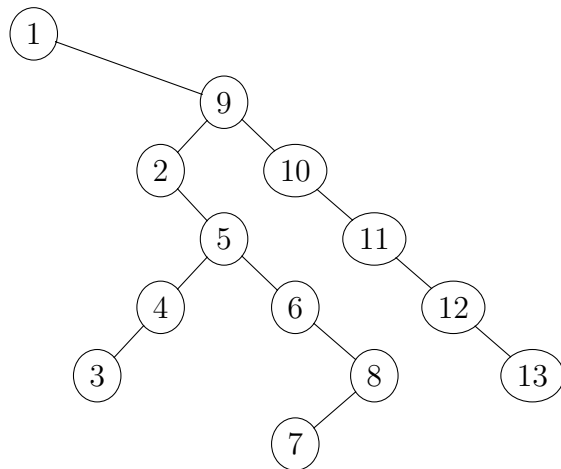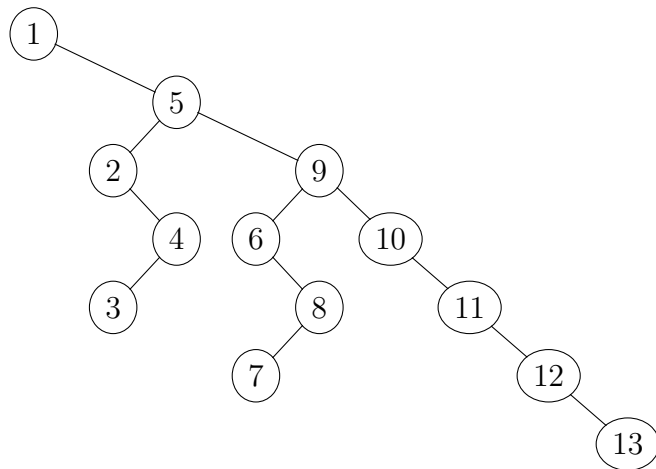
zig-zig (left-left)

zig (left)

Find 5

zig-zig (left-left)

zig-zig (left-left)

zig-zag (left-right)

zig (left)