CSCI 232:
Data Structures and Algorithms

Minimum Spanning Tree (MST) Part 1

Reese Pearsall

Spring 2024

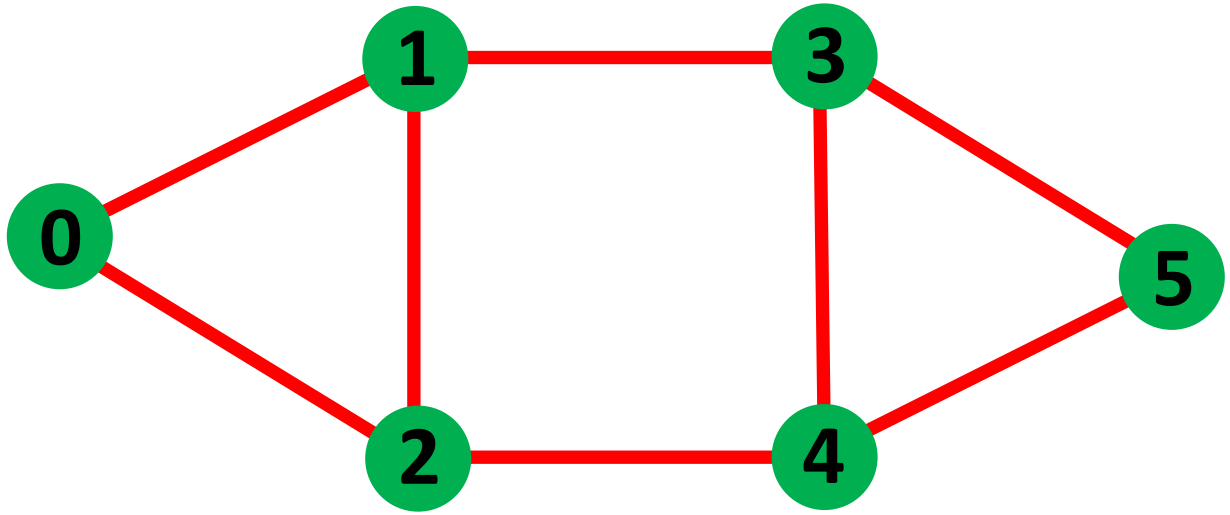
Announcements

Lab 9 due on Friday

Fill out survey if you haven’t already for lab 8

Graphs

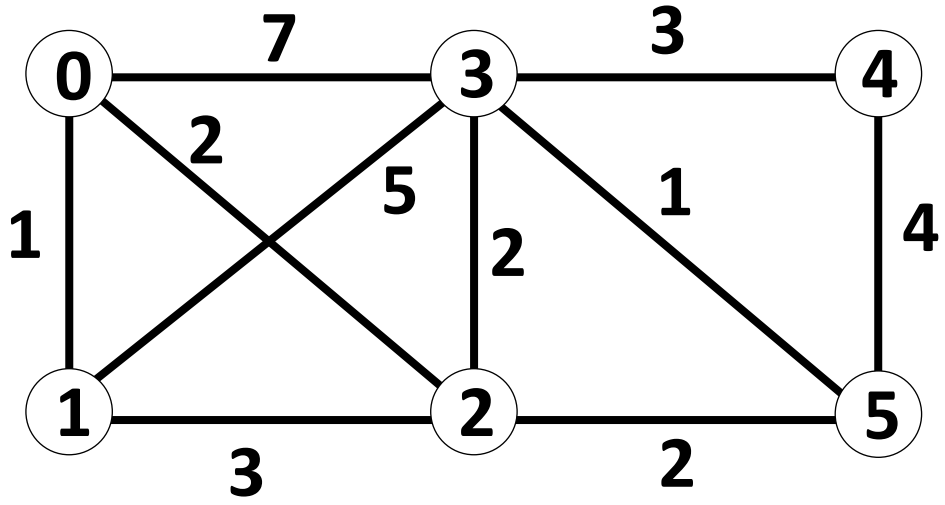
G = (V, E)



Adjacency List

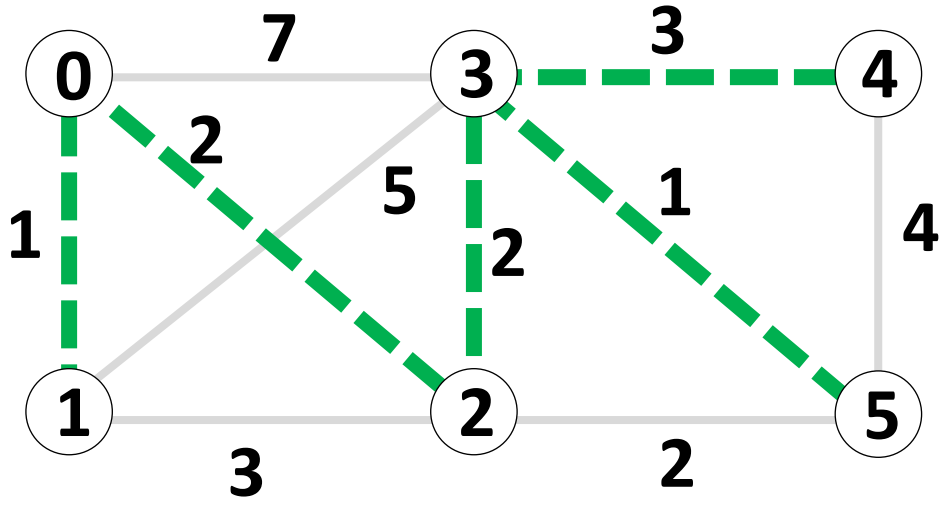
0	→	{1,2}
1	→	{0,2,3}
2	→	{0,1,4}
3	→	{1,4,5}
4	→	{2,3,5}
5	→	{3,4}

Minimum Spanning Tree



Edge-weighted graph: A graph where each edge has a weight (cost).

Minimum Spanning Tree

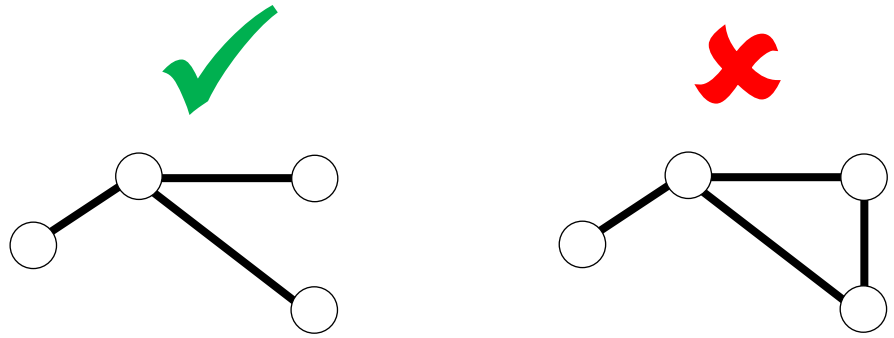


Edge-weighted graph: A graph where each edge has a weight (cost).

MST Goal: Connect all vertices to each other with a minimum weight subset of edges.

Minimum Spanning Tree

Tree – connected graph with no loops.



Minimum Spanning Tree

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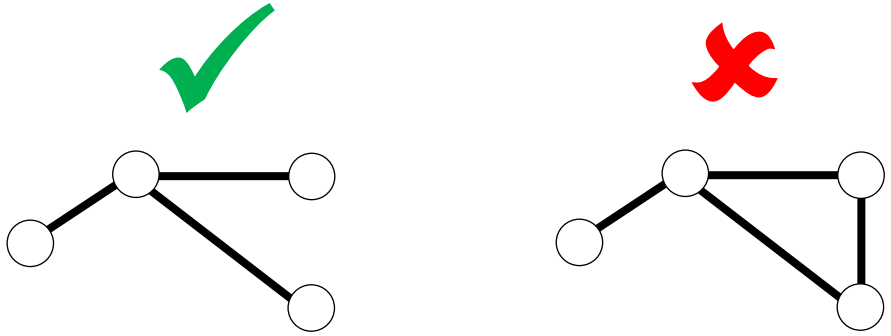

Spanning tree – tree that includes all vertices in a graph.

Minimum Spanning Tree

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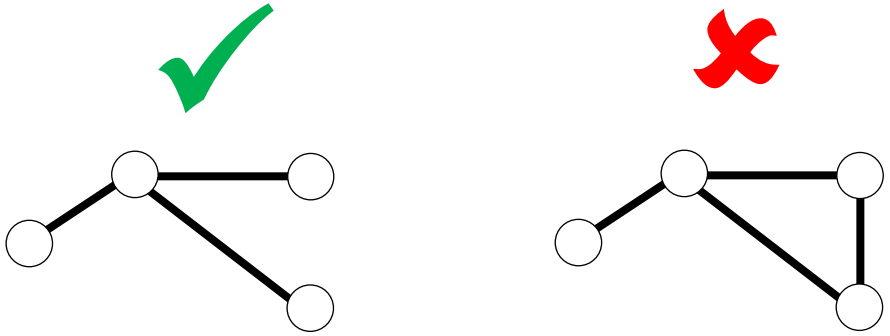
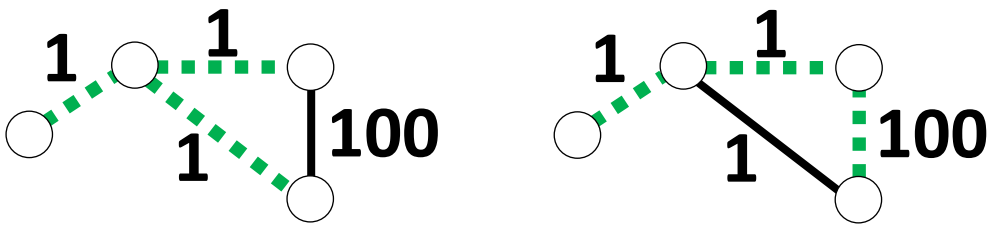
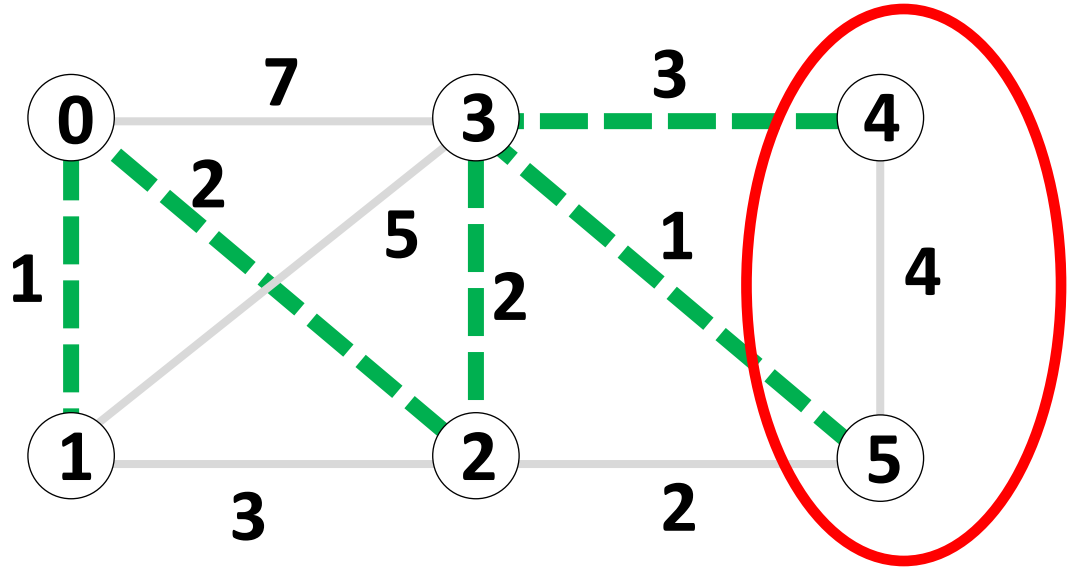


Spanning tree – tree that includes all vertices in a graph.

Minimum spanning tree – spanning tree whose sum of edge costs is the minimum possible value.



Minimum Spanning Tree



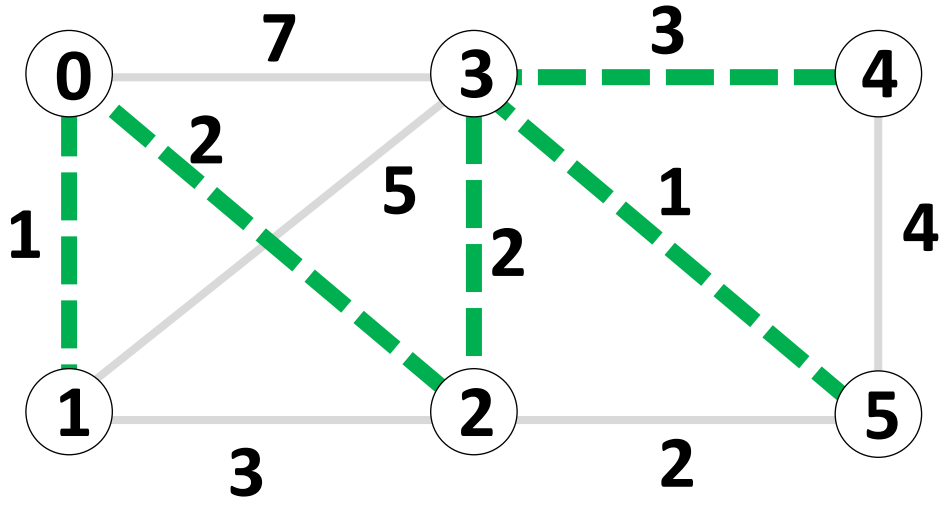
Does it ever make sense to have a cycle?

No!

Must be a tree!

MST Goal: Connect all vertices to each other with a minimum weight subset of edges.

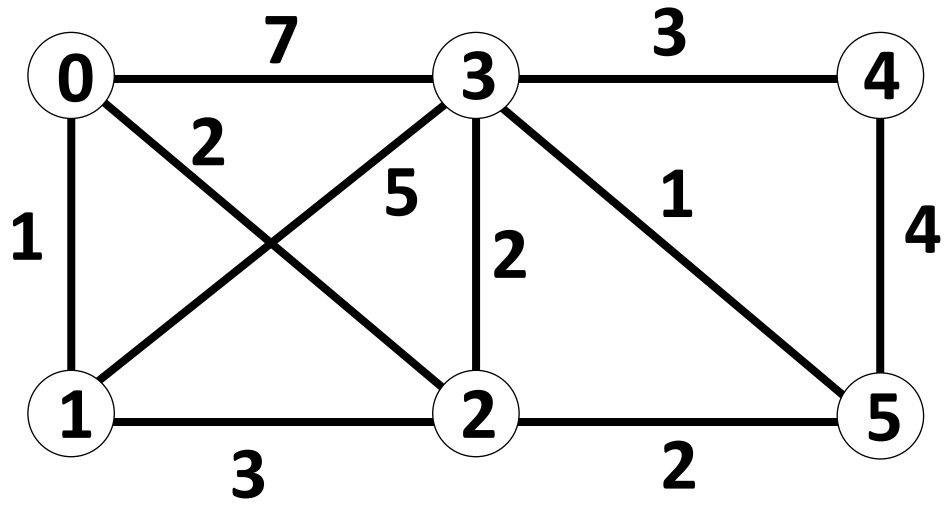
Minimum Spanning Tree



How to find MSTs?

Kruskal's MST Algorithm

At each iteration, add the edge with smallest weight, that does not create a cycle.



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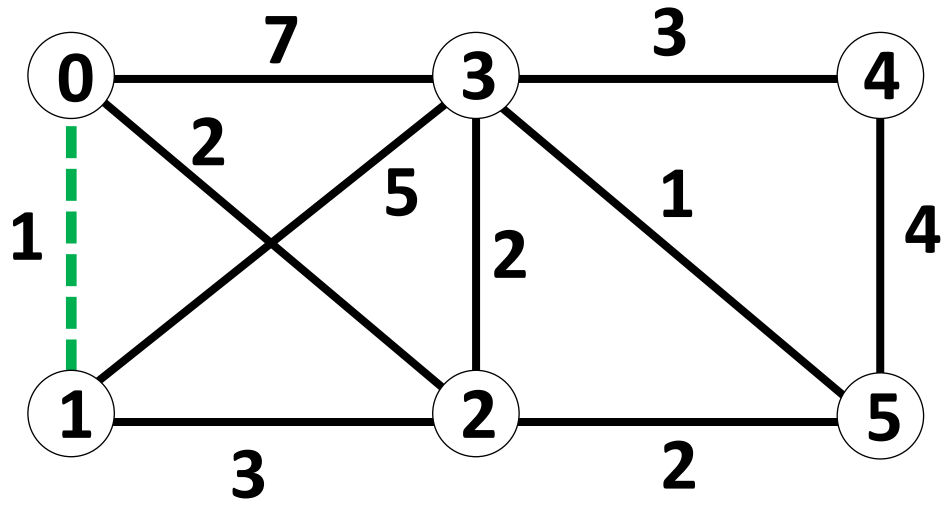

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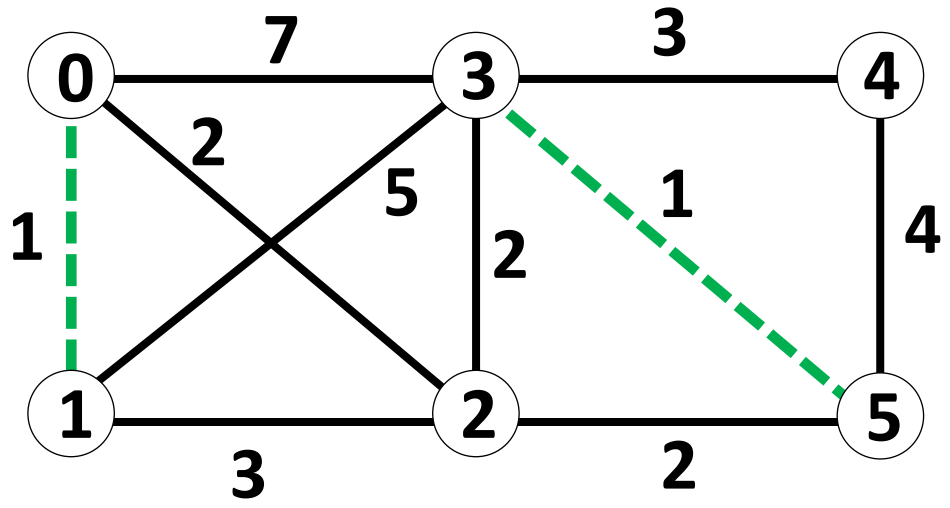

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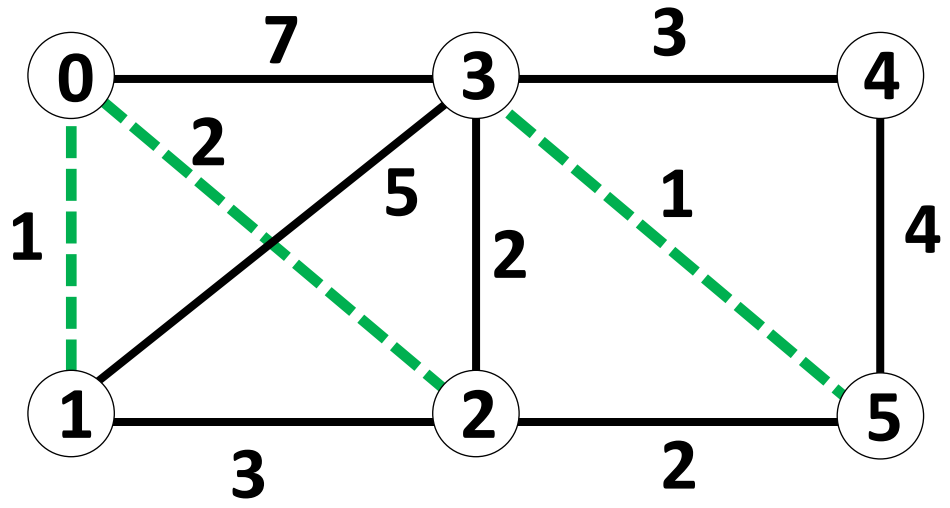

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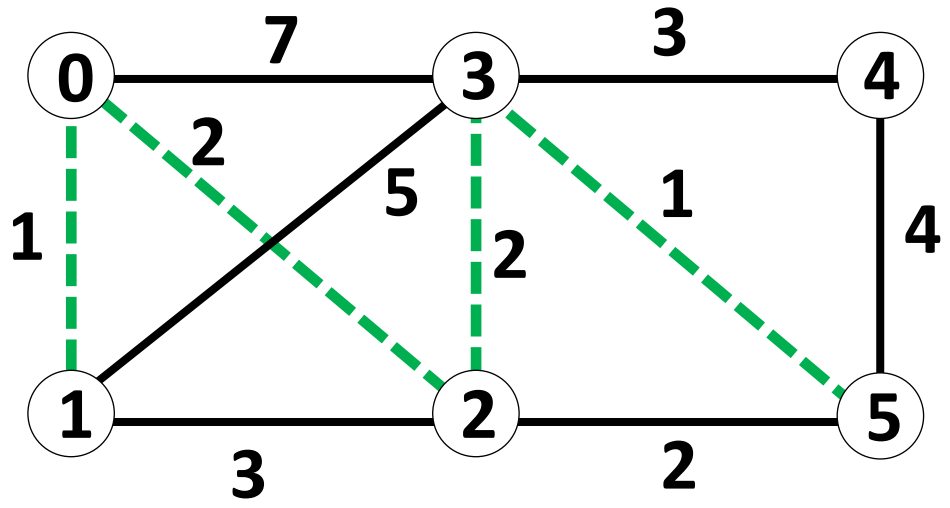

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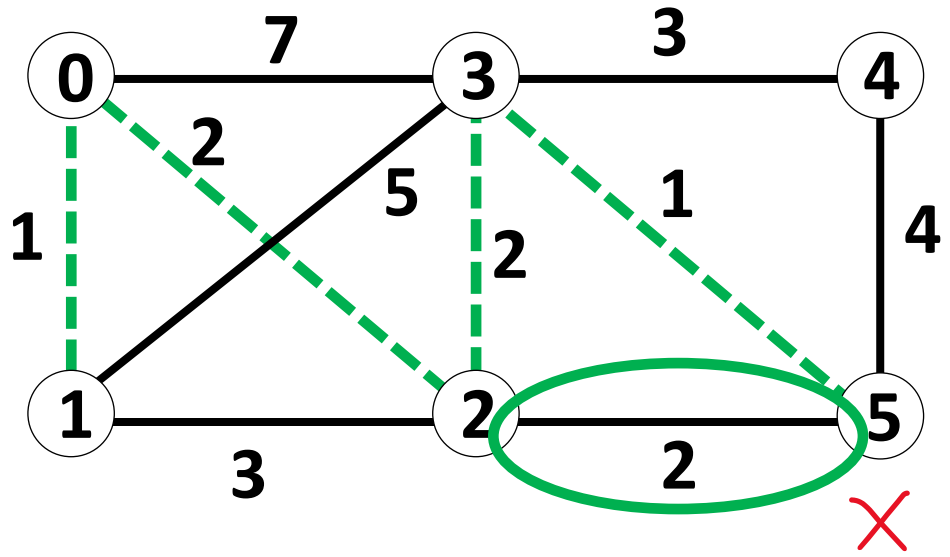

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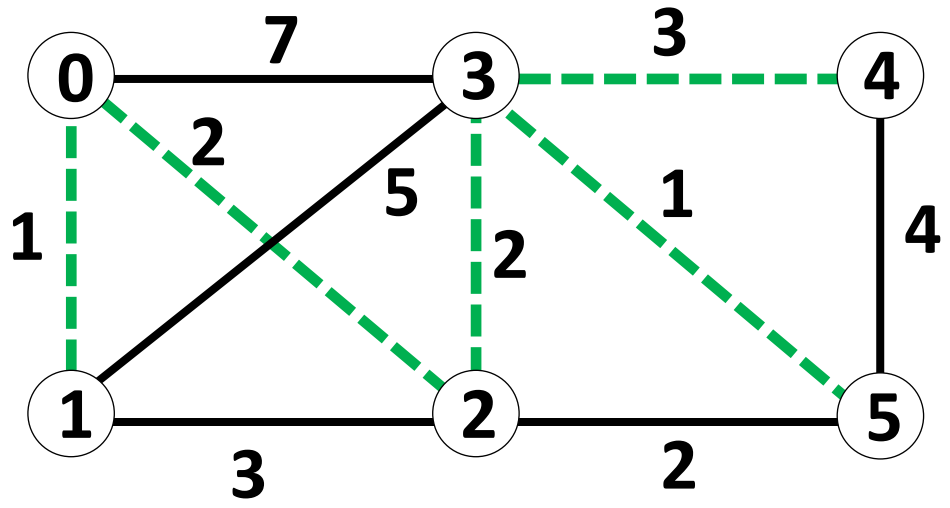

Kruskal's MST Algorithm

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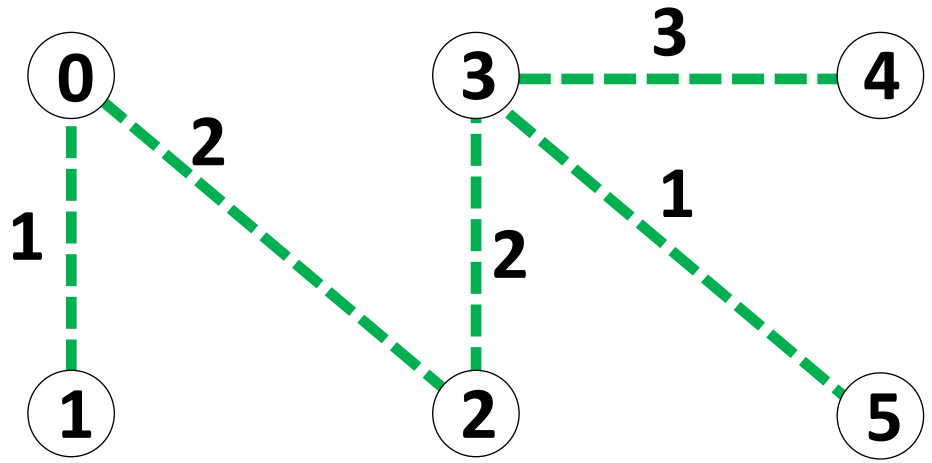
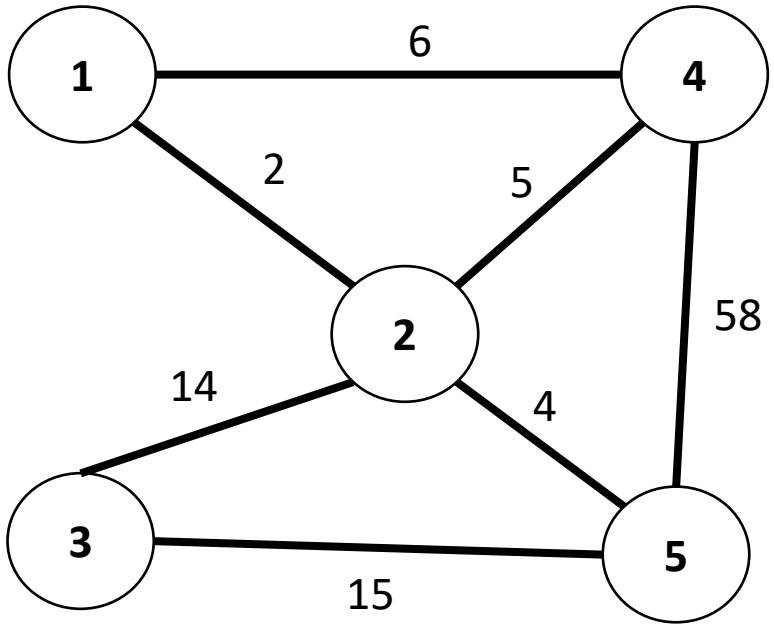
MST = [0, 1], [0, 2], [2,3], [3,5], [3,4] **Total Cost = 9**



MST vs Shortest Path

MST and shortest path are two different problems, and sometimes that shortest path will not be part of the MST



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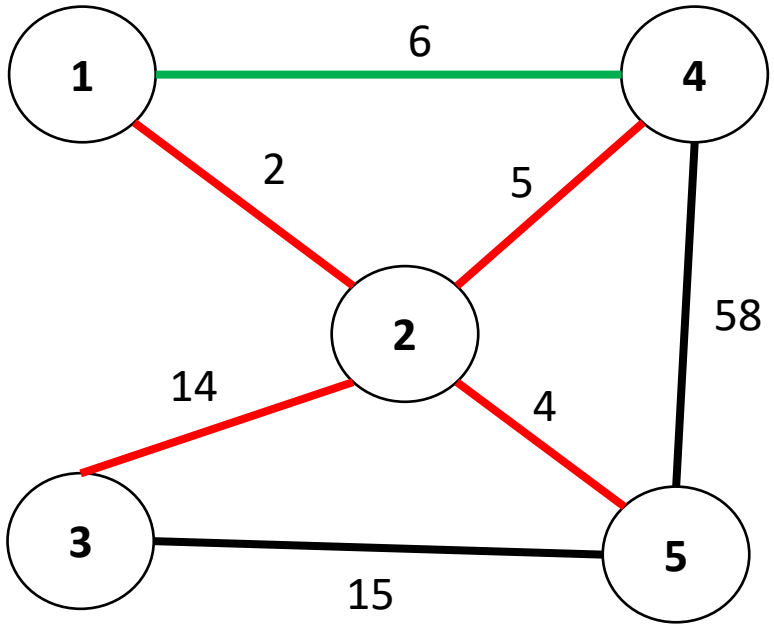
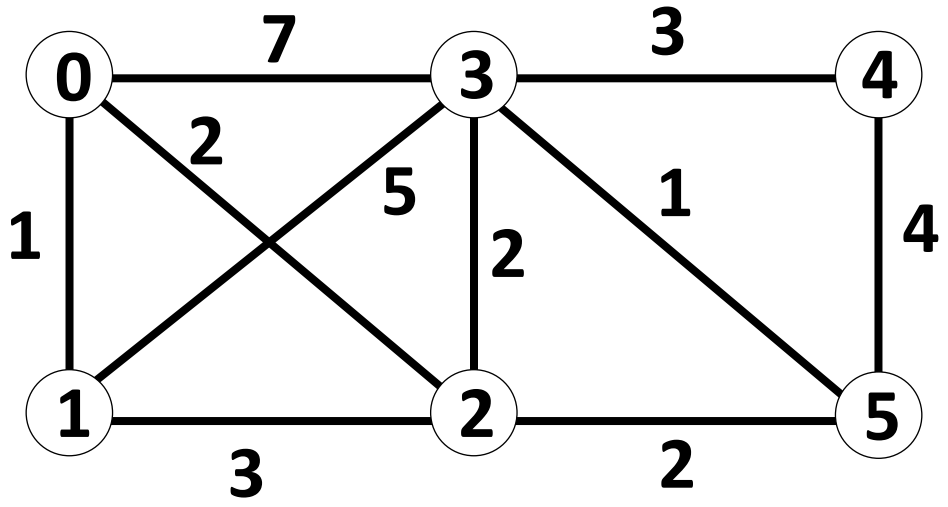


MST Cost = 25

Shortest Path from 1 to 4 = 6

Weighted Graph




```
public class Edge {

        private int vertex1;
        private int vertex2;

        private int weight;

        public int[] getVertices()

        public int getWeight()

        public String toString()

        public boolean equals()
```