

1 Graph Representation

Represent the graph above with an adjacency list and an adjacency matrix representation.

2 Searches and Traversals

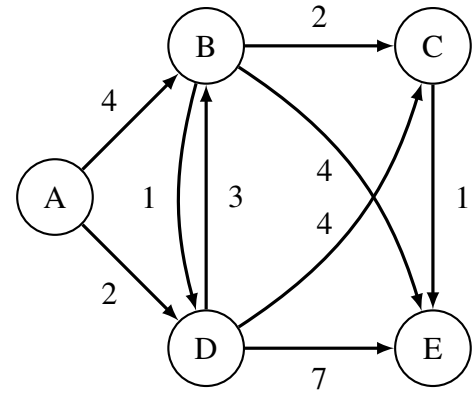
Run depth first search (DFS) preorder and breadth first search (BFS) on the graph above, starting from node A. List the order in which each node is first visited. Whenever there is a choice of which node to visit next, visit nodes in alphabetical order.

3 Topological Sorting

Give a valid topological ordering of the graph. Is it unique?

4 Dijkstra's Algorithm

- (a) Given the following graph, run Dijkstra's algorithm starting at node A . For each iteration, write down the entire state of the algorithm. This includes the value $\text{dist}(v)$ for all vertices v . Keep track of the vertices traversed along the shortest paths from A to every other node in the graph. You will need to maintain an `edgeTo` array.



- (b) What must be true about our graph in order to guarantee Dijkstra's will return the shortest path's tree to every vertex? Draw an example of a graph that demonstrates why Dijkstra's might fail if we do not satisfy this condition.