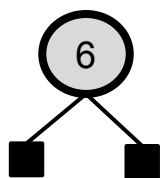


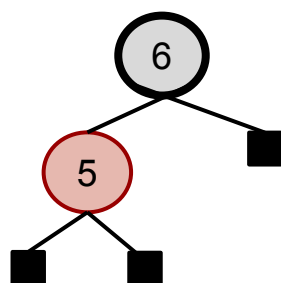
Solutions: Class 10/09, Balanced Trees

Copyright (c) 2020 Dan Suthers. All rights reserved. These solution notes may only be used by students, instructors and TAs in ICS 311 Fall 2020 at the University of Hawaii.



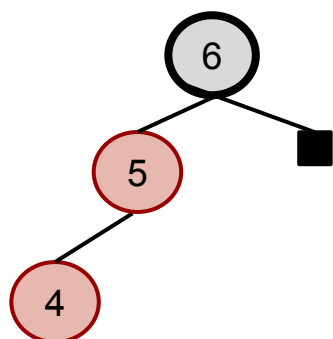
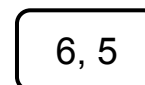
Insert 6:

- ← (a) RBT after insert
- (b) **no** property is violated
- (c) **no** remedy needed
- (d) RBT after fixup is the same.
- (e) (2,4): →



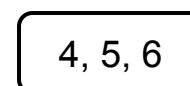
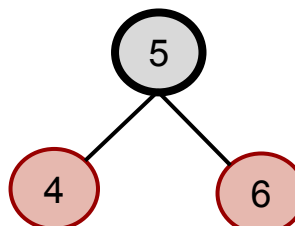
Insert 5:

- ← (a) RBT after insert
- (b) **no** property is violated
- (c) **no** remedy needed
- (d) RBT after fixup is the same.
- (e) (2,4): →

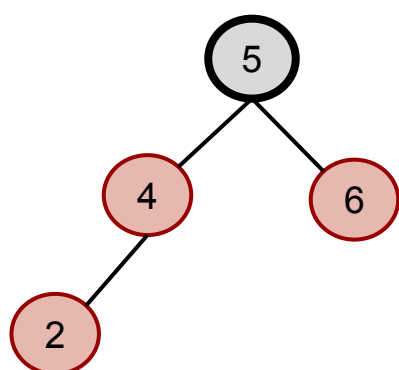


Insert 4:

- ← (a) RBT after insert
- (b) **double red** = **incorrect representation**
- (c) **black uncle** (sibling of red parent): **restructure**
- (d,e) RBT and (2,4): →



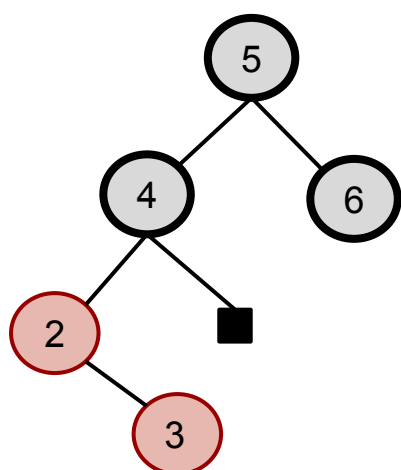
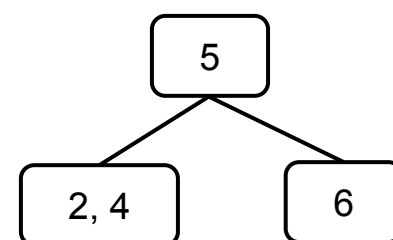
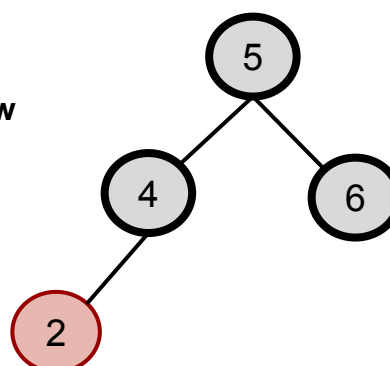
(You may leave out the black leaf nodes in the remainder. Show them only when they are the “uncle”)



Insert 2:

- ← (a) RBT after insert
- (b) **double red** = **overflow**
- (c) **red uncle**: **recolor**
- (d,e) RBT and (2,4): →

Note: 5 stays black because it is the root!



Insert 3:

- ← (a) RBT after insert
- (b) **double red** = **incorrect representation**
- (c) **black uncle**: **restructure**
- (d,e) RBT and (2,4): →

