Prim's Algorithm

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Course Title: Design and Analysis of Algorithm Lab

Basic Concepts

Spanning Tree:

- A subgraph T of an undirected graph G (V,E) is a spanning tree of G , if it is a tree and contains every vertex of G.
- There is a fixed number of edges in the spanning tree which is equal to one less than the total number of vertices (E = V-1).
- There can be many possible spanning trees for a graph.
- To find the minimum spanning tree two algorithms can be used.

    1. Prim’s Algorithm.
    2. Kruskal’s Algorithm.

Introduction

To Prim's Algorithm

- Prim's algorithm is used to find the **Minimum Spanning Tree** for a given graph.
- The algorithm finds the **subset of edges** for graph G (V , E) such that the summation of edge weights is minimum.
- Prim's algorithm is a **Greedy Algorithm**.

Prim's Algorithm

Problem:

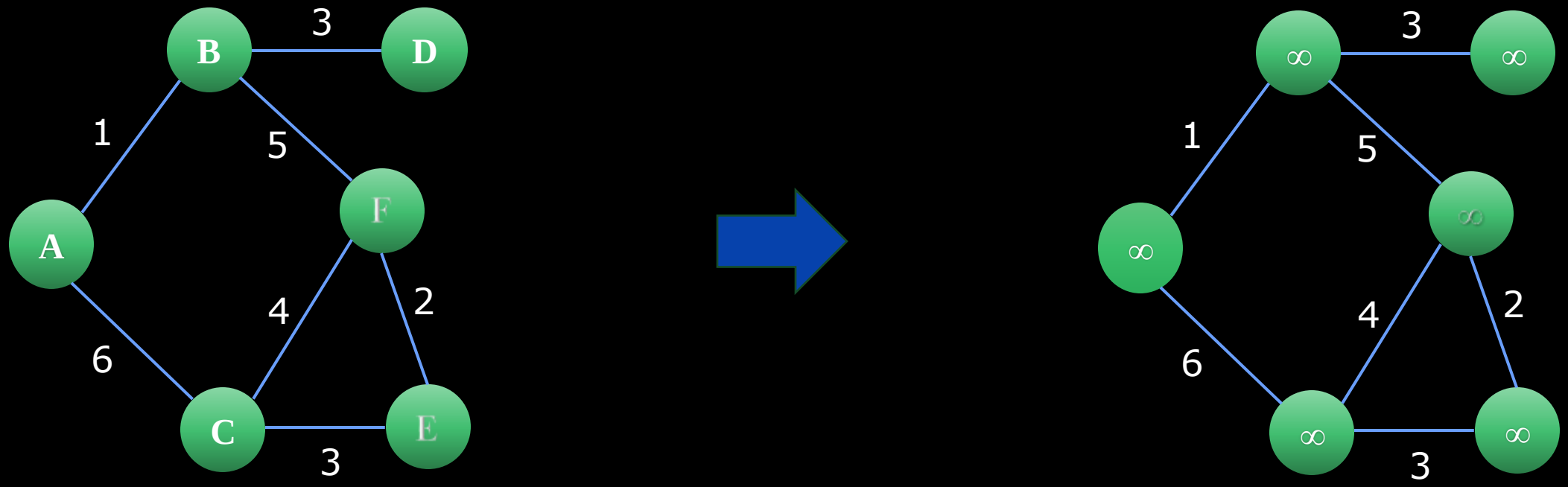
- In computer networks, routing data efficiently between different points is important for fast and smooth communication.
- Prim’s algorithm helps by figuring out the best way to connect these points, like finding the shortest path between them.
- It’s like planning the fastest root on a map to deliver something from one place to another.

Pseudo Code:

MST-Prim (G, w, r) {
Q = V[G];
for each u ∈ Q
key[u] = ∞;
key[r] = 0;
p[r] = NULL;
while (Q not empty)
u = ExtractMin(Q);
for each v ∈ Adj[u]
if (v ∈ Q and w(u,v) < key[v])
p[v] = u;
key[v] = w(u,v);
}

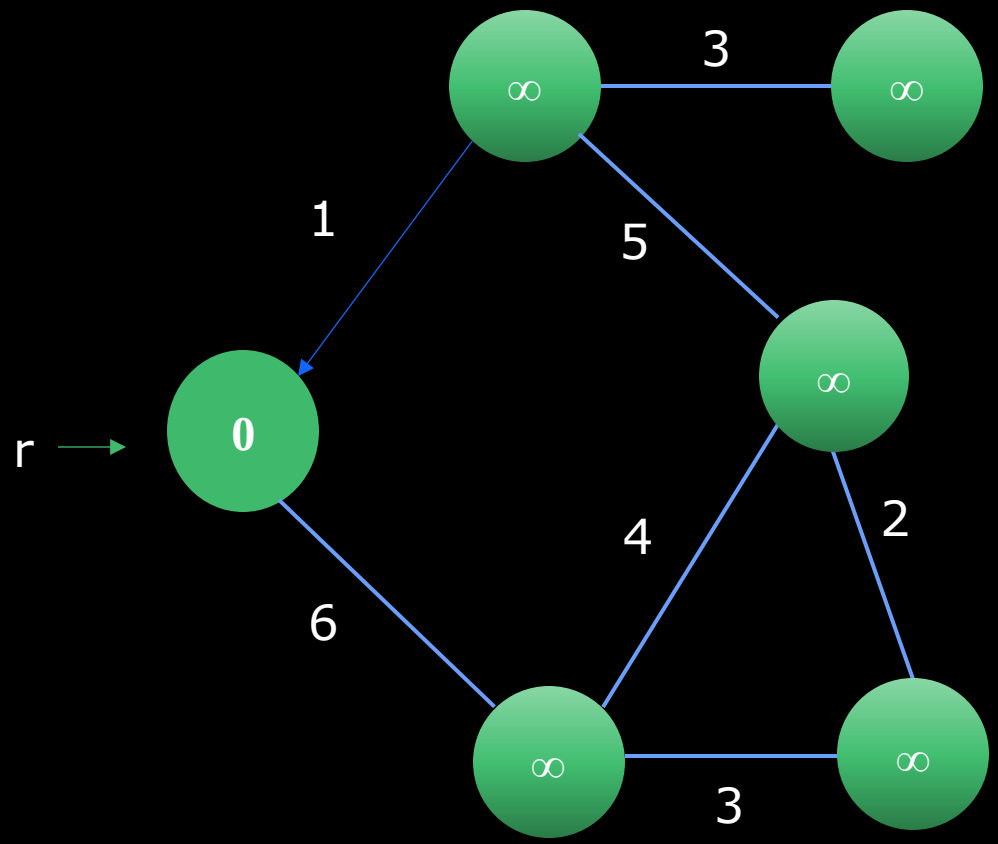
Finding MST with Prim's Algorithm

Step 1: Initially set the value of all vertices to infinity.



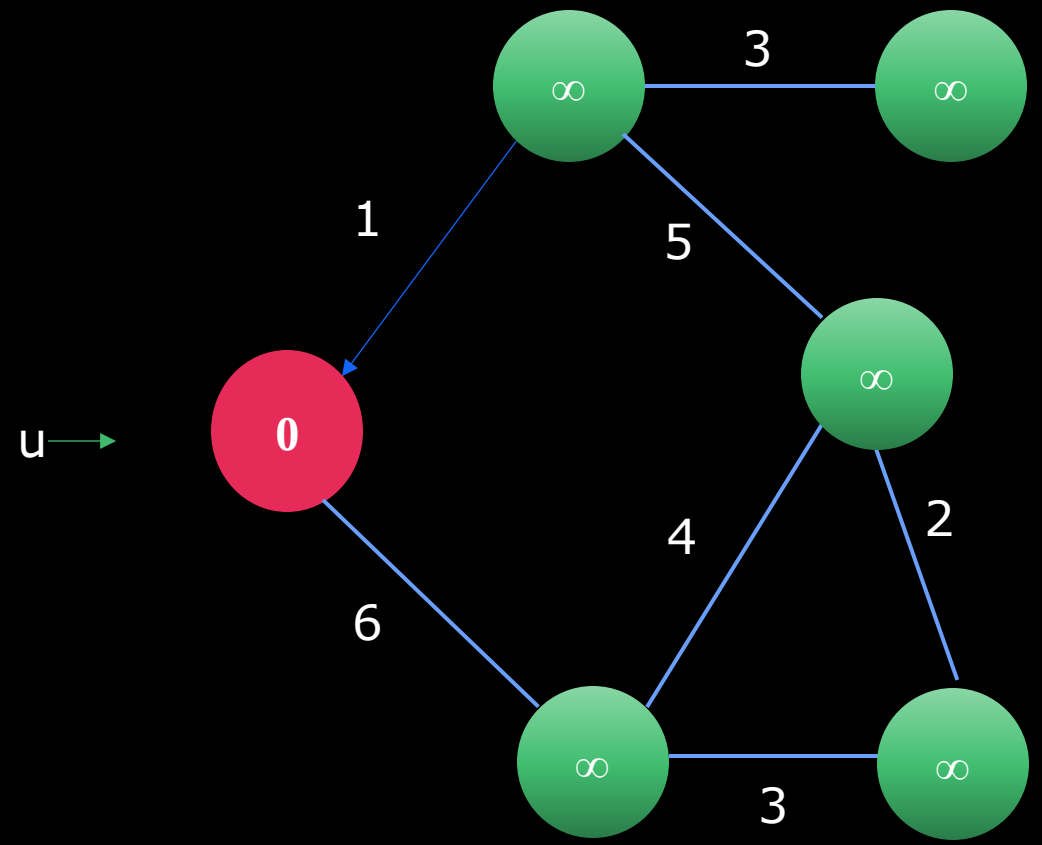
Finding MST with Prim's Algorithm

Step 2: Choose an arbitrary starting vertex r.



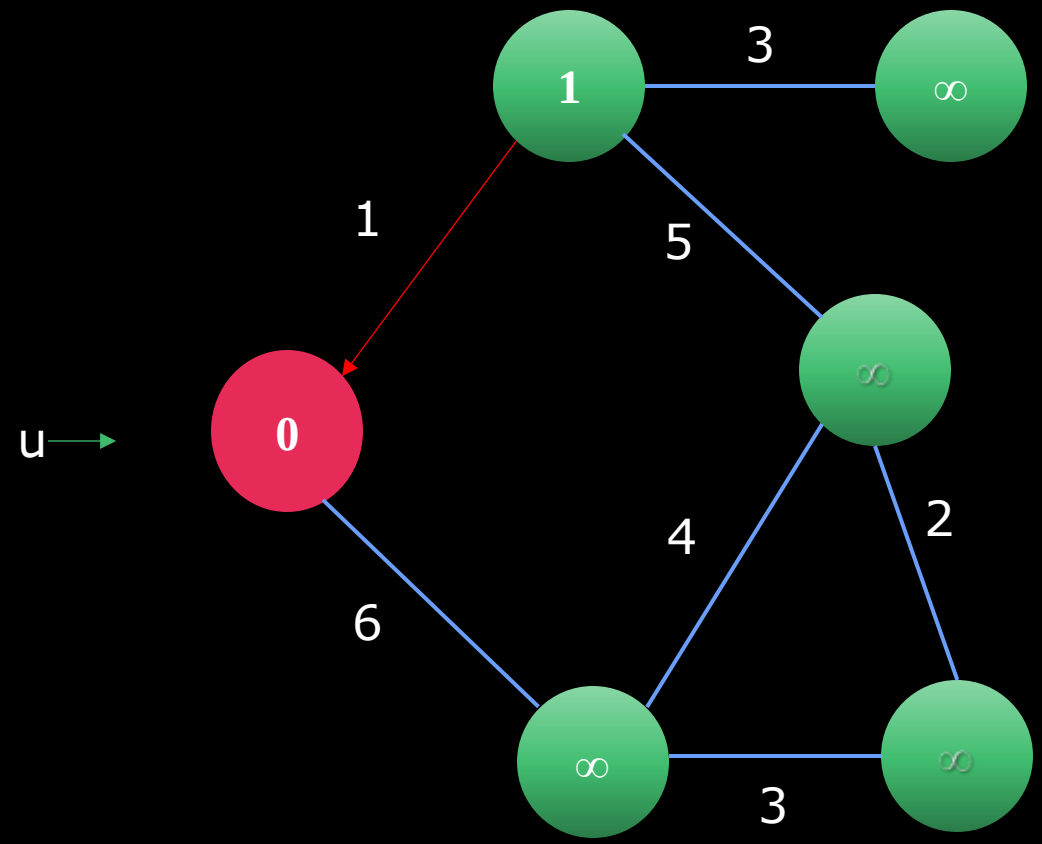
Finding MST with Prim's Algorithm

Step 3: Red vertices have been removed from Q.

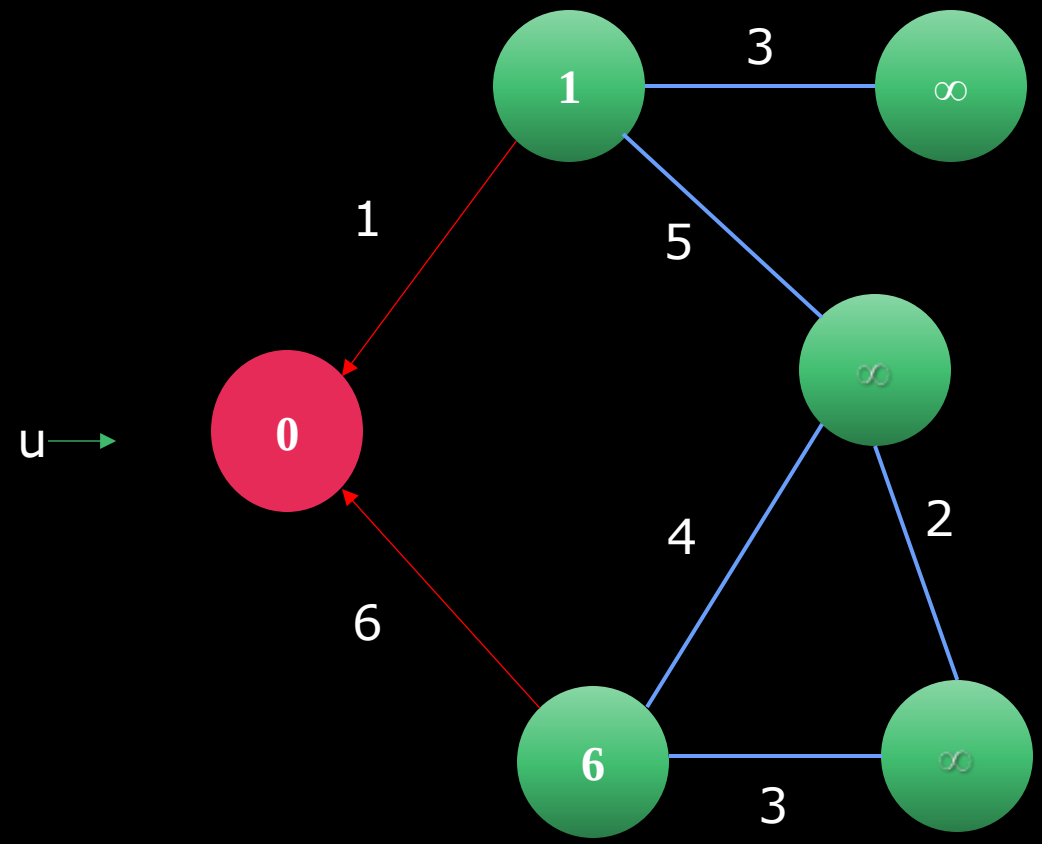


Finding MST with Prim's Algorithm

Step 4: Red arrows indicate parent vertices.



Finding MST with Prim's Algorithm



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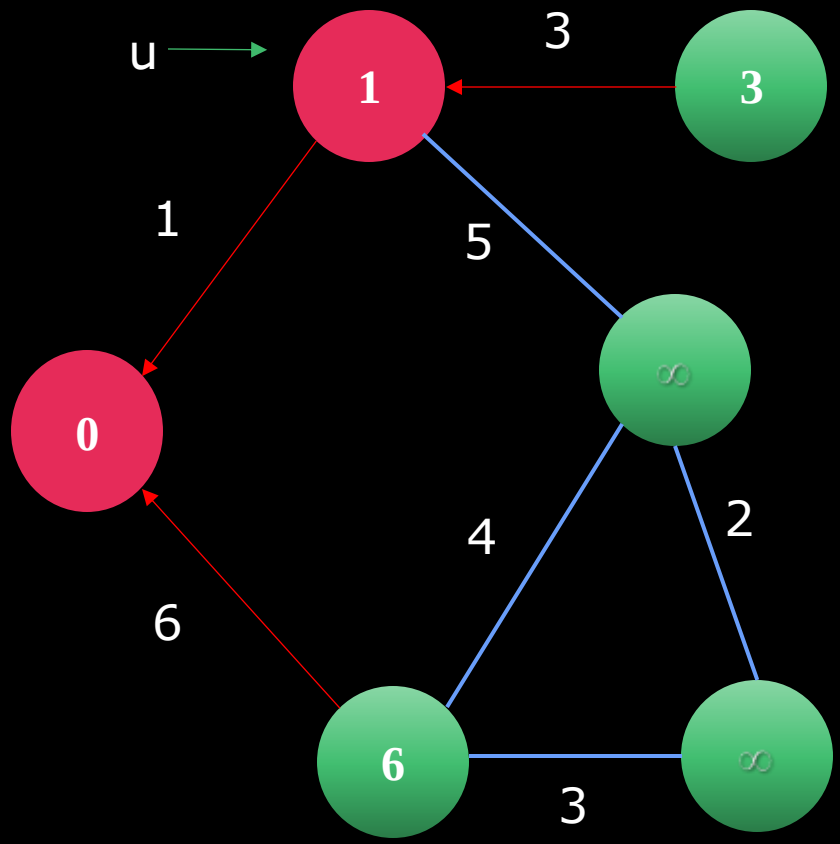
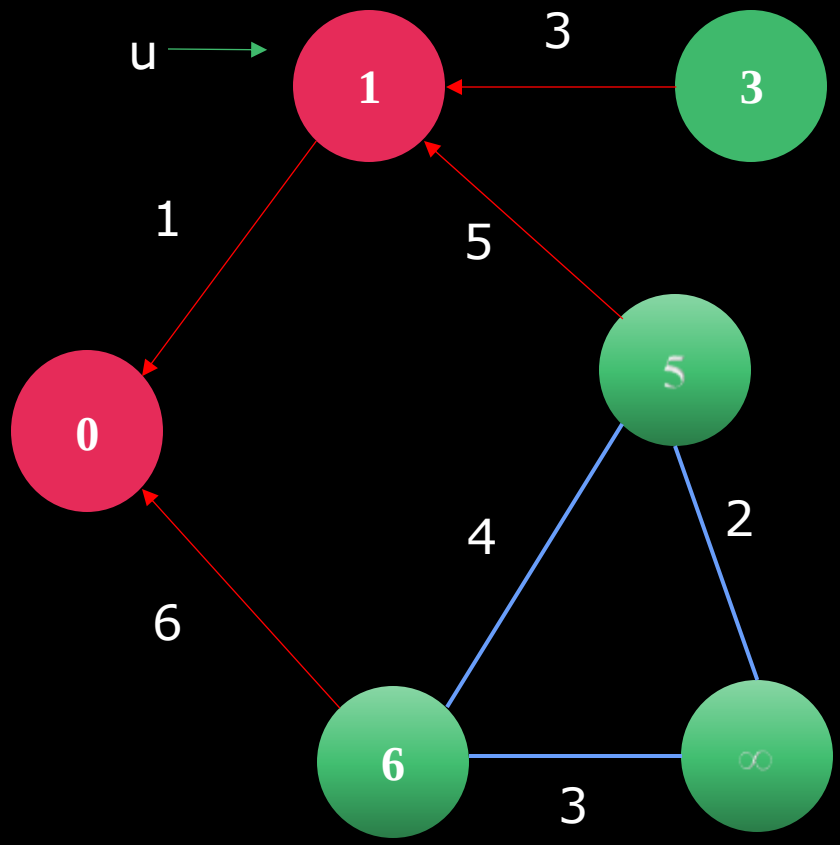
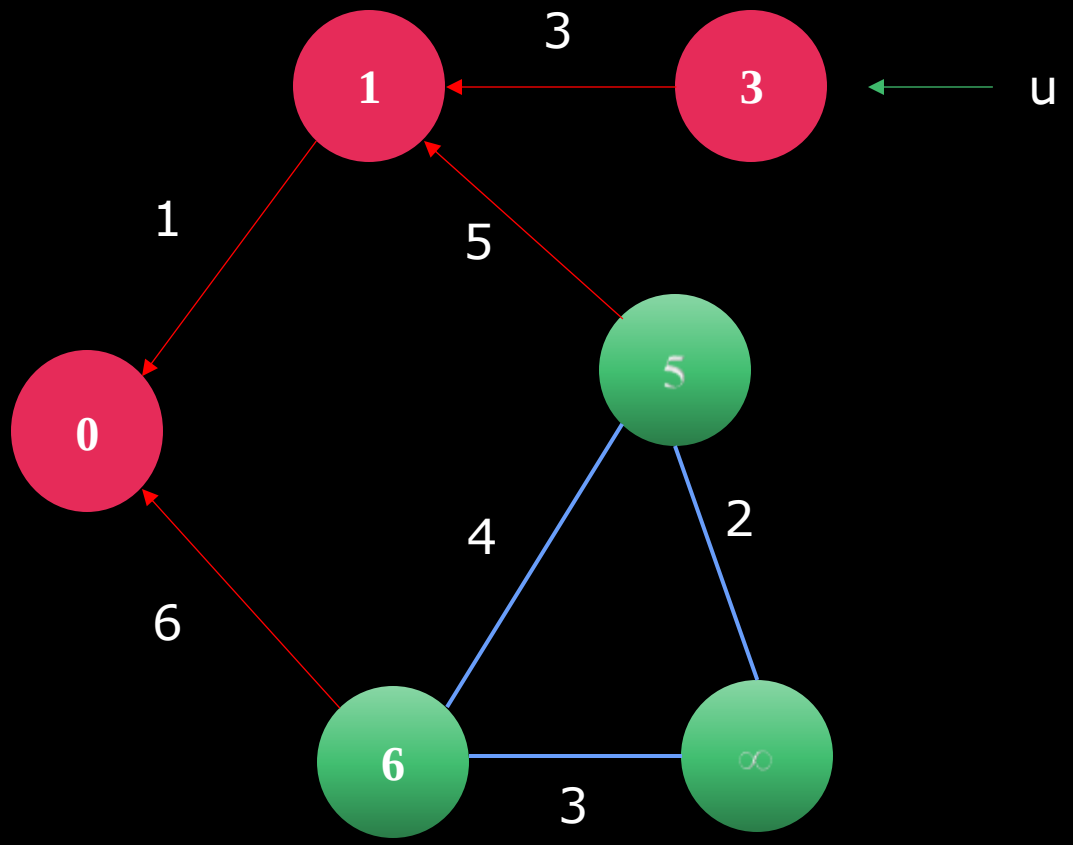


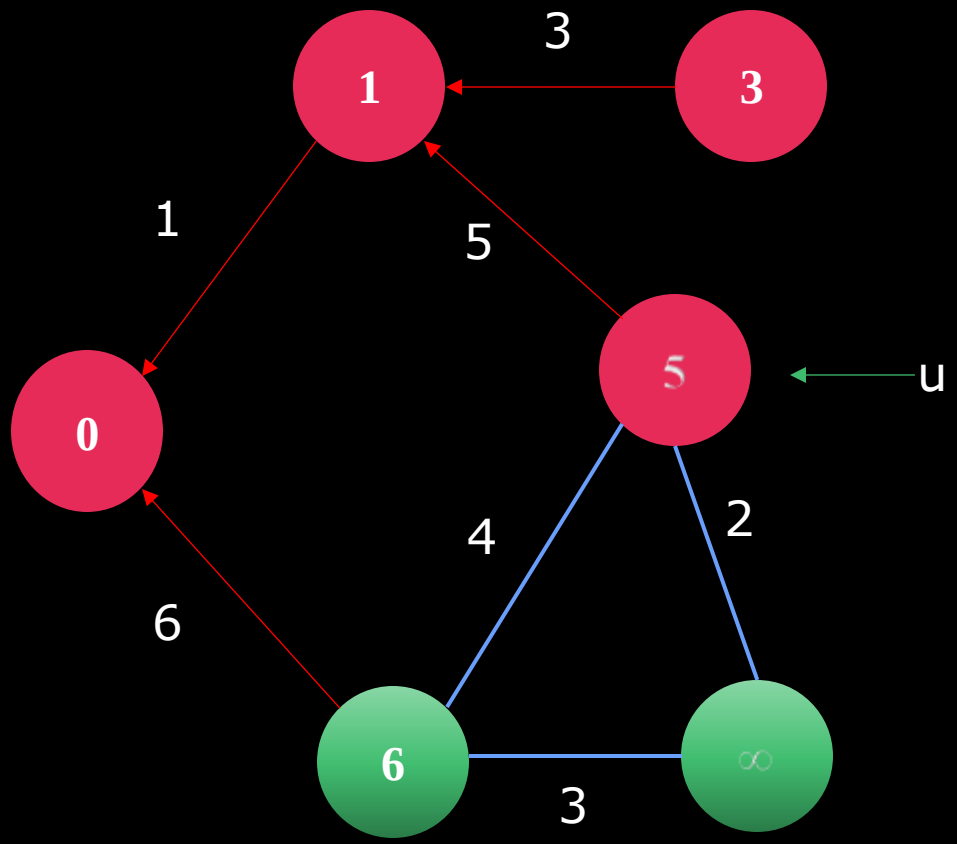
Finding MST with Prim's Algorithm



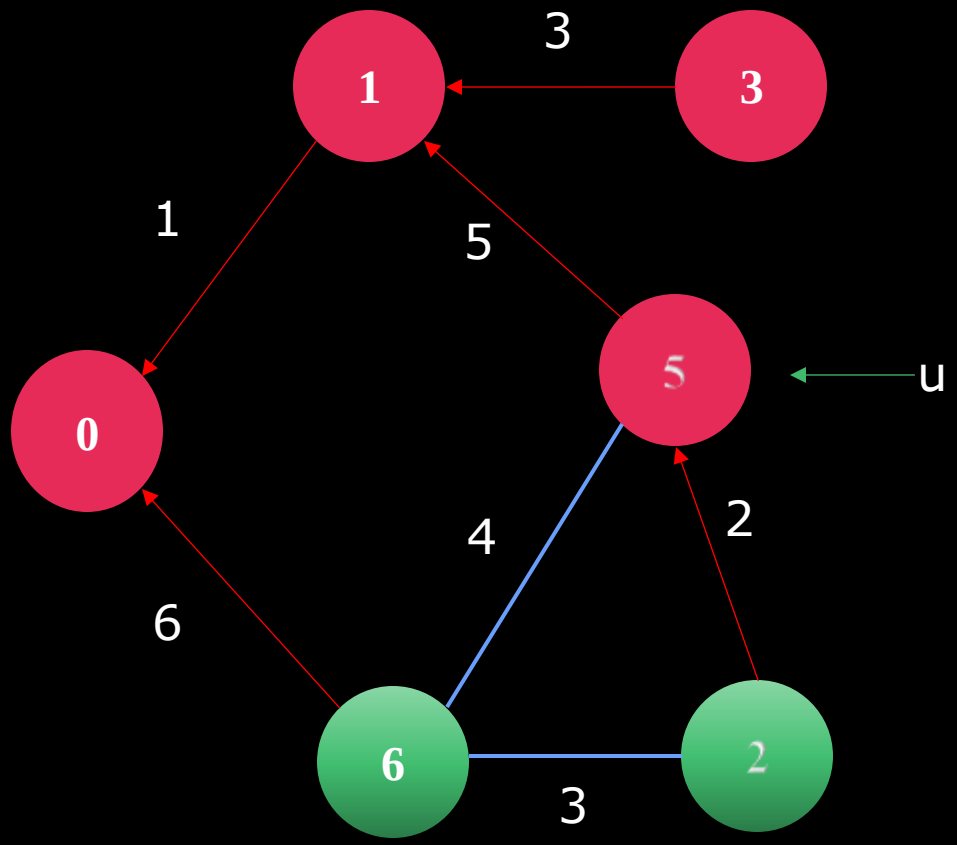
Finding MST with Prim's Algorithm



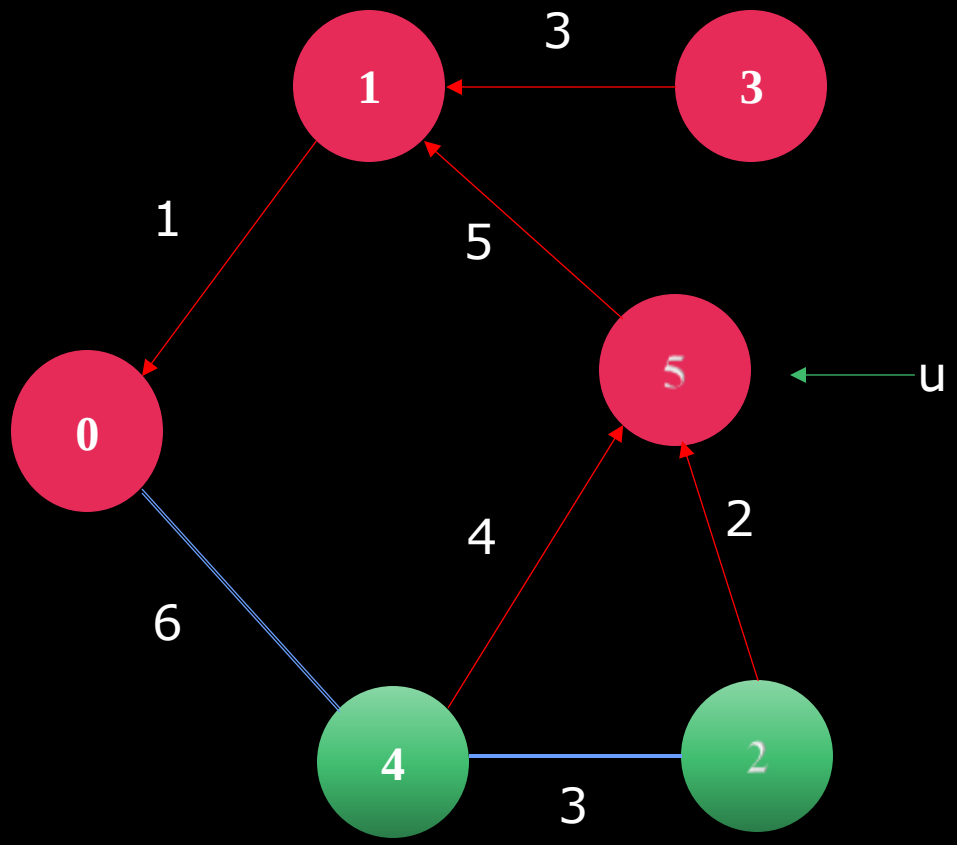
Finding MST with Prim's Algorithm



Finding MST with Prim's Algorithm



Finding MST with Prim's Algorithm



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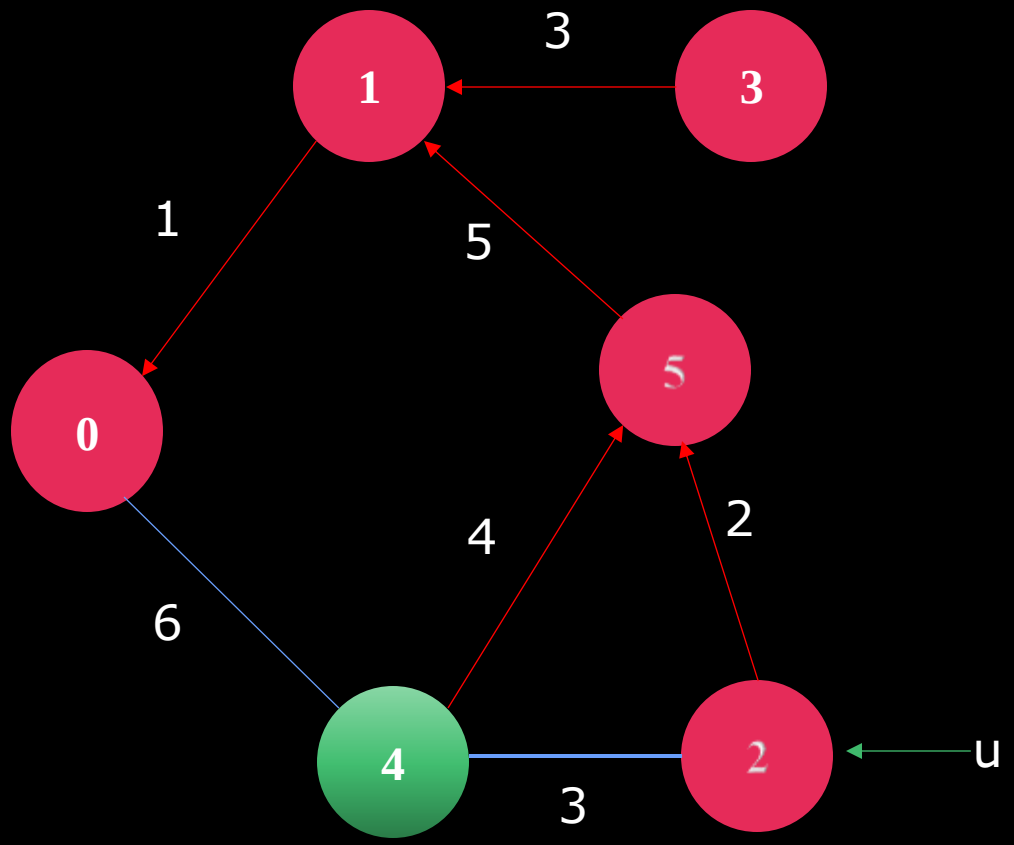

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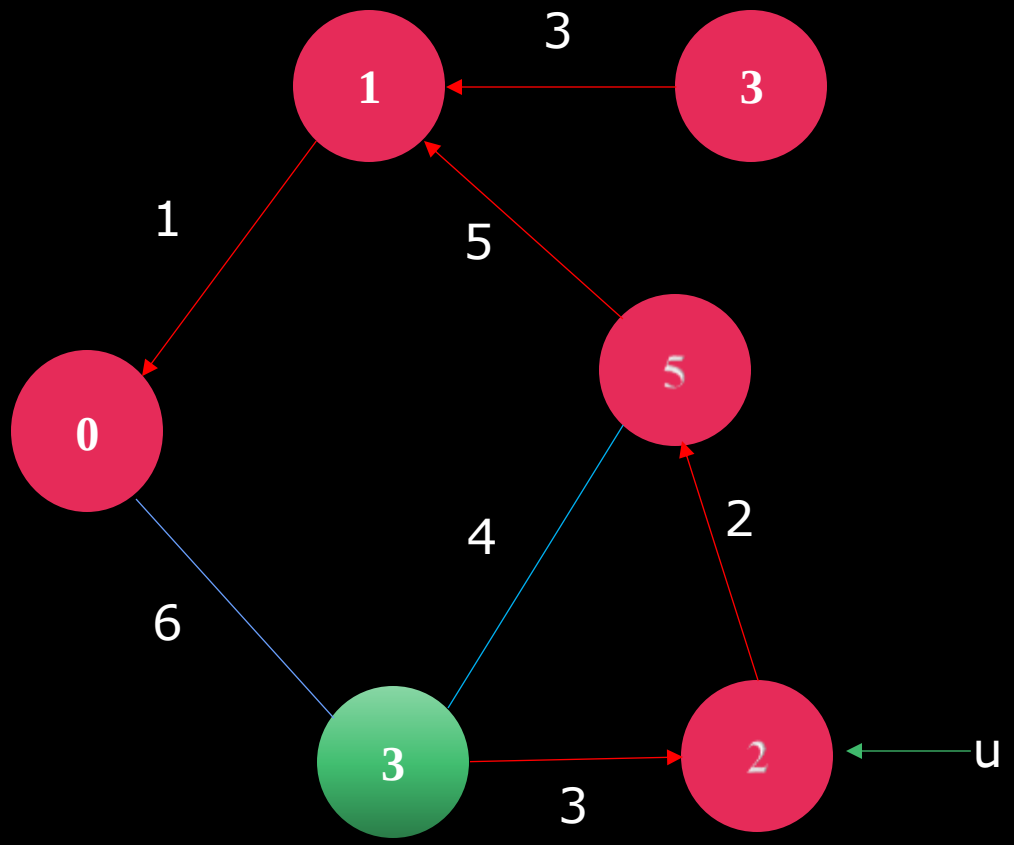

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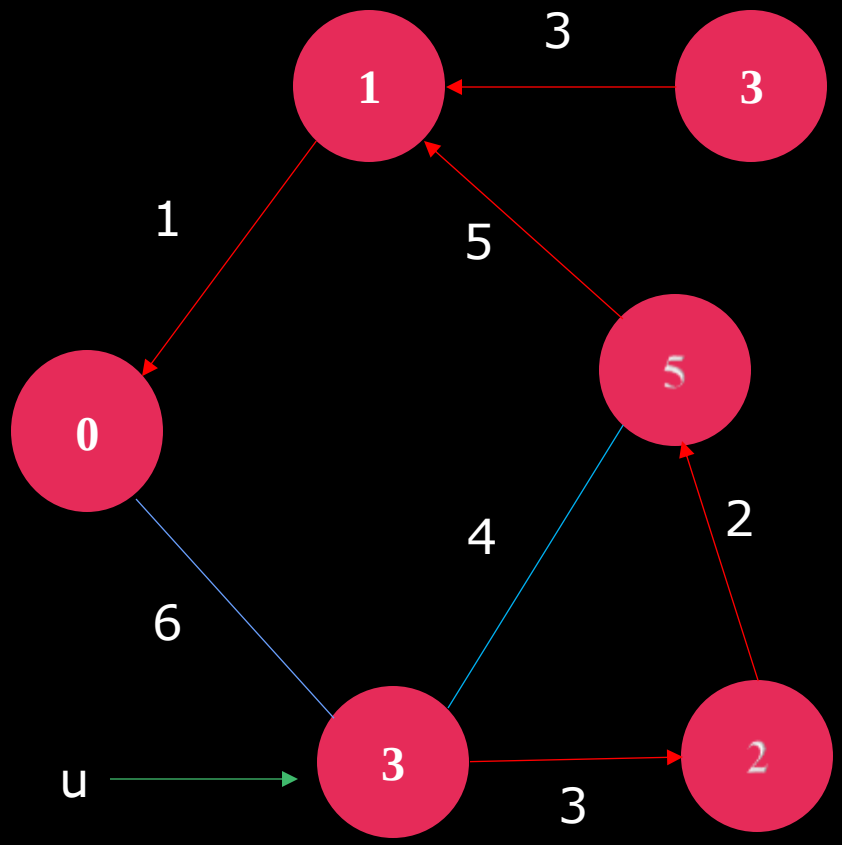

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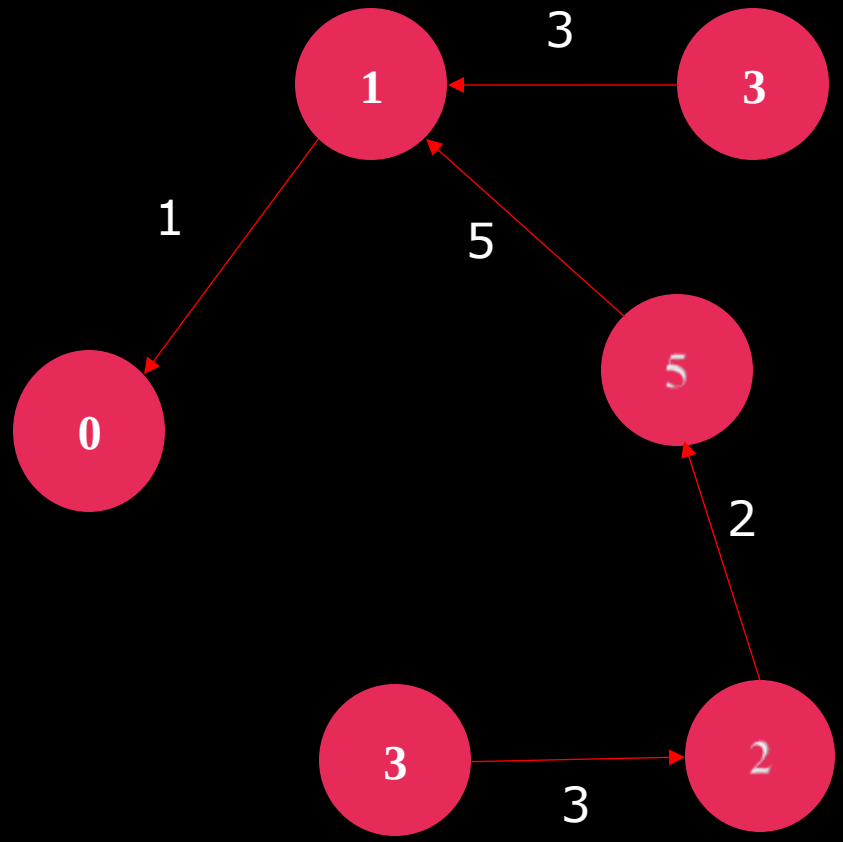
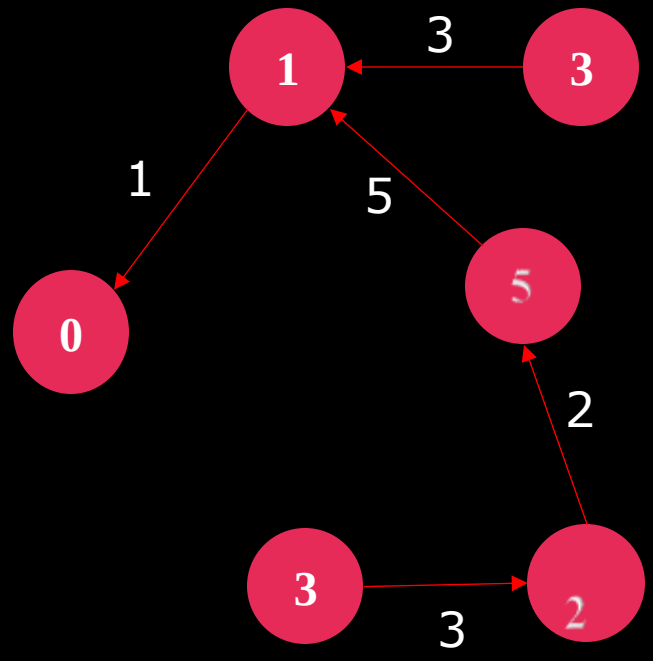


Weight : 1+3+5+2+3=14

Running Time



The Final Minimum Spanning Tree

What will be the running time?
A: Depends on queue
Binary heap: O(E lg V)
Fibonacci heap: O(V lg V + E)


Thank you