

1 Trees, Graphs, and Traversals

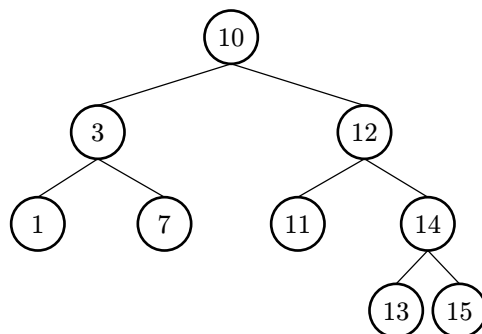
- (a) Write the following traversals of the BST below.

Pre-order:

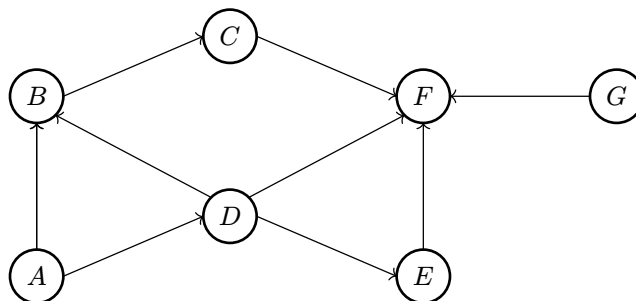
In-order:

Post-order:

Level-order (BFS):



- (b) Write the graph below as an adjacency matrix, then as an adjacency list. What would be different if the graph were undirected instead?



- (c) Write the order in which (1) DFS pre-order, (2) DFS post-order, and (3) BFS would visit nodes in the same directed graph above, starting from vertex A. Break ties alphabetically.

Pre-order:

Post-order:

BFS:

2 Graph Conceptuals

(a) Answer the following questions as either **True** or **False** and provide a brief explanation:

1. If a graph with n vertices has $n - 1$ edges, it **must** be a tree.
2. Every edge is looked at exactly twice in each full run of DFS on a connected, undirected graph.
3. In BFS, let $d(v)$ be the minimum number of edges between a vertex v and the start vertex. For any two vertices u, v in the fringe (recall that the fringe in BFS is a queue), $|d(u) - d(v)|$ is **always less than 2**.

(b) Given an undirected graph, provide an algorithm that returns true if a cycle exists in the graph, and false otherwise. Also, provide a Θ bound for the worst case runtime of your algorithm.

3 Sticky Flights

Your airline company has been contracted to fly a large shipment of honey from Honeysville to the 61Bees in Goldenhive City. However, the airplane doesn't have enough fuel capacity to fly directly to Goldenhive City so it will stop at at least one of n airports along the way to refuel. Refueling takes an hour, and if the airport is one of $k < n$ airports, your airplane will be grounded for six hours due to curfews (refueling is included in the six hours). The 61Bees want their honey as soon as possible so please design an algorithm to find the route that will allow your airplane to reach Goldenhive City in the least amount of hours.

Hint: Think of the n airports as a graph, where the paths between them are edges of weight equivalent to the number of hours it takes to fly from airport A to airport B . You may assume that the amount of time it takes to fly from A to B is equal to the amount of time it takes to fly from B to A .