Shortest path in edge-weighted case

→ BFS is not suitable. It is suitable when edge weight is same for all edges.

→ To find the shortest path from a given node to all other nodes in a directed weighted graph.

→ Dijkstra's algorithm

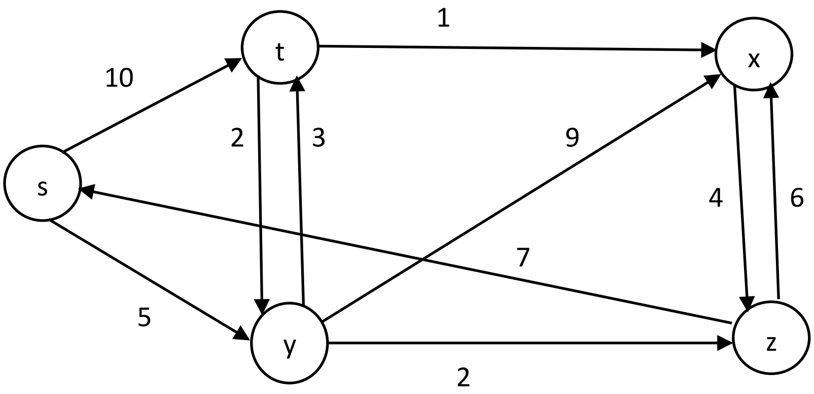
  → The algorithm progressively labels the nodes of the graph permanently starting from the designated start node.

  → The permanent label of a node is the shortest distance of the node from the designated start node.

  → By making each node of the graph as the starting node, we can find the shortest distance among all pairs of nodes of the graph by repetitively applying the Dijkstra's algorithm.

Singl Source Shortest Path Problem

- Given a weighted directed graph G(V, E)



s	**t**	**y**	**x**	**z**	**S**	**V – S**
0^*	10	5	α	α	{s}	{t, y, x, z}
0	10	5*	α	α	{s, y}	{t, x, z}
0	8	5	14	7*	{s, y, z}	{t, x}
0	8*	5	13	7	{s, y, z, t}	{x}
0	8	5	9*	7	{s, y, z, t, x}	{ϕ}

  → 5* denotes, y is being used as intermediate node.

  → 5 denotes, y is permanently labelled

Given,

- *u*, the source node
- *w*, the set of edge weights,
    - *w(u,v)*, the weight between *u*, *v*

Dijkstra (G, w, u) {

```
    S = {u}; d[u] = 0;
    for each node v Ɛ V – {u} do
        d[v] = w(u, v);
                        /* w(u, v) = α if there is no edge (u, v) */
    while S ≠ V do {
        choose a node y in V – S such that d(y) is a minimum;
        add y to S;
        for each node v Ɛ V – S do
            d[v] = min(d[v], d[y] + w(y, v));
    }
}
```

Complexity

→ $O(|V|^2)$