

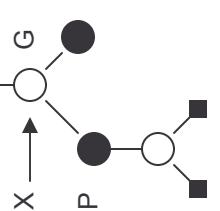
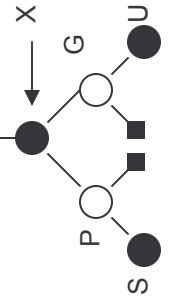
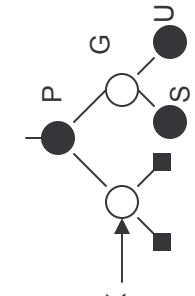
Red-Black Tree Rotations

Red-Black Diagrams

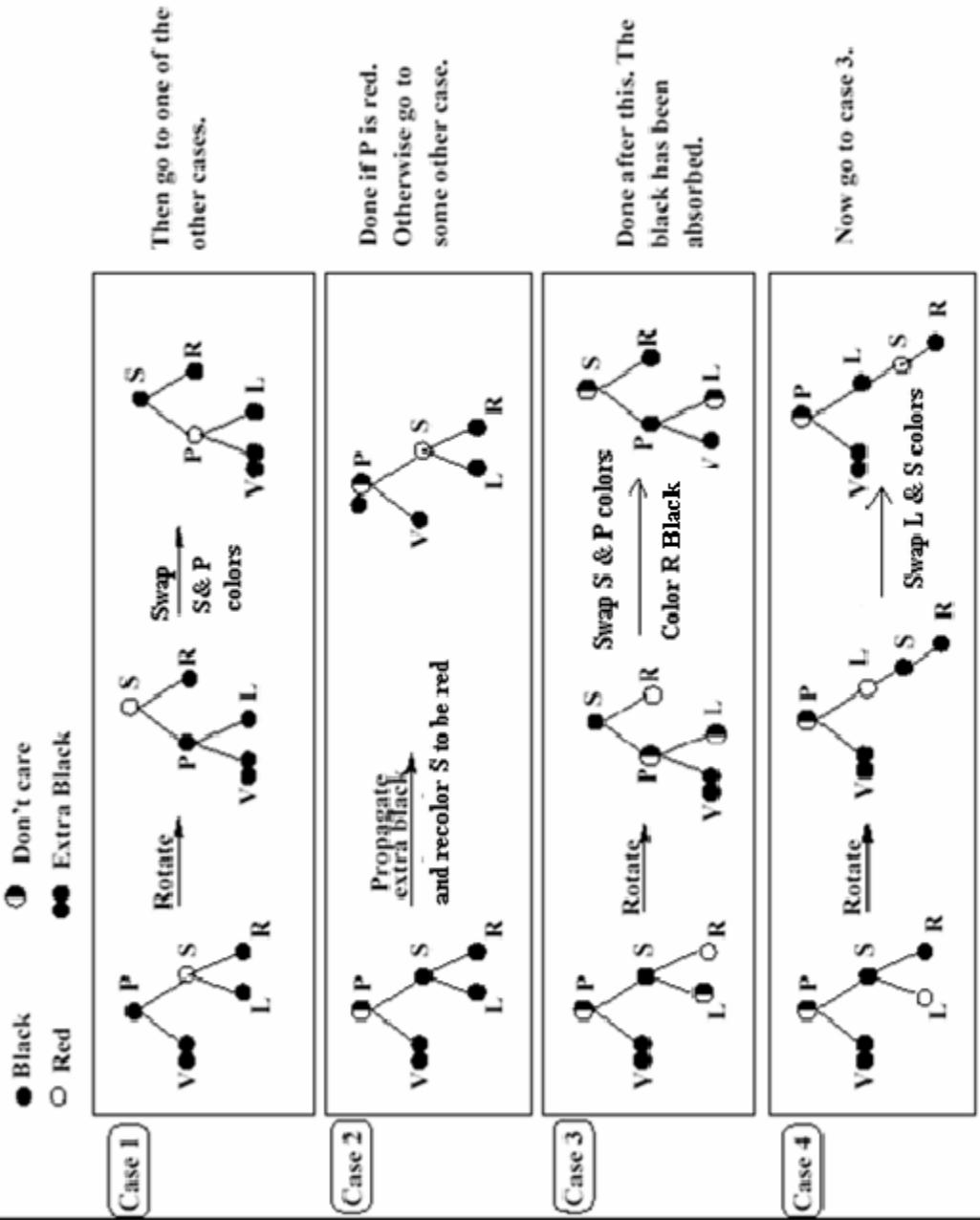
The diagrams which follow show the rotations and recoloring for each “case” for Bottom-Up Insertion, Top-Down Insertion and Bottom-Up Deletion.

Bear in mind that each case has a left-right symmetrical twin which is not shown here.

Bottom-Up Insertion

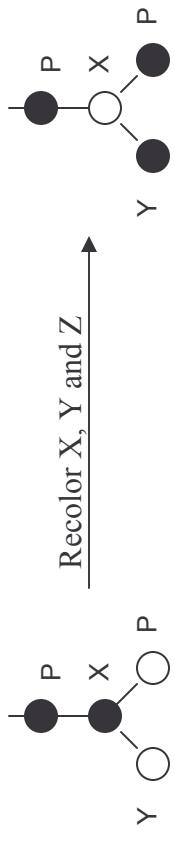
Case 0 - X is the root  Color it Black →	 Case 1 – U is Red X → Recolor P, G, U Move X up to G Move to another case →	 Case 2 - Uncle is black. X and P are opposite children S → X → Zig-Zag Rotation Recolor X and G →	 Case 3 – Uncle is Black X and P are both left (right) children X → Rotate P around G Recolor P and G →
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Bottom-Up Deletion



Top Down Insertion

Case 1 – P is Black



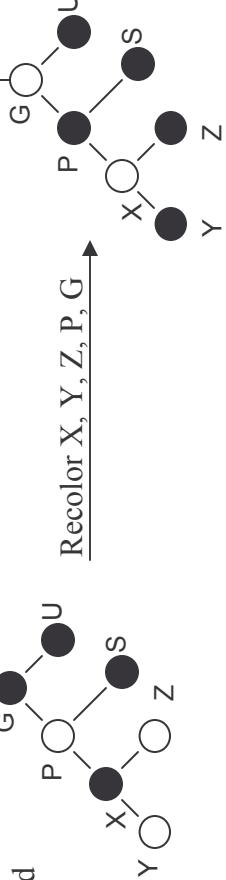
Recolor X, Y and Z



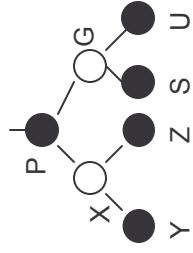
**Case 2 – P is red
and P and X are
both left (right)
children**



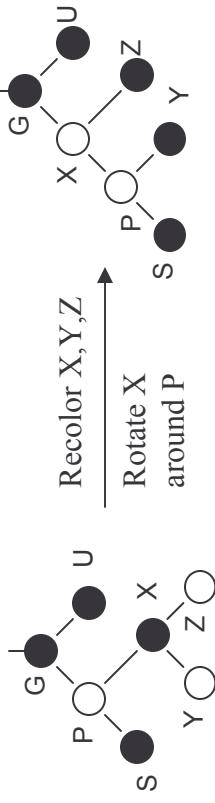
Recolor X, Y, Z, P, G



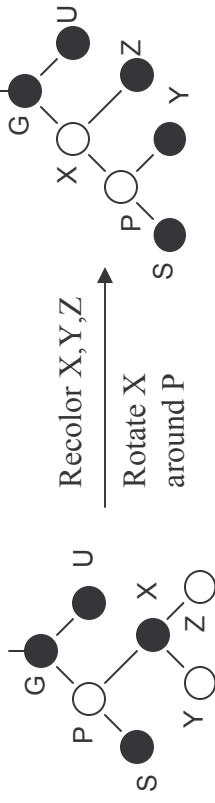
Rotate P around G



**Case 3 – P is red and
P and X are opposite
children**



Recolor X, Y, Z
Rotate X
around P



Recolor X, G
Rotate X
around G

