# Dijkstra's algorithm

Dijkstra's algorithm is an algorithm for finding the shortest paths between nodes in a weighted graph, which may represent, for example, road networks. It was conceived by computer scientist Edger W. Dijkstra in 1956 and published three years later

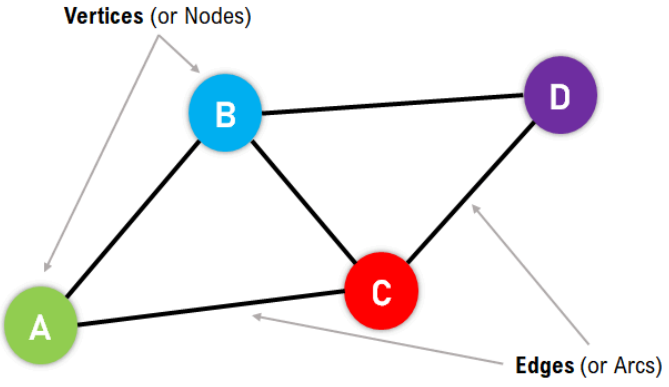
The algorithm maintains a set of visited vertices and a set of unvisited vertices. It starts at the source vertex and iteratively selects the unvisited vertex with the smallest tentative distance from the source. It then visits the neighbors of this vertex and updates their tentative distances if a shorter path is found. This process continues until the destination vertex is reached, or all reachable vertices have been visited.

## Graph:

**Graphs** are non-linear data structures representing the "connections" between the elements. These elements are known as the **Vertices**, and the lines or arcs that connect any two vertices in the graph are known as the **Edges**. More formally, a Graph comprises **a set of Vertices (V)** and **a set of Edges (E)**. The Graph is denoted by **G(V, E)**.

## Components of a Graph

1. **Vertices:**Vertices are the basic units of the graph used to represent real-life objects, persons, or entities. Sometimes, vertices are also known as Nodes.
2. **Edges:**Edges are drawn or used to connect two vertices of the graph. Sometimes, edges are also known as Arcs.

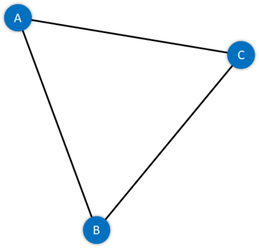


## Types of Graphs

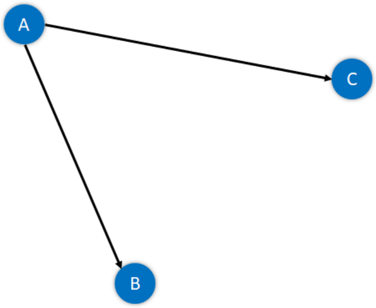
The Graphs can be categorized into two types:

1. Undirected Graph
2. Directed Graph

**Undirected Graph:** A Graph with edges that do not have a direction is termed an Undirected Graph. The edges of this graph imply a two-way relationship in which each edge can be traversed in both directions.



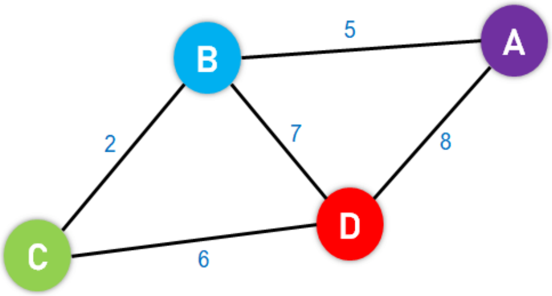
**Directed Graph:** A Graph with edges with direction is termed a Directed Graph. The edges of this graph imply a one-way relationship in which each edge can only be traversed in a single direction.



Weighted Graph:

A Graph is said to be Weighted if each edge is assigned a 'weight'. The weight of an edge can denote distance, time, or anything that models the 'connection' between the pair of vertices it connects.

For instance, we can observe a blue number next to each edge in the following figure of the Weighted Graph. This number is utilized to signify the weight of the corresponding edge.



Weightage of C___ B = 2

Weightage of B___ A = 5

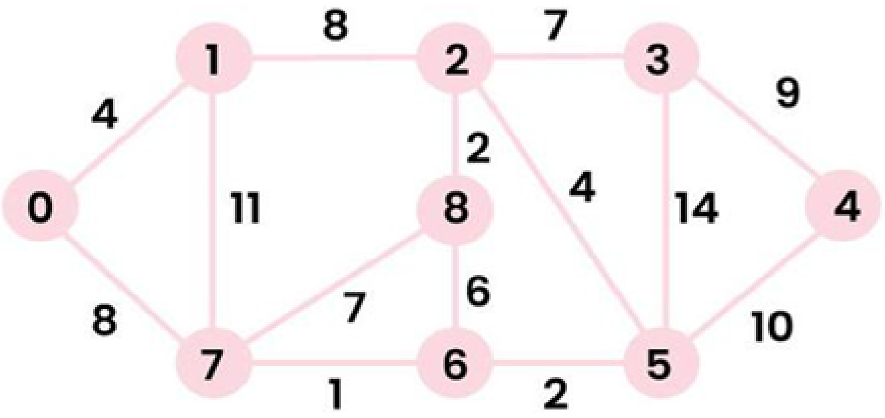
Weightage of A___ D =8

Weightage of D___ C = 6

Weightage of D___ B =7

Algorithm

1. Mark the source node with a current distance of 0 and the rest with infinity.
2. Set the non-visited node with the smallest current distance as the current node.
3. For each neighbor, N of the current node adds the current distance of the adjacent node with the weight of the edge connecting 0->1. If it is smaller than the current distance of Node, set it as the new current distance of N.
4. Mark the current node 1 as visited.
5. Go to step 2 if there are any nodes are unvisited.



Number of Nodes: 9

Number of Vertices: 14

Source Node: 0

Destination node: any

Minimum Distance:

The distance from 0 to 1 = 4.
The minimum distance from 0 to 2 = 12. 0->1->2
The minimum distance from 0 to 3 = 19. 0->1->2->3
The minimum distance from 0 to 4 = 21. 0->7->6->5->4
The minimum distance from 0 to 5 = 11. 0->7->6->5
The minimum distance from 0 to 6 = 9. 0->7->6

The minimum distance from 0 to 7 = 8. 0->7
The minimum distance from 0 to 8 = 14. 0->1->2->8

Note: Include the steps whatever taught in the class ( Step 1 to Step 5) with your own explanation with possible ways from source to destination.