

Graph

A graph (or undirected graph) is a diagram consisting of a collection of vertices together with edges joining certain pair of these vertices. Mathematically, we can write

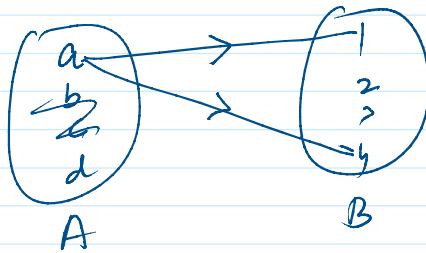
$$\text{A graph } G = [V(G), E(G)]$$

where $V(G)$ and $E(G)$ are sets defined as

$V(G)$ = Vertex set (points set or nodes set) of the graph G ,

$E(G) \subseteq V(G) \times V(G)$, a relation on $V(G)$, called edge set of G

Each element e of $E(G)$ is assigned an unordered pair of vertices (a, b) called the end vertices of e .



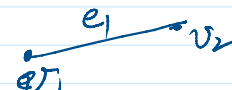
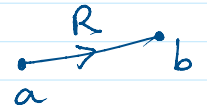
$$E(G) \subseteq V \times V$$

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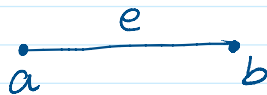
$$G(V, E)$$

$$R \subseteq A \times B = \{(a, b) \dots\}$$

$$\underline{a R b}$$

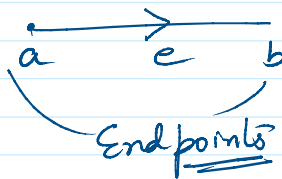


$$\underline{e_1 = (v_1, v_2)}$$



$$e = (a, b) \\ (b, a)$$

$$R \subseteq A \times A$$

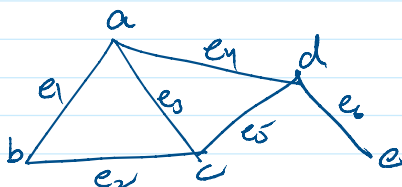


$$\underline{e = (a, b)}$$

$\left[\begin{array}{l} a \rightarrow \text{Initial point of edge } e \\ b \rightarrow \text{Terminal point} \\ \text{End " " } \end{array} \right]$

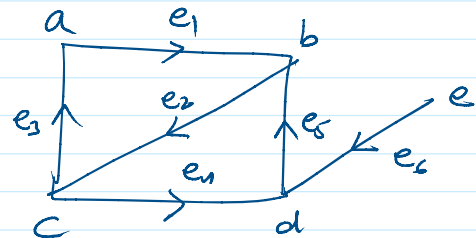
Directed Graph

A directed graph is a graph in which each element e of $E(G)$ is assigned an ordered pair of vertices (a, b) along with arrow starting from a to b , where a is called the **initial vertex** and b is called the **terminal vertex** of the edge e .



Undirected graph

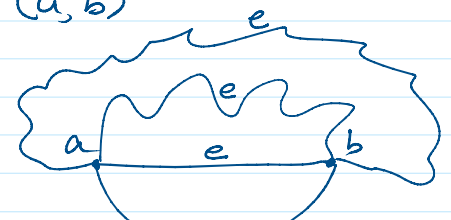
$$e_4 = \text{Edge b/w } a \text{ \& } d \\ = (a, d) \text{ or } (d, a)$$



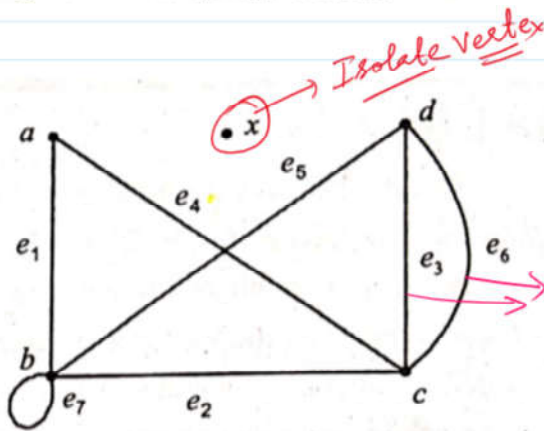
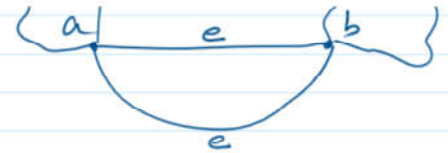
$$e_1 = \text{Edge from } a \text{ to } b \\ = (a, b)$$

REMARK : (i) A graph is represented by means of a diagram in which the vertices are denoted by points and edges are represented by line segments joining its end vertices.

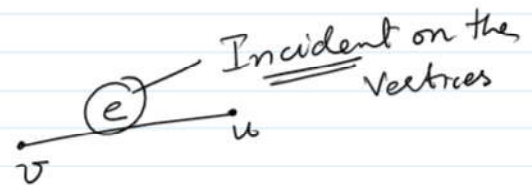
(ii) It does not matter whether the joining of the two vertices in a graph is a straight line or a curve, longer or shorter.



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① Adjacent Vertex



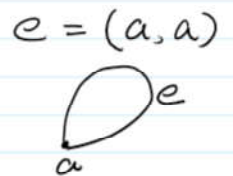
Adjacent vertices

Two vertices u and v of a graph $G = (V, E)$ are said to be adjacent if there is an edge $e = (u, v)$ connecting u and v . Also the edge e is said to be incident on each of its end points u and v .

Loop (or self loop)

An edge that is incident from and into itself starts and ends at same vertex is called self loop or sting.

e_7 is a loop $e_7 = (b, b)$

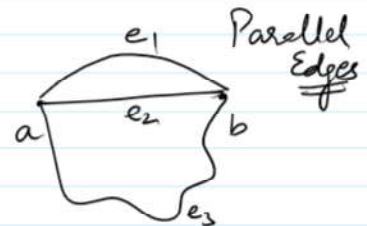


Isolated Vertex

A vertex of a graph $G = (V, E)$, which is not joined to any vertex by an edge in G , is called an isolated vertex.

Parallel edges

If two (or more) edges of a graph G have the same end vertices, then these edges are called parallel edges.



Adjacent edges

Two non-parallel edges of the graph are called adjacent if they have one common vertex.



e_1 & e_2 are called adjacent edges

Types of Graph ① Simple graph \rightarrow No loop, No parallel edges

② General graph (Multigraph) \rightarrow has loop or Parallel Edges or Both.

