Data Structures, Graphs, BFS, DFS: Exercise Handout

Data Structures and Algorithms (X_400614)

1. Would you use the stack or the queue data structure to implement the "Undo" feature in some word processor? What about for storing the mouse click events (such as copy-paste) when implementing the mouse user interface?

2. You wish to create a database of stars. For each star, the database will store several megabytes of data. Considering that your database will store billions of stars, choose the data structure that will provide the best performance. With this data structure you should be able to find the smallest star, insert, and delete stars. Justify your choice.

3. Which of the following statements are true (n=number of vertices, m=number of edges in a graph):
    a. BFS can be used to compute the connected components of an undirected graph in O(m+n) time.
    b. BFS can be used to compute the lengths of shortest path from starting vertex to every other vertex in the graph in O(m+n) time, where shortest means the fewer number of edges.
    c. DFS can be used to compute the strongly connected components of a directed ~~acyclic~~ graph in O(m+n) time.

4. Study the graph from Figure 1 and answer the questions a through e.

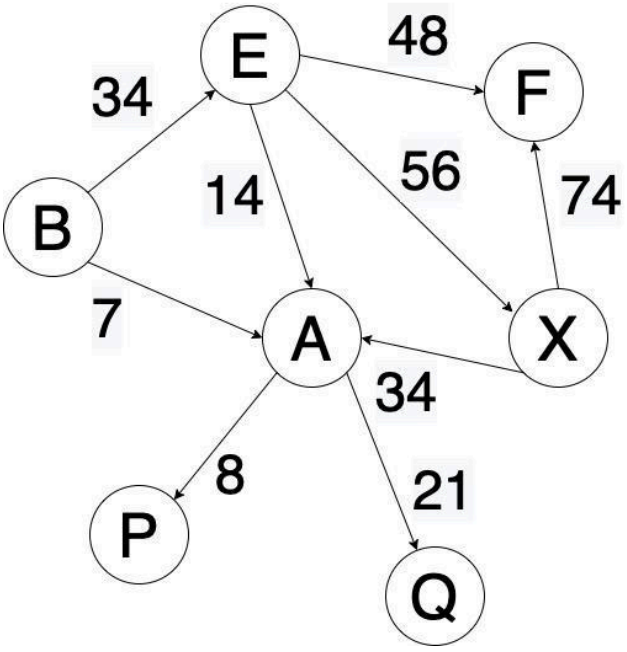

Figure 1: Directed graph with weighted edges.

a) Create the adjacency matrix representation of the graph from Figure 1. Use -1 to represent that there is no edge and use the weights for the edges that exist.
b) Give one reason why the adjacency list might be a better representation compared to the adjacency matrix.

c) Give one reason why the adjacency matrix might be better compared to the adjacency list representation.

d) How would the matrix change if the graph was *undirected*?

e) Perform a topological sort of the graph and show the final topological ordering. If more than one order exists, listing just one is sufficient.

5. Study the graph from Figure 2 and answer the questions a and b.

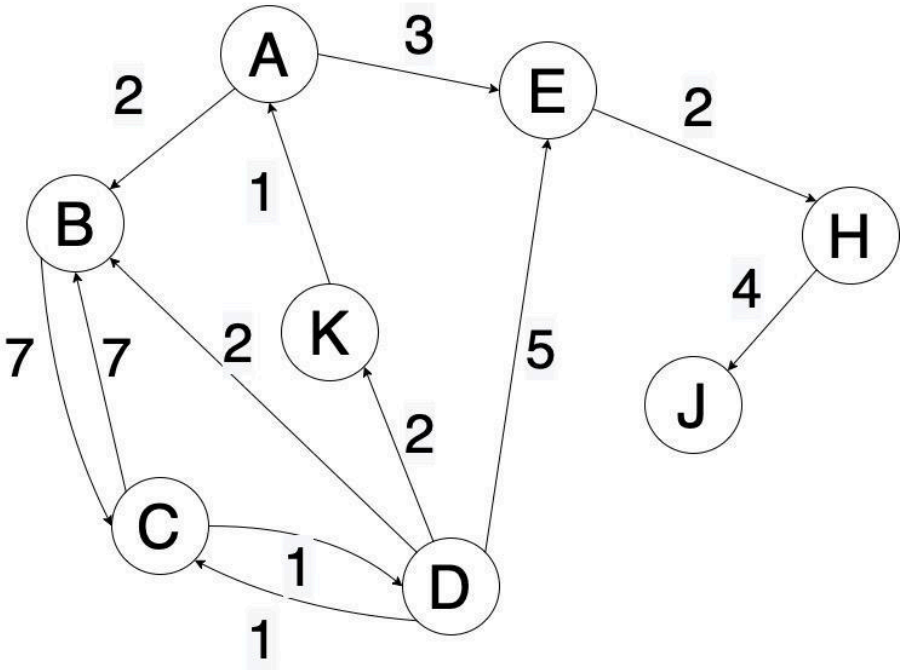

Figure 2: Directed graph with weighted edges.

a) Given this graph, simulate the breadth first graph search algorithm starting with vertex A. Write down one possible order of vertices that would be processed by the BFS traversal.

b) Given this graph, simulate the depth first graph search algorithm starting with vertex A. Write down one possible order of vertices that would be processed by the DFS traversal.