Minimum spanning tree

import heapq

# Graph representation using adjacency list

def prim\_mst(graph):

# Number of vertices in graph

V = len(graph)

# Initialize the priority queue and visited nodes

min\_heap = [(0, 0)] # (weight, vertex)

visited = [False] \* V

mst\_edges = []

total\_weight = 0

while min\_heap:

weight, node = heapq.heappop(min\_heap)

if visited[node]:

continue

visited[node] = True

total\_weight += weight

# Add the edge to MST (if it's the first edge, it's from the starting node)

if weight > 0:

mst\_edges.append((node, weight))

# Add all neighbors of the node to the min heap

for neighbor, edge\_weight in graph[node]:

if not visited[neighbor]:

heapq.heappush(min\_heap, (edge\_weight, neighbor))

return mst\_edges, total\_weight

# Example graph represented as adjacency list [(neighbor, weight)]

graph = {

0: [(1, 2), (3, 6)],

1: [(0, 2), (2, 3), (3, 8), (4, 5)],

2: [(1, 3), (4, 7)],

3: [(0, 6), (1, 8), (4, 9)],

4: [(1, 5), (2, 7), (3, 9)]

}

mst, total\_weight = prim\_mst(graph)

print("Edges in MST:", mst)

print("Total weight of MST:", total\_weight)

theory

. Greedy Search Algorithm for Minimum Spanning Tree (MST) – Prim’s Algorithm:

Prim's algorithm is a greedy algorithm used to find the Minimum Spanning Tree of a graph. It starts with an arbitrary node and grows the MST by adding the least weight edge that connects a node inside the tree to a node outside the tree.

Steps:

Start with an arbitrary node, and mark it as visited.

Add the smallest weight edge that connects a visited node to an unvisited node.

Repeat the above step until all nodes are visited.

Explanation:

Graph Representation: The graph is represented as an adjacency list where each node points to a list of tuples (neighbor, weight).

Priority Queue (Min-Heap): A min-heap (priority queue) is used to pick the smallest edge that connects a visited node to an unvisited node.

Visited Array: Keeps track of visited nodes to prevent cycles.

MST Edges: Stores the edges that are part of the MST.