

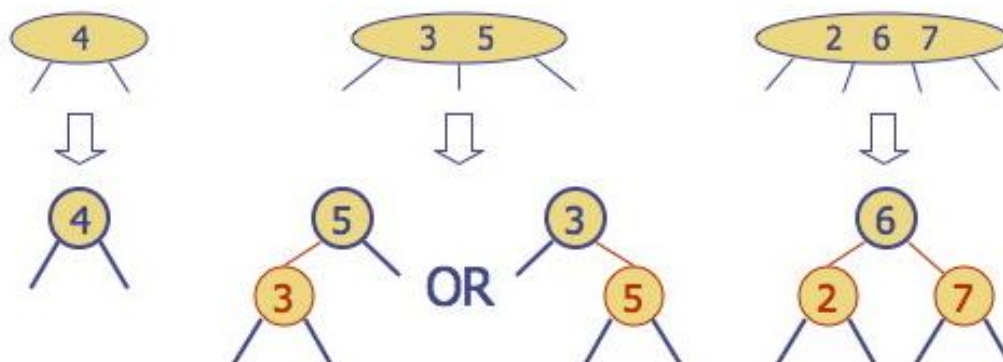
Col-106 Q5. Model Solution

Q5.1 show how 2-4 tree corresponds to red black tree:

The correspondence between 2-4 trees and red-black trees can be proven by demonstrating that there exists a one-to-one mapping between the structures of the two types of trees, and that this mapping preserves the properties of each tree type.

Node Correspondence:

- In a 2-4 tree, a 2-node corresponds to a black node in a red-black tree.
- In a 2-4 tree, a 3-Node in a 2-4 tree corresponds to a black Node in a Red-Black Tree connected to a **Red Node**.
- In a 2-4 tree, a 4-node corresponds to a black node with two connected red nodes in a red-black tree.
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Tree Structure:

- The structure of a red-black tree and a 2-4 tree is also similar, but the transformation involves splitting 4-nodes into separate 2-nodes and 3-nodes.

2nd Part: How one can convert a 2-4 tree to a red black tree and vice-versa.

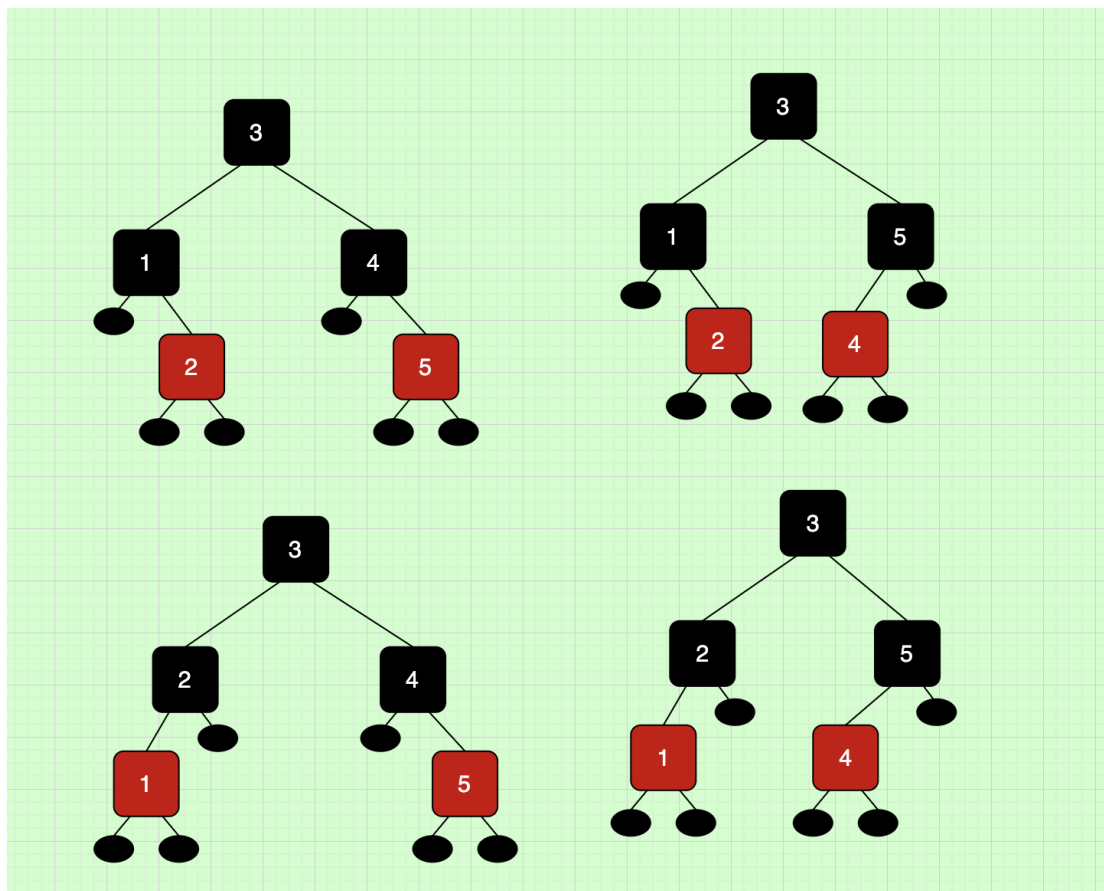
Conversion of 2-4 tree to red black tree

Any 2-4 tree can be converted into a red-black tree

we replace a node of the 2-4 tree with one black node and 0/1/2 red nodes which are children of the black node

The height of the 2-4 tree is the black height of the red black tree created
Every red node has a black child.

Q5.2: Draw four different red black trees that correspond to the same (2,4) tree



Explanation:

Our assignment is to show example in which 4 different red-black trees correspond to same (2,4) tree.

Before showing our example, we will show on which principle we created our example.

2 - node in (2,4) - tree corresponds to unique construct in red-black tree. That is, to black node with key in this node with two black children.

4 - node in (2,4) - tree also corresponds to unique construct in red-black tree. That is, to black node with middle key and two red children, left with lower and right with greater key.

But, unlike these two sorts of nodes, 3 - node in (2,4) - tree can correspond to two possible constructs in red-black tree.

In one is lower of these two keys in 3 - node in black node and greater key is in its right child which is red. In other is greater key in black node and lower key in its left child which is red.

3 - node in (2,4) - tree with keys 1 and 2 corresponds to two possible different constructs in red-black tree and 3- node in (2,4) - tree with keys 4 and 5 corresponds to two possible different constructs in red-black trees.

By combining two corresponding constructs for 3- node with keys 1 and 2 with two corresponding constructs for 3 - node with keys 4 and 5 we get these four possible corresponding red-black trees: