Balanced Search Trees

Maryam Shahid

21801344

CS202

Assignment 4

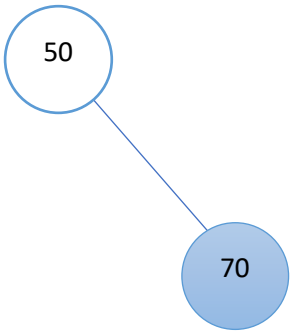
Question 1

a) AVL Trees

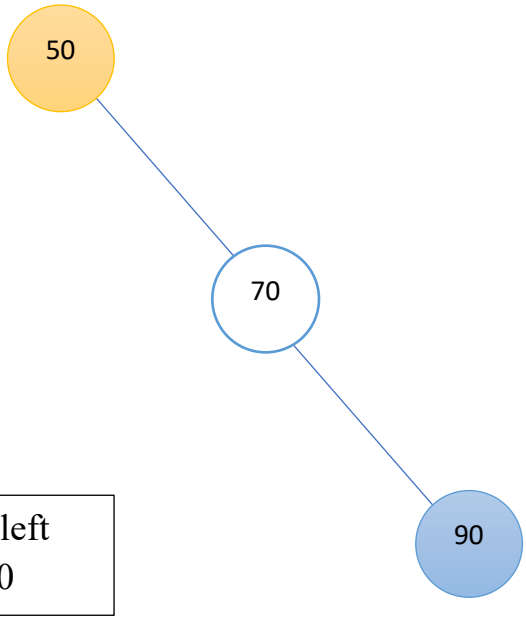
Initially: no node present; AVL tree is empty

Insert 50:

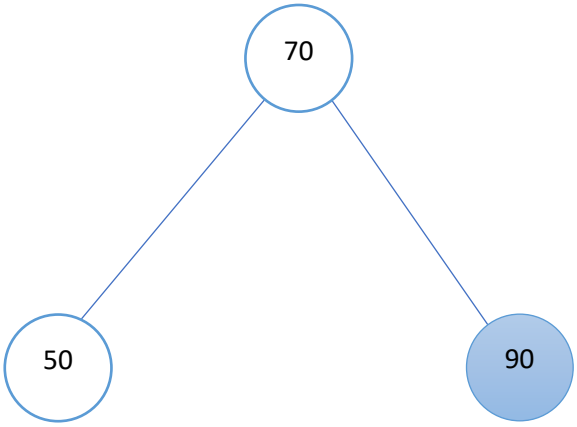
Insert 70:



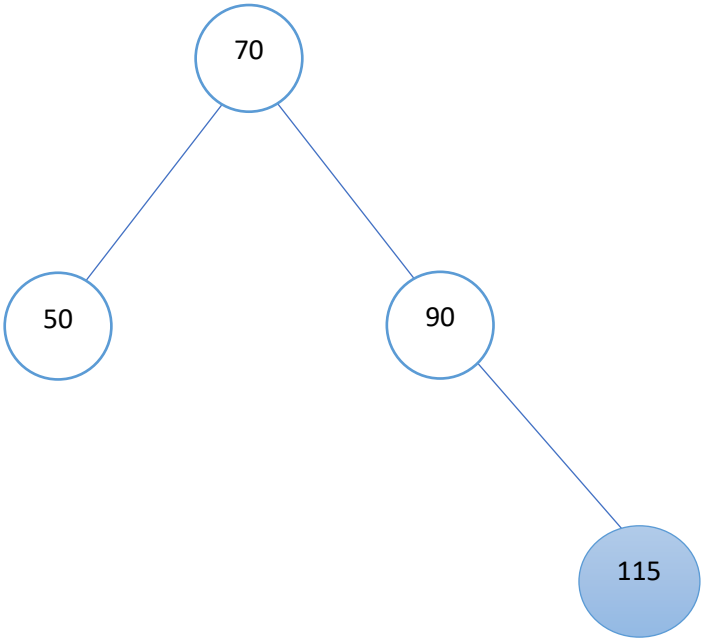
Inset 90:



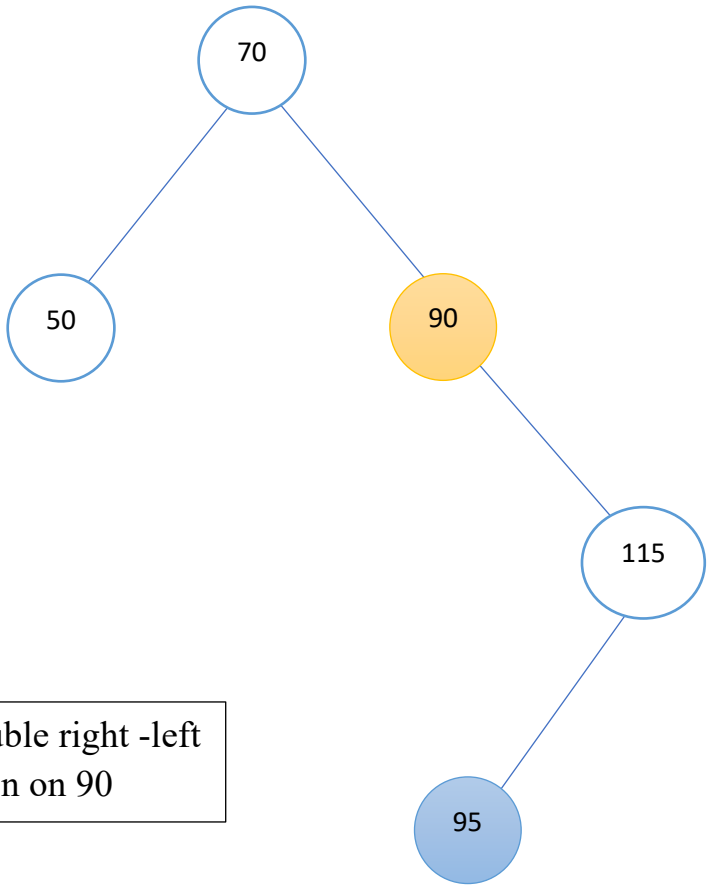
Perform single left rotation on 50



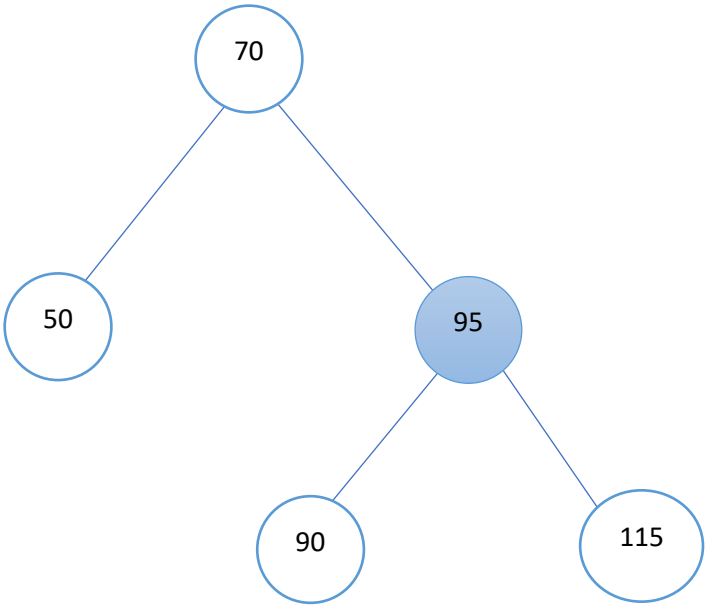
Insert 115:



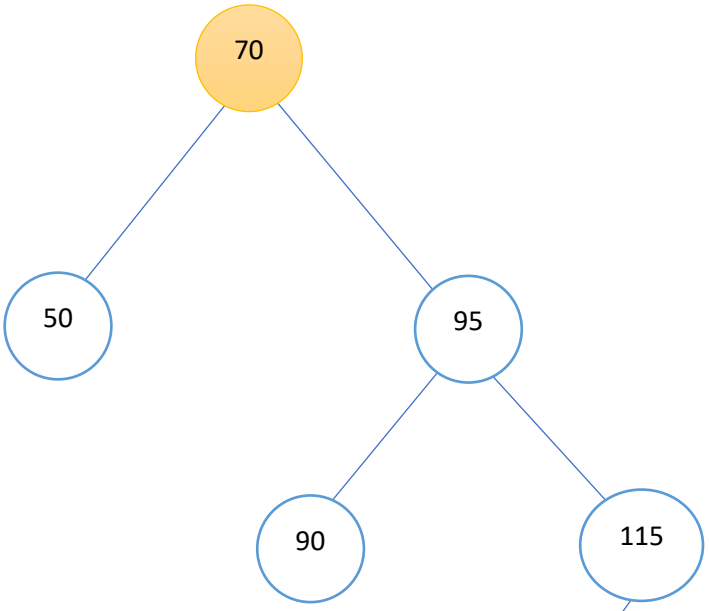
Insert 95:



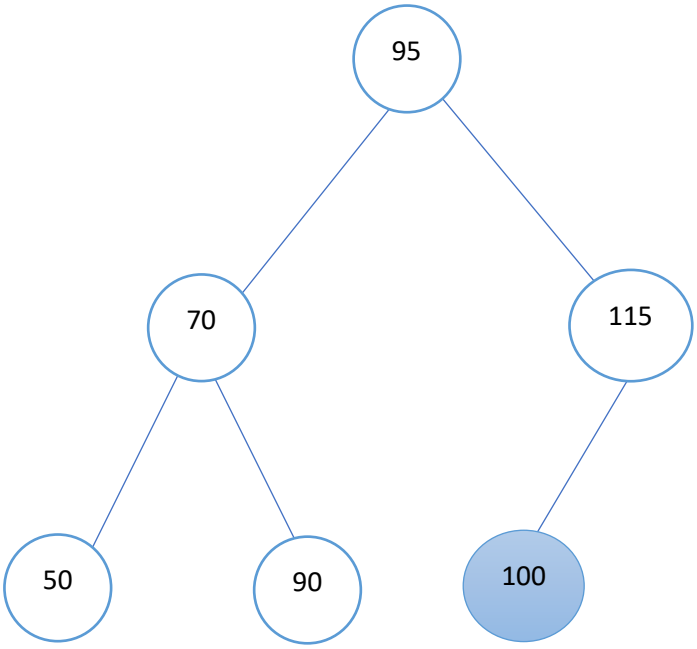
Perform double right -left rotation on 90



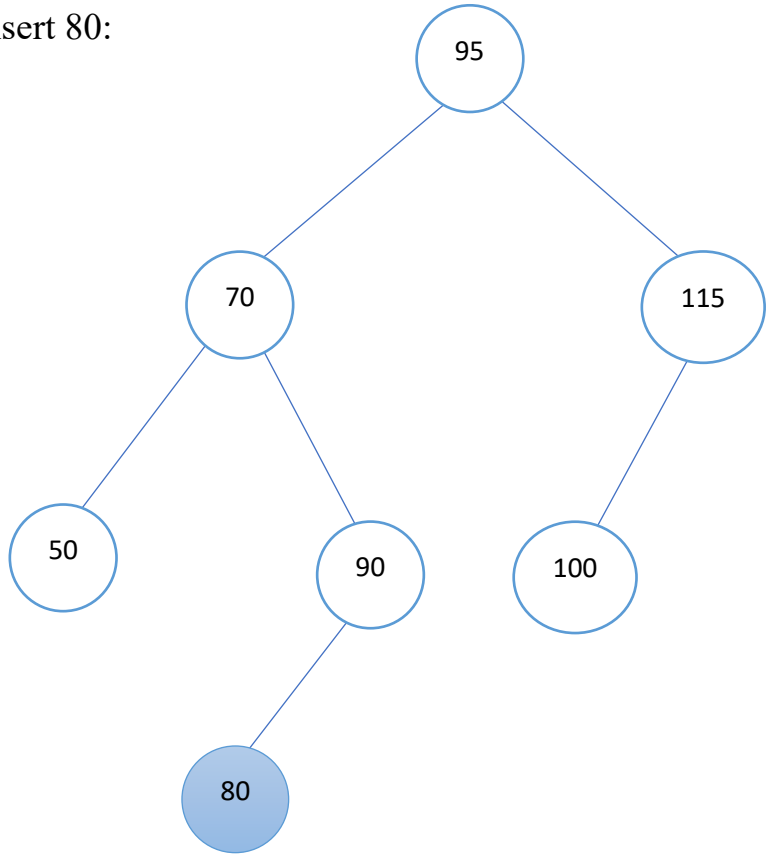
Insert 100:



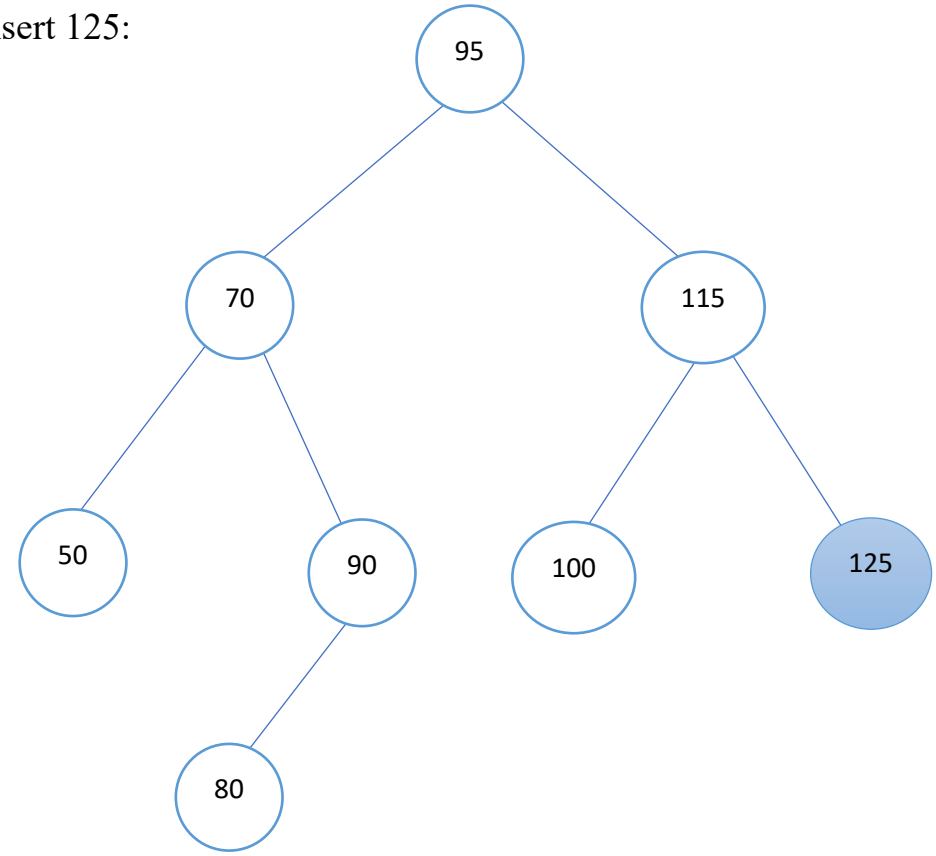
Perform single left rotation on 70



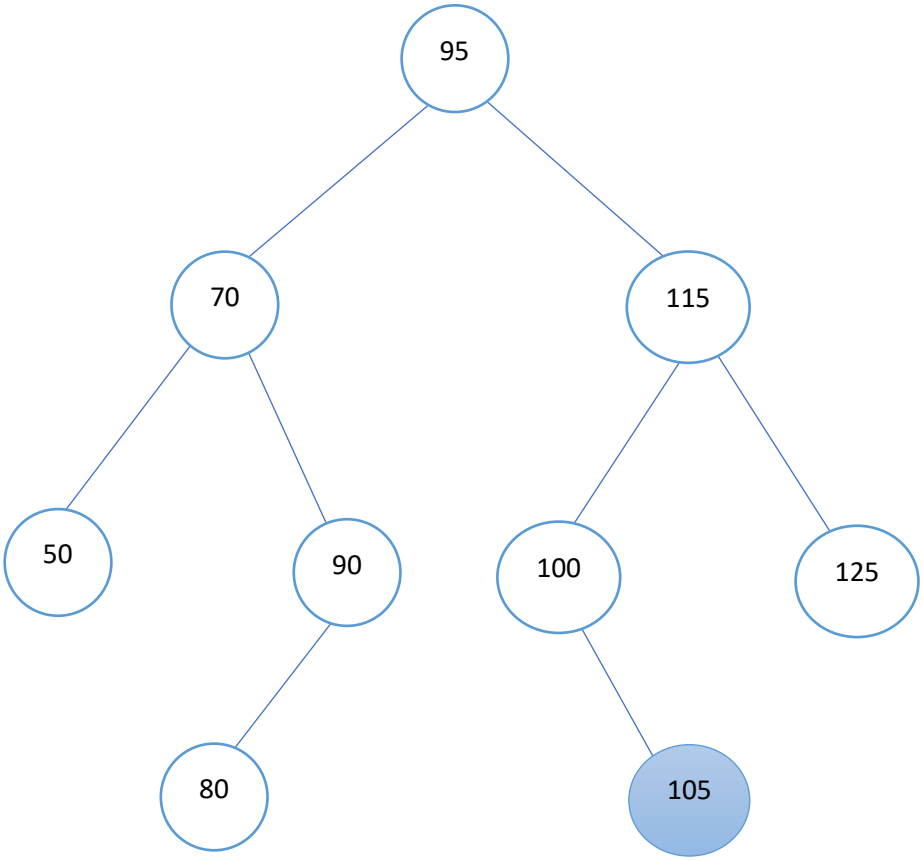
Insert 80:



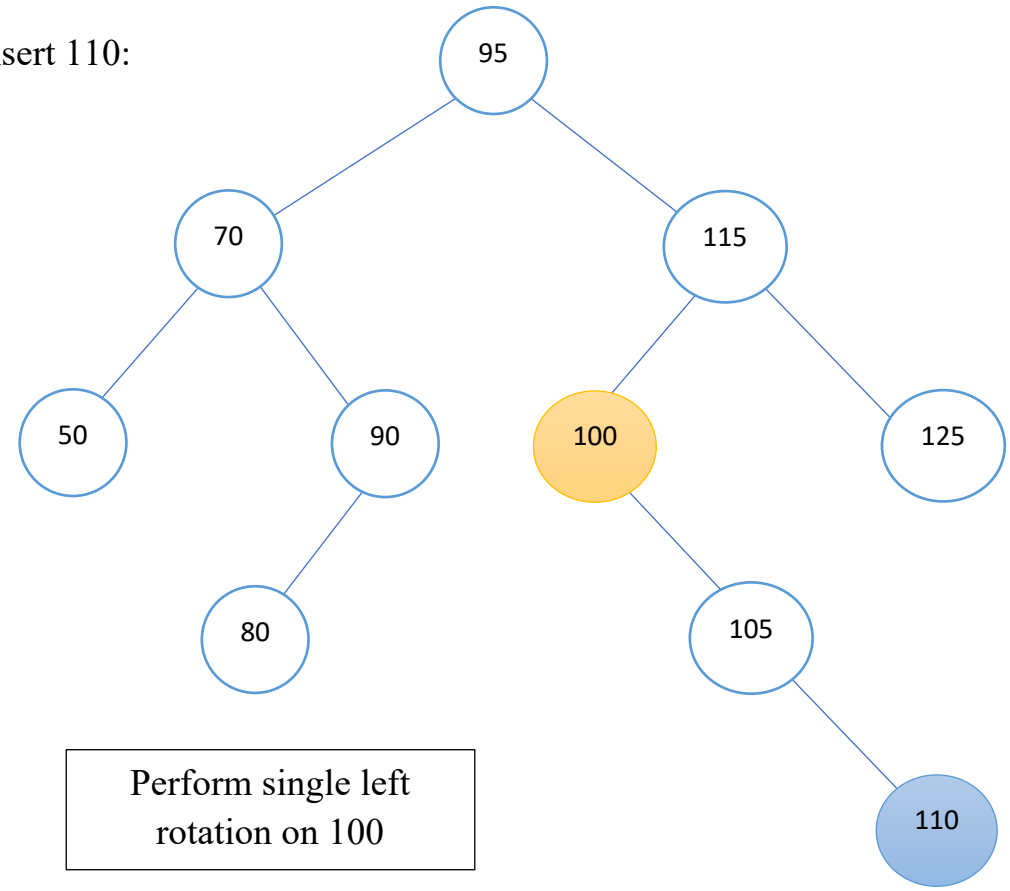
Insert 125:



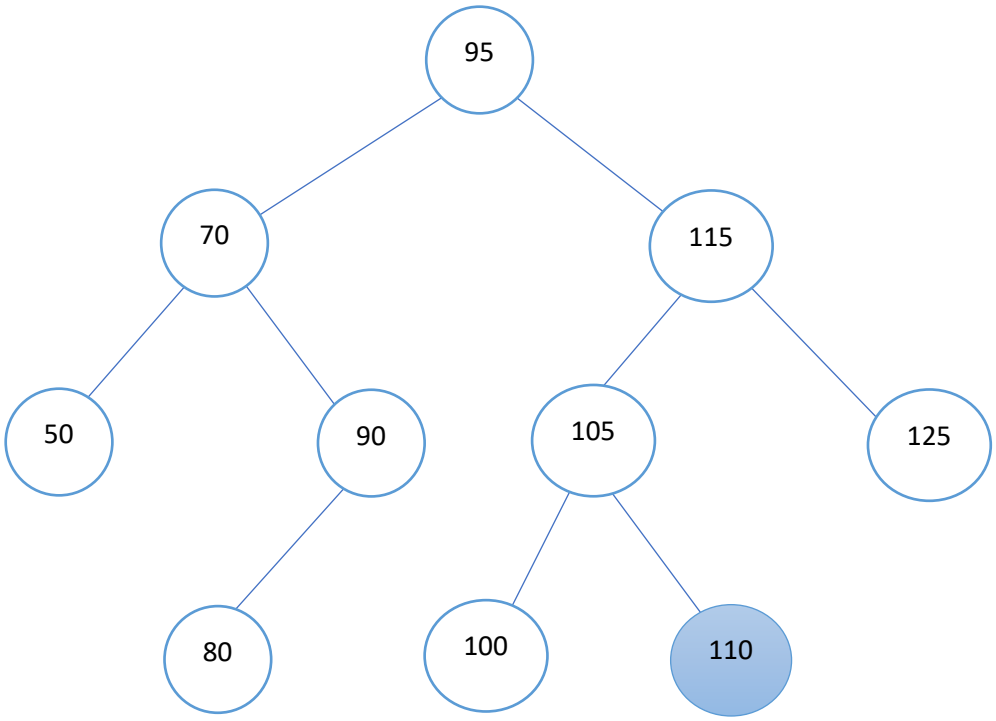
Insert 105:



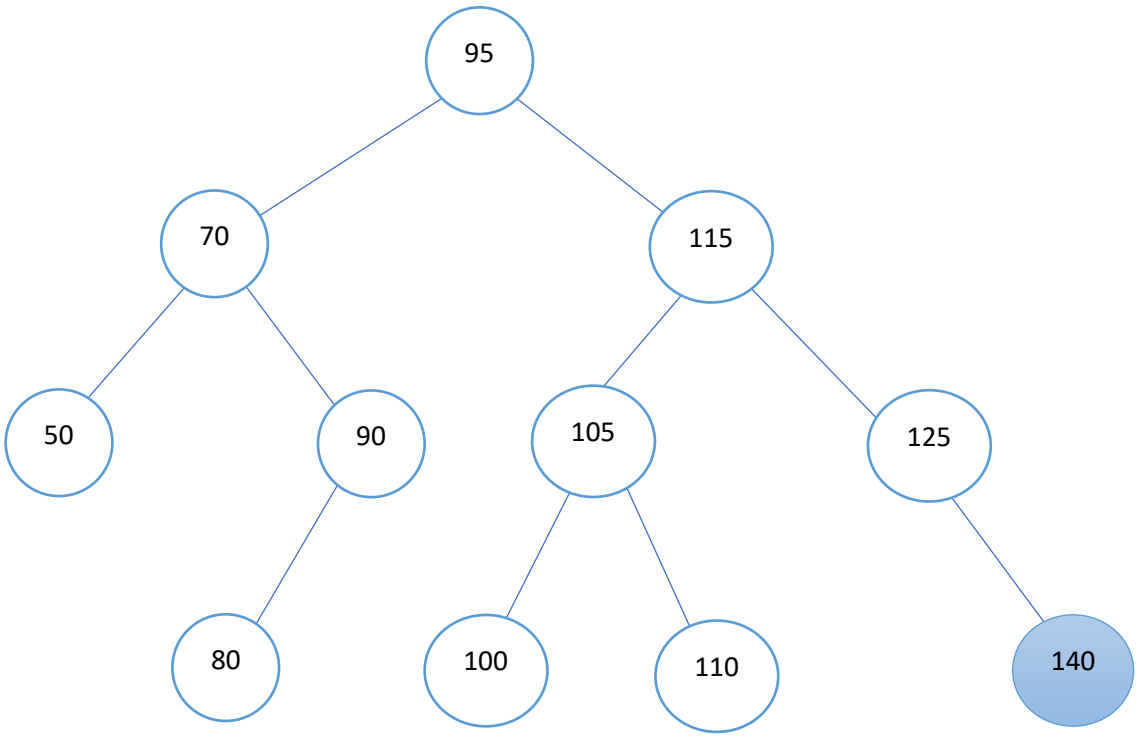
Insert 110:



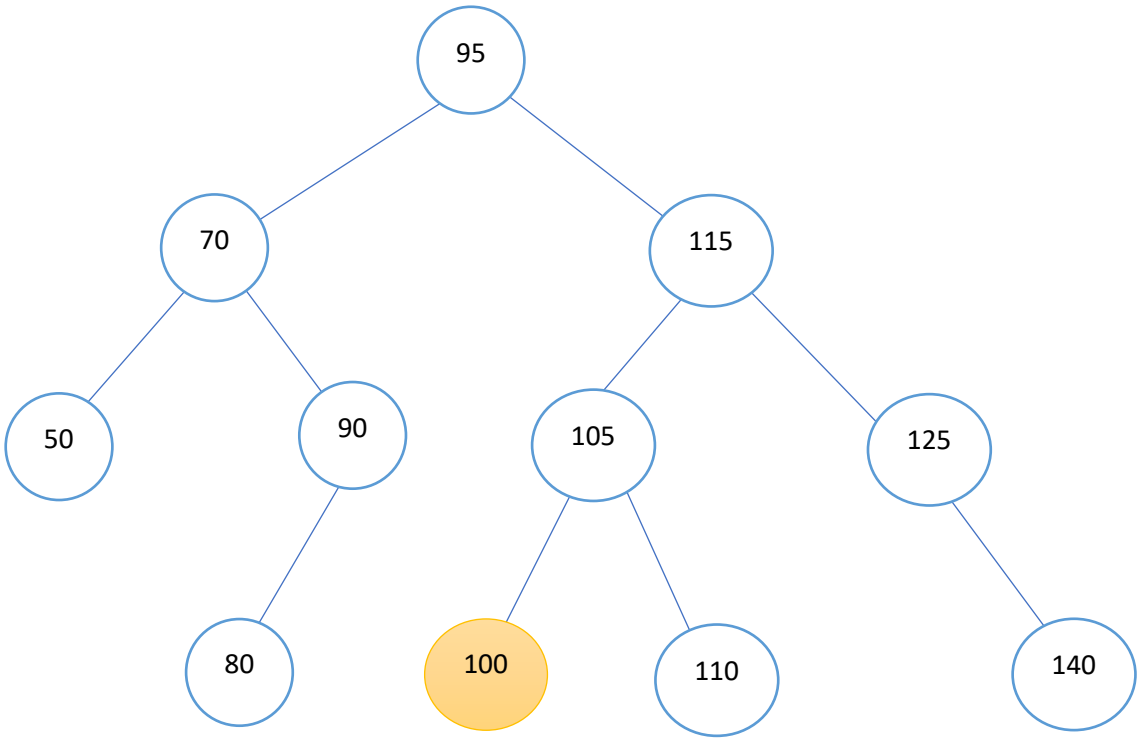
Perform single left rotation on 100



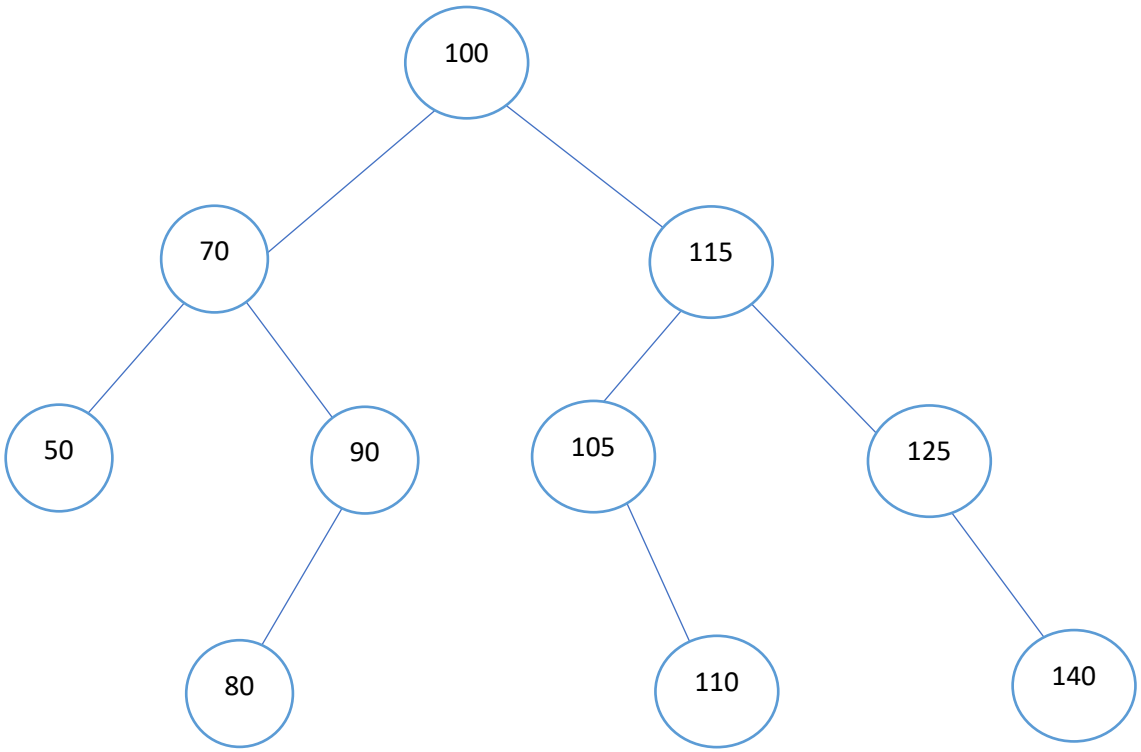
Insert 140:



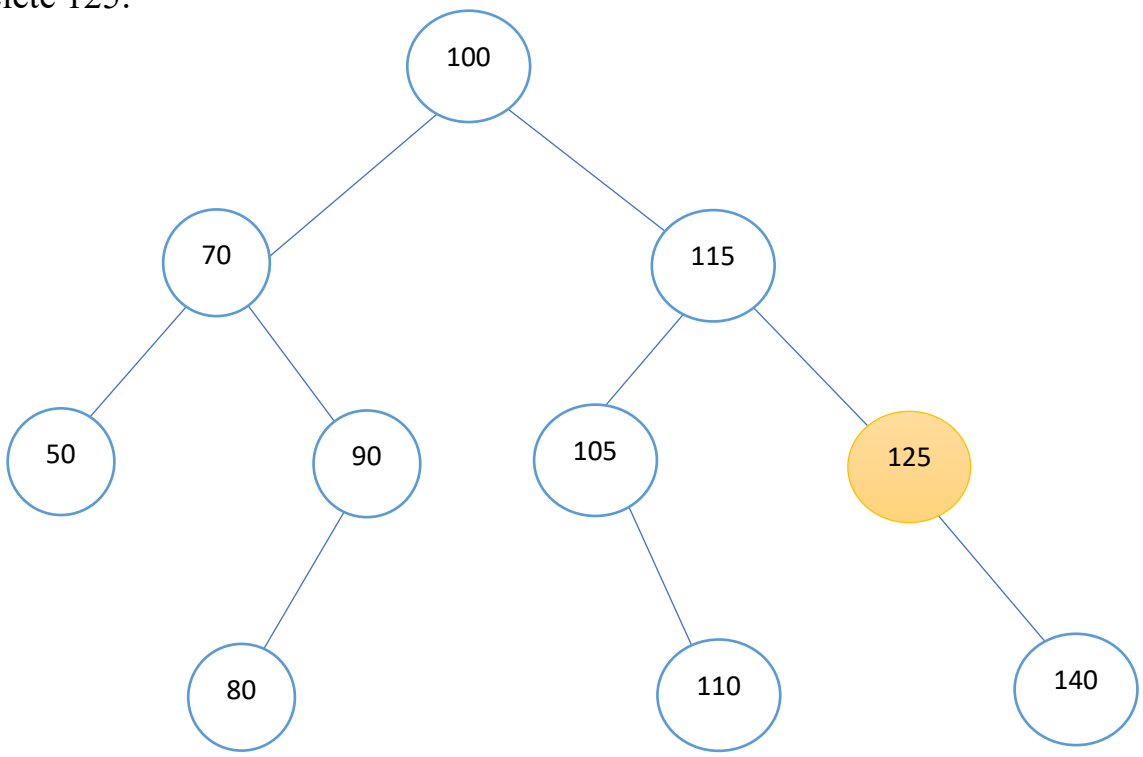
Delete 95:



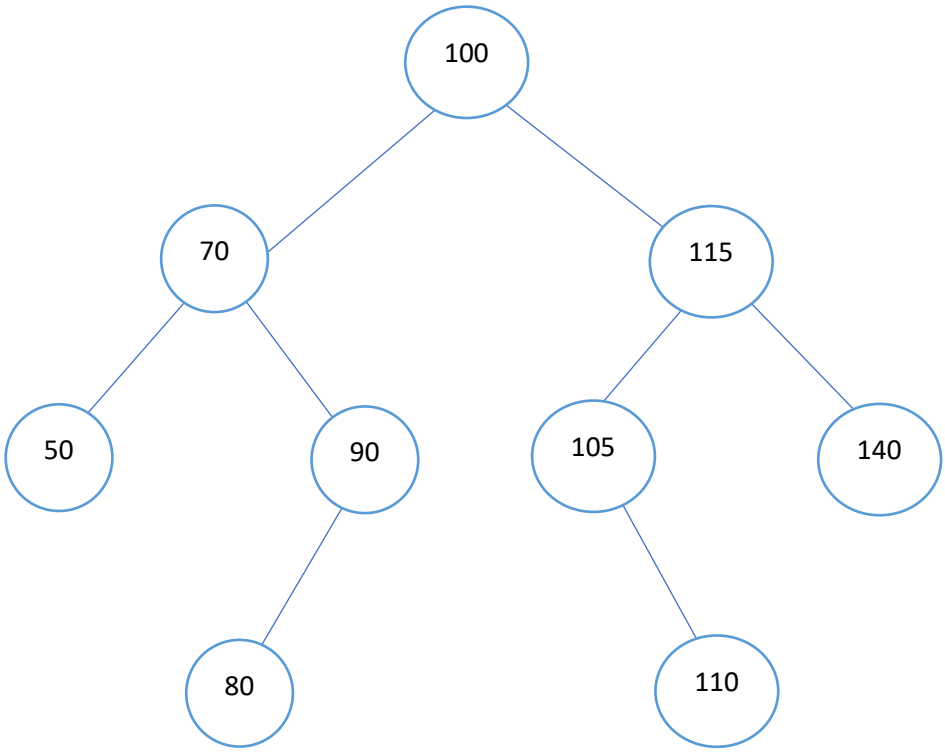
Replace 95 with its in-order successor (100), then remove 95



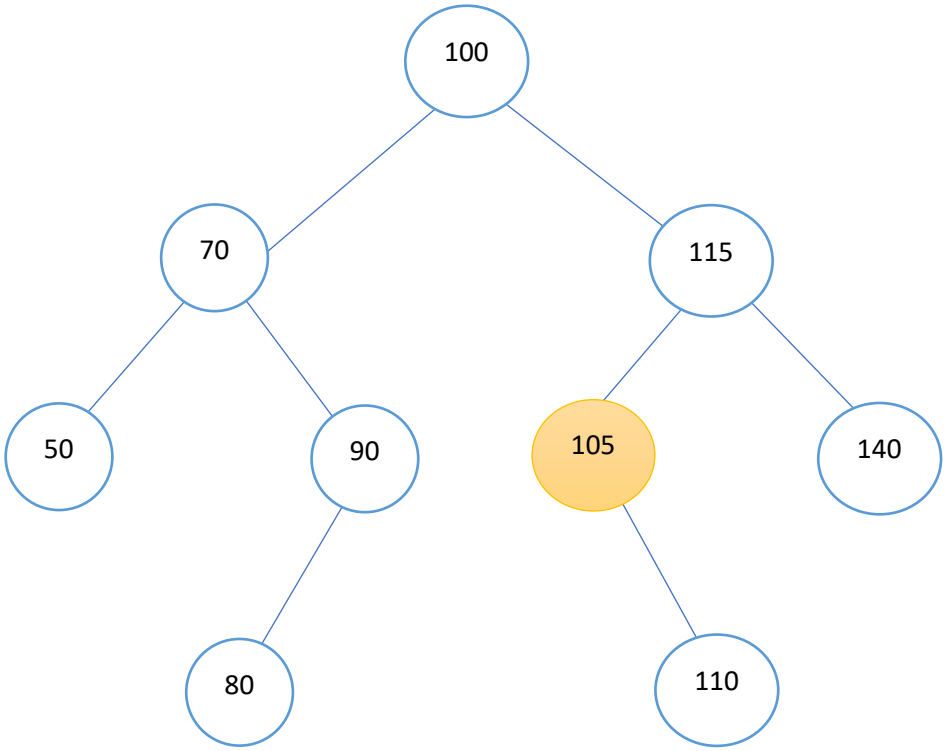
Delete 125:



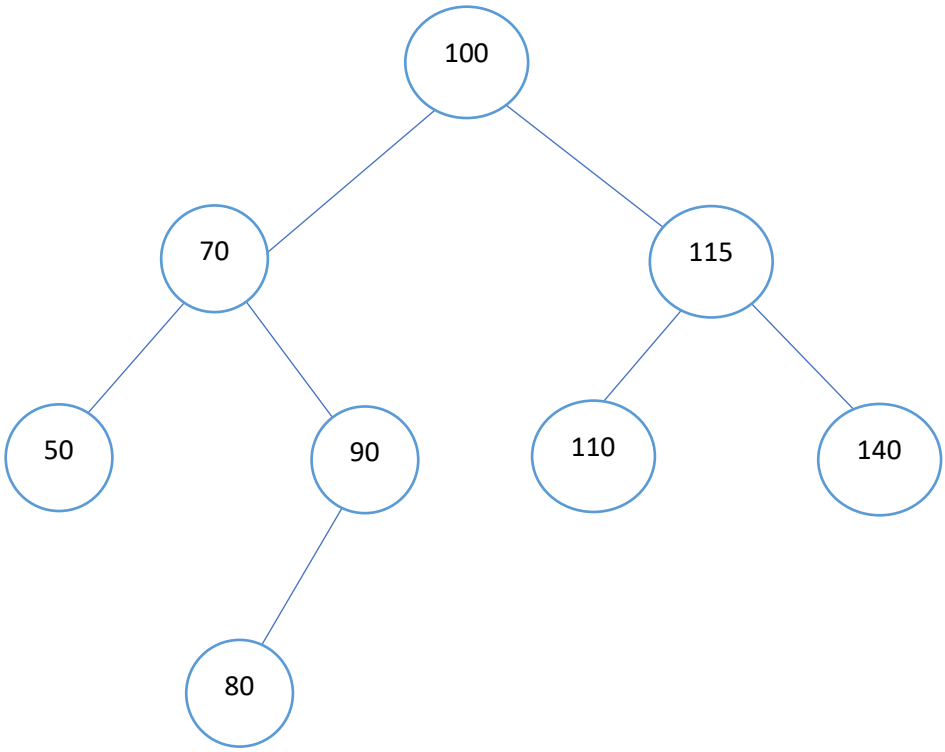
Replace 125 with its in-order successor (140), then remove



Delete 105:



Replace 105 with its in-order successor (110), then remove

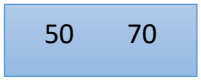


b) 2-3 Tree

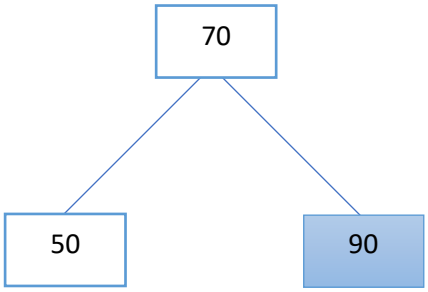
Initially: no node present; 2-3 tree is empty

Insert 50:

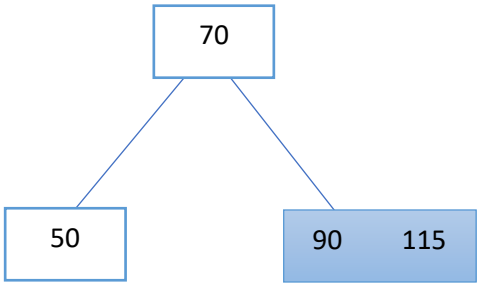
Insert 70:



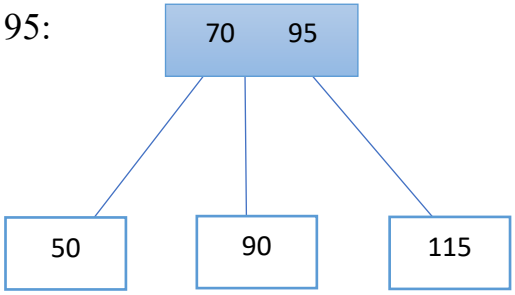
Insert 90:



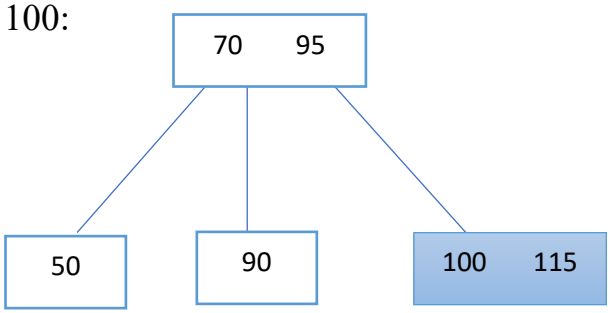
Insert 115:



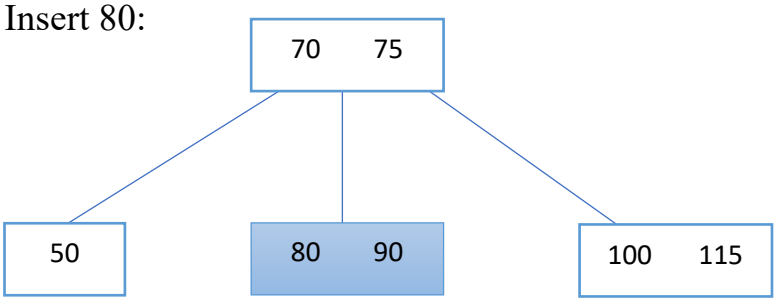
Insert 95:



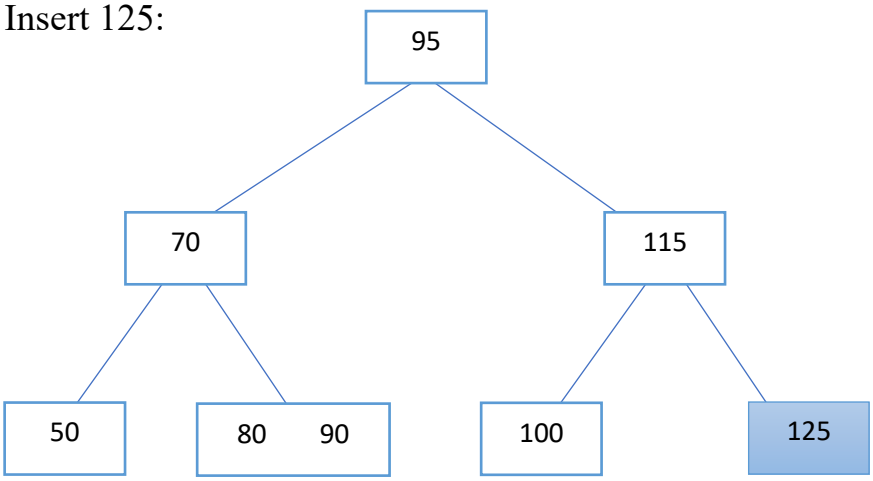
Insert 100:



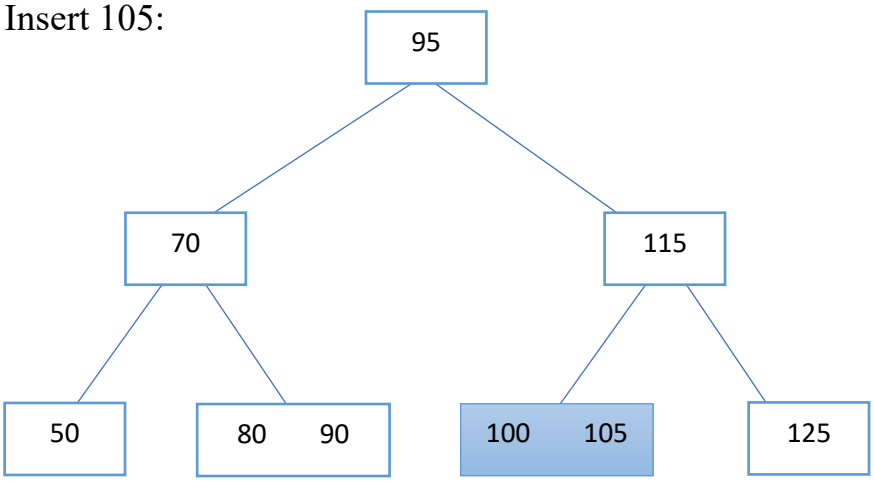
Insert 80:



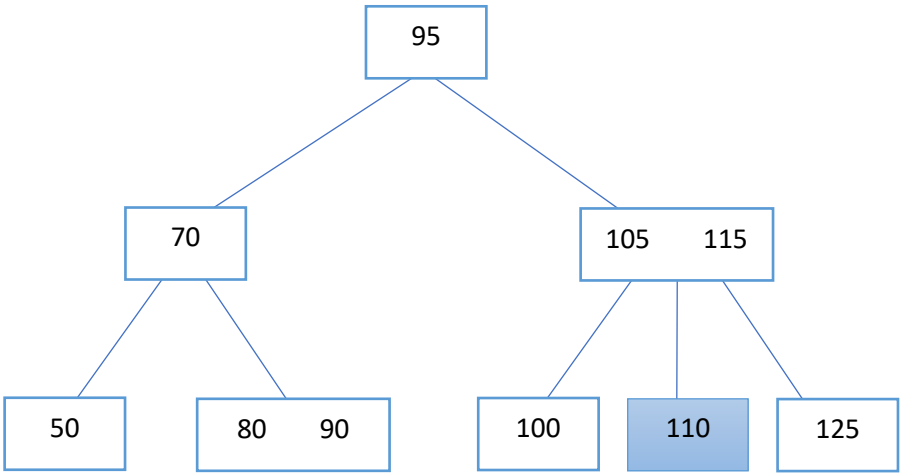
Insert 125:



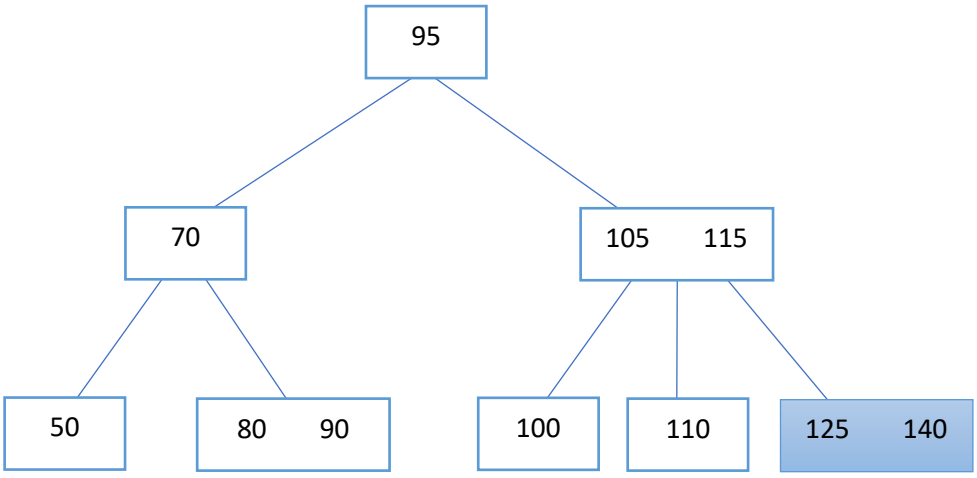
Insert 105:



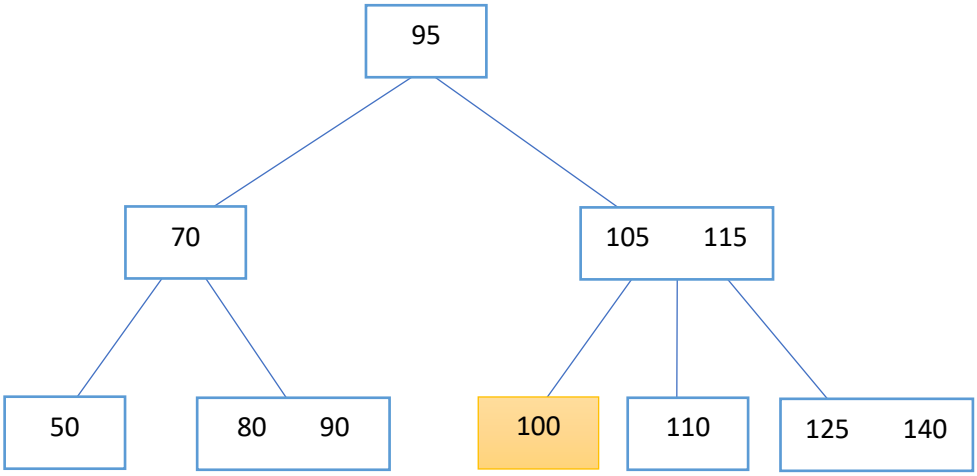
Insert 110:



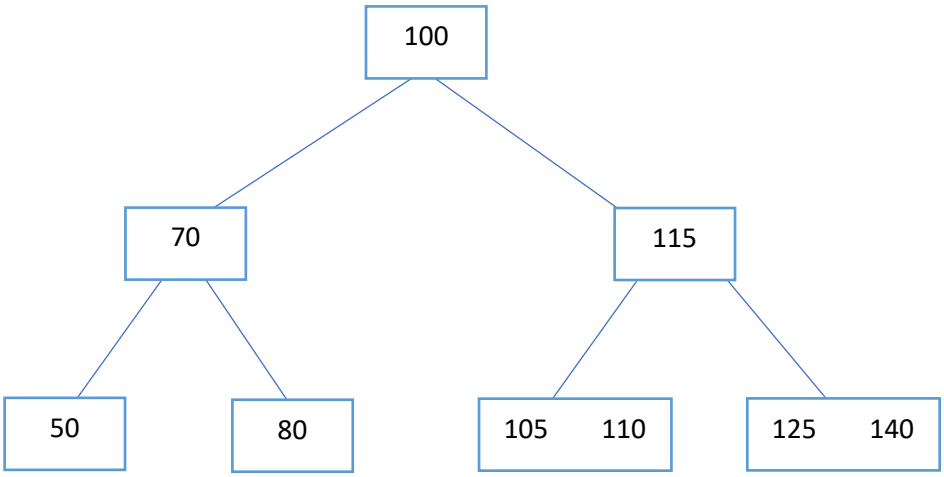
Insert 140:



Delete 95:

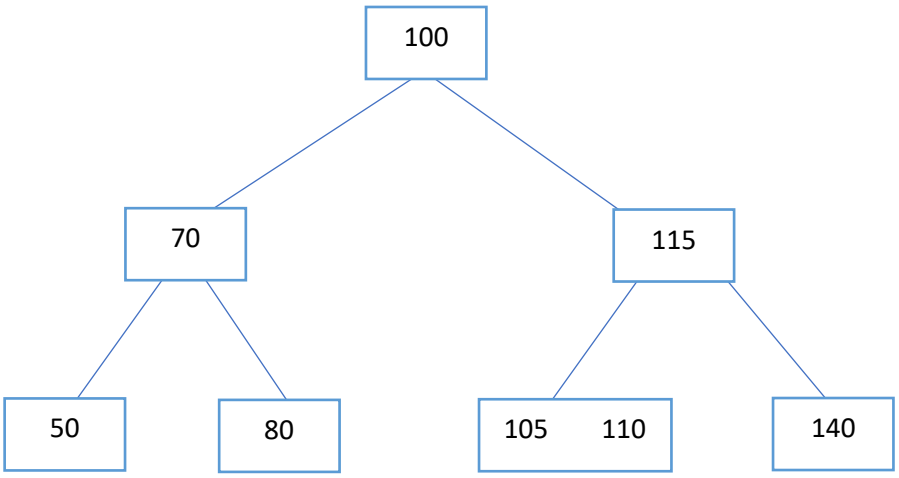


Replace 95 with its in-order successor (100) and remove
Merge 105 and 110



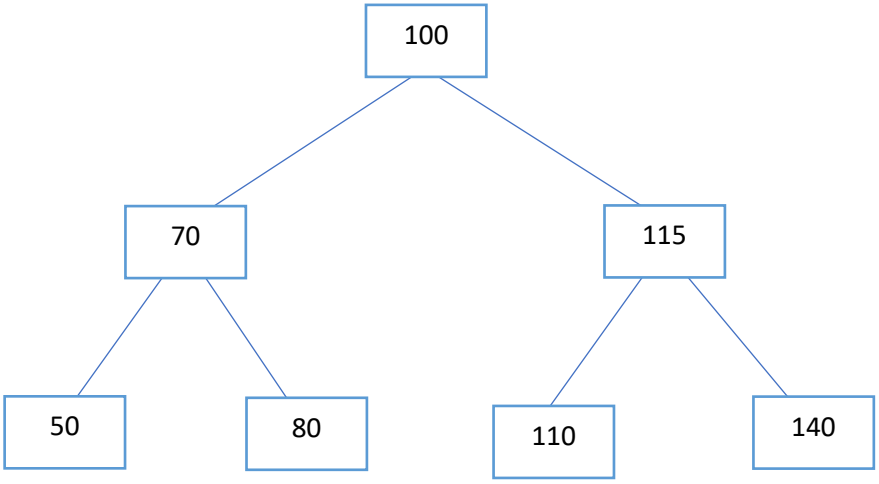
Delete 125:

Since 125 is a leaf, simply remove



Delete 105:

Since 105 is a leaf, simply remove

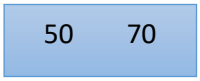


c) 2-3-4 Tree

Initially: no node present; 2-3-4 tree is empty

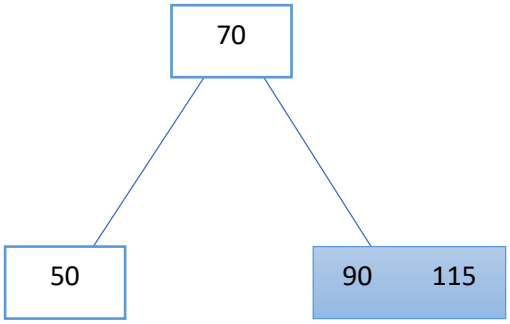
Insert 50:

Insert 70:

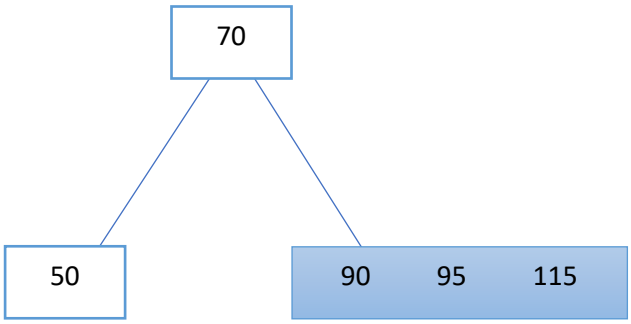


Insert 90:

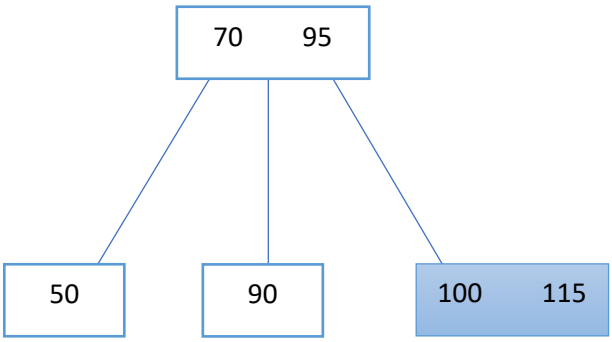
Insert 115:



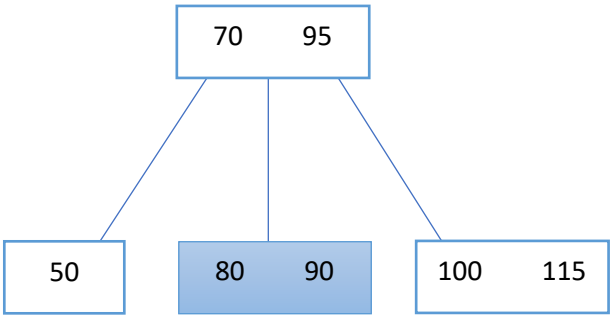
Insert 95:



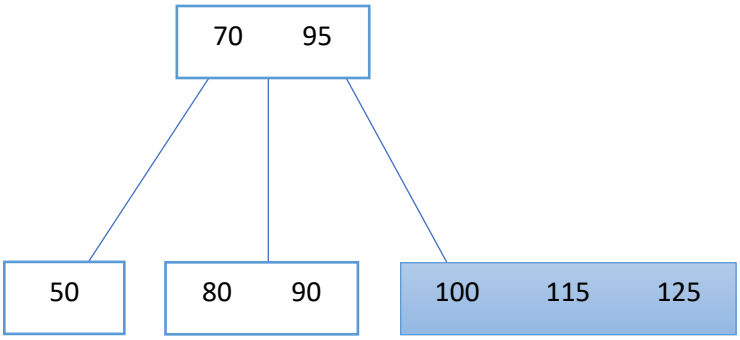
Insert 100:



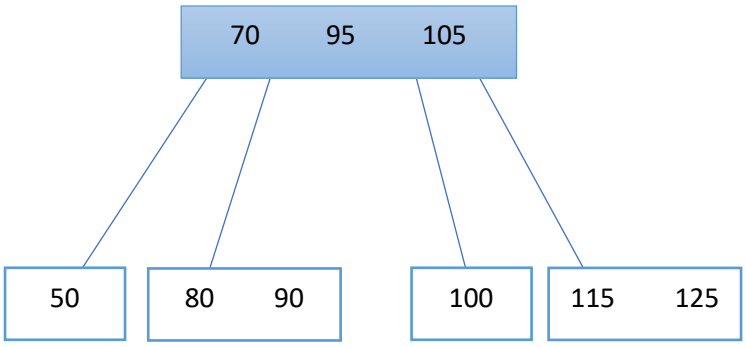
Insert 80:



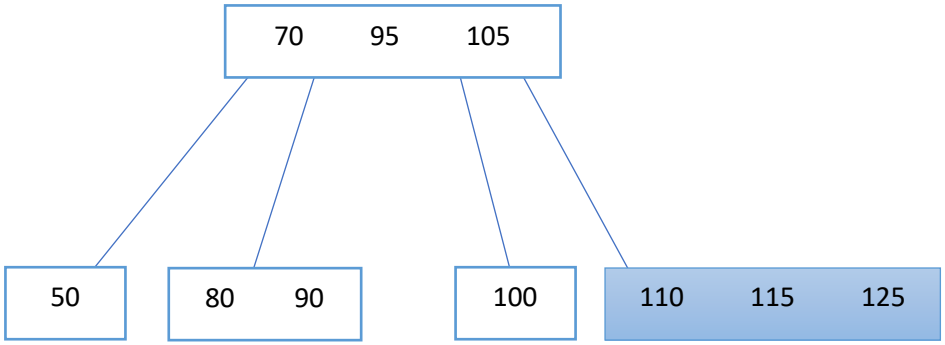
Insert 125:



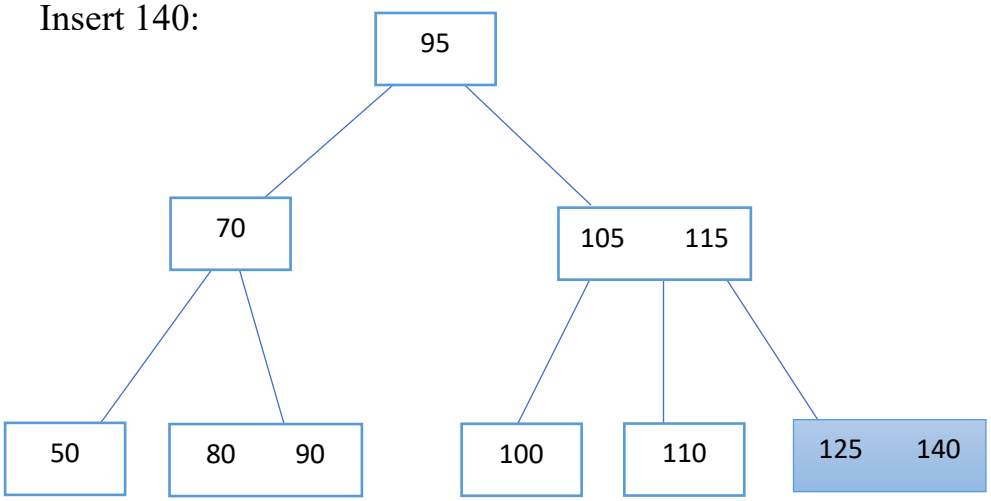
Insert 105:



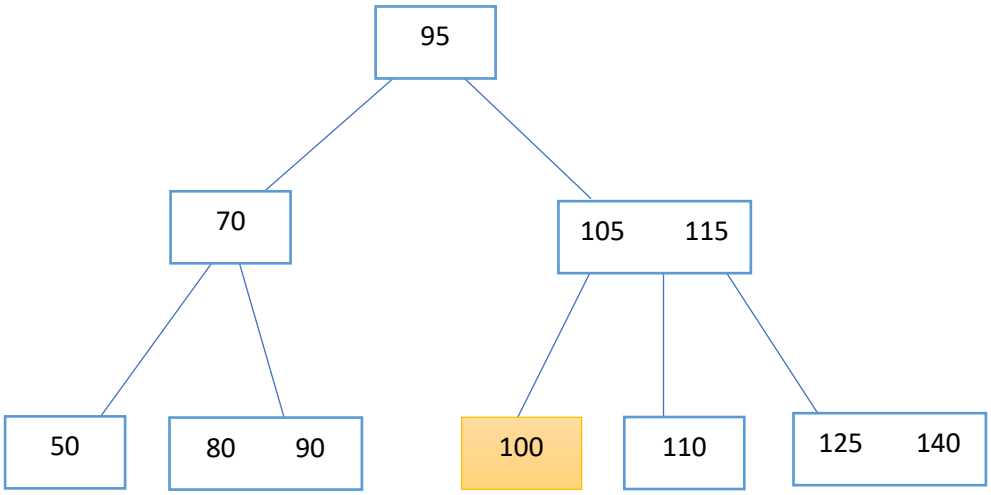
Insert 110:



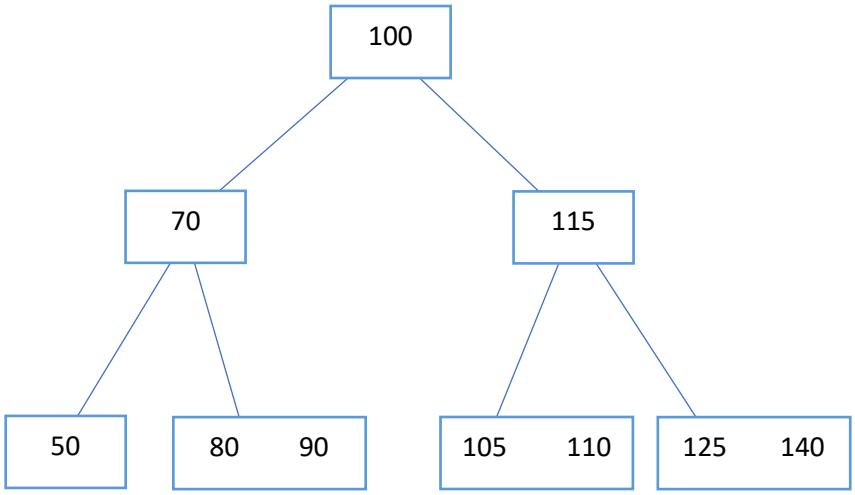
Insert 140:



Delete 95:

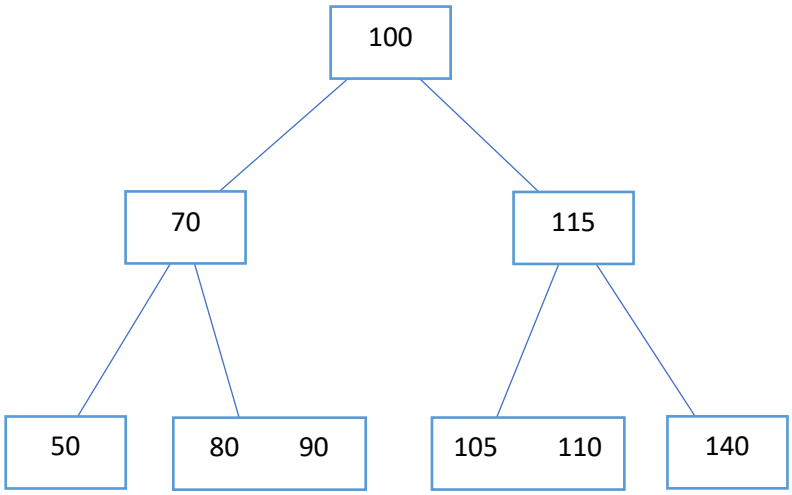


Replace 95 with its in-order successor (100) and remove
Merge 105 and 110



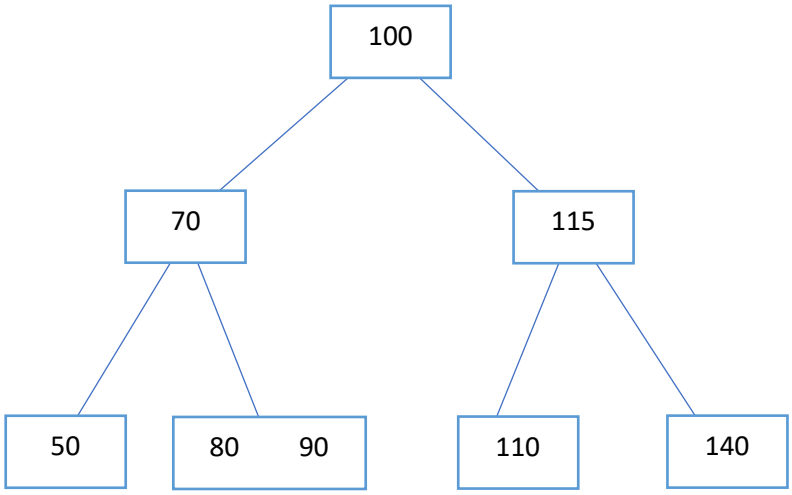
Delete 125:

Since 125 is a leaf, simply remove



Delete 105:

Since 105 is a leaf, simply remove



Question 2

Output Observed:

```
Macs-MacBook-Air:avlfreq mac$ Make
g++ -o avlfreq AVLTree.cpp avlfreq.cpp
Macs-MacBook-Air:avlfreq mac$ ./avlfreq jamesJoyceDubliners.txt
Output generated
Macs-MacBook-Air:avlfreq mac$
```

Output (first 20 items) on wordfreqs using the sample text:

```
1   a 1646
2   aback 1
3   abandoned 1
4   abbot 1
5   abhorred 1
6   abide 1
7   abject 1
8   able 6
9   about 137
10  above 18
11  abroad 3
12  abrupt 2
13  abruptly 5
14  absence 2
15  absent 1
16  absentmindedness 1
17  absolve 1
18  abstinent 1
19  abstract 1
20  abstracted 2
```

Output on statistics using the sample text:

```
Total Word Count: 7480
Tree Height: 16
Most Frequent: the 4260
Least Frequent: aback 1
Standard Deviation: 81.0032
```