GRAPHS

Consider a situation that

Person A wants to visit Dhaka University
(located at NSU

So, he/she decides to create a map that would include routes.

Nodes ≡ Vertices

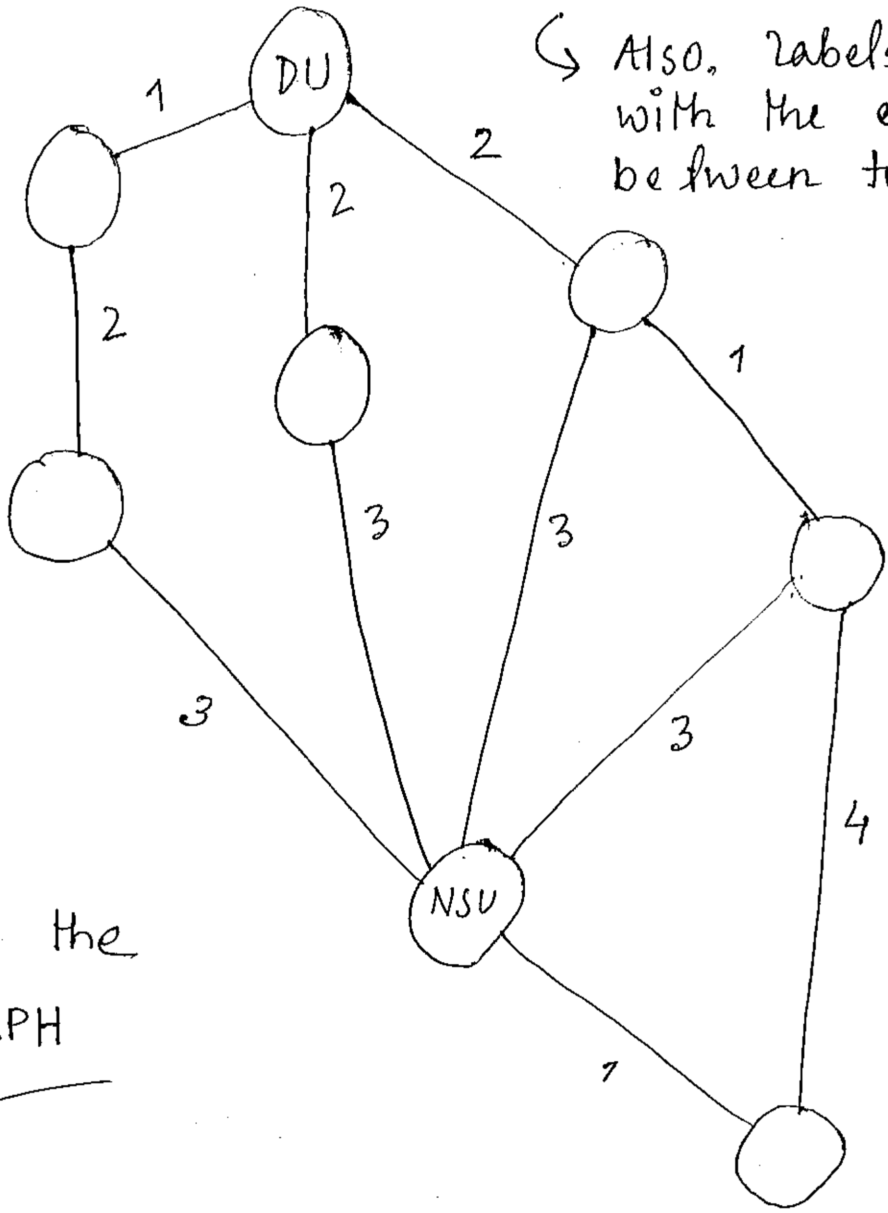
Lines ≡ edges

Considers different stoppage places as <u>nodes</u>

Measures the distance between different nodes.

Finally, connect nodes by drawing a line between the two nodes.

Also, labels each line with the exact distance between two nodes



This is the GRAPH

Definition

* By definition, a graph $G = (\overset{\text{Vertices}}{V}, \overset{\text{Edges}}{E})$ consists of a nonempty set of vertices (or, nodes) and a set of Edges (E).

* Each edge has either $\underbrace{\text{one or two vertices}}_{\text{endpoints}}$ a ociated with it.

* Each edge connects its endpoints

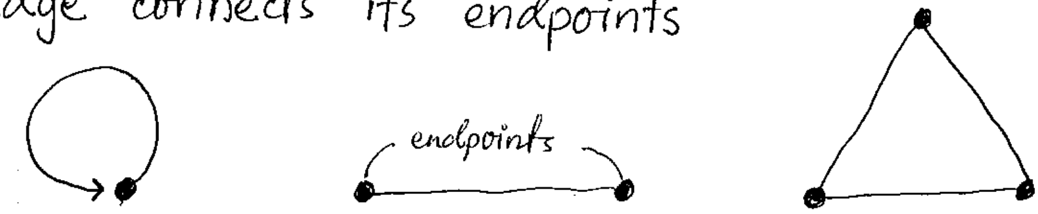


Fig. example

Example :

Suppose, a network is made up of data centers and communication link between all the computers. Now, if the location of the data centers is represented as points, the network can be represented as a Graph

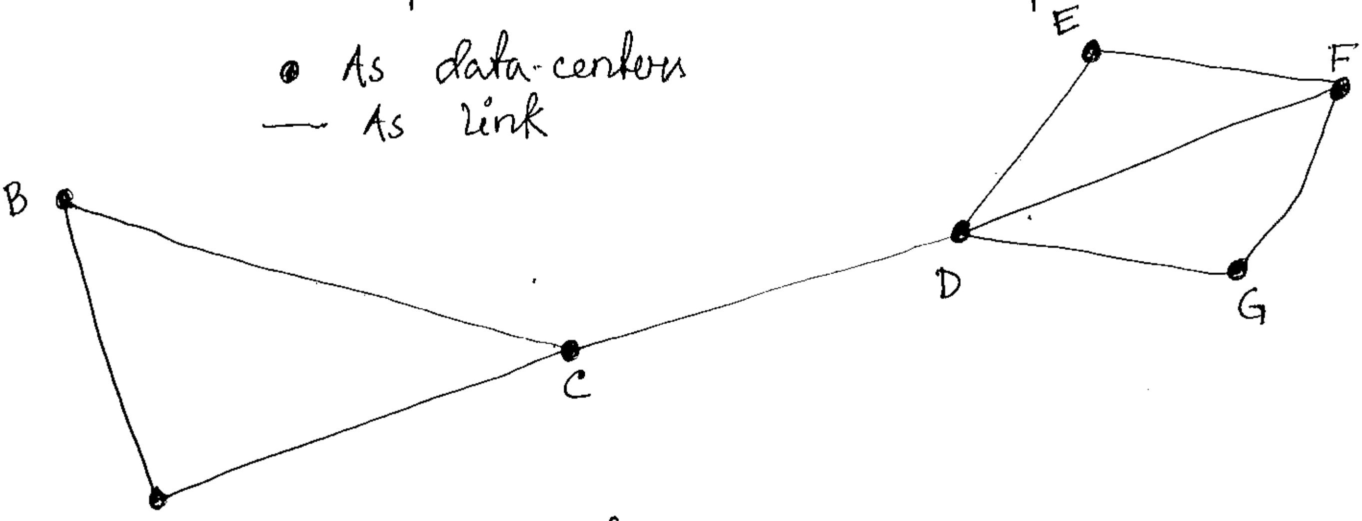


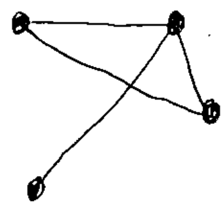
Fig. Network as a graph

Labeled and Unlabeled graph

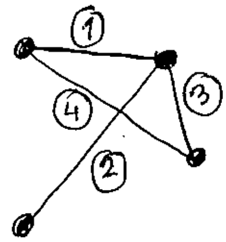
In any graph, the edges and vertices, both, may be assigned specific values, labels or colors.

↓ Generates

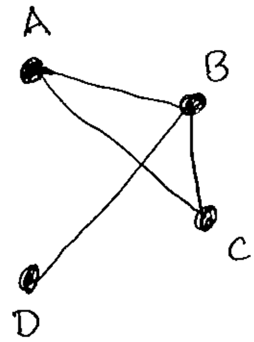
Labeled Graph



Unlabeled graph



Edge-labeled graph

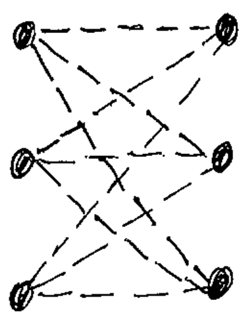


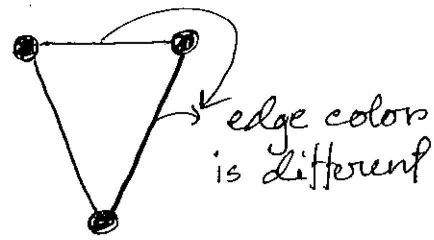
Vertex-labeled graph

Colors can be assigned to vertices or edges — this is known as edge coloring and graph coloring

Vertex coloring :

It is an assignment of colors or labels to each vertex such that no edge connects two nodes of similar color





Edge coloring :

Adjacent edges ~~to~~ receive different colors.

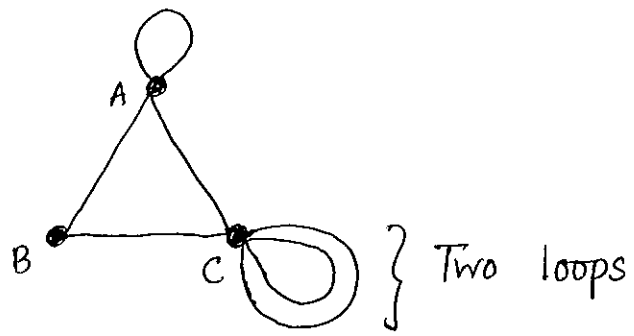
⊞ Application of Graphs & Graph Theory

(i) Computer networks

Loops

It is the edge of a graph which joins a vertex to itself.

It is also known as self-loop



Edge multiplicity

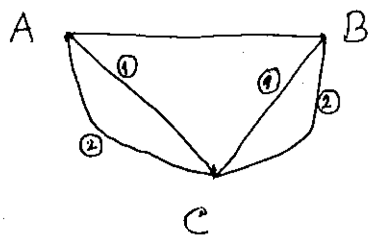
Finite Vs. Infinite Graph

A graph with finite number of vertices is known as Finite graph.

A graph with infinite number of vertices is infinite graph.

Multigraphs

In multigraphs, multiple edges may connect same two vertices.



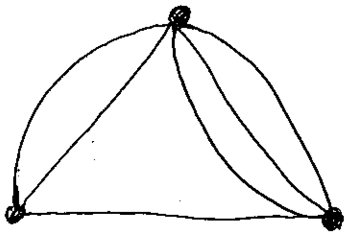
Here, multiple edges connect A and B
B and C

When (m) different edges connect vertices A and B, then we can say that

{A, B} is an edge of multiplicity (m)

In above graph multiplicity m is two for both {A, C} and {B, C}

Precisely, multiple edges between nodes are permitted or required in multigraphs.



Simple Graph

In a simple graph, each edge of the graph two different vertices, and no two edges connect the same pair of vertices.

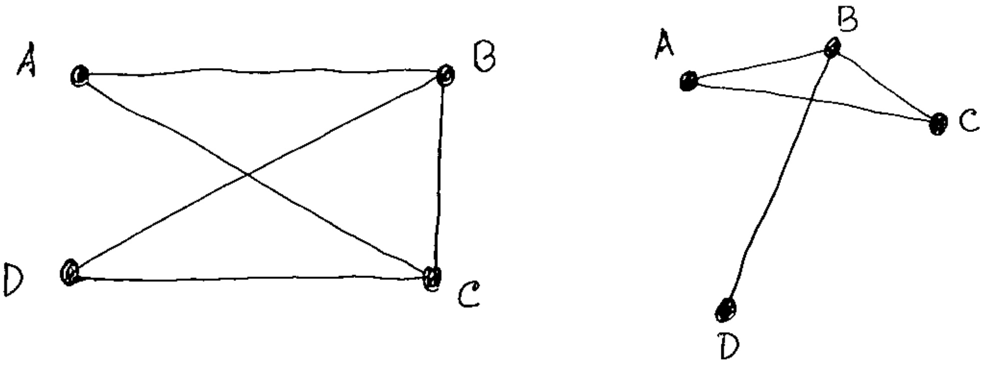
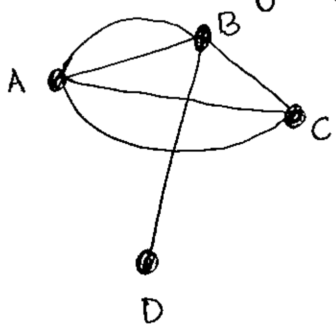
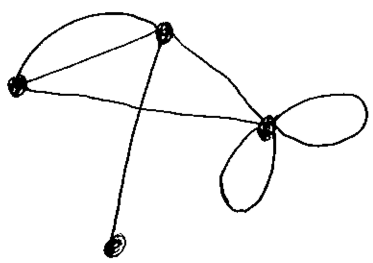


Fig. Simple Graph

Example of non-simple graph



✓ This graph has multiple edges.

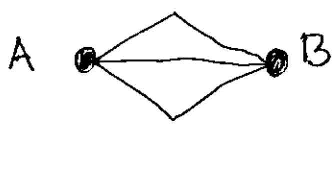


✓ This graph has multiple edges and loops.

Loops Edge

Multiple edges are two or more edges connecting the same two vertices.

Number of edges is denoted as degree "d"



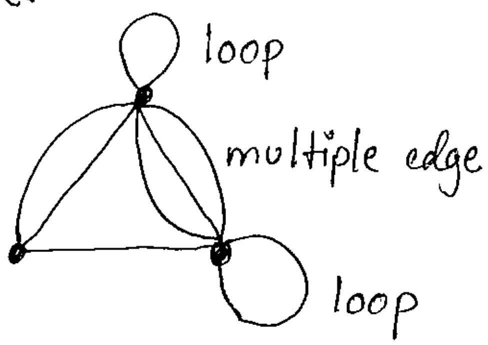
Here, $d = 3$

Pseudograph

In a pseudograph,

- Graph Loops &
- Multiple Edges

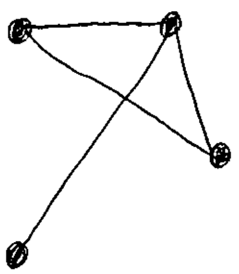
are permitted.



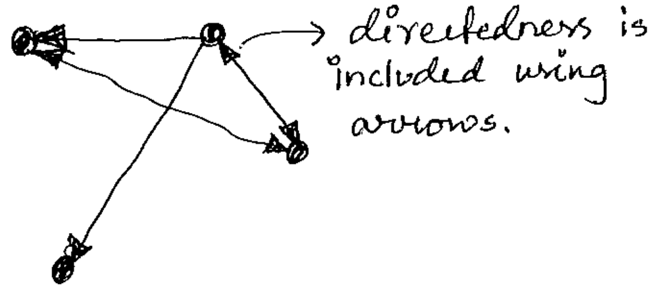
Directedness of a graph :

Based on the direction of an edge between two nodes, a graph can be subdivided into two main subclasses :

a. Undirected graph
b. Directed graph



Undirected graph



Directed graph