Data Structures Lab (CSC204) **Session: Monsoon 2021-22**
III B.Tech. CSE **Date: 09.11.2021**

Assignment-9 (Graph)

1. You are given a directed graph $\boldsymbol{G = (V, E)}$, where $\boldsymbol{V}$ represents the set of vertices and $\boldsymbol{E}$ shows the set of edges. Suppose $\boldsymbol{|V| = m}$ and $\boldsymbol{|E| = n}$, your task is write a program to generate the graph $\boldsymbol{G}$ based on the user inputs. Your program should first take $\boldsymbol{m}$ and $\boldsymbol{n}$ as inputs and then a set of edges are supplied to the program. Use adjacency list to display the graph $\boldsymbol{G}$. After construction of the graph, your program should also check that a path of a given length exists between two vertices or not. Assume the weight of each edge in the graph is $\boldsymbol{1}$.

   Sample Input:

   $\boldsymbol{m = 6}$

   $\boldsymbol{n = 7}$

   Edges: **1 2, 1 3, 2 3, 2 4, 3 5, 4 6, 5 6**

   Enter two vertices for finding path= **2 6**

   Enter length of the path= **3**

   Sample Output: The graph is:

   1 → 2 3

   2 → 3 4

   3 → 5

   4 → 6

   5 → 6

   6 →

   A path of length *3* exists between the vertices *2* and *6*.

2. A social networking application maintains the database of the users by utilizing the graph data structure. Each user in the database is represented using a vertex in the graph. The edges in the graph are used for representing the relationships between users. This application requires to find *minimum spanning tree* of the graph. It utilizes a *greedy* approach for building *minimum spanning tree*. The tree is constructed by adding the edges one at a time. The edges are added in *non-decreasing order* of the cost. Your task is to implement this approach for finding *minimum spanning tree*. Assume that the graph is an undirected graph.

Sample Input:

$\boldsymbol{Enter\ number\ of\ vertices = 7}$

$\boldsymbol{Enter\ number\ of\ edges = 9}$

$\boldsymbol{Weight\ of\ edge\ (1,2) = 28}$

$\boldsymbol{Weight\ of\ edge\ (1,6) = 10}$

$\boldsymbol{Weight\ of\ edge\ (2,3) = 16}$

$\boldsymbol{Weight\ of\ edge\ (2,7) = 14}$

$\boldsymbol{Weight\ of\ edge\ (3,4) = 12}$

$\boldsymbol{Weight\ of\ edge\ (4,5) = 22}$

$\boldsymbol{Weight\ of\ edge\ (4,7) = 18}$

$\boldsymbol{Weight\ of\ edge\ (5,6) = 25}$

$\boldsymbol{Weight\ of\ edge\ (5,7) = 24}$

Sample Output:

$\boldsymbol{The\ cost\ of\ minimum\ spanning\ tree\ is}$: **99**

3. A smart-phone manufacturing firm manufactures phones by performing several tasks. These tasks are usually interrelated and follow some dependencies. Before start of the production, the dependencies between tasks are properly analyzed and modeled in the form of a directed acyclic graph $\boldsymbol{G = (V, E)}$, where $\boldsymbol{V}$ represents the set of tasks or vertices and $\boldsymbol{E}$ shows the set of edges or dependencies. The company utilizes following scheme to find the ordering of tasks for completion of the production: take linear ordering of vertices in the graph $\boldsymbol{G}$ in such a way that for every directed edge $\boldsymbol{u \rightarrow v}$ from vertex $\boldsymbol{u}$ to vertex $\boldsymbol{v}$, $\boldsymbol{u}$ should come before $\boldsymbol{v}$ in the ordering. Your task is write a program that takes a directed acyclic graph as input and produces an ordering of tasks.

Sample Input:

$\boldsymbol{Enter\ number\ of\ vertices = 6}$

$\boldsymbol{Enter\ number\ of\ edges = 9}$

Edges: **1 2, 1 3, 2 3, 2 4,2 5, 3 5,4 5, 4 6, 5 6**

Sample Output:

An ordering of tasks is: 1, 2, 3, 4, 5, 6