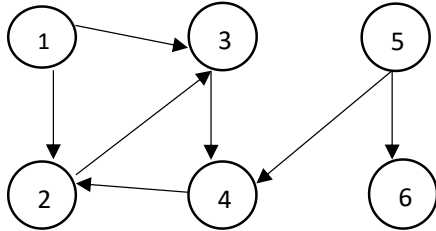


Programming Assignment 8: Graph Theory

For each question below, you can take a graph as input in the following format. Consider a directed graph as below:



Input Graph:

Enter the number of nodes: 5

Enter edges separated by a comma: 1 3, 1 2, 2 3, 3 4, 4 2, 5 4, 5 6

Question 1: Write a program that implements basic functionalities of a directed graph using adjacency list and adjacency matrix. Clearly state which data structure is best for each of these operations. Does your observation change when graph exhibits special properties such as complete graph or star graph? [6 Marks]

- 1) Given a vertex, compute out-degree/in-degree of a vertex.

Input: Enter the vertex: 2

Output: Indegree: 2

Outdegree: 1

- 2) Given a graph G , compute G^T , where G^T has all the edges in G but reversed.

Input: Suppose the input graph is the above graph

Output: Reversed Graph is: 2 1, 2 4, 3 1, 3 2, 4 3, 4 5, 6 5

- 3) Given a vertex, list down all the neighbours of a graph.

Input: Input a vertex: 4

Output: The neighbour of 4 are: 2

Input: Input a vertex: 1

Output: The neighbours of 1 are: 2, 3

Question 2: Write a program to implement Breadth first search algorithm for a given graph G. Your program should generate a BFS tree at the end. [4 Marks]

Input: Suppose the above graph is the input graph

Output: BFS traversal is: 1, 2, 3, 4, 5, 6

Question 3: Below questions are the applications of BFS. So, you can reuse the code implemented in the previous question for the following question: [6 Marks]

- 1) Given two vertices u and v, check whether there exists a path between u and v or not.

Input: Enter two vertices: 1, 4

Output: There exists a path between 1 and 4

Input: Enter two vertices: 1, 6

Output: There does not exist a path between 1 and 6

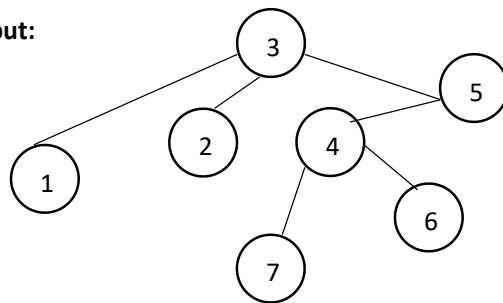
- 2) Write a program to compute shortest distance between two vertices u and v.

Input: Enter two vertices: 1, 4

Output: Shortest path between 1 and 4 is of length 2

- 3) Write a program to compute the diameter of a **tree**.

Input:



The above tree can be taken as input in the same way, you took directed graph as input

Output: The diameter of the tree is 2

Question 4: Write a program to implement Depth First Search algorithm and generate a DFS tree. [4 Marks]

Input: The input graph is shown above

Output: The DFS traversal is 5,4,2,3,6,1

Question 5: Implement the following with respect to DFS implementation: [6 Marks]

- 1) For a given directed/undirect graph, write a program to check whether there is a cycle or not by checking if there exists a back edge.

Input: The above graph

Output: Graph has a cycle with vertices 2,3,4

- 2) Write a program that check whether a given graph is strongly connected or not

Input: The above graph

Output: The graph is not strongly connected

- 3) Write a program that finds number of strongly connected components in the graph.

Input: The above graph

Output: The number of strongly connected components are 4

Question 6: Implement Prim's algorithm to find a minimum spanning tree for a given unweighted undirected graph. [4 Marks]

Input: The above graph by making directed edges undirected

Output: The edges in the MST are: 1 2, 1 3, 2 4, 4 5, 5 6

