CSCI 136:
Data Structures
and
Advanced Programming

Lecture 22-1

Trees, part 2

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Williams

Outline

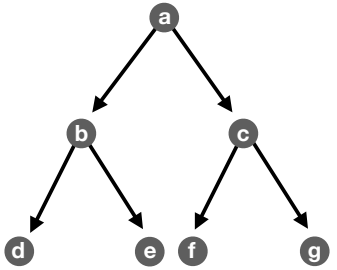
Tree traversals

Computing tree height

Binary tree traversals

Binary tree traversals

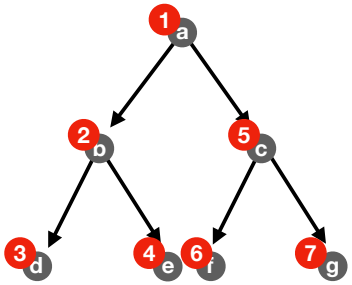
Suppose you are asked to write an `Iterator<T>` for a binary tree. What order do you choose?



Remember that tree nodes store data (`T`). A **traversal** corresponds with the order that data is returned.

Binary tree traversals

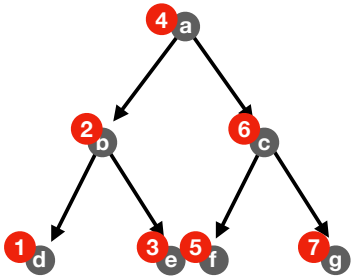
Pre-order traversal: Return data from each node **before its children**, and then return child data from **left to right**.



Returns the sequence: **a, b, d, e, c, f, g**

Binary tree traversals

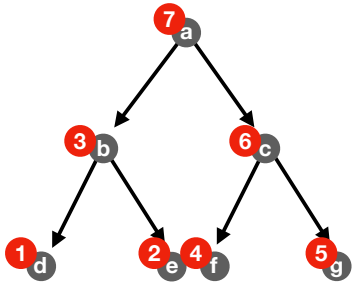
In-order traversal: Return data from each node **after its left child** and **before its right child**.



Returns the sequence: **d, b, e, a, f, c, g**

Binary tree traversals

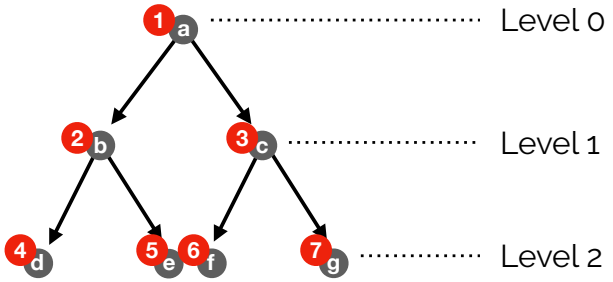
Post-order traversal: Return data from each node **after its children**; return child data from **left to right**.



Returns the sequence: **d, e, b, f, g, c, a**

Binary tree traversals

Level-order traversal (aka **breadth-first order**): Return data from each node in **level *i*** before data in **level *i+1***.

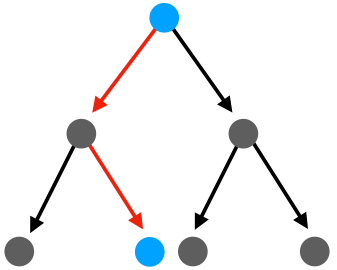


Returns the sequence: **a, b, c, d, e, f, g**

Binary Tree Height

Binary Tree Height

The **height** of **a tree** is the length of the longest path between **the root** and **any leaf**.



Height of **tree** = **2**

Binary Tree Height

Let's think about some corner cases.

What is the height of a tree with just one node?

The **height** of **a tree** is the length of the longest path between **the root** and **any leaf**.

Height of **tree** = **0**

Binary Tree Height

Let's think about some corner cases.

What about the empty tree?

The **height** of **a tree** is the length of the longest path between **the root** and **any leaf**.

Height of **tree** = **-1**

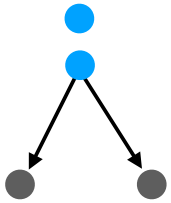
Binary Tree Height

Here's a more formal definition.

The **height** of a tree is defined as:

- **-1** if the tree is empty, or
- **height(left)** or **height(right)**, whichever is bigger, **+ 1**

empty tree: -1



just a root: 0

any other tree: longest path

Binary Tree Height

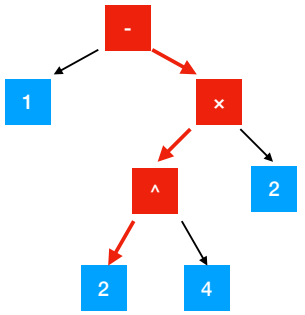
How might we implement `getHeight()`?

Binary Tree Height

Let's implement this together.

Height

$1 - 2^4 \times 2$



Height of **tree** = **3**

Recap & Next Class

This lecture:

- Tree traversals
- Computing tree height

Next lecture:

- Binary Search Trees