Data structures Lab

Lab 8

Date: 28.08.25

Observation Questions

1. Differentiate between **directed** and **undirected** weighted graphs with real-world examples.
2. Explain **Dijkstra's Algorithm** and its limitations when negative weights are present.
3. Compare **Prim's Algorithm** and **Kruskal's Algorithm** for finding MST. Which is better for dense graphs?
4. Why is the **shortest path problem** important in real-time systems like GPS navigation?
5. Write the adjacency matrix representation of the following directed weighted graph:

   Vertices = {A, B, C, D}
   Edges = A→B (3), A→C (2), B→D (4), C→D (1).

Execution Questions

1. An airline wants to find the cheapest route between cities. Implement Dijkstra's algorithm to find the minimum cost from a source city to all others.

Number of cities: 5
Edges:
0 1 10
0 2 3
1 2 1
2 1 4
2 3 2
1 3 2
3 4 7

2. In a computer network, routers may have negative delay due to data compression. Use Bellman-Ford to find shortest paths.

Vertices: 5, Edges: 8

Edges:
0 1 -1
0 2 4
1 2 3
1 3 2
1 4 2
3 2 5
3 1 1
4 3 -3

Source = 0

3. A power company wants to lay wires connecting cities with **minimum cost**. Implement Kruskal's algorithm.

   Number of cities: 4
   Edges:
   0 1 10
   0 2 6
   0 3 5
   1 3 15
   2 3 4

4. A cable TV company wants to connect houses with the minimum cable length. Implement Prim's algorithm.
   Number of houses: 5
   Cost adjacency matrix:
   0 2 0 6 0
   2 0 3 8 5
   0 3 0 0 7
   6 8 0 0 9
   0 5 7 9 0

5. A delivery company wants to calculate the shortest travel time between **every pair of warehouses**. Implement Floyd-Warshall algorithm.

   Number of warehouses: 4

   Adjacency matrix:
   0 5 INF 10
   INF 0 3 INF
   INF INF 0 1
   INF INF INF 0

Spot questions

1. A city's transport system has **bus routes and metro routes** represented as a **directed weighted graph**.

- Bus routes have **normal weights (time in minutes)**.
- Metro routes are **faster but cost an extra penalty of +5 minutes** at every transfer.

Find the **fastest route** from a **source station** to a **destination station**, considering both time and transfer penalty.

Input: Vertices: 6

Edges (u v w mode):

0 1 10 BUS

0 2 3 METRO

1 2 1 BUS

1 3 2 METRO

2 3 8 BUS

2 4 2 METRO

3 4 7 BUS

4 5 4 BUS

Source = 0, Destination = 5

Output:

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Fastest travel time from 0 to 5 = 14
Path: 0 -> 2 (METRO) -> 4 (METRO) -> 5 (BUS)
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2. A telecom company is building an optical fiber network using MST. However, they also want a backup network in case one edge fails.

- Task: Find the cost of the Minimum Spanning Tree (MST).
- Then, also compute the cost of the Second-Best MST (the next smallest spanning tree if one edge is removed).

Input:

Vertices: 5

Edges:
0 1 2
0 2 3
1 2 1
1 3 4
2 3 5
2 4 6
3 4 7

Output:

MST edges:
1 -- 2 (1)
0 -- 1 (2)
0 -- 2 (3)
2 -- 4 (6)
MST Cost = 12

Second-Best MST Cost = 13