

# RB-DELETE-FIXUP( $T, x$ )

**while**  $x \neq T.root$  and  $x.color == \text{BLACK}$

**if**  $x == x.p.left$

$w = x.p.right$

**if**  $w.color == \text{RED}$

$w.color = \text{BLACK}$

// case 1

$x.p.color = \text{RED}$

// case 1

            LEFT-ROTATE( $T, x.p$ )

// case 1

$w = x.p.right$

// case 1

**if**  $w.left.color == \text{BLACK}$  and  $w.right.color == \text{BLACK}$

$w.color = \text{RED}$

// case 2

$x = x.p$

// case 2

**else if**  $w.right.color == \text{BLACK}$

$w.left.color = \text{BLACK}$

// case 3

$w.color = \text{RED}$

// case 3

            RIGHT-ROTATE( $T, w$ )

// case 3

$w = x.p.right$

// case 3

$w.color = x.p.color$

// case 4

$x.p.color = \text{BLACK}$

// case 4

$w.right.color = \text{BLACK}$

// case 4

            LEFT-ROTATE( $T, x.p$ )

// case 4

$x = T.root$

// case 4

**else** (same as **then** clause with “right” and “left” exchanged)

$x.color = \text{BLACK}$