FLIPPED LECTURE 3

- *Symbol tables*
- *BSTs*
- *Red-Black BSTs*

Algorithms
FOURTH EDITION

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BST Deletion

Strategy from class

- Find the successor of deleted node. Move it into the deleted node's place.

Heap-like deletion strategies

- Strategy 1: Take the largest node from the entire BST. Move it into the deleted node's place. Sink until it can sink no further.
- Strategy 2: Take the largest node from the right subtree of the deleted note. Move it into the deleted node's place. Sink until it can sink no further.

In groups

- For each of these two strategies:
  - Does it work? If not, give a counterexample.
  - If it does work, how does it generally compare to the efficiency of the strategy from class?

Discussion problems:

- T/F: The median is always in the root node of a 2-3 tree.
- T/F: The height of an LLRB always stays the same or increases when a new node is inserted.
- Given an N node 2-3 tree with best case height, what is the height of the corresponding LLRB tree?

Tougher problem

- Describe a sequence of inputs that results in a LLRB where most of the leaf nodes have depth 2 log2 N.
  - You don't have to describe the sequence exactly!

Match up each *worst-case* quantity on the left with the best matching order-of-growth term on the right. You may use a letter more than once.

___ Height of a binary heap with N keys

___ Height of a BST with N keys

___ Number of comparisons to quicksort N equal keys using our standard version of quicksort

___ Number of comparisons to quicksort N equal keys using 3-way quicksort

___ Time to iterate over the keys in a BST using inorder traversal

___ Number of equality tests to insert N keys into an empty linear probing hash table of size $2N$.

A. 1

B. $\log N$

C. N

D. $N \log N$

E. N^2

F. 2^N

Design problem

- Using resizing arrays, we showed how to build a randomized queue with amortized linear time operations.
- How could we build a randomized queue with guaranteed logarithmic time?

Worst case insertion

N = 254
max = 14
avg = 7.5
opt = 7.0
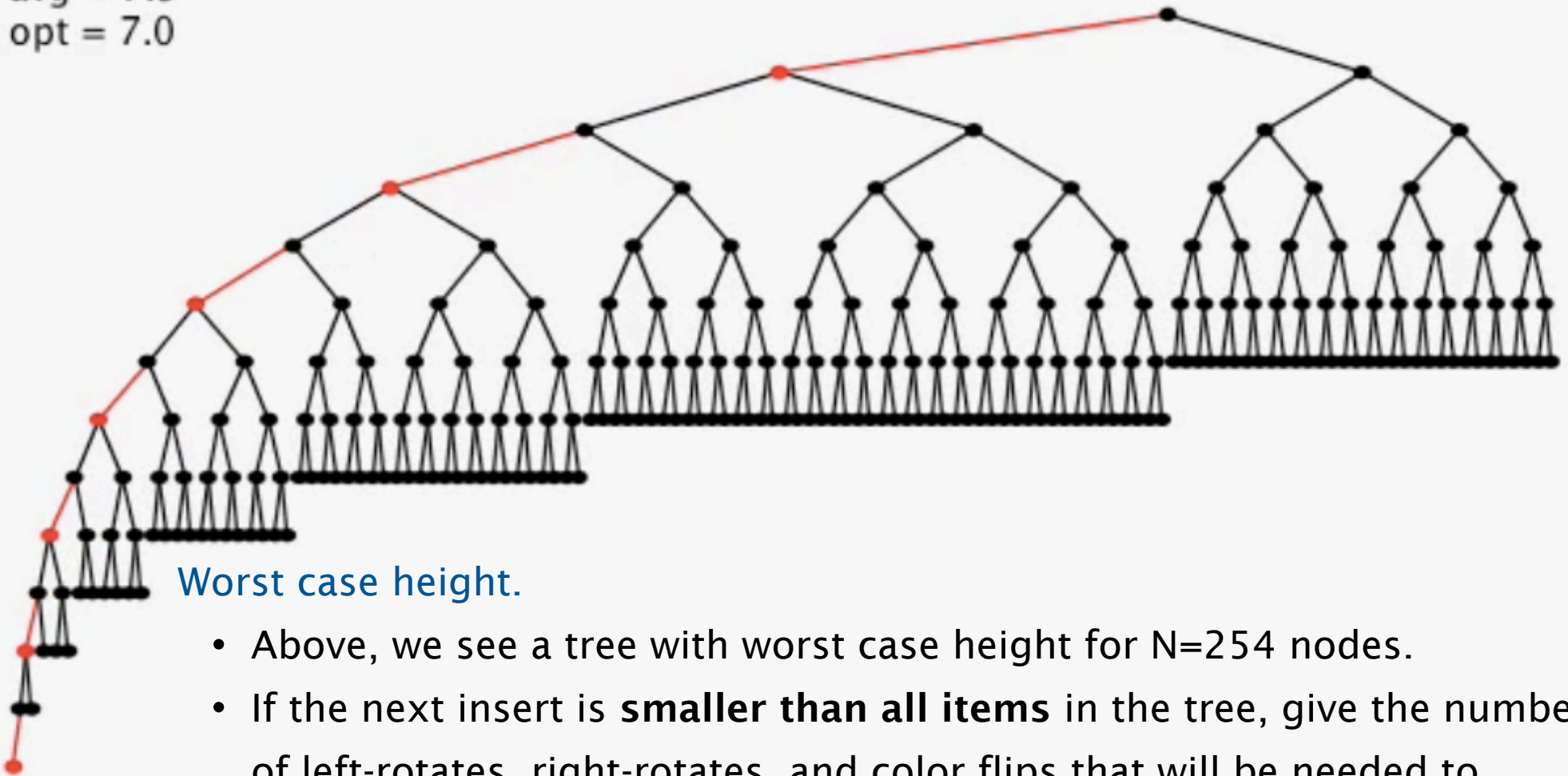
Worst case height.

- Above, we see a tree with worst case height for N=254 nodes.
- If the next insert is **smaller than all items** in the tree, give the number of left-rotates, right-rotates, and color flips that will be needed to complete the insertion.

Design Problem

- **Erweiterten Netzwerk** is a new German minimalist social networking site that provides only two operations for its logged-in users.

    - [📋 Neu] : Enter another user's username and click the **Neu** button. This marks the two users as friends.

    - [Erweiterten Netzwerk] : Type in another user's username and determine whether the two users are in the same extended network (i.e. there exists some chain of friends between the two users).

pollEv.com/jhug   text to **37607**

Identify at least one ADT that **Erweiterten Netzwerk** should use:

A. Queue   [879345]   D. Priority Queue   [879348]

B. Union-find   [879346]   E. Symbol Table   [879349]

C. Stack   [879347]   F. Randomized Queue   [879350]

Note: There may be more than one 'good' answer.