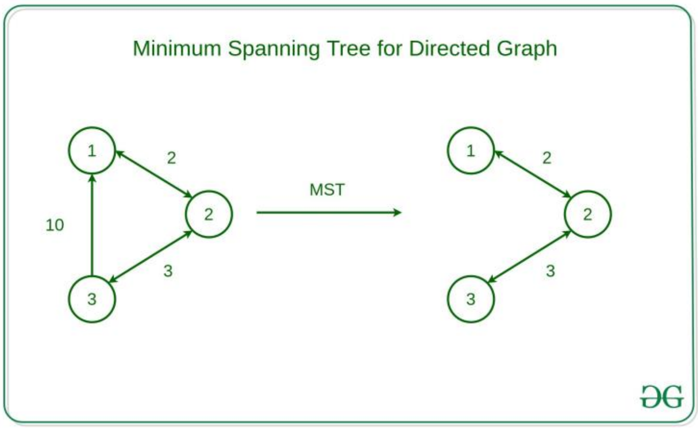
What is Minimum Spanning Tree (MST)

*A **minimum spanning tree (MST)** is defined as a **spanning tree** that has the minimum weight among all the possible spanning trees*

A **spanning tree** is defined as a tree-like subgraph of a connected, undirected graph that includes all the vertices of the graph. Or, to say in Layman's words, it is a subset of the edges of the graph that forms a tree (**acyclic**) where every node of the graph is a part of the tree.

The minimum spanning tree has all the properties of a spanning tree with an added constraint of having the minimum possible weights among all possible spanning trees. Like a spanning tree, there can also be many possible MSTs for a graph.



Properties of a Spanning Tree:

The spanning tree holds the **below-mentioned principles**:

- The number of vertices (**V**) in the graph and the spanning tree is the same.
- 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**).
- The spanning tree should not be **disconnected**, as in there should only be a single source of component, not more than that.
- The spanning tree should be **acyclic,** which means there would not be any cycle in the tree.
- The total cost (or weight) of the spanning tree is defined as the sum of the edge weights of all the edges of the spanning tree.

- There can be many possible spanning trees for a graph.

Minimum Spanning Tree:

*A **minimum spanning tree (MST)** is defined as a **spanning tree** that has the minimum weight among all the possible spanning trees.*

The minimum spanning tree has all the properties of a spanning tree with an added constraint of having the minimum possible weights among all possible spanning trees. Like a spanning tree, there can also be many possible MSTs for a graph.

Algorithms to find Minimum Spanning Tree:

There are several algorithms to find the minimum spanning tree from a given graph, some of them are listed below:

Kruskal's Minimum Spanning Tree Algorithm:

This is one of the popular algorithms for finding the minimum spanning tree from a connected, undirected graph. This is a greedy algorithm. The algorithm workflow is as below:

- First, it sorts all the edges of the graph by their weights,
- Then starts the iterations of finding the spanning tree.
- At each iteration, the algorithm adds the next lowest-weight edge one by one, such that the edges picked until now does not form a cycle.

This algorithm can be implemented efficiently using a DSU (Disjoint-Set) data structure to keep track of the connected components of the graph. This is used in a variety of practical applications such as network design, clustering, and data analysis.