Home work 5

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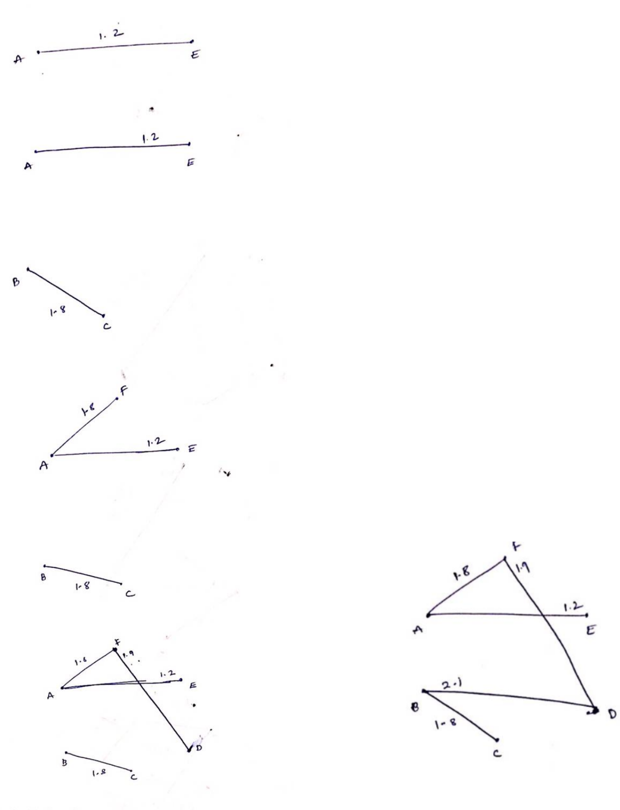
Q1.

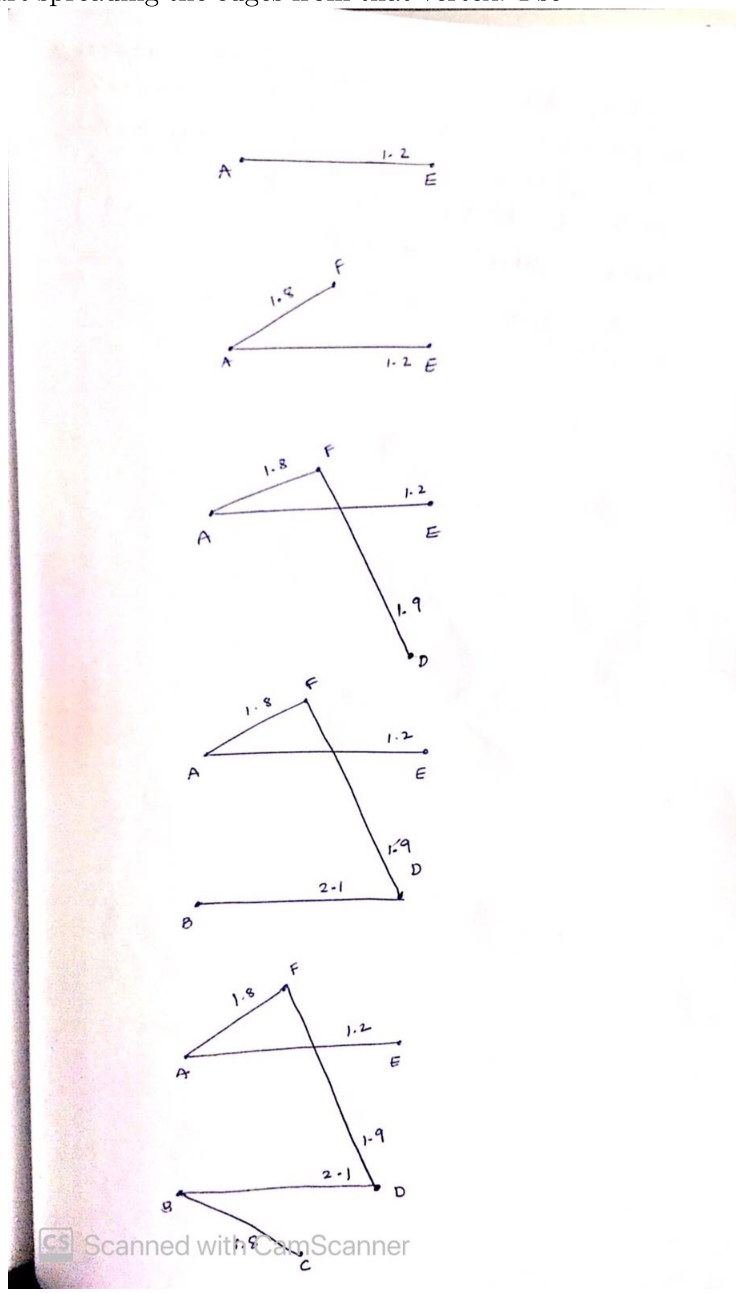
edges in increasing order

AE	1.2
BC	1.8
AF	1.8
FD	1.9
ED	2.0
BD	2.1
BE	2.2
CD	2.4
CE	2.4
AC	2.5
AB	2.6
AD	2.7
FC	2.8
FE	3.0
FB	3.2



Q2.

In Prim's Algorithm, we should select one vertex and start spreading the edges from that vertex. I selected vertex A and extended the edges from that vertex.



Q3.

If a graph is given $G = (V, E)$ is a directed graph then the transpose of that such graph would be obtained by reversing the direction of arrows we get $G^T = (V, E^T)$. In adjacent matrix case, Adjacency matrix for graph G is given by $A = [a_{ij}]$. Adjacency matrix for G^T is given by $A^T = [a_{ij}^T]$, where $a_{ij}^T = a_{ji}$. So, we need to find the transpose of the matrix A

Algorithm 1 Transpose of Adjacency matrix

procedure MATRIX TRANSPOSE(G, G^T)
  e = number of edges
  for i in range of e **do**
    for j in range of e **do**
      $G^T[i][j] = G[j][i]$

As the algorithm is running it's all vertices twice. Time complexity of the above algorithm is O(e^2) , i.e O(V^2)

Algorithm 2 Transpose of Adjacency List

procedure ADJACENCY LIST TRANSPOSE(G)
  for u in range of V[G] **do**
    for element v ∈Adj[u] **do**
      Insert u in front of Adj[v]

Time complexity is O(V+E)

Q4.

edge(i, j)	White	Gray	Black
White	T,B,F,C	B,C	C
Gray	T,F	T,F,B	T,F,C
Black		B	T,F,B,C

Table 1: Directed Graph

Q5.

After running the Slow-all-pairs-shortest-path algorithm, we get the following output :

edge(i,j)	White	Gray	Black
White	T,B	T,B	
Gray	T,B	T,B	T,B
Black		T,B	T,B

Table 2: UnDirected Graph

L$^{(1)}$ (Initial matrix)

$$\begin{bmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & \infty & \infty \\ \infty & 2 & 0 & \infty & \infty & -8 \\ -4 & \infty & \infty & 0 & 3 & \infty \\ \infty & 7 & \infty & \infty & 0 & \infty \\ \infty & 5 & 10 & \infty & \infty & 0 \end{bmatrix}$$

L$^{(2)}$ (m = 2)

$$\begin{bmatrix} 0 & 6 & \infty & \infty & -1 & \infty \\ -2 & 0 & \infty & 2 & 0 & \infty \\ 3 & -3 & 0 & 4 & \infty & -8 \\ -4 & 10 & \infty & 0 & -5 & \infty \\ 8 & 7 & \infty & 9 & 0 & \infty \\ 6 & 5 & 10 & 7 & \infty & 0 \end{bmatrix}$$

L$^{(3)}$ (m = 3)

$$\begin{bmatrix} 0 & 6 & \infty & 8 & -1 & \infty \\ -2 & 0 & \infty & 2 & -3 & \infty \\ -2 & -3 & 0 & -1 & 2 & -8 \\ -4 & 2 & \infty & 0 & -5 & \infty \\ 5 & 7 & \infty & 9 & 0 & \infty \\ 3 & 5 & 10 & 7 & 5 & 0 \end{bmatrix}$$

$L^{(4)}$ (m = 4)

$$\begin{bmatrix} 0 & 6 & \infty & 8 & -1 & \infty \\ -2 & 0 & \infty & 2 & -3 & \infty \\ -5 & -3 & 0 & -1 & -3 & -8 \\ -4 & 2 & \infty & 0 & -5 & \infty \\ 5 & 7 & \infty & 9 & 0 & \infty \\ 3 & 5 & 10 & 7 & 2 & 0 \end{bmatrix}$$

$L^{(5)}$ (m = 5)

$$\begin{bmatrix} 0 & 6 & \infty & 8 & -1 & \infty \\ -2 & 0 & \infty & 2 & -3 & \infty \\ -5 & -3 & 0 & -1 & -6 & -8 \\ -4 & 2 & \infty & 0 & -5 & \infty \\ 5 & 7 & \infty & 9 & 0 & \infty \\ 3 & 5 & 10 & 7 & 2 & 0 \end{bmatrix}$$

Q6.

After running the Flyod-Warshall algorithm, we get the following output :

$D^{(0)}$ (Initial matrix)

$$\begin{bmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & \infty & \infty \\ \infty & 2 & 0 & \infty & \infty & -8 \\ -4 & \infty & \infty & 0 & 3 & \infty \\ \infty & 7 & \infty & \infty & 0 & \infty \\ \infty & 5 & 10 & \infty & \infty & 0 \end{bmatrix}$$

$D^{(1)}$ (k = 1)

$$\begin{bmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & 0 & \infty \\ \infty & 2 & 0 & \infty & \infty & -8 \\ -4 & \infty & \infty & 0 & -5 & \infty \\ \infty & 7 & \infty & \infty & 0 & \infty \\ \infty & 5 & 10 & \infty & \infty & 0 \end{bmatrix}$$

$D^{(2)}$ (k = 2)

$$\begin{bmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & 0 & \infty \\ 3 & 2 & 0 & 4 & 2 & -8 \\ -4 & \infty & \infty & 0 & -5 & \infty \\ 8 & 7 & \infty & 9 & 0 & \infty \\ 6 & 5 & 10 & 7 & 5 & 0 \end{bmatrix}$$

$D^{(3)}$ (k = 3)

$$\begin{bmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & 0 & \infty \\ 3 & 2 & 0 & 4 & 2 & -8 \\ -4 & \infty & \infty & 0 & -5 & \infty \\ 8 & 7 & \infty & 9 & 0 & \infty \\ 6 & 5 & 10 & 7 & 5 & 0 \end{bmatrix}$$

$D^{(4)}$ (k = 4)

$$\begin{bmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ -2 & 0 & \infty & 2 & -3 & \infty \\ 0 & 2 & 0 & 4 & -1 & -8 \\ -4 & \infty & \infty & 0 & -5 & \infty \\ 5 & 7 & \infty & 9 & 0 & \infty \\ 3 & 5 & 10 & 7 & 2 & 0 \end{bmatrix}$$

$D^{(5)}$ (k = 5)

$$\begin{bmatrix} 0 & 6 & \infty & 8 & -1 & \infty \\ -2 & 0 & \infty & 2 & -3 & \infty \\ 0 & 2 & 0 & 4 & -1 & -8 \\ -4 & 2 & \infty & 0 & -5 & \infty \\ 5 & 7 & \infty & 9 & 0 & \infty \\ 3 & 5 & 10 & 7 & 2 & 0 \end{bmatrix}$$

$D^{(6)}$ (k = 6)

$$\begin{bmatrix} 0 & 6 & \infty & 8 & -1 & \infty \\ -2 & 0 & \infty & 2 & -3 & \infty \\ -5 & -3 & 0 & -1 & -6 & -8 \\ -4 & 2 & \infty & 0 & -5 & \infty \\ 5 & 7 & \infty & 9 & 0 & \infty \\ 3 & 5 & 10 & 7 & 2 & 0 \end{bmatrix}$$