Question - 1

2-3 Tree and Red-Black Tree

SCORE: **5 points**

Which of the following about 2-3 Tree and Red-Black Tree is correct?

○ Only Red-Black Tree is “perfectly balanced”

○ Both 2-3 Tree and Red-Black Tree are “perfectly balanced”

● 2-3 Tree is “perfectly balanced” and Red-Black Tree is “perfectly BLACK balanced”

○ 2-3 Tree is “perfectly balanced” and Red-Black Tree is “perfectly RED balanced”

○ None of the above

Question - 2

Binary Search Tree

SCORE: **5 points**

Suppose the numbers 7, 5, 1, 8, 3, 6, 0, 9, 4, 2 are inserted in that order into an empty binary search tree. The binary search tree uses the natural order for the elements. What is the in-order traversal sequence of the binary search tree?

○ 7 5 1 8 3 6 0 9 4 2

○ 0 2 4 6 8 1 3 5 7 9

● 0 1 2 3 4 5 6 7 8 9

○ 1 3 5 7 9 0 2 4 6 8

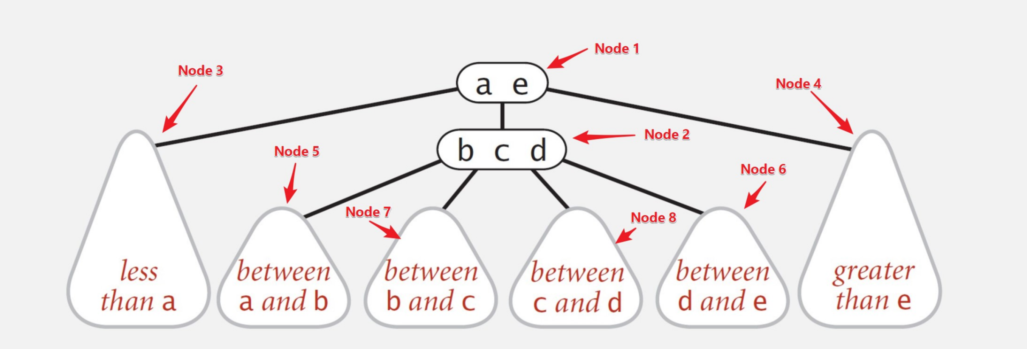
Question - 3

2-3 Tree

SCORE: **5 points**

While splitting a (temporary) 4-node in a 2-3 Tree (Node 2 in the diagram), which nodes will be modified?

Help



○ Node 1

● Node 1 and Node 2

○ Node 1, Node 2, Node 3 and Node 4

○ All of the above 8 Nodes (Node 1 to 8)

Question - 4

Red-Black Tree

SCORE: **5 points**

Which of the following about Red-Black Tree is correct?

○ Every path from root to null link has the same number of RED links

● Every path from root to null link has the same number of BLACK links

○ Every path from root to null link has the same number or (RED + BLACK) links

○ None of the above

Question - 5

Binary Search Tree

SCORE: **30 points**

Please implement the *put* method in a Binary Search Tree (natural order), which inserts the specified key-value pair into the BST.
Hint: 1. Overwrite the old value with the new value if the BST already contains the specified key.
2. Keep track of the size when inserting.
examples:

```
    1. put("X",99)
    X

    2. put("X",99), put("Y",99)
      X
        \
         Y

    3.put("X",99), put("Y",88),put("A",77)
```

```
     X
   /   \
 A       Y
```

4. put("X",99), put("Y",99),put("X",0)

```
X(0)
   \
     Y(99)
```