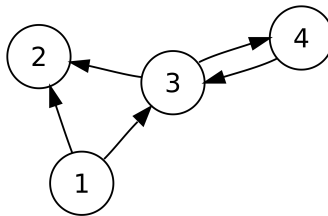


REC 13 Graphs

Problem 1 Graph Representation

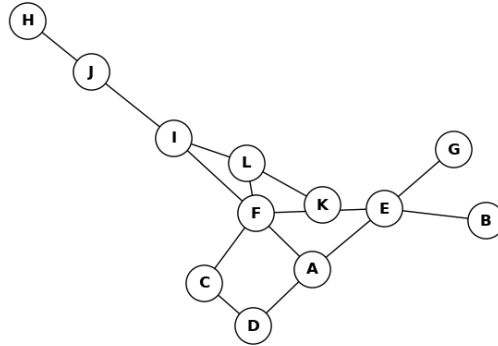


The graph above is G_{directed} . Let $G_{\text{undirected}}$ be its undirected counterpart created by removing the edge direction associated with each edge (Ignore the repeated undirected edge between 3 and 4). Represent each of the graphs below using the indicated method. Note that you must take special care to represent the directions of G_{directed} where necessary. Be sure to explain your representation of the direction of edges.

Hint: Textbook example 16.22 in Fell and Aslam and recitation7 both provide schemes to encapsulate edge direction in a list or matrix representation.

- i Adjacency List representation of $G_{\text{undirected}}$
- ii Adjacency Matrix representation of $G_{\text{undirected}}$
- iii Adjacency List representation of G_{directed}
- iv Adjacency Matrix representation of G_{directed}

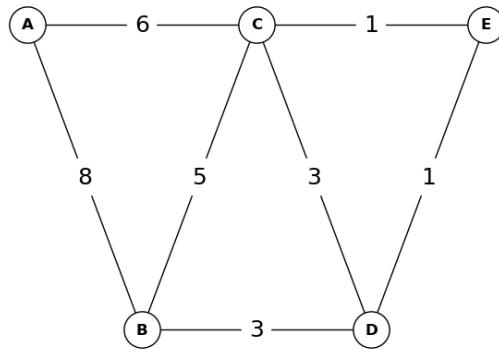
Problem 2 Graph Traversal



Wherever possible below, select the node which is earlier in the alphabet first (e.g. prefer visiting node A first over node B, when the search allows you to visit either).

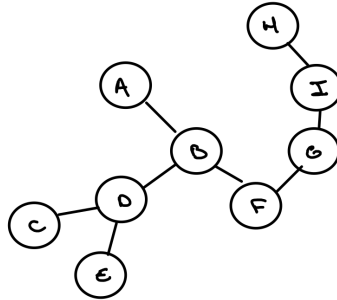
- i Starting at K, find the Breadth-First-Search (BFS) ordering of nodes in the graph above.
- ii Starting at G, find the Breadth-First-Search (BFS) ordering of nodes in the graph above.
- iii Starting at H, find the Breadth-First-Search (BFS) ordering of nodes in the graph above.
- iv Starting at K, find the Depth-First-Search (DFS) ordering of nodes in the graph above.
- v Starting at G, find the Depth-First-Search (DFS) ordering of nodes in the graph above.
- vi Starting at H, find the Depth-First-Search (DFS) ordering of nodes in the graph above.

Problem 3 Dijkstra Run



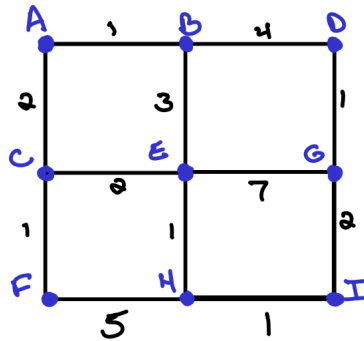
Using Dijkstra's algorithm, find the shortest path from node A to D. Please provide a table which shows the path weight and predecessor from A to every node, labelling the visited node at each step. [an example solution is given here.](#)

Problem 4 Graph Quiz



- i Is the graph above a tree? Explain why.
- ii List the vertices in the order they are visited in a *Depth First Search* that starts at *B*. (Whenever there are multiple vertices which may be chosen to produce a valid DFS, choose the vertex which comes first alphabetically.)
- iii List the vertices in the order they are visited in a *Breadth First Search* that starts at *B*. (Whenever there are multiple vertices which may be chosen to produce a valid BFS, choose the vertex which comes first alphabetically.)

Problem 5 Dijkstra Run 2



Using Dijkstra's algorithm, find the total weight of the shortest path from node A to I . You do not need to give the path itself, only its total weight. To show your work, give the vector representing the "shortest path weight from A " as well as the list of nodes "visited" every step, formatted as:

example step

The shortest path weight from A , potentially through [some-list-of-nodes] to each of the following nodes is:

A	B	C	D	E	F	G	H	I
■	■	■	■	■	■	■	■	■

where each ■ is some number.

Problem 6 Chromatic Number

Color the vertices of the graph below using the minimum number of colors, such that adjacent vertices have different colors.

