LECTURE 17 BINARY SEARCH TREES

MCS 275 Spring 2023 Emily Dumas

LECTURE 17: BINARY SEARCH TREES

Reminders and announcements:

- Project 2 due at 6pm on Friday
- Project 1 solutions posted

SAMPLE CODE

Tree-related examples will go in the new directory datastructures in the course sample code repository.

GOALS

- Learn about **search** and **insert** operations on binary search trees.
- Implement in Python.
- Explore application to a fast data structure for storing a set of integers.

BINARY SEARCH TREE (BST)

A binary tree in which:

- Nodes have keys that can be compared
- The key of a node is greater than or equal to any key in its left subtree.
- The key of a node is less than or equal to any key in its right subtree.

BINARY TREE































NOT A BST



This "just" is a binary tree with keys.

NOT A BST



This "just" is a binary tree with keys.

NOT A BST



This "just" is a binary tree with keys.



















CODING

Let's build a class to represent nodes of a binary tree that also store keys.

TREEVIS

I provide a module treevis in the sample code
repository that can "pretty print" a tree with the
function treeprint(root_node).

Challenge: Read the source of treevis and figure out how it works!

FROM TREE TO BST

Now let's build a subclass of Node to represent a BST.

Desired features:

- Insert nodes (maintaining BST property)
- Search for nodes by key











INTEGERSET

Let's use this to build a class to store a collection of integers that supports fast insertion and membership testing.

IMPLEMENTATION HIDING

IntegerSet has many possible implementations (e.g. a list, a tree, ...), and a user of the class doesn't need to know about which one it uses.

REFERENCES

- In optional course texts:
 - Problem Solving with Algorithms and Data Structures using Python by Miller and Ranum, discusses binary trees in Chapter 7.
- Elsewhere:
 - Cormen, Leiserson, Rivest, and Stein discusses graph theory and trees in Appendices B.4 and B.5, and binary search trees in Chapter 12.

REVISION HISTORY

- 2022-02-24 Last year's lecture on this topic finalized
- 2023-02-20 Updated for 2023