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Assignment 3

Problem 1:-

Given the set of integers, write a C++ program to create a binary search tree (BST) and print all possible paths for it. You are not allowed to use subarray to print the paths.

Convert the obtained BST into the corresponding AVL tree for the same input. AVL tree

Convert the obtained BST into the corresponding red-black tree for the same input. Red-Black Tree is a self-balancing Binary Search Tree (BST) where every node follows following rules.

1) Every node has a colour either red or black.

2) Root of tree is always black.

3) There are no two adjacent red nodes (A red node cannot have a red parent or red child).

4) Every path from a node (including root) to any of its descendant NULL node has the same number of black nodes.

Write a menu driven program as follows:

1. To insert a node in the BST and in the red-black tree

2. To create AVL tree from the BST

3. To print the in order traversal of the BST/AVL/red-black tree

4. To display all the paths in the BST/AVL tree/red-black tree

5. To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation (print colour for red-black tree)

6. Exit

```
10

20->40->30->25
40->30->25
30->25
25

20->40->50
40->50
50

The paths of AVL tree
30->20->10
20->10
10

30->20->25
20->25
25

30->40->50
40->50
50

press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
5
BST
10[4]
    20[3]
        30[2]
            25
            40[1]
                50
Red-Black tree
20[2][Black]
    10[Black]
    40[1][Red]
        30[1][Black]
            25[Red]
        50[Black]
30[0]
    20[0]
        10
        25
    40[1]
        50
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
6

real    0m53.732s
user    0m0.004s
sys     0m0.005s
Deepanshus-Air:CSN-261 L3 deepanshumatia$
```

```
enter the number to be inserted
25

Node Inserted.
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
2
AVL tree created
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
3
inorder traversal of BST
10 20 25 30 40 50
Inorder traversal of Red-Black tree
10 20 25 30 40 50
Inorder traversal of AVL tree
10 20 25 30 40 50
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
4
The paths of BST
10->20->30->25
20->30->25
30->25
25

10->20->30->40->50
20->30->40->50
30->40->50
40->50
50

The paths of Red Black Tree
20->10
10

20->40->30->25
40->30->25
30->25
25

20->40->50
40->50
50

The paths of AVL tree
30->20->10
20->10
10

30->20->25
```

```
[Deepanshus-Air:CSN-261 L3 deepanshumatia$ time ./tree
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
1
enter the number to be inserted
10

Node Inserted.
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
1
enter the number to be inserted
20

Node Inserted.
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
1
enter the number to be inserted
30

Node Inserted.
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
1
enter the number to be inserted
40

Node Inserted.
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
1
enter the number to be inserted
50

Node Inserted.
press 1 To insert a Node in the BST and in the red-black tree
press 2 To create AVL tree from the inorder traversal of BST
press 3 To print the inorder traversal of the BST/AVL/red-black tree
press 4 To display all the paths in the BST/AVL tree/red-black tree
press 5 To print the BST/AVL tree/red-black Tree in the terminal using level-wise indentation
press 6 to Exit
1
```

Problem 2:-

For a given sequence of positive integers A1, A2, ..., AN in decimal, find the triples (i, j, k), such that $1 \le i < j \le k \le N$ and $Ai \oplus Ai+1 \oplus ... \oplus Aj-1 = Aj \oplus Aj+1 \oplus ... \oplus Ak$, where $\oplus$ denotes bitwise XOR. This problem should be solved using dynamic programming approach and linked list data structures.

Print the number (count) of triples and list all the triplets in lexicographic order (each triplet in a new line)

```
Last login: Wed Aug 21 02:31:45 on ttys000
[Deepanshus-Air:CSN-261 L3 deepanshumatia$ cd L3Q2
[Deepanshus-Air:L3Q2 deepanshumatia$ gcc -o l3q2 l3q2.c
[Deepanshus-Air:L3Q2 deepanshumatia$ time ./l3q2
Enter the numbers of integers!3
Enter the 3 integers in order!5 2 7
This is the given list of numbers
5 2 7
These are the triplets ( i,j,k ) which follows the given condition!
( 1, 2, 3 )
( 1, 3, 3 )

real    0m6.850s
user    0m0.002s
sys     0m0.004s
Deepanshus-Air:L3Q2 deepanshumatia$
```