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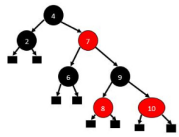
1. Consider the following red-black tree: sentinels (NIL) are shown by black squares. 1 / 1 point



Suppose we insert a new key "1" into this tree, which of the following options are true?

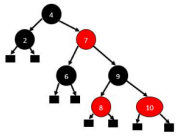
- [ ] The node with key 1 will be inserted as a black node which is a left child of the node 2.
- [x] The node with key 1 will be inserted as a red node which is a left child of the node 2.

Correct
Correct.

- [ ] The insertion of the new node as a black node will not cause any violations.
- [x] The new node if inserted as a red node will cause no further violation of the red-black tree properties.

Correct
Correct

2. Consider again the following red-black tree: sentinels (NIL) are shown by black squares. 1 / 1 point



Suppose we wish to insert the node with key 11. Which of the following facts are true about the subsequent steps in removing the red-red violation that results?

- [x] The inserted node will be a right child of the node 10.

Correct
Correct

- [x] The inserted node when colored red will cause a red-red violation.

Correct
Correct

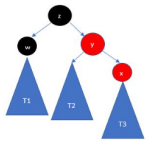
- [x] Since the node 8 is red, the inserted node falls into the case where it has a "red uncle".

Correct
Correct

- [ ] All red-red violations can be fixed by coloring nodes 8, 10 black while coloring the node 9 red.
- [x] The result of eliminating the red-red violation between newly inserted node and its parent causes a red-red violation further up in the tree.

Correct
Correct

3. Consider a left (anti clock wise) rotation of the following tree with a red-red violation at node z. 1 / 1 point



Select all the facts that hold in the resulting tree. It may help to first draw the result on a piece of paper before answering the questions below.

- [x] The node y is now the root of the tree with z being its left child.

Correct
Correct

- [ ] The node y is now the root of the tree with z being its right child.
- [x] The node w and subtree T1 remains to the left of z.

Correct
Correct

- [x] The node x and T3 remain to the right of y.

Correct
Correct

- [x] Subtree T2 becomes the right subtree of z.

Correct
Correct

- [ ] The binary search tree property i.e, the relative ordering between keys of a node and those of its left and right subtrees are broken by tree rotations.