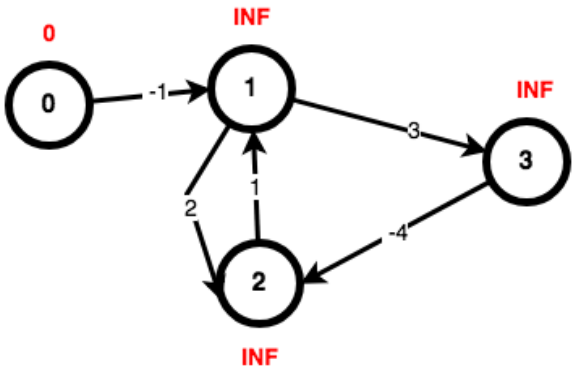
1. For the following edge weighted digraph, provide “SPT” from source vertex 0

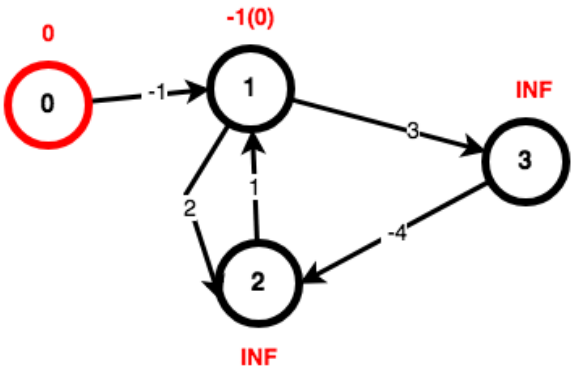
1) Use Dijkstra’s algorithm
2) Use Bellman-Ford Algorithm

Answer:

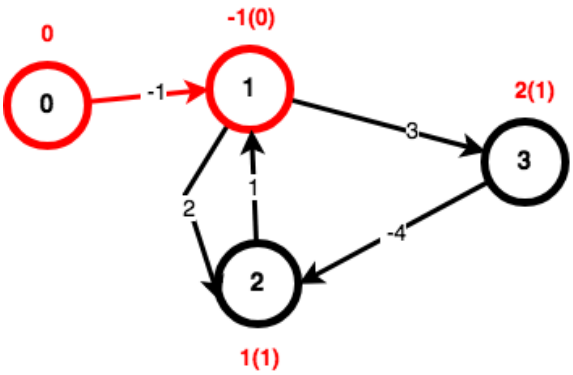
1) This is the result of using Dijkstra’s SPT algorithm and edges of SPT are shown in red



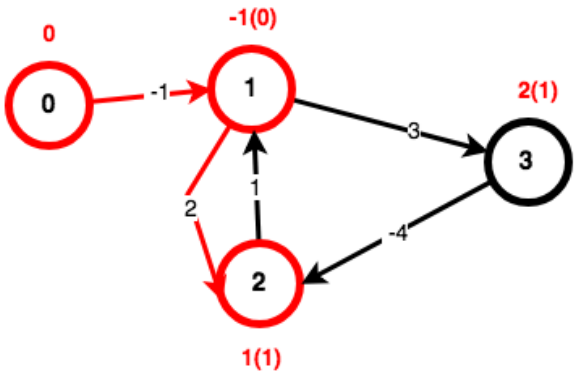
0) Original



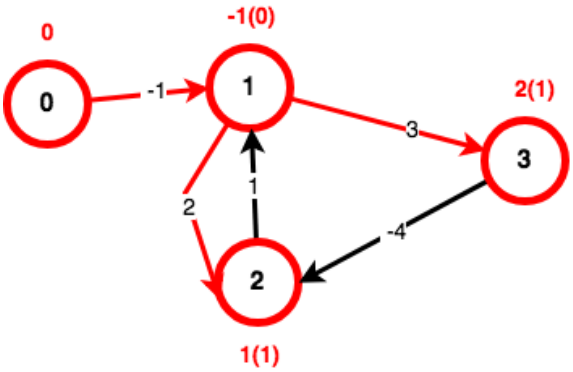
1) relax0



2) relax1



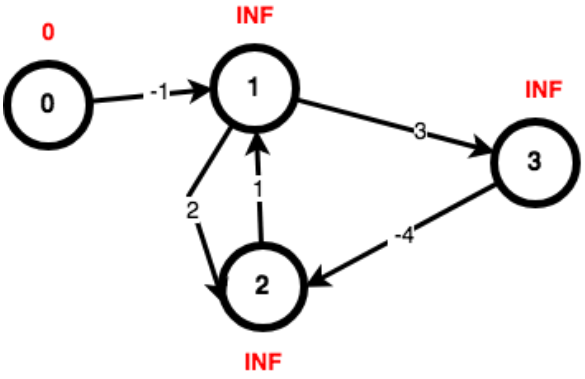
3) relax2



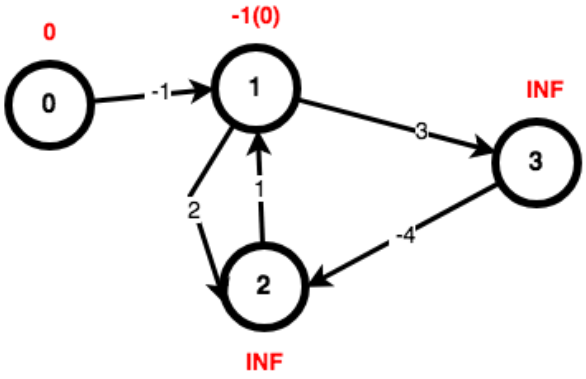
4) relax3

Using Dijkstra's SPT algorithm, the "shortest path" from 0 to 2 is 0-->1-->2, which gives 1 as the distance value. However, this path 0-->1-->3-->2 provides a shorter distance, -2. This demonstrates that Dijkstra's SPT algorithm does not alway work correctly when there are negative edge weights.

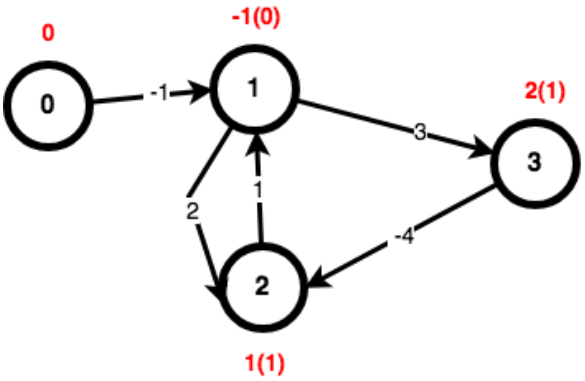
2) This is the result of using Bellman-Ford SPT algorithm and edges in SPT are shown in red



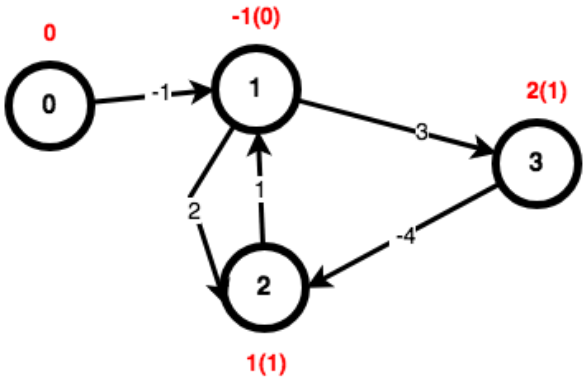
0) Original **queue: 0**



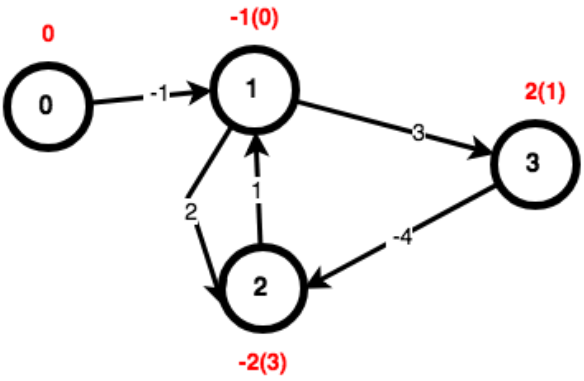
1) relax0 **queue: 1**



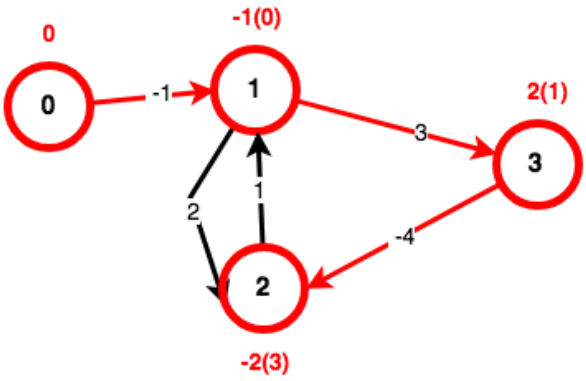
2) relax1 **queue: 2, 3**



3) relax2 **queue: 3**

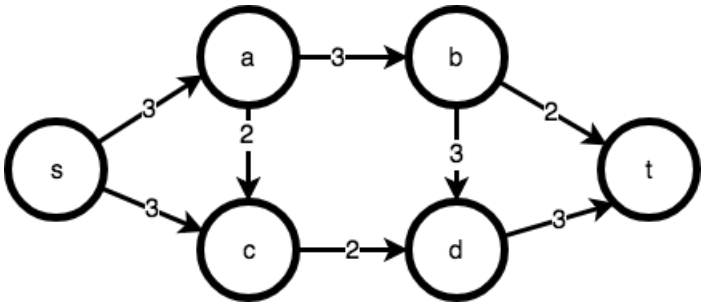


4) relax3 **queue: 2**

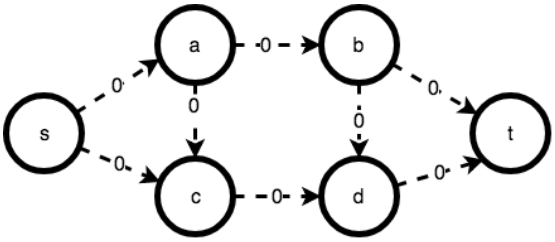


4) relax2 **queue:**

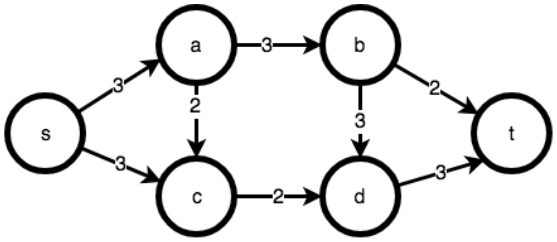
2. Provide the maximum flow and associated flow graph for the following network digraph



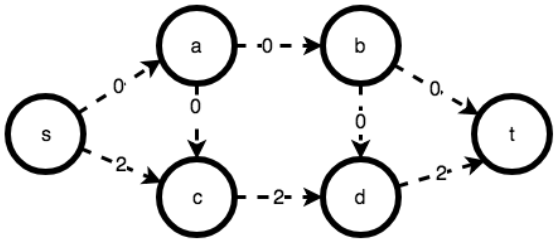
Answer:

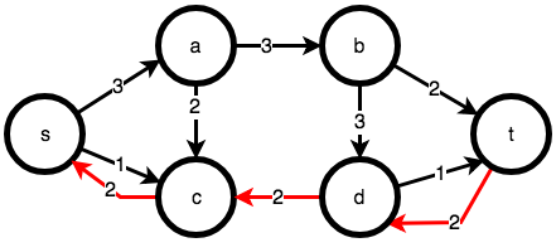


Gf: Flow Graph

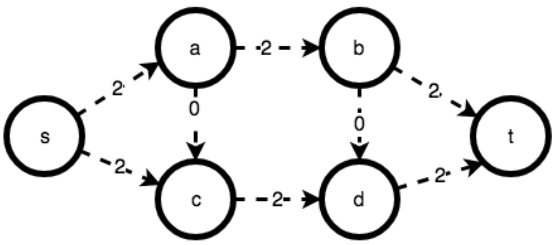


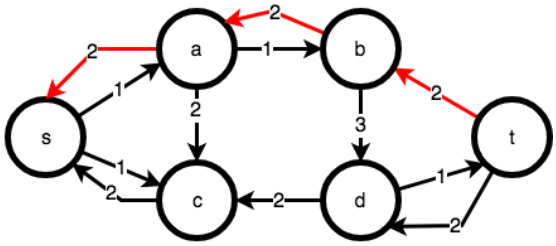
Gr: Residual Graph



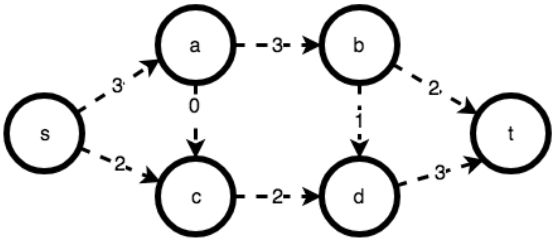


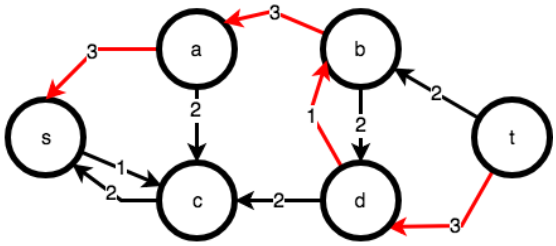
1) After 2 flow units added along s, c, d, t





2) After 2 flow units added along s, a, b, t





3) After 1 flow unit1 added along s, a, b, d, t

3. Fill the table. Types of graph include 1) undirected graph, 2) directed graph (digraph), 3) edge-weighted undirected graph, and 4) edge-weighted digraph. The shortest un-weighted path from source to target is the path having the least number of edges. The shortest weighted path from source to target is the path has the smallest sum of edge weight along the path.

Answer: Note Dijkstra's SPT algorithm can also be used on edge-weighted undirected graph.

Graph Problems	Types of Graph	Algorithms
Reachability	1, 2, 3, 4	DFS or BFS Algorithm
Cycle detection	1, 2, 3, 4	DFS or BFS Algorithm
Shortest Un-weighted Path	1, 2, 3, 4	BFS Algorithm
Topological Order	2, 4	DFS Algorithm
Minimum Spanning Tree	3	Prim's or Kruskual's MST
Shortest Weighted Path	3, 4	Dijkstra's SPT
Network Max-Flow	4	The Simple Max-Flow Algorithm