Graph Representation

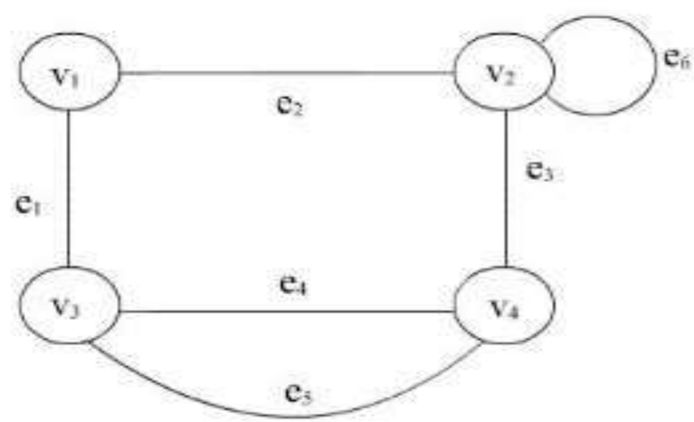
Graph Representation

- **Graph** consists of a non empty set of points called **vertices** and a set of **edges** that link vertices.

Definition: A graph *G= (V, E)* consists of

- a set $V=\{v_1 , v_2 .....,v_n \}$ of *n* >1 **vertices** and
- a set of $E=\{e_1 ,e_2 ,.....,e_m \}$ of m>0 **edges**
- such that each edge e_k is corresponds to an un ordered pair of vertices (v_i ,v_j)
- A road network is a simple example of a graph, in which vertices reprents cities and road connecting them are correspond to edges.

- **Loop** is an edge that connects a vertex to itself. Edge e_6 in the figure below is a loop.
- Edges with same end vertices are called **parallel edges** . Edges e_4 and e_5 are parallel edges in the below figure

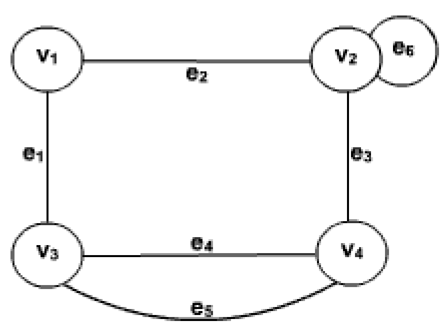


- A Graph without loops and parallel edges is called a **simple graph.**
- A graphs with isolated vertices (no edges) is called **null** graph.
- Set of edges ***E*** can be empty for a graph but not set of vertices ***V***.

<u>Incidence</u>: if an vertex v_i is an end vertex of an edge e_k , we say vertex v_i is **incident** on e_k and e_k is **incident on** v_i.

- e_1 is incident on v_1 and v_3 in the below figure.
- v_4 is incident on e_3 , e_4 , and e_5 in the figure below

<u>Degree</u>: Degree of an vertex is number of edges incident on it, with loops counted twice.



Basic Operations

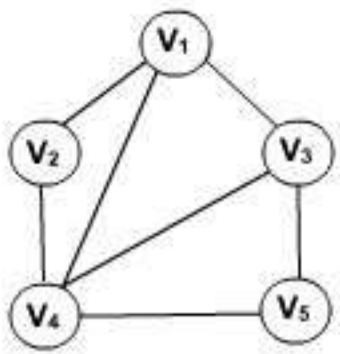
- **Adjacent Edges:** Two non parallel edges are adjacent if they have a vertex in common.
- e_1 and e_2 , e_2 and e_6 , e_2 and e_3 , e_1 and e_4 are adjacent edges in the above diagram.
- **Adjacent vertices:** Two vertices are adjacent if they are connected by an edge.
- v_1 and v_3 , v_1 and v_2 , v_2 and v_4 are adjacent vertices in the above diagram.

Graph Representation

Graph Representation: There are several different ways to represent graphs in a computer. Two main representations are **Adjacency Matrix** and **Adjacency list.**

Adjacency Matrix Representation:

- An **adjacency matrix** of a graph *G=(V,E) (let* V = { v_1 , v_2 ....., v_n}) is a n X n matrix A, such that A [i, j] = 1 if there is edge between v_i and v_j.
- 0 , other wise



	1	2	3	4	5
1	0	1	1	1	0
2	1	0	0	1	0
3	1	0	0	1	1
4	1	1	1	0	1
5	0	0	1	1	0

Adjacency List Representation:

- It consists of a list of vertices, which can be represented either by linked list or array. For each vertex, adjacent vertices are represented in the form of a linked list.