1. **[LO 1, LO 2, 12 points]** Using a stack, evaluate the following postfix expression:

5	12	2	1	+	3	1	-	*	/	3	+	*

Answer:

Element	Action	Operation	Stack
5	Push 5 into the stack	-	5
12	Push 12 into the stack	-	5 12
2	Push 2 into the stack	-	5 12 2
1	Push 1 into the stack	-	5 12 2 1
+	Pop two values from the top of the stack and do the '+" operation on the two values, then push the result into the stack	2+1=3	5 12 3
3	Push 3 into the stack	-	5 12 3 3
1	Push 1 into the stack	-	5 12 3 3 1
-	Pop two values from the top of the stack and do the '-" operation on the two values, then push the result into the stack	3-1=2	5 12 3 2
*	Pop two values from the top of the stack and do the '*" operation on the two values, then push the result into the stack	3*2=6	5 12 6
/	Pop two values from the top of the stack and do the '/" operation on the two values, then push the result into the stack	12/6=2	5 2
3	Push 3 into the stack	-	5 2 3
+	Pop two values from the top of the stack and do the '+" operation on the two values, then push the result into the stack	2+3=5	5 5
*	Pop two values from the top of the stack and do the '*" operation on the two values, then push the result into the stack	5*5=25	25

Finally, the result obtained in the stack after reading the postfix expression.

So the answer is 25

2. **[LO 1, LO 2, 8 points]** Mrs. Cook is selling her home-made cakes and cookies. Since there are a lot of type and varieties, she has to store her recipes somewhere such that it would be easy and quick to search for the recipes. You, as a friend of Mrs. Cook suggests her to use a hash table to store the recipes. The Recipe ID is a 5-digit code, and the size of the hash table is 80, where the address is from 00 to 79. Determine the address for the following ID, using linear probing when a collision occurs.

   i. 00050

   ii. 10021

   iii. 20100

   iv. 21141

   v. 36079

   vi. 40959

   Answer:

   i. 00050

   50%80 = 50. So, Will be Stored at Location 50.

   ii. 10021

   10021%80 = 21. So, Will be Stored at Location 21.

   iii. 20100

   20100%80 = 20. So, Will be Stored at Location 20.

   iv. 21141

   21141%80 = 21. Collision Happen. So, Will be Stored at Location 22.

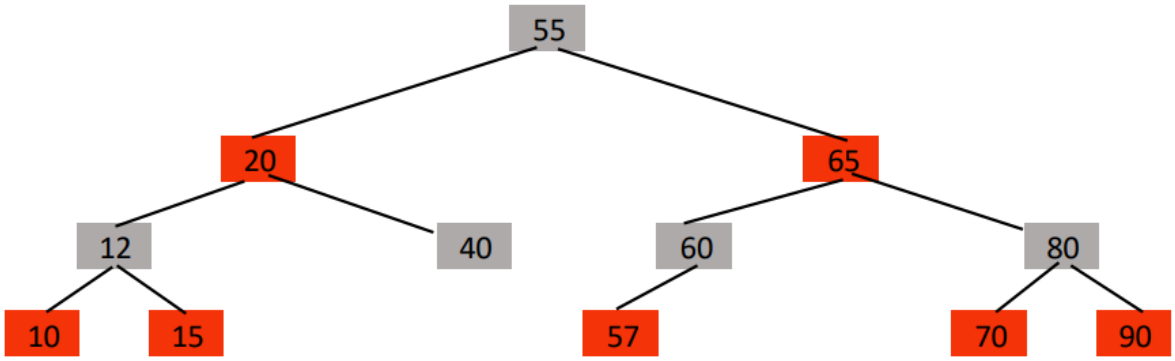
   v. 36079

   36079%80 = 79. So, Will be Stored at Location 79.

   vi. 40959

   40959%80 = 79. Collision Happen. So, Will be Stored at Location 80.

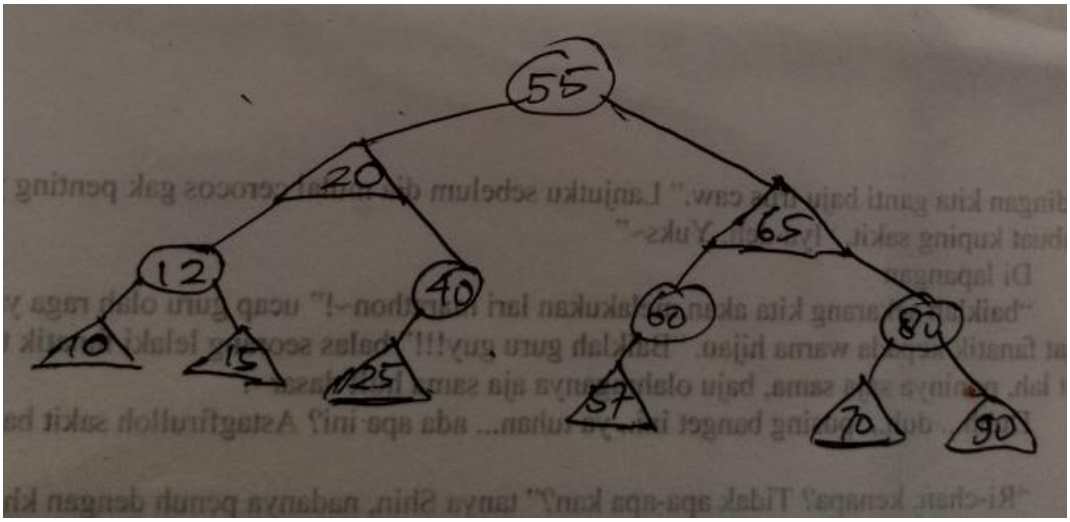
3. **[LO 1, LO 2, 12 points]** Consider the following Red Black Tree:



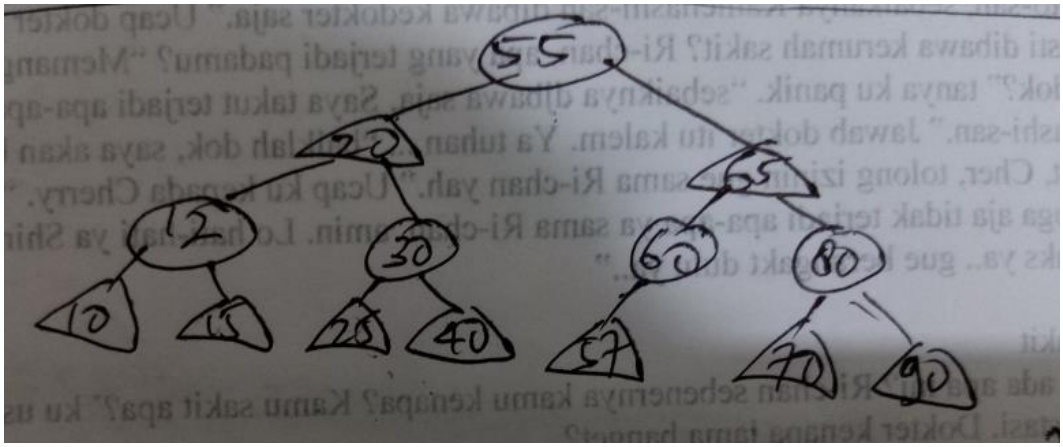
Answer:

i. From the above tree, add the following numbers in sequence: 25, 30 and 27.

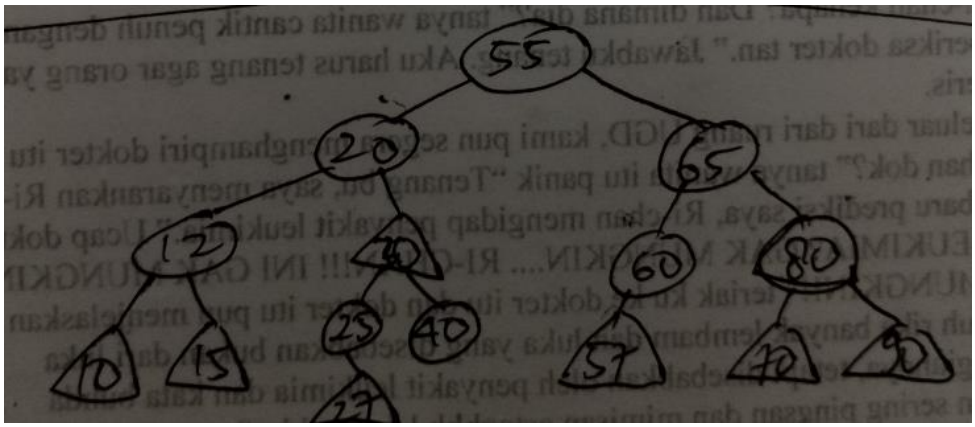
Insert 25



Insert 30

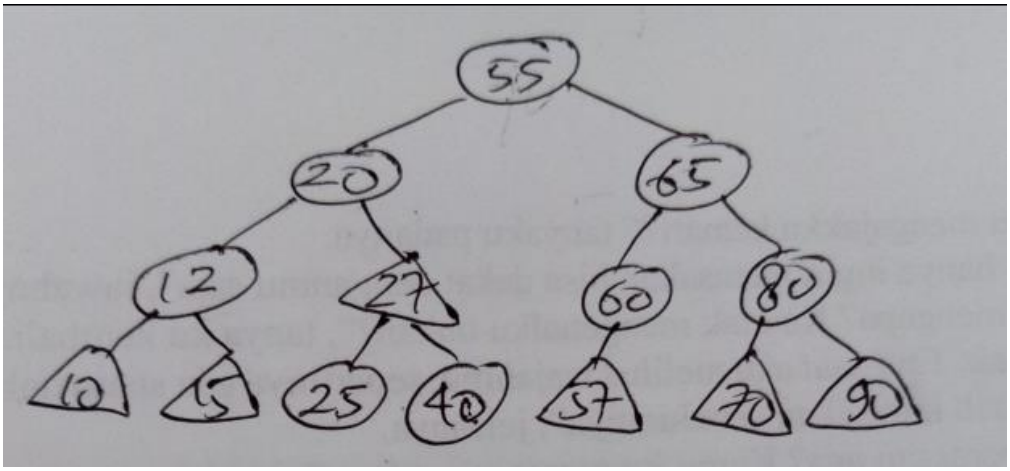


Insert 27

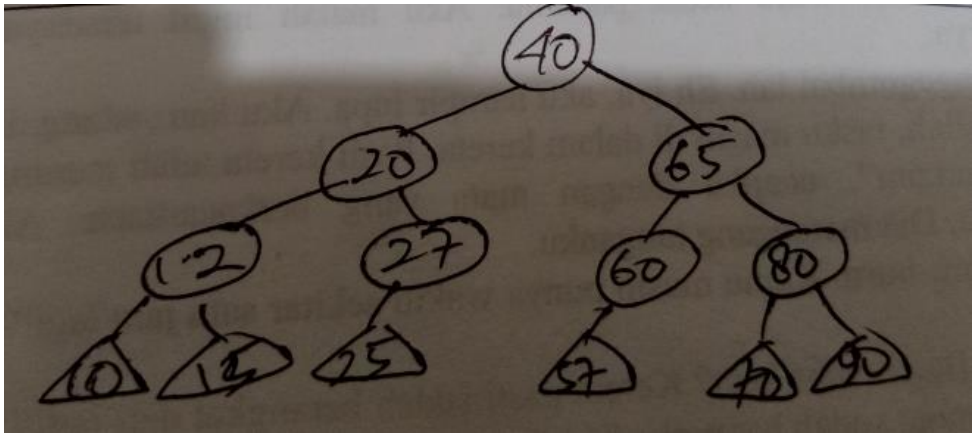


ii. From the result tree in (i), delete the following numbers in sequence: 30, 55

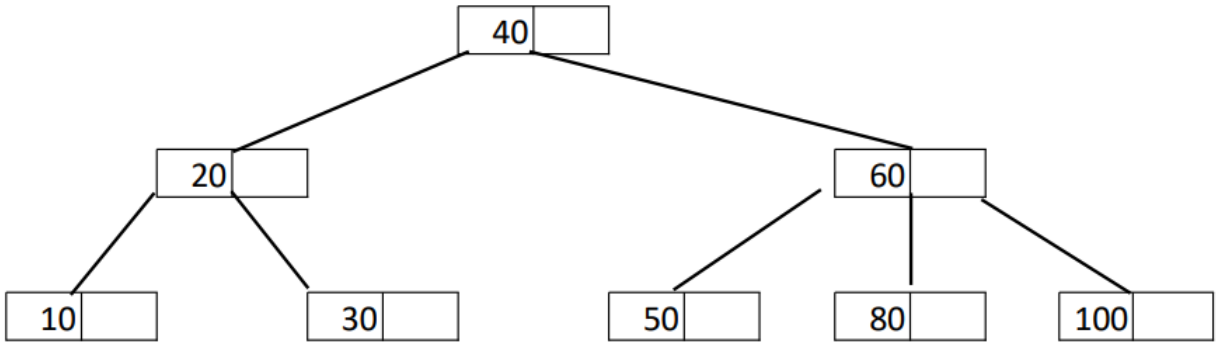
Delete 30



Delete 55



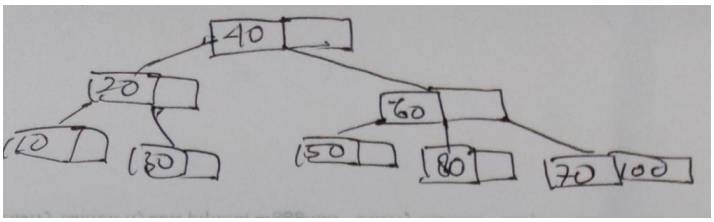
4. **[LO 1, LO 2, 8 points]** Consider the following B-Tree of order 3.



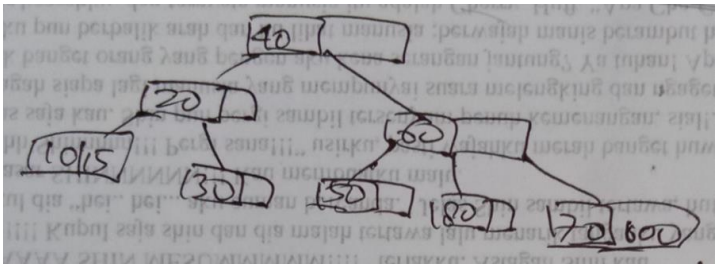
Answer:

i. **From the above tree, add the following numbers in sequence: 70, 15, 5.**

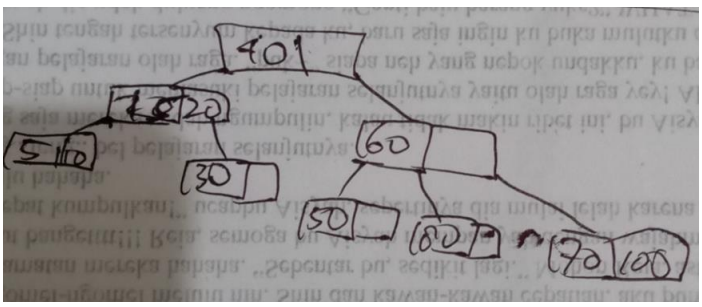
Insert 70



Insert 15

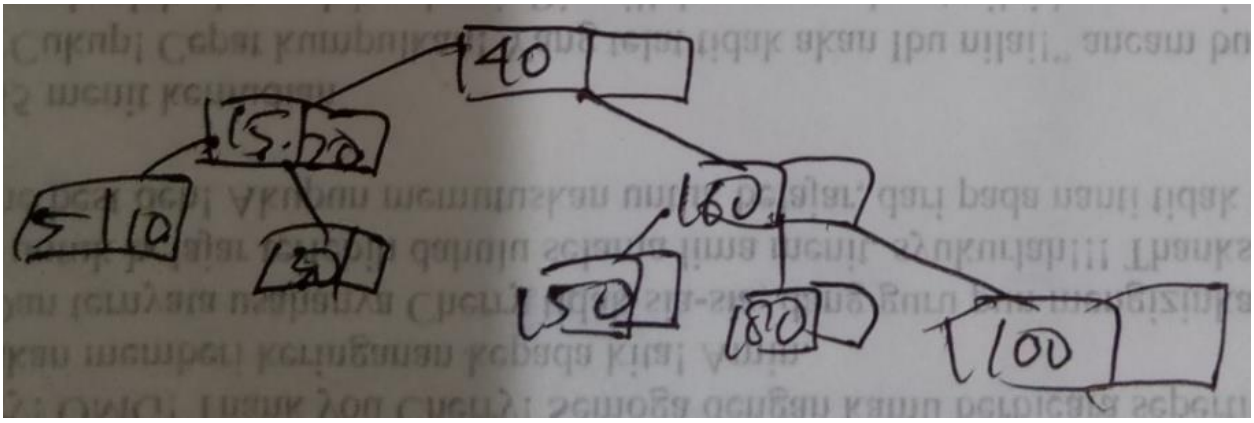


Insert 5

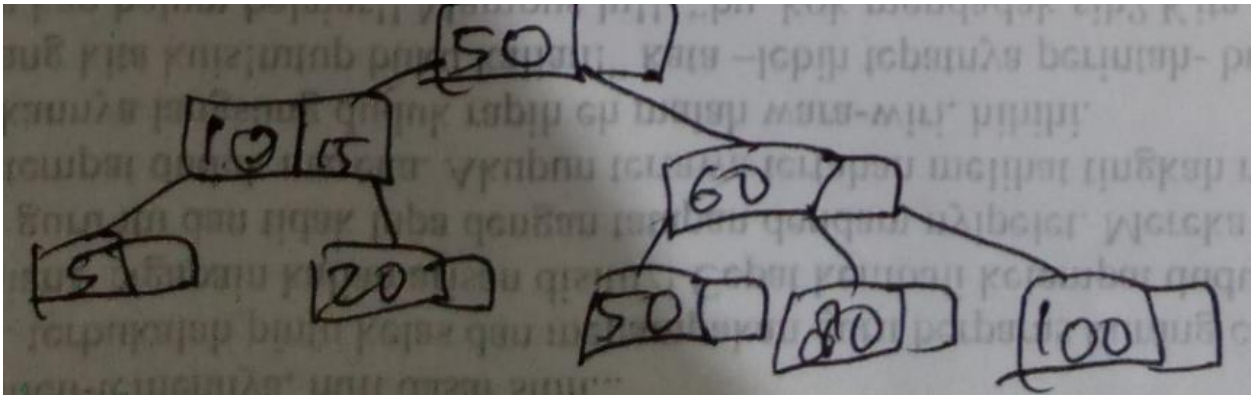


ii. **From the result tree in (i), delete the following numbers in sequence: 70, 40**

Delete 70



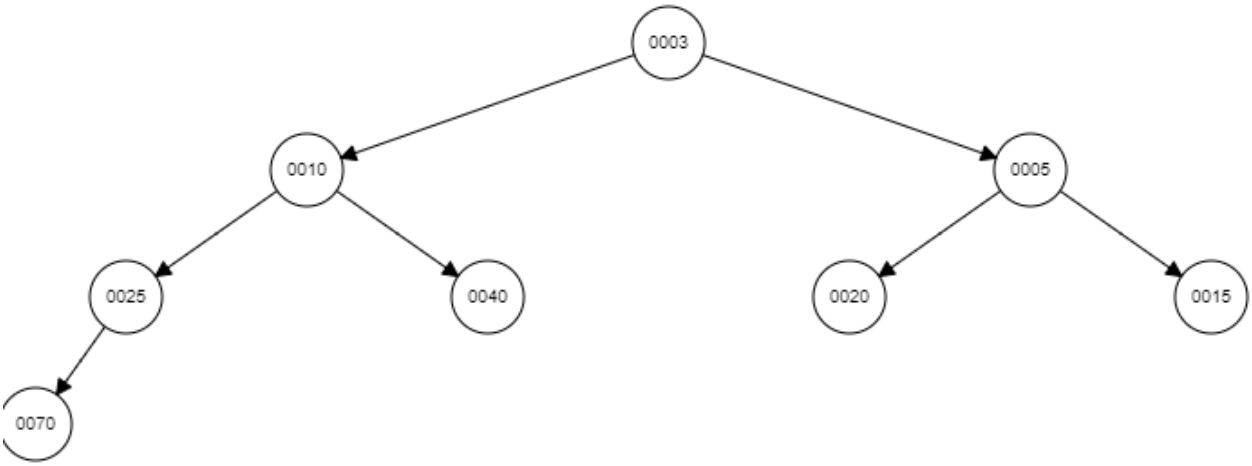
Delete 40



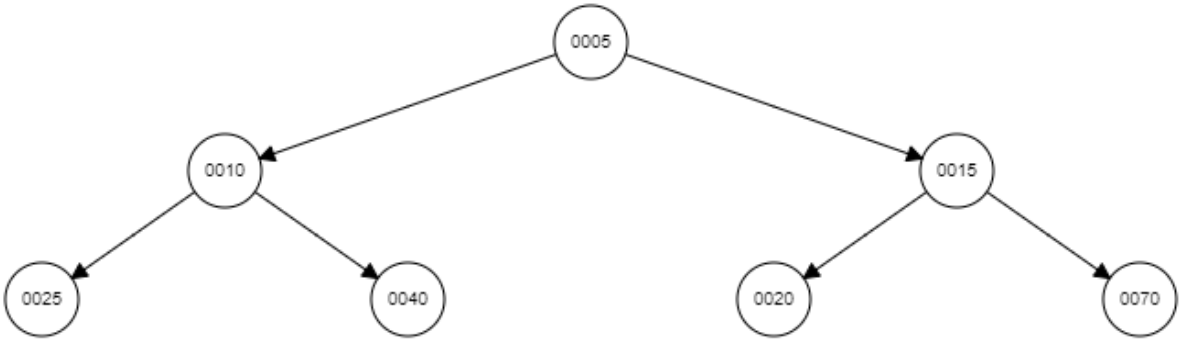
5. **[LO 1, LO 2, 8 points]** Create a min-max heap from the following sequence of numbers: 20, 40, 10, 70, 5, 15, 3, 25. And then from the resulting tree delete minimum and delete maximum.

Answer:

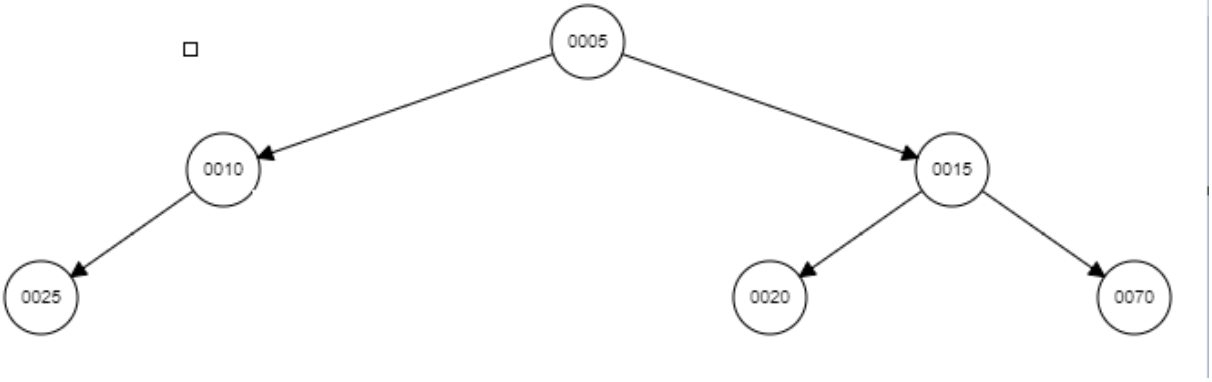
Insert All Numbers



Remove Smallest



Remove Largest



6. **[LO 1, LO 2, 12 points]** A car is almost out of petrol and must go to the nearest petrol station. There are several routes that the car can take, however because of limited petrol, the diver needs to find the shortest way from his current position to the petrol station. The map with distances can be shown as follows:

Answer:

Step 1:

Starting Point	Danube Street	Basito Street	Ende Street	Golden Street	France Street	Indiana Street	Petrol Station.
0	3	4	8	∞	∞	∞	∞

Step 2:

Starting Point	Danube Street	Basito Street	Ende Street	Golden Street	France Street	Indiana Street	Petrol Station.
0	3	4	~~8~~ 7 (3+4)	13 (9+3)	∞	∞	∞

Step 3:

Starting Point	Danube Street	Basito Street	Ende Street	Golden Street	France Street	Indiana Street	Petrol Station.
0	3	4	7	10	9	∞	∞

Step 4

Starting Point	Danube Street	Basito Street	Ende Street	Golden Street	France Street	Indiana Street	Petrol Station.
0	3	4	7	10	9	∞	17

Step 5:

Starting Point	Danube Street	Basito Street	Ende Street	Golden Street	France Street	Indiana Street	Petrol Station.
0	3	4	7	10	9	11	15

Shortest Path With Cost of 17 is :

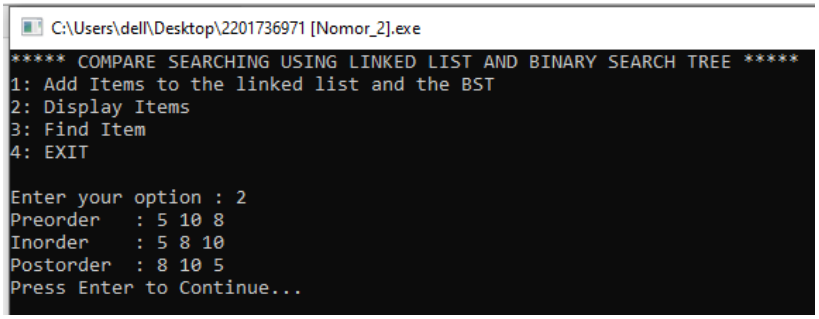
Starting Point → Danube Street → Ende Street → Golden Street → Indiana Street → Patrol Station

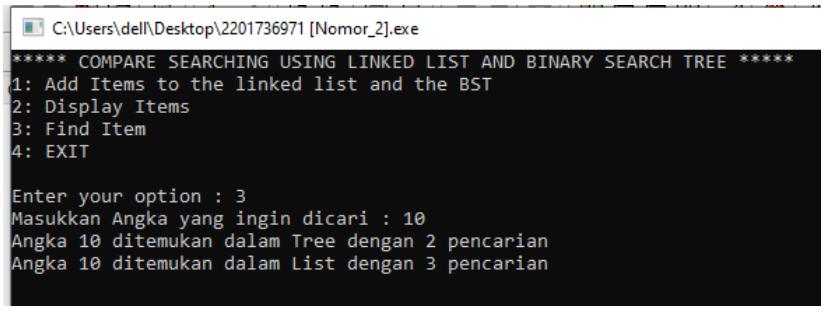
PROGRAMMING CASE

Question:

Please explain based on your result, which of the search (find) is better?

Answer:





OVERALL SEARCH IS BETTER WITH BINARY SEARCH TREE