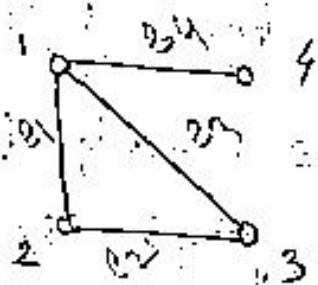


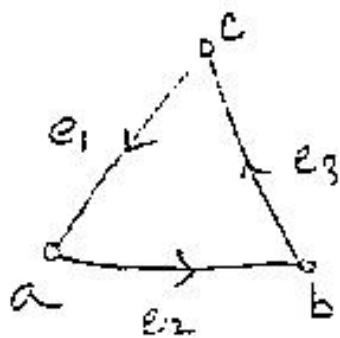
Ex: Let $V = \{1, 2, 3, 4\}$ and $E = \{(1, 2), (1, 3), (2, 3), (4, 4)\}$. Then $G = (V, E)$ is a graph.



Trivial graph: The $(1, 0)$ graph is called a trivial graph. That is a graph having only one vertex and no edges is called a trivial graph.

Directed and Undirected graph:

In Directed graph: A directed graph (Also called a digraph) G consists of a set V of vertices and a set E of edges such that $e \in E$ is associated with an ordered pair of vertices. That is, if each edge of the graph G has a direction then the graph is called directed graph. The following diagram is a directed graph.



Here the edge,

e_1 directed from c to a , e_2 directed from a to b and e_3 directed from b to c .

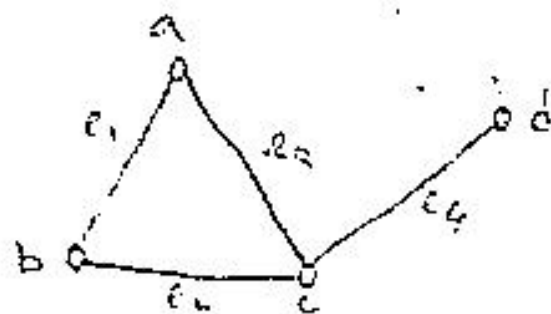
Suppose $e = (u, v)$ [i.e. e is an edge from u to v] is a directed edge in a graph, then

(i) u is called initial vertex of e and v is called terminal vertex of e .

(ii) e is said to be incident from u and to be incident to v .

(iii) u is adjacent to v and v is adjacent from u .

2. Undirected graph: An undirected graph G consists of set V of vertices and a set E of edges such that each edge $e \in E$ is associated with an unordered pair of vertices. i.e. if each edge of the graph G has no direction then the graph is called an undirected graph. The following diagram is an undirected graph.

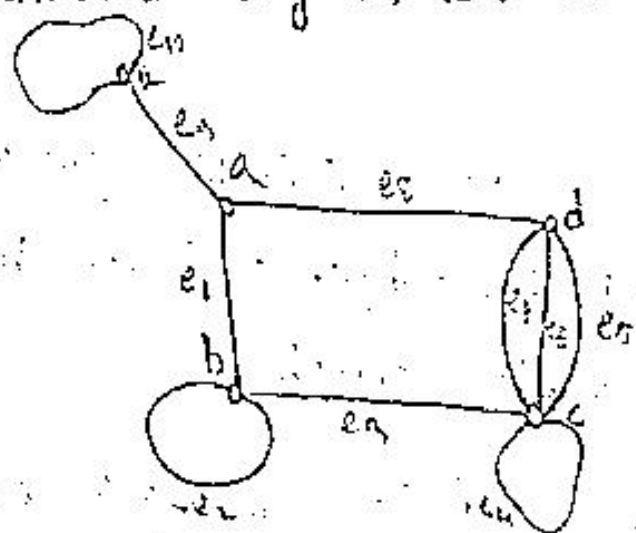


We can refer to an edge joining the vertex pair i and j , as either (i, j) or (j, i) .

Loops and parallel edges:

A edge of a graph which join a vertex to itself is called a loop or self loop. If more than one edge join two vertices, then these edges are called parallel edges or multiple edges.

Now, to illustrate the concept of loops and parallel edges, let us consider the following graph.



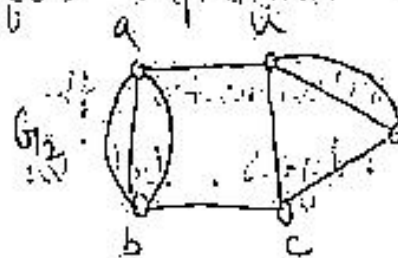
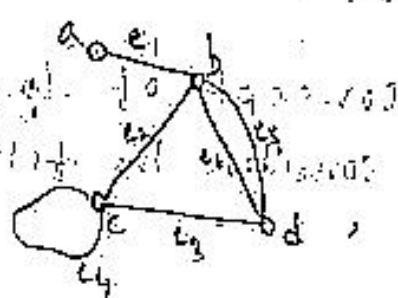
Here, e_2 , e_4 and e_{10} are loops.

e_2 join the vertex b to itself, e_4 join the vertex c to itself, e_{10} join the vertex u to itself.

e_1 , e_3 , e_5 are multiple edges. They join the vertices d and c .

Simple graph, Multigraph and pseudo graph:

A simple graph is one for which there is no more than one edge between a pair of vertices. It is a graph which has neither loops nor multiple edges - is called simple graph. Consider the following graphs:



Here G_1 and G_2 are not simple graphs, since G_1 has loops and parallel edges and G_2 has parallel edges. G_3 is a simple graph.

A graph which contains multiple edges but no loops is called a ~~multiple~~ multigraph. G_2 is a multigraph but G_1 is not a multigraph since G_1 has loops.

A graph in which loops and multiple edges are allowed is called a pseudo graph. G_1 is a pseudo graph.

Finite and infinite graphs: A graph with finite number of vertices as well as finite number of edges is called a finite graph. Otherwise, it is an infinite graph.