

CSN - 261: DATA STRUCTURES LABORATORY

Lab Assignment 3

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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 is a selfbalancing binary search tree. In an AVL tree, the heights of the two child subtrees of any node differ by at most one; if at any time they differ by more than one, rebalancing is done to restore this property. 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 color 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 inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit

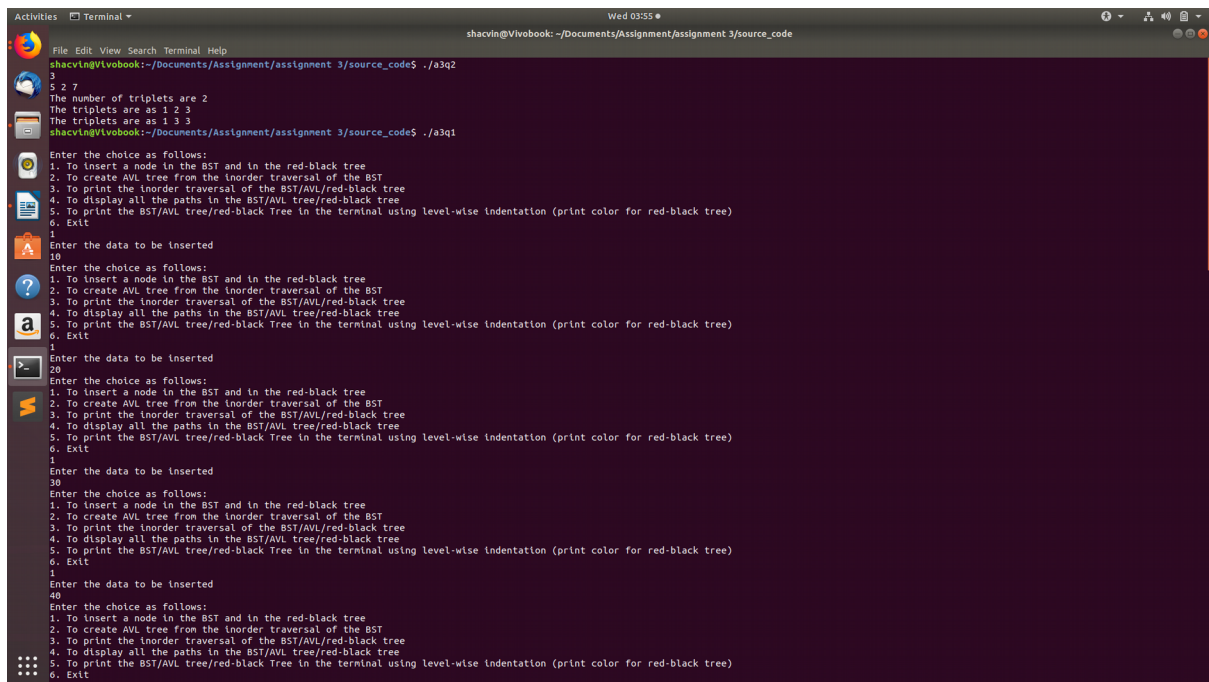
The Main Data Structures used include: -

- Array
- Vector
- Trees

- Struct

The Algorithms used include: -

- Recursion
- Rotation
- Inorder Traversal



```
shacvin@Vivobook: ~/Documents/Assignment/assignment 3/source_code$ ./a3q2
3
5 2 7
The number of triplets are 2
The triplets are as 1 2 3
The triplets are as 1 3 3
shacvin@Vivobook:~/Documents/Assignment/assignment 3/source_code$ ./a3q1

Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
1
Enter the data to be Inserted
10
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
4
Enter the data to be Inserted
20
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
5
Enter the data to be Inserted
40
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
6
```

```
Activities Terminal Wed 03:55
shacvin@Vivobook: ~/Documents/Assignment/assignment 3/source_code

2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
1
Enter the data to be inserted
25
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
2
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
3
10 20 25 30 40 50
10 20 25 30 40 50
10 20 25 30 40 50
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
4
10 -> 20 -> 30 -> 25
10 -> 20 -> 30 -> 40 -> 50
20 -> 30 -> 25
20 -> 30 -> 40 -> 50
30 -> 25
30 -> 40 -> 50
25
40 -> 50
50
25 -> 10 -> 20
25 -> 40 -> 30
25 -> 40 -> 50
10 -> 20
20
40 -> 30
40 -> 50
30
50
```

```
Activities Terminal Wed 03:55
shacvin@Vivobook: ~/Documents/Assignment/assignment 3/source_code

25 -> 40 -> 50
10 -> 20
20
40 -> 30
40 -> 50
30
50
20 -> 10
20 -> 40 -> 30 -> 25
20 -> 40 -> 50
10
40 -> 30 -> 25
40 -> 50
30 -> 25
25
50
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
5
10 [-4]
20 [-3]
30 [-1]
25 [0]
40 [-1]
50 [0]
25 [0]
10 [-1]
20 [0]
40 [0]
30 [0]
50 [0]
20 [-2] [RED]
10 [0] [RED]
40 [1] [BLACK]
30 [1] [RED]
25 [0] [BLACK]
50 [0] [RED]
Enter the choice as follows:
1. To insert a node in the BST and in the red-black tree
2. To create AVL tree from the inorder traversal of the BST
3. To print the inorder 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 color for red-black tree)
6. Exit
6
[]
```

Problem 2:

For a given sequence of positive integers A_1, A_2, \dots, A_N in decimal, find the triples (i, j, k) , such that $1 \leq i < j \leq k \leq N$ and $A_i \oplus A_{i+1} \oplus \dots \oplus A_{j-1} = A_j \oplus A_{j+1} \oplus \dots \oplus A_k$, where \oplus denotes bitwise XOR. This problem should be solved using dynamic programming approach and linked list data structures.

Input:

- (a) Number of positive integers N .
- (b) N space-separated integers A_1, A_2, \dots, A_N .

Output:

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

The Main Data Structures used include: -

- Array
- Linked List

The Algorithms used include: -

- Dynamic Programming
- Bit Manipulation

```
Activities  Terminal  Wed 03:54  shacvin@Vivobook: ~/Documents/Assignment/assignment 3/source_code
File Edit View Search Terminal Help
shacvin@Vivobook:~/Documents/Assignment/assignment 3/source_code$ ./a3q2
3
5 2 7
The number of triplets are 2
The triplets are as 1 2 3
The triplets are as 1 3 3
shacvin@Vivobook:~/Documents/Assignment/assignment 3/source_code$
```