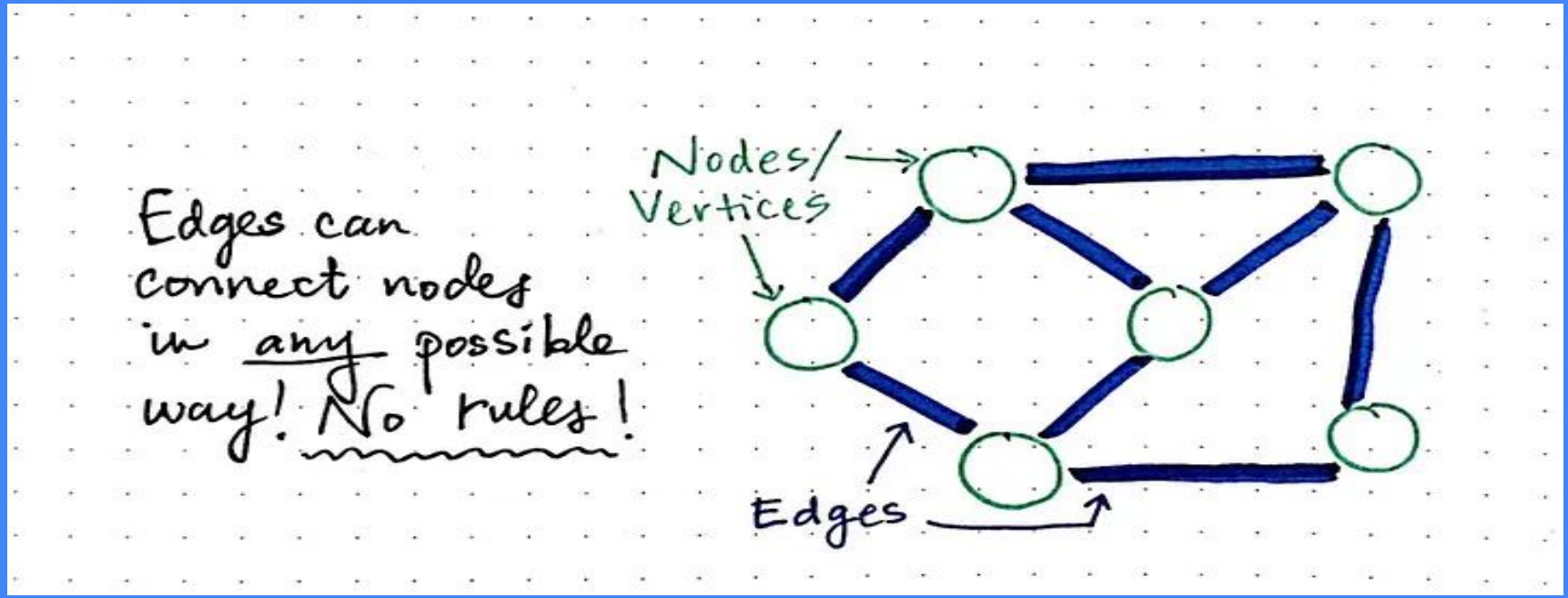
Introduction to Graph Theory

- Graphs consist of Node and Edges
- Used to represent relationships and connections



What is Graph Decomposition?

- Breaking down a graph into smaller, manageable parts
- Helps in simplifying complex structures

Use Cases

Community Detection in Facebook

- Example: Facebook groups or news feed optimization.

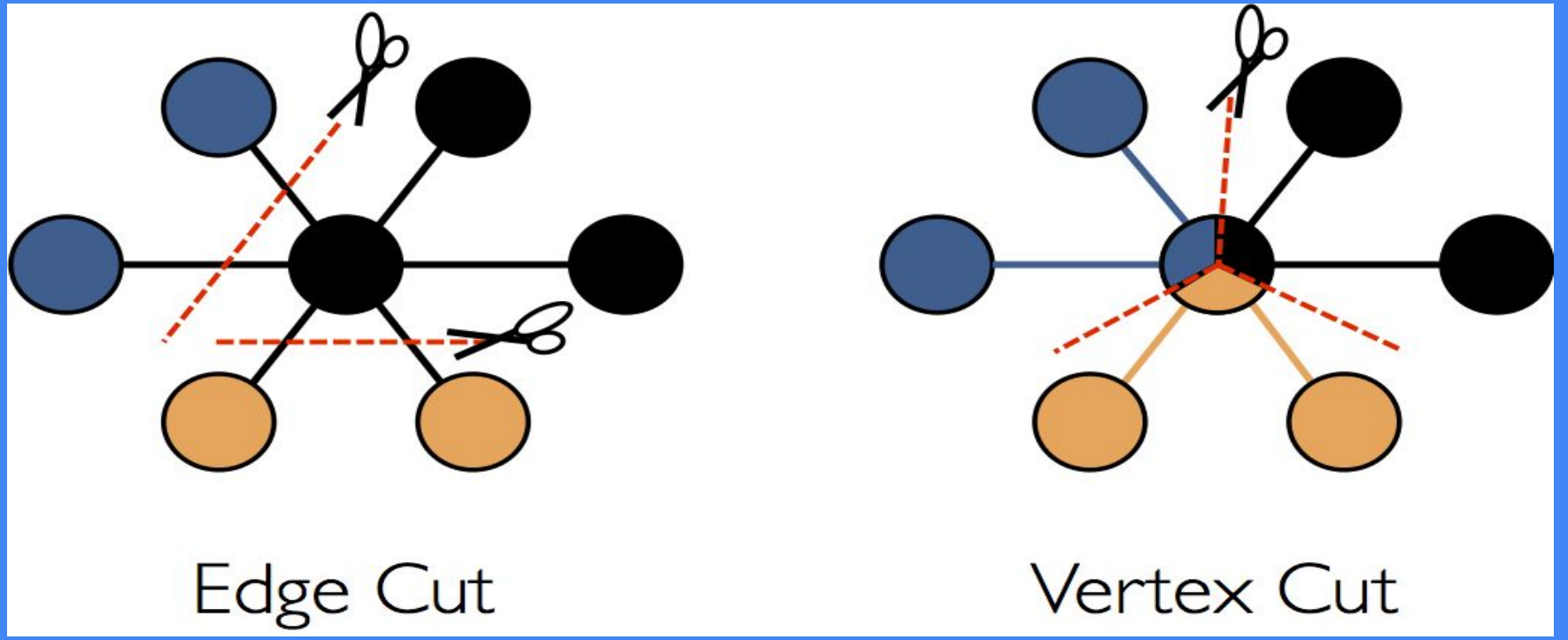
Infrastructure Planning

- Example: Used in GPS apps like Google Maps, Waze.

Power Grid Optimization

- Example: Twitter uses variations of centrality algorithms to recommend followers.

Node Partitioning and Edge Partitioning



Computational Complexity

- Time and space efficiency
- Scalability with graph size

Scalability

- Ability to handle large graphs
- Important for real-time systems

What is the Shortest Path Problem?

Def:- How do I get from Point A to Point B using the least distance, time, or cost?

Ex..

- GPS navigation
- Delivery route planning
- Internet data routing
- Game AI (like finding a path in a maze)

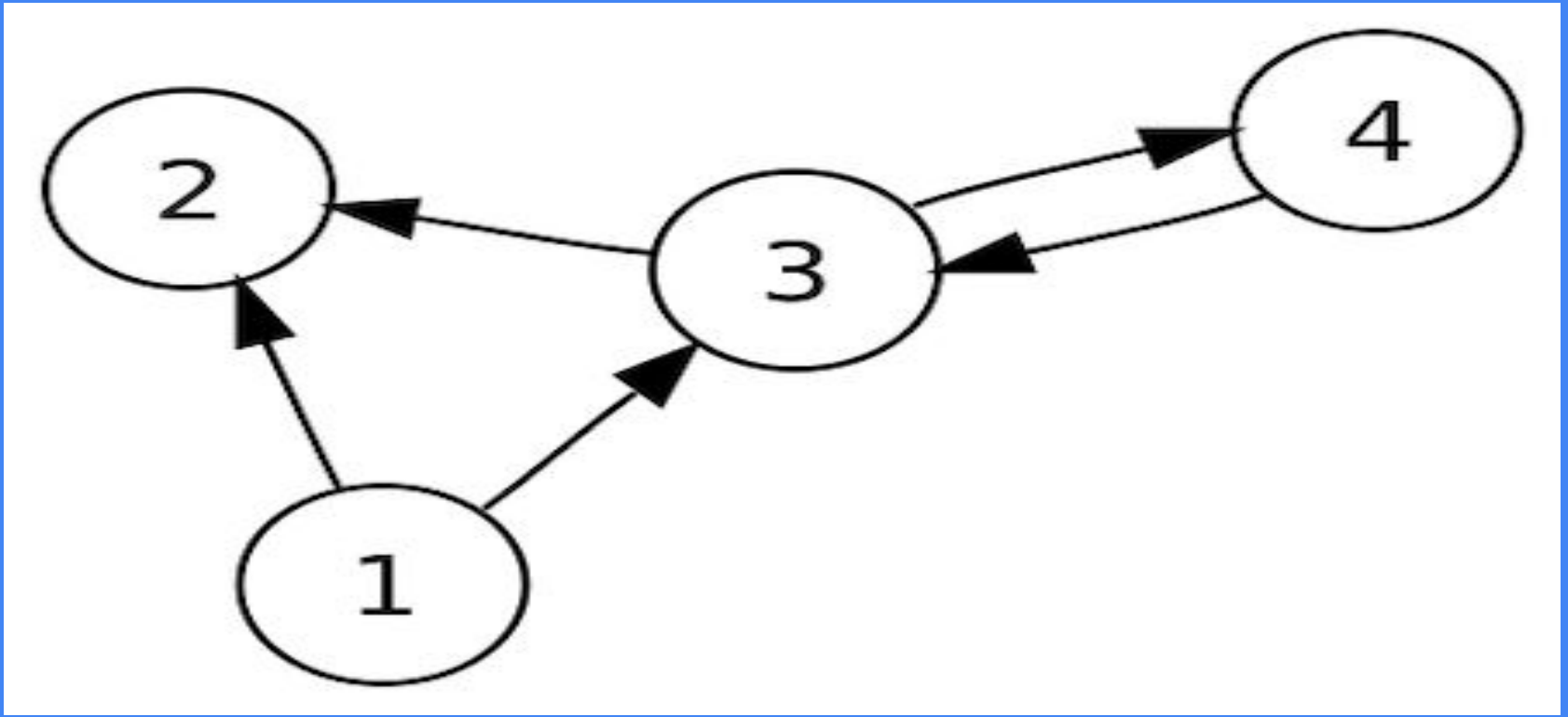
What is a Graph?

- **Def:-** Graph is a collection of Node and Edges

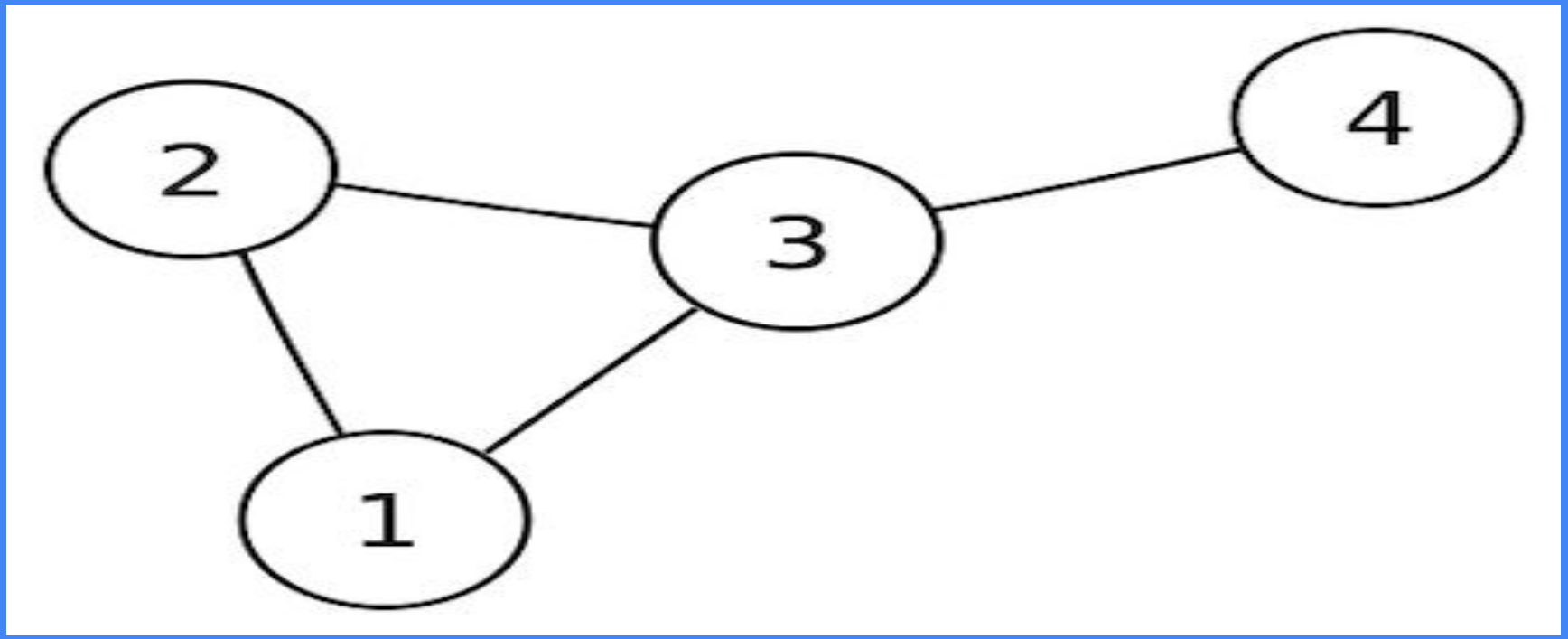
Types of Graphs

- Directed and Undirected
- Weighted and Unweighted

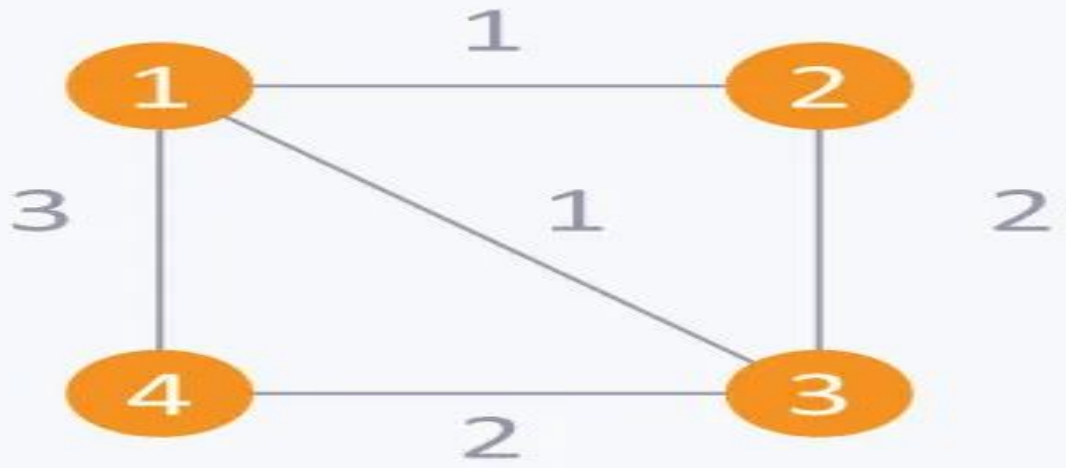
Directed Graph



Undirected Graph

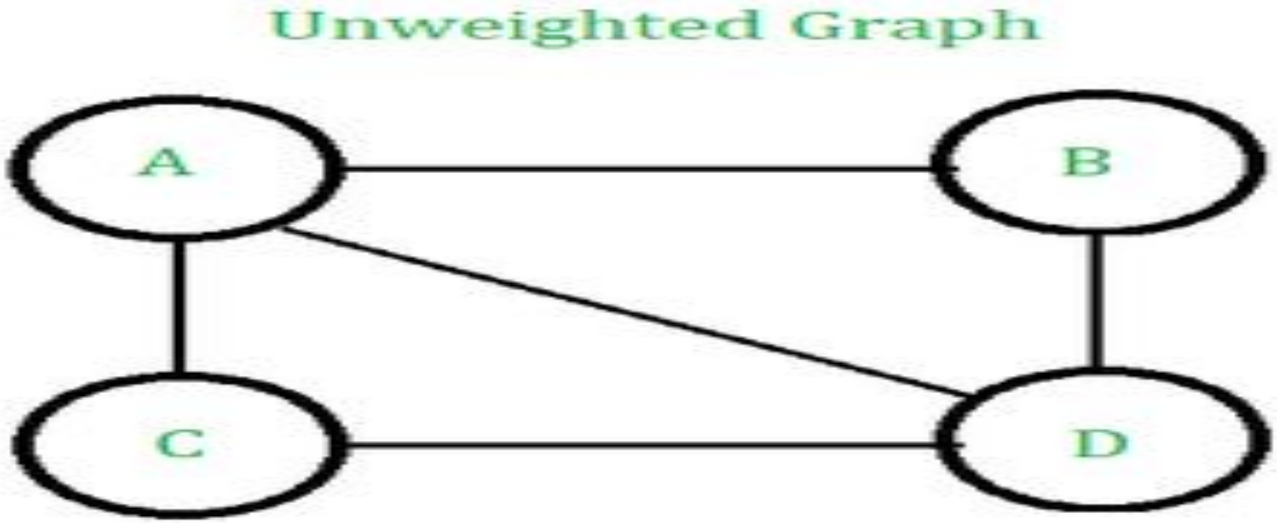


Weighted Graph

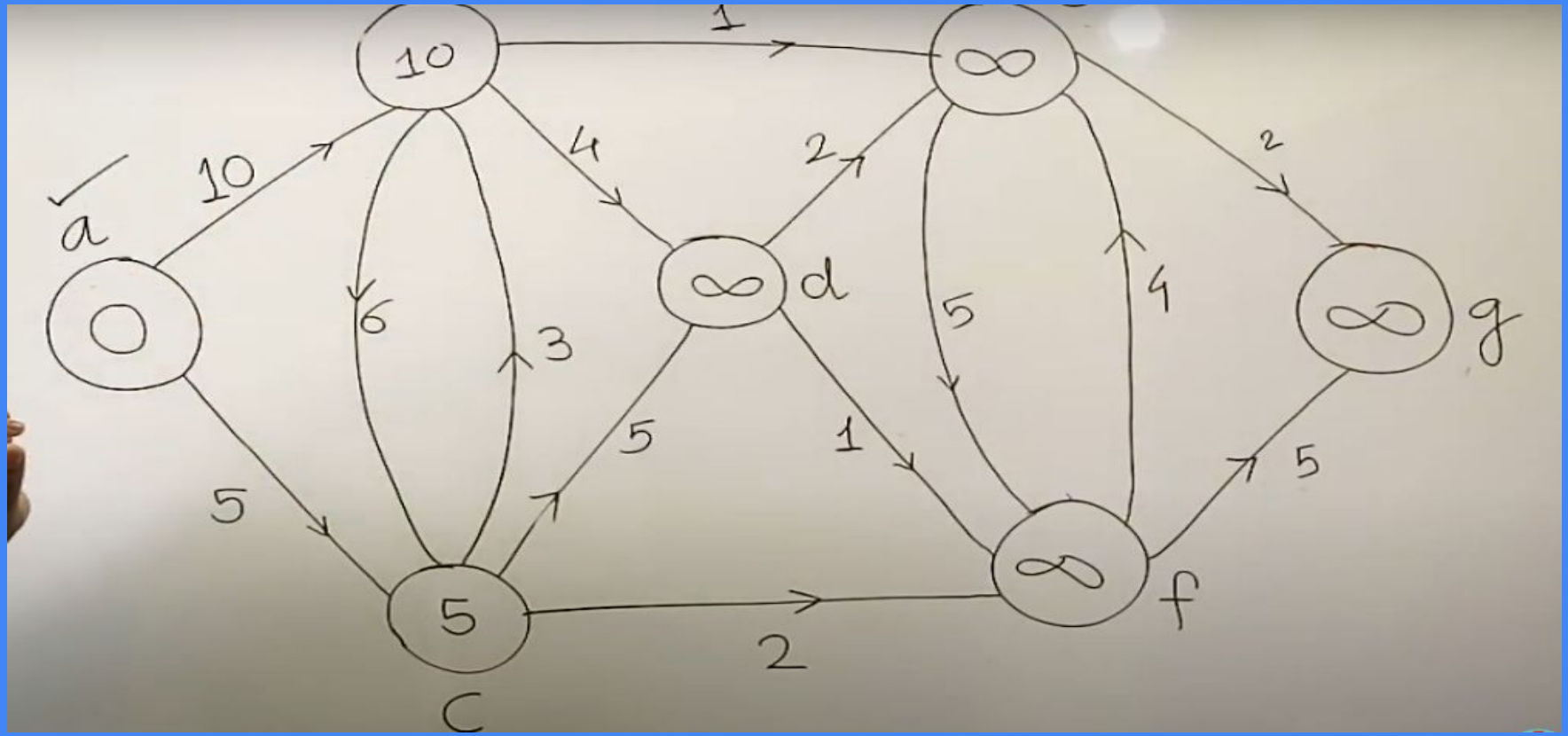


Weighted Graph

Unweighted Graph



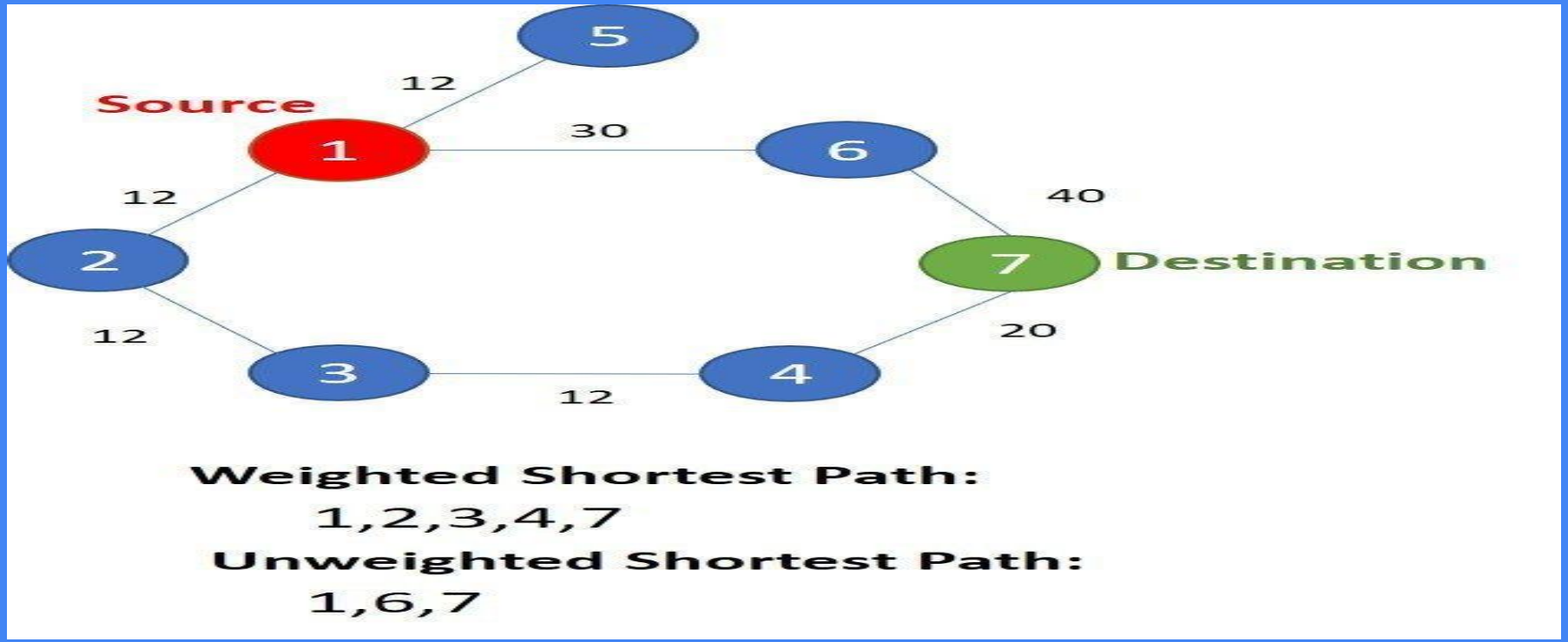
Dijkstra's Algorithm



Terminologies

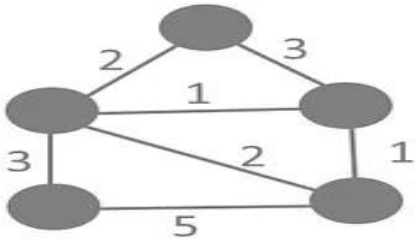
- Node
- Edge
- Weight path
- Unweighted path
- Path
- Source and Destination

Terminologies Explanation

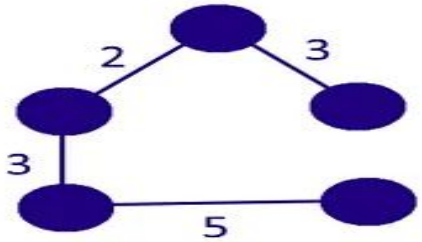


What is a Spanning Tree?

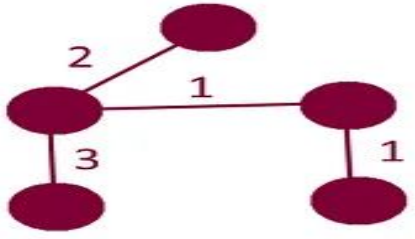
Def:-A spanning tree is a way of connecting all the nodes in a network using the edges without making any loops



Graph

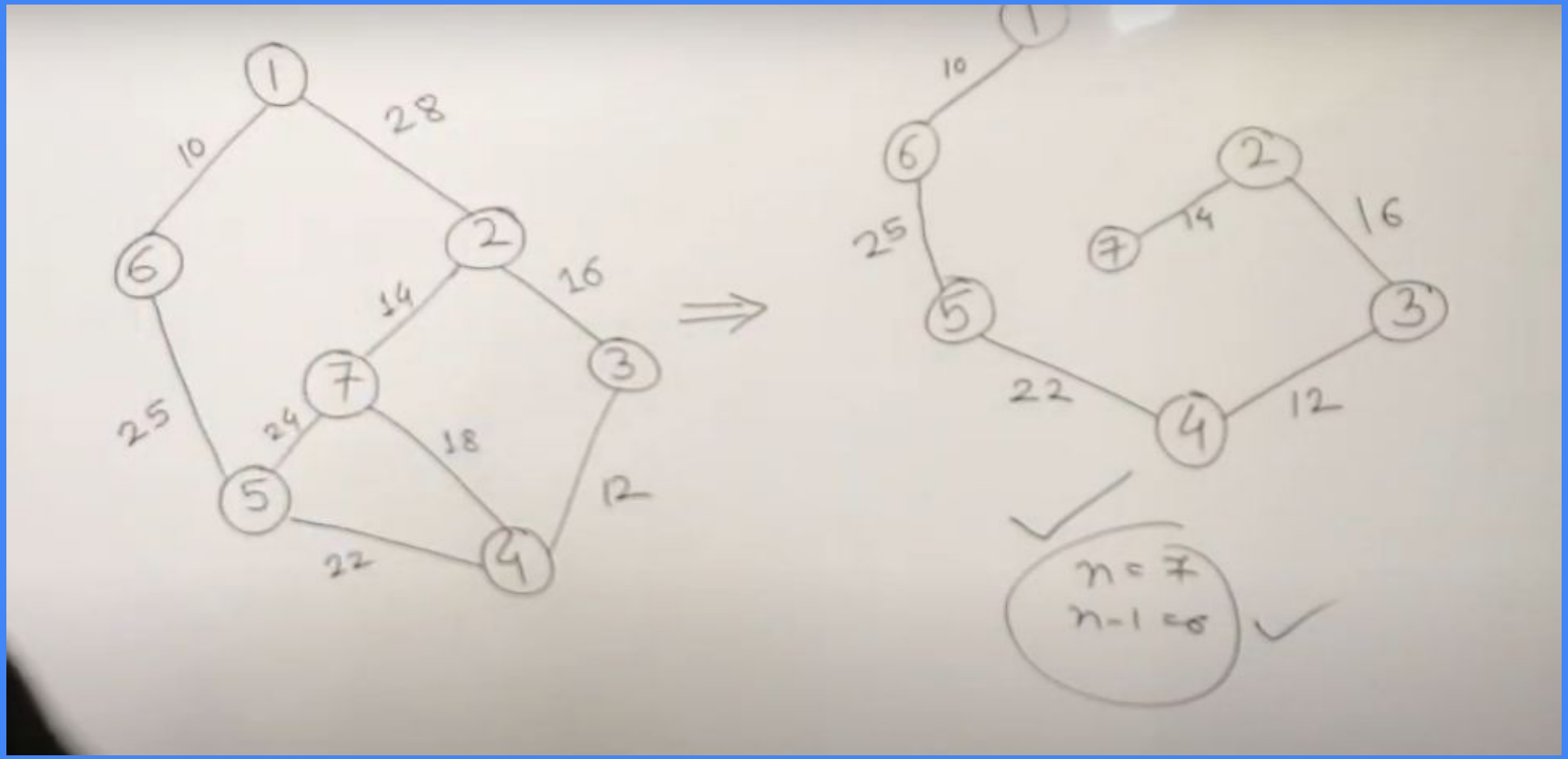


Spanning Tree
Cost = 13



Minimum Spanning
Tree, Cost = 7

Working of Kruskal's Algorithm



Applications of Kruskal's Algorithm

Telecommunications & Electrical Grids

- Used to design the most cost-effective network without cycles. For example, minimizing the cost of laying cables between cities

Computer Networks

- Designing network topologies to ensure minimum total wiring cost while maintaining full connectivity (e.g., LAN setups)

Civil Infrastructure Planning

- For planning roads, railways, or pipeline construction where the goal is to connect a set of points with the least total cost

Image Processing and Computer Vision

- Used for segmentation where an image is treated as a graph and Kruskal's algorithm helps to partition it into meaningful parts