

Exam Conflicts: Check your course and exam schedule for Midterm and Final and report any conflicts via the [Exam Conflicts Form](#).

WACM Explains... Linux - Intermediate: Monday 4/11 5:30-7:00pm in CS1240

Week 4

ASSIGNMENTS

x2 available soon

p2 available soon

h3 available soon and due before 10pm on Monday 2/18

Peer Mentors: will help students practice Git and GitHub commands

Module: Week 4 (start on week 5 before next week)

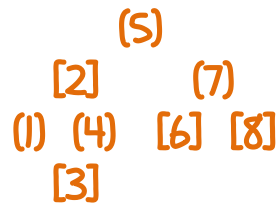
THIS WEEK

- AVL Summary (from Week 3 outline)
- **Red-Black Tree**
 - insert
 - lookup
 - delete
- **Git and GitHub (x2)**
 - version control
 - centralized and decentralized

NEXT WEEK

- **B-Tree**
 - 2-3 Tree
 - 2-3-4 Tree
 - B+ Tree
- **x2 due next week**

Red-Black Trees (RBT)

*RBT:***A BST that stays balanced***Example:***Black node () circle****Red Node [] square****(draw a red black tree)***Red-Black Tree Properties*

root property

red property

black property

Red-Black Tree Operations

print

lookup

insert

delete

Inserting into a Red-Black Tree

Goal:

If T is Empty

If T is Non-Empty

Which of the properties might be violated as a result of inserting a red leaf node?

root property

black property

red property

Non-Empty Case 1: K's parent P is black

Non-Empty Case 2: K's parent P is red

Fixing an RBT

Tri-Node Restructuring if _____

Recoloring is done if _____

RBT Insert Practice I

1. Start with an empty RBT, show the RBT that results from inserting 7 and 14.
2. Redraw the tree from above and then show the result from inserting 18.
3. Redraw the tree from above and then show the result from inserting 23.
4. Redraw the tree from above and then show the result from inserting 1 and 11.
5. Redraw the tree from above and then show the result from inserting 20.

RBT Insert Practice II

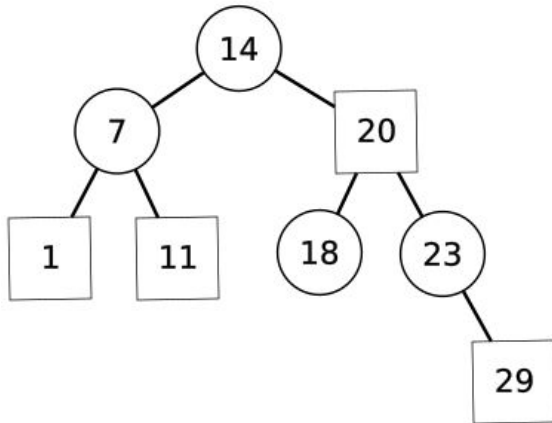
6. Redraw the tree from the previous page and then show the result from inserting 29.

7. Insert the same list of values into an empty BST: 7, 14, 18, 23, 1, 11, 20, 29

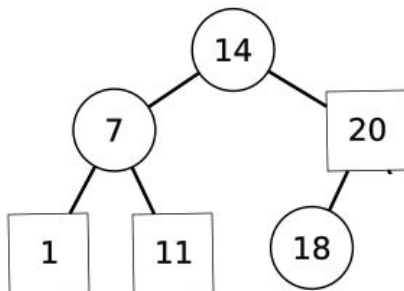
What does this demonstrate about the differences between a BST and RBT?

RBT Practice III

8. Show the result from inserting 25 in the RBT below.



9. Redraw the tree from above and then show the result from inserting 27.



Cascading Fixes

Fixing an RBT UPDATED!

Recoloring is done if P's sibling S is red

Tri-Node Restructuring is done if P's sibling S null _____

Return to previous page and cascade the fixes.

RBT Complexity

print

lookup

insert

delete

RBT Delete Practice

Delete as from BST and then fix RBT properties

Visualize inserts and deletes at:

<https://www.cs.usfca.edu/~galles/visualization/RedBlack.html>

Insert 9, 8, 5, 4, 3, 2, 6, 1, 7

Practice deleting

- leaf nodes
- red interior
- black interior

Git and GitHub

git commands

- clone
- status
- log
- init
- config
- add
- commit
- push
- pull

GitHub

1. Create account with wisc.edu
2. Install Student Pack (unlimited free private repositories)
3. Create a repository
4. clone it to your CS account
5. config
6. add/edit a file
7. add
8. commit
9. push to GitHub repository
10. add a collaborator (for working in teams)