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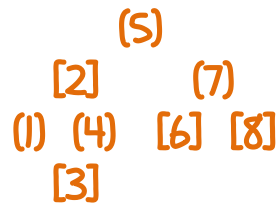
Module: Week 4 (start on week 5 before next week)

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)

```
               (5)
          [2]        (7)
        (1)  (4)   [6]  [8]
             [3]
```

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.
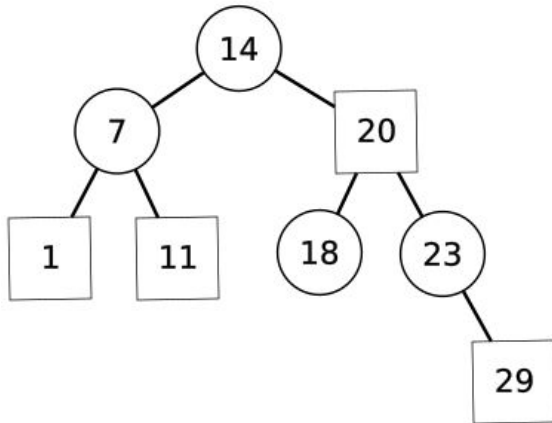
RBT Insert Practice II

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

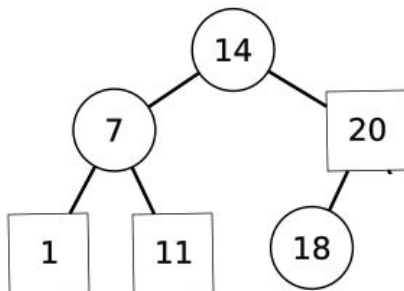7. Insert the same list of values into an empty BST: 7, 14, 18, 23, 1, 11, 20, 29

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,

Practice deleting
```
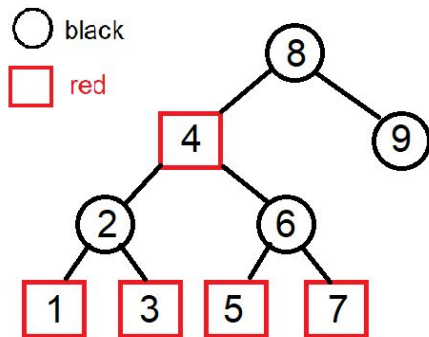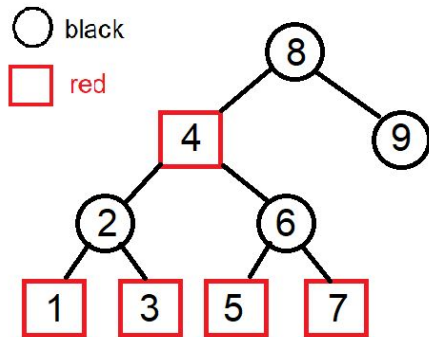- red leaf nodes
- red interior
- can red nodes have a single child?   (I don't think so)
- black interior
- black with one child
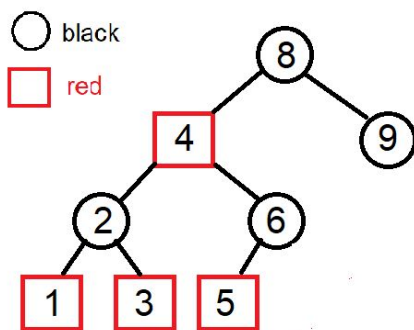- black leaf nodes

Delete Practice SOLUTION PAGE
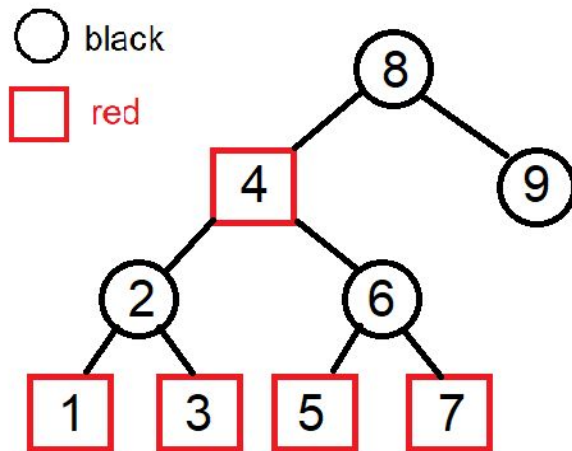
Delete 1, 3, 5, or 7

Delete 2, 4, 6, or 8

Delete 6

RBT Delete II

Delete 9

Version Control

In the beginning...

Version Control systems

https://bitbucket.org/product/version-control-software

Distributed vs Centralized

Git and GitHub

git commands

- clone - get a copy of all files and all commits (changes) to those files

- status

- log

- init

- config

- add

- commit

- push

- pull

GitHub (in-class exercise)

1. create a GitHub.com account with wisc.edu (remember your GitHub user name)

2. install Student Pack (unlimited free private repositories)

3. create a private repository

4. Remote connect to your CS account (has git installed already)

5. clone your repository to your your CS account

6. CREATE SOME NEW CONTENT

7. add

8. commit

9. push your changes to your GitHub.com repository

10. add a classmate as a collaborator to your repo