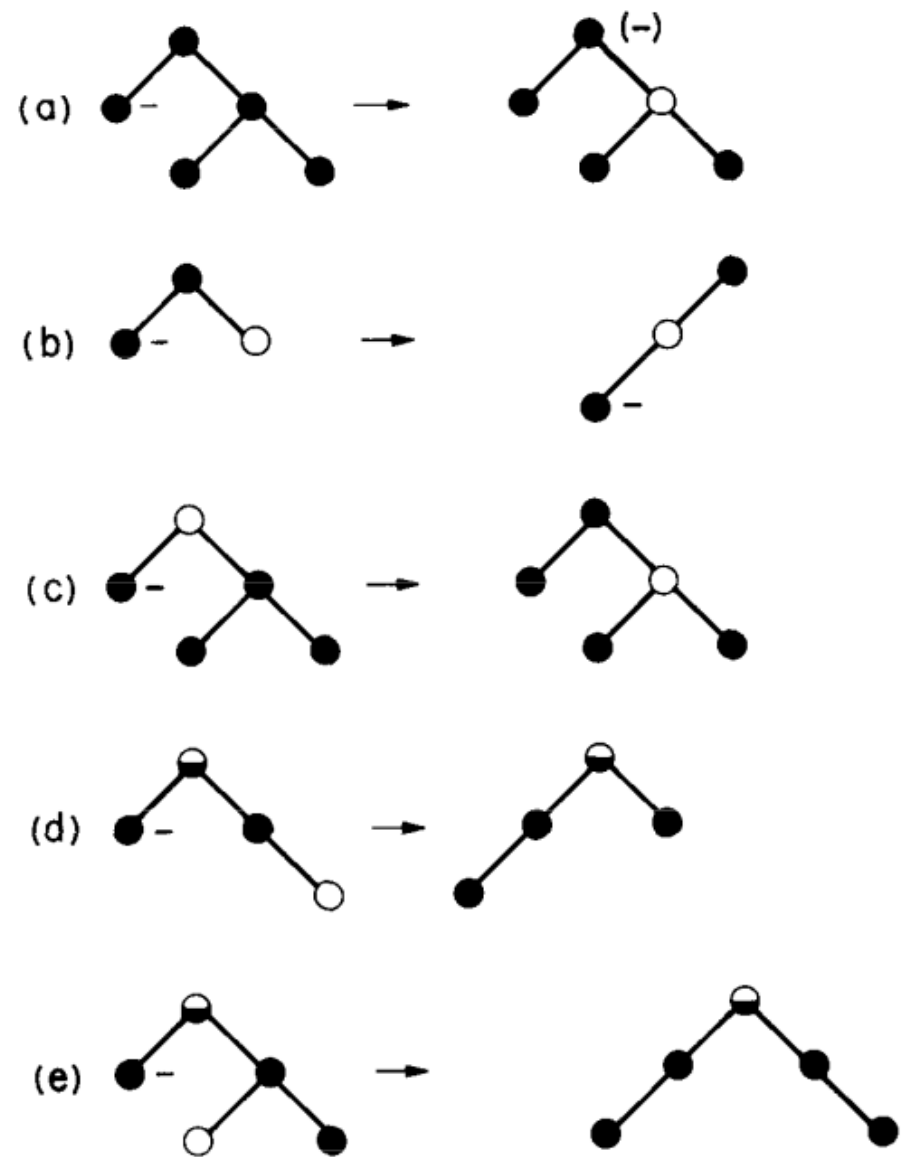FIGURE 4. The Rebalancing Transformations in Red-Black Tree Insertion. Symmetric cases are omitted. Solid nodes are black; hollow nodes are red. All unshown children of red nodes are black. In cases (c) and (d) the bottommost black node can be missing.

FIGURE 5. The Rebalancing Transformation in Red-Black Tree Deletion. The two ambiguous (half-solid) nodes in (d) have the same color, as do the two in (e). Minus signs denote short nodes. In (a), the top node after the transformation is short unless it is the root.