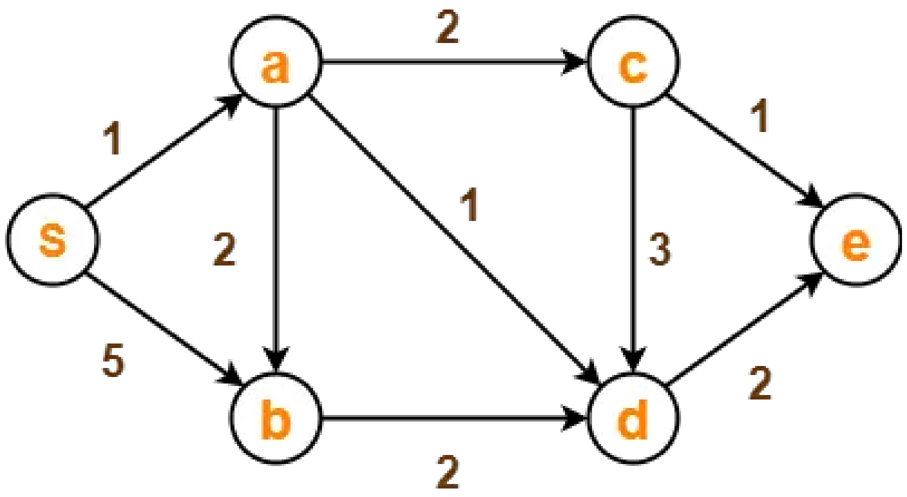
Tutorial- 2

Graph

Dijkstra's Algorithm

- Given a graph and a source vertex in the graph, find the shortest paths from the source to all vertices in the given graph.



Shortest Path

S – a 1

S – b 3

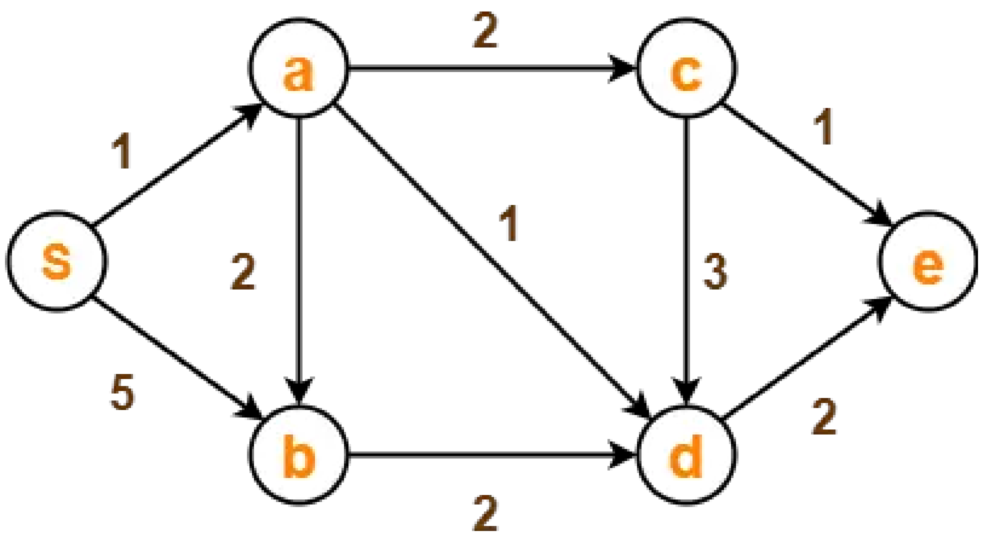
S – c 3

S – d 2

S – e 4

Dijkstra's Algorithm Example

- Given Graph:

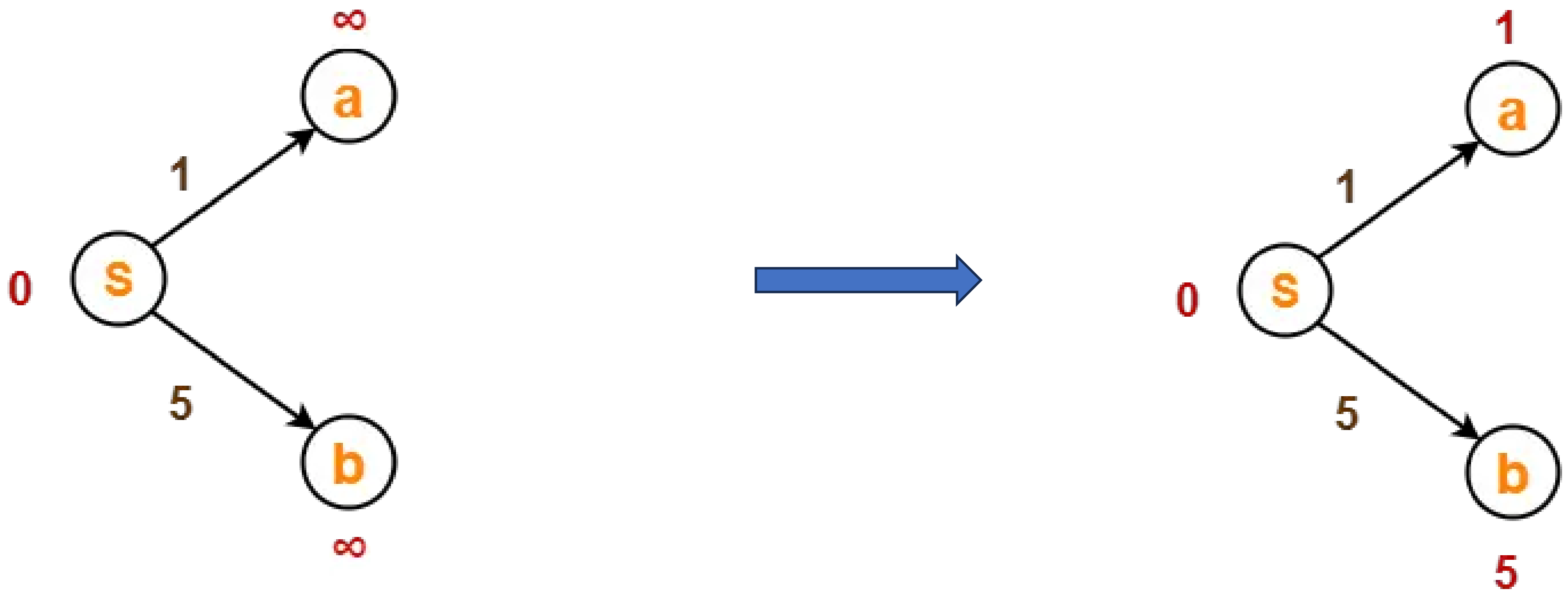


Pseudo code

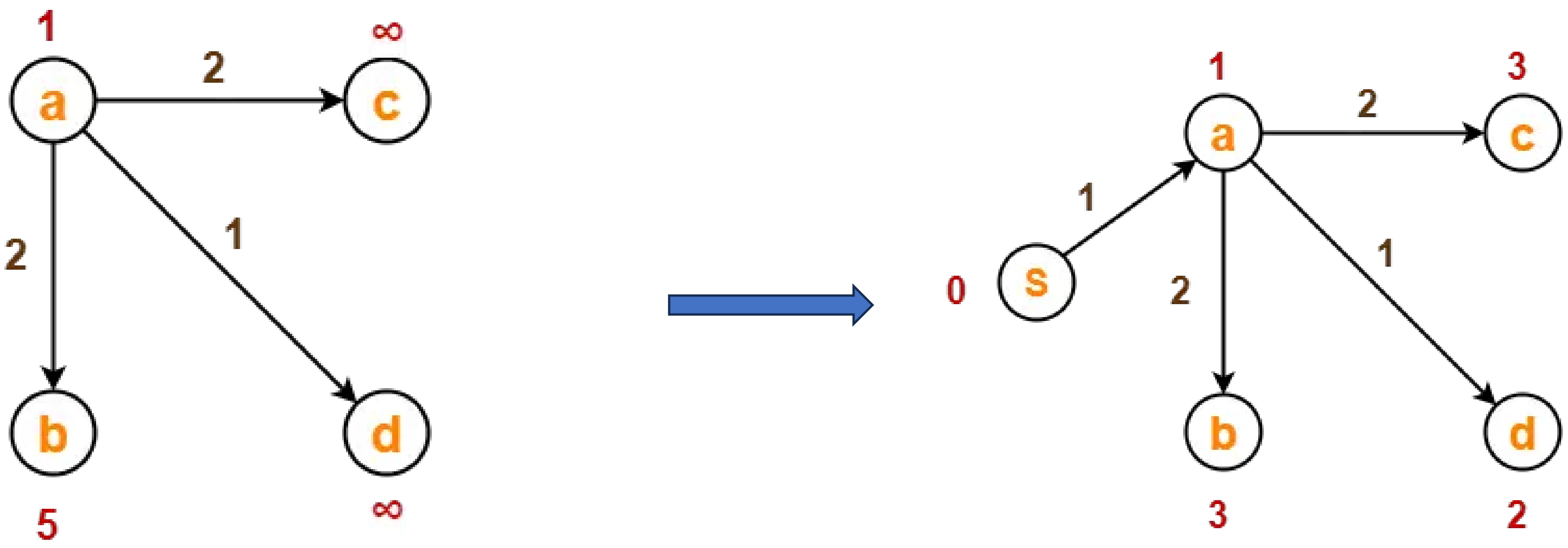
```
function dijkstra(G, S)
    for each vertex V in G
        distance[V] <- infinite
        previous[V] <- NULL
        If V != S, add V to Queue Q
    distance[S] <- 0

    while Q IS NOT EMPTY
        U <- Extract MIN from Q
        for each unvisited neighbour V of U
            tempDistance <- distance[U] + edge_weight(U, V)
            if tempDistance < distance[V]
                distance[V] <- tempDistance
                previous[V] <- U
    return distance[], previous[]
```

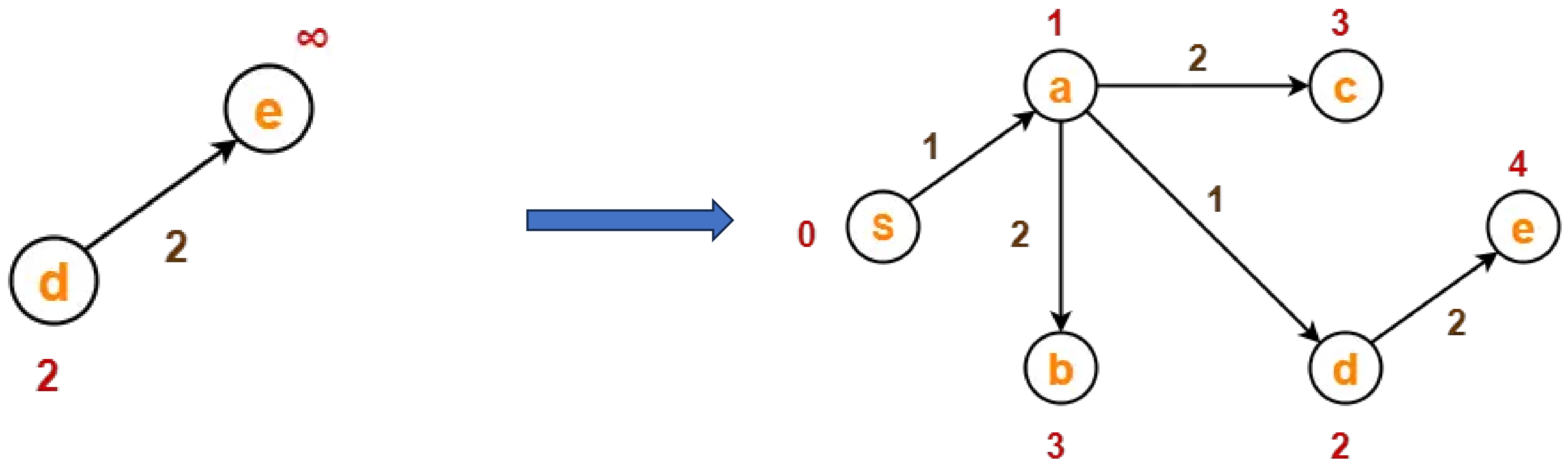
- Step 1:



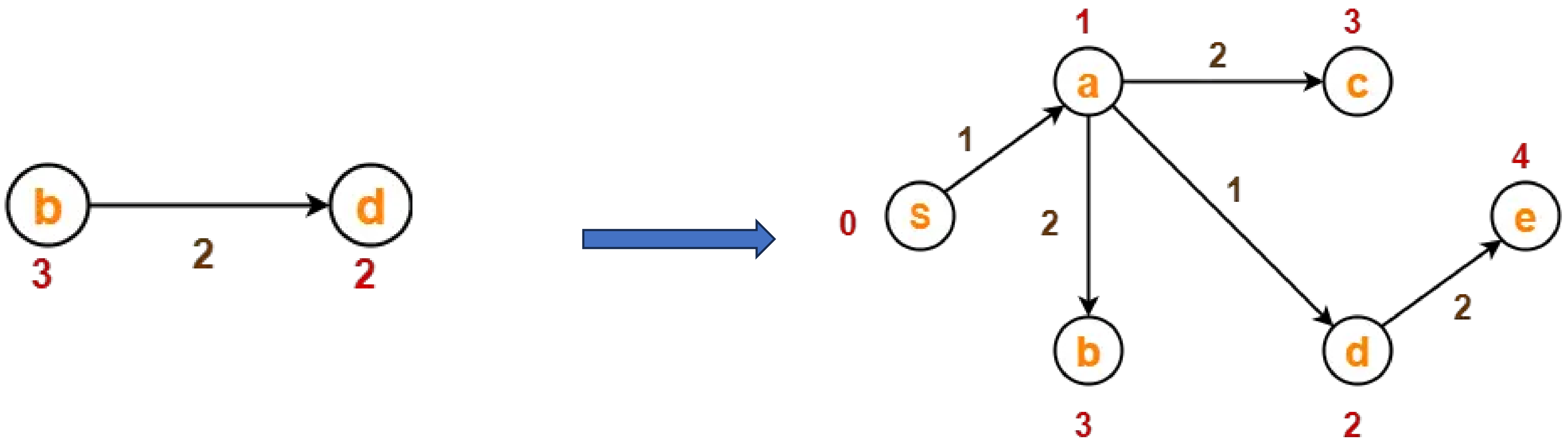
- Step 2



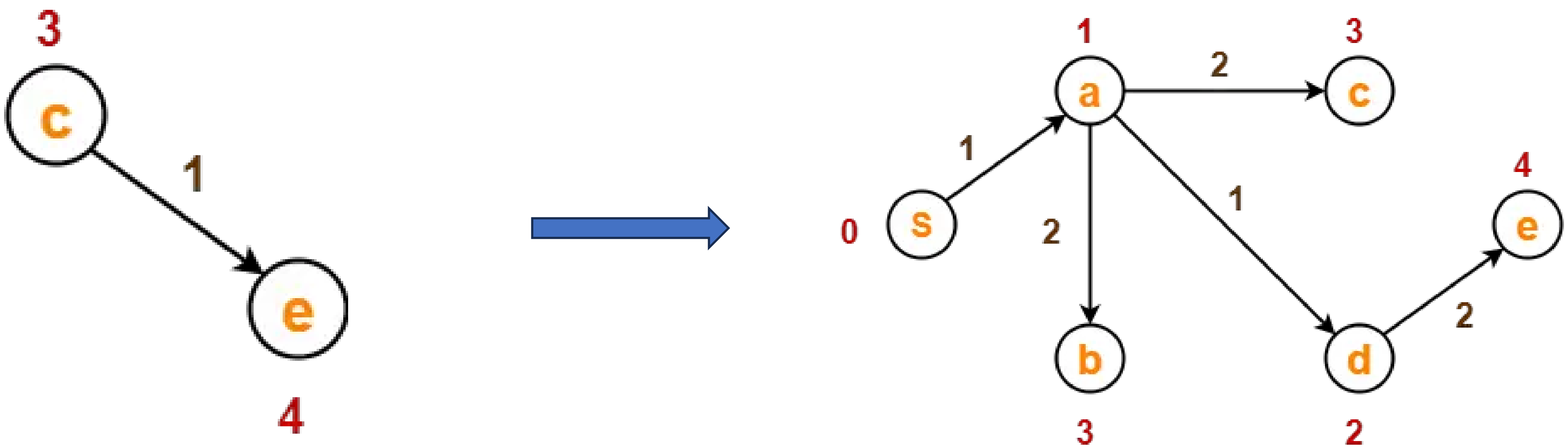
• Step 3



- Step 4



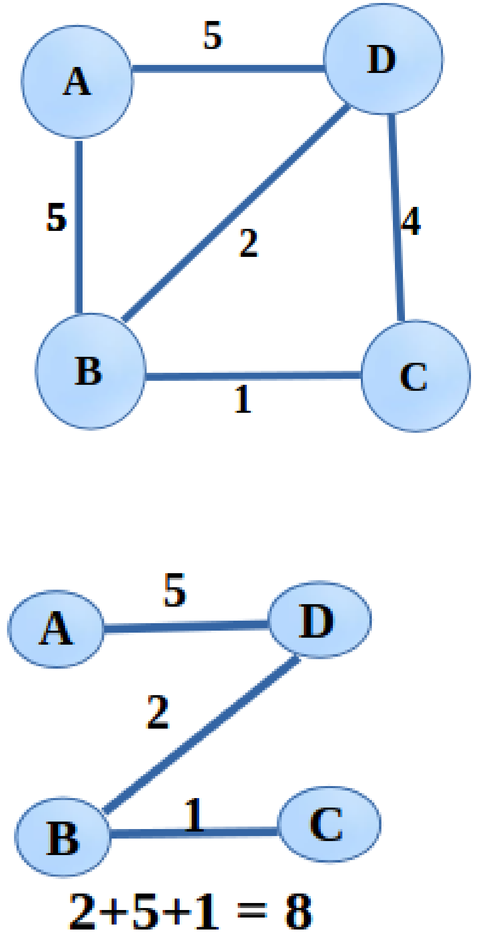
- Step 5



Shortest Path Tree

Minimum Spanning Tree

- A minimum spanning tree (MST) is a subset of the edges of a connected, edge-weighted undirected graph that connects all the vertices together, without any cycles and with the minimum possible total edge weight.



Minimum Spanning Tree

Prims Algorithm

- Prim's algorithm is a minimum spanning tree algorithm that takes a graph as input and finds the subset of the edges of that graph.
- MST form a tree that includes every vertex
- MST has the minimum sum of weights among all the trees that can be formed from the graph

The steps for implementing Prim's algorithm

1. Initialize the minimum spanning tree with a vertex chosen at random.

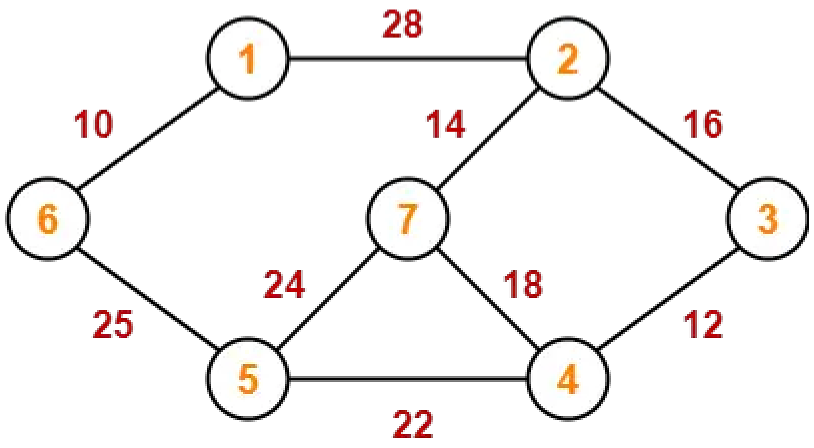
2. Find all the edges that connect the tree to new vertices, find the minimum and add it to the tree

3. Keep repeating step 2 until we get a minimum spanning tree

Pseudo code

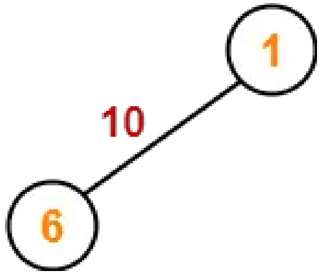
```
MST − Prim(G, ω, r)
for each u ∈ G,V :
    u.key = ∞
    u . π = NIL
r . key = 0
Q = G.V
while Q ≠ ϕ :
    u = EXTRACT − MIN(Q)
    for each v ∈ G . Adj[u] :
        if v ∈ Q and ω(u, v) < v . key :
            v . π = u
            v . key = ω(u, v)
```

MST Example

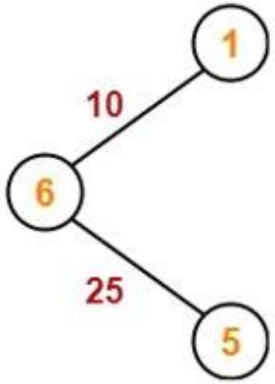


Given Graph

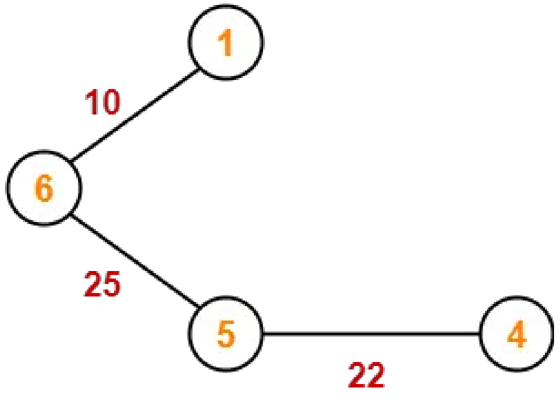
Step 1



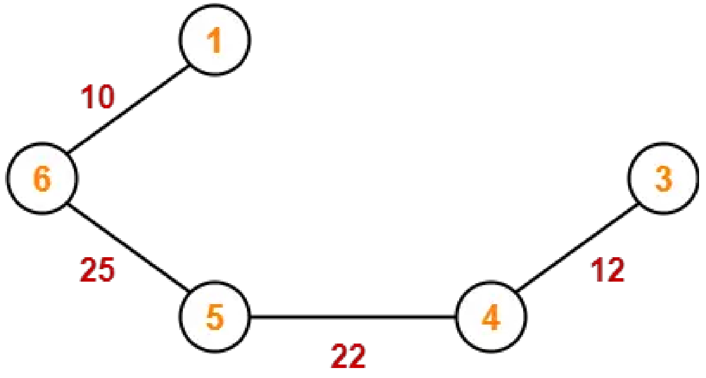
Step 2



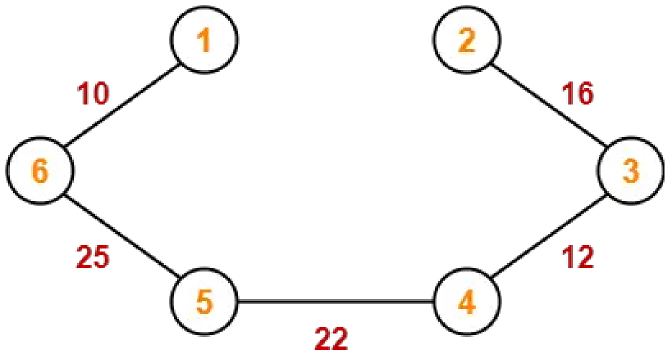
Step 3



Step 4



Step 5



Step 6