Topics

Tree terminology

Your to-dos

1. Read **before Wed**: Bailey, Ch 14.4.
2. Lab 7 (solo lab), **due Tuesday 4/19 by 10pm**.

Announcements

**CSCI 136 final exam**
Sunday, May 22 at 9:30am
Thompson Physics Lab 205
A tree is a recursive data structure that stores information hierarchically. A tree is either:

- empty (i.e., $\emptyset$), or
- a node containing a value and references to one or more trees.

The empty tree:

A non-empty binary tree:

The topmost node is called the root.

Connected: every node in a tree is reachable by following a single unique path starting from the root node.
Properties of trees

# edges: a tree having $n$ vertices always has $n-1$ edges.

Terminology

The nodes at the bottom of a tree are called leaves.

Terminology

Any node that is not a leaf is an interior node.

Terminology

A node may have children.
A node may have children.

A node that has children is called the parent of those children.

For a given node, all of the nodes above it are called ancestors.
Properties of trees

**Single ancestor:** every node in a tree has at most one ancestor.

Subtrees: the descendants of every tree (except the empty tree) are also trees.

Terminology

For a **given node**, all of the nodes below it are called **descendants**.

The **degree** of a tree is the maximum number of **children** had by any node.

Degree of this tree: 2
Degree 2 trees are common: we call them **binary trees**.
Terminology

A tree that is missing no leaves is **full**.

**Properties of trees**

*Cycle-free*: no path will ever revisit the same node.

**Terminology**

A **path** is a sequence of edges between **two nodes**.

The **length** of a path is the **number of edges** in the path.

Length $= 2$
Terminology

The **height** of node **n** is the length of the longest path between **n** and any leaf.

![Diagram of a tree with node height](image)

Height of **n** = 1

Terminology

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

![Diagram of a tree with tree height](image)

Height of tree = 2

Terminology

The **depth** of node **n** is the length of the longest path between the root and **n**.

![Diagram of a tree with node depth](image)

Depth of **n** = 1

Terminology

The **level** of any node is its depth.

![Diagram of a tree with node level](image)

Level 0

Level 1

Level 2
Terminology

The depth of $n$ + the height of $n$ ≤ the height of the tree.

(depth of $n$: 1) + (height of $n$: 0) ≤ (height of tree: 2)

Terminology

A complete tree of height $h$ is a full tree with zero or more rightmost leaves of level $h$ removed.

Properties of trees

Directed or undirected: trees can be either directed, meaning that traversals can only happen in one direction, or undirected, meaning that traversals can happen in any direction.

Is a list a tree?

Yes, a list is a tree whose nodes have degree 1.

We call such trees degenerate.
Recap & Next Class

**Today:**

- Tree terminology

**Next class:**

- Binary tree implementation
- Tree height