



Graph Theory

Class-BCA IV Semester



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OUTLINE-

UNIT :- I

Graph Representation

Graph Terminology

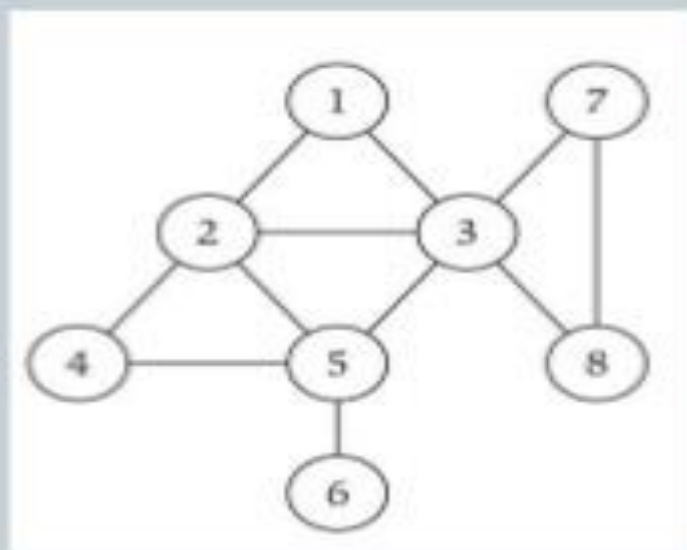
Graph Representations

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1. Adjacency Matrix



- n-by-n matrix with $A_{uv} = 1$ if (u, v) is an edge.
 - Diagonal Entries are self-links or loops
 - Symmetric matrix for undirected graphs

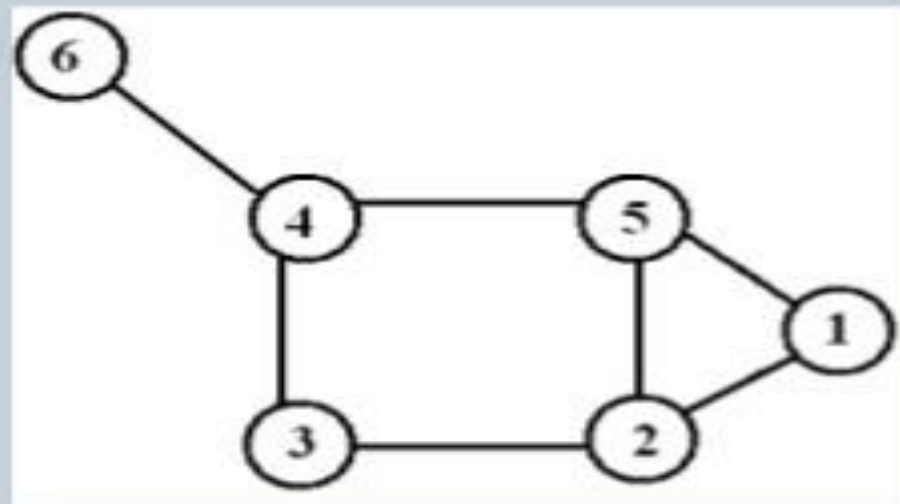


	1	2	3	4	5	6	7	8
1	0	1	1	0	0	0	0	0
2	1	0	1	1	1	0	0	0
3	1	1	0	0	1	0	1	1
4	0	1	0	1	1	0	0	0
5	0	1	1	1	0	1	0	0
6	0	0	0	0	1	0	0	0
7	0	0	1	0	0	0	0	1
8	0	0	1	0	0	0	1	0

2. Incidence Matrix



- $V \times E$
- [vertex, edges] contains the edge's data



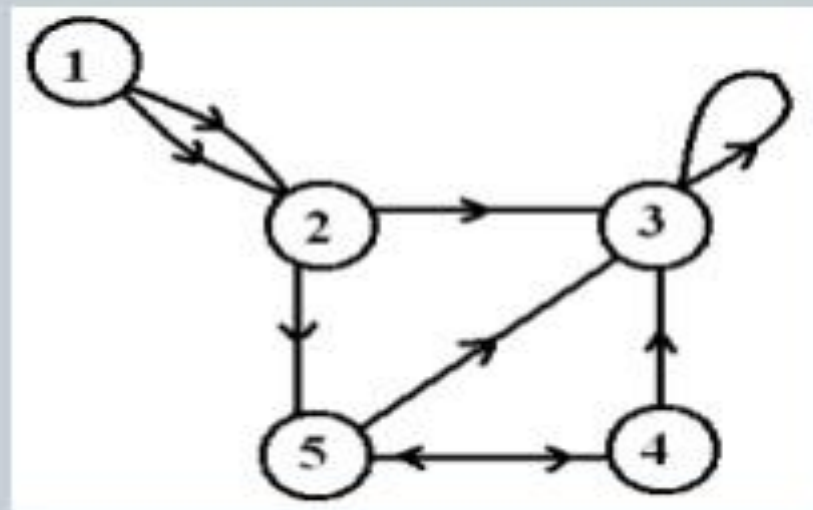
	1,2	1,5	2,3	2,5	3,4	4,5	4,6
1	1	1	0	0	0	0	0
2	1	0	1	1	0	0	0
3	0	0	1	0	1	0	0
4	0	0	0	0	1	1	1
5	0	1	0	1	0	1	0
6	0	0	0	0	0	0	1

3. Adjacency List

- Edge List

Edge List

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

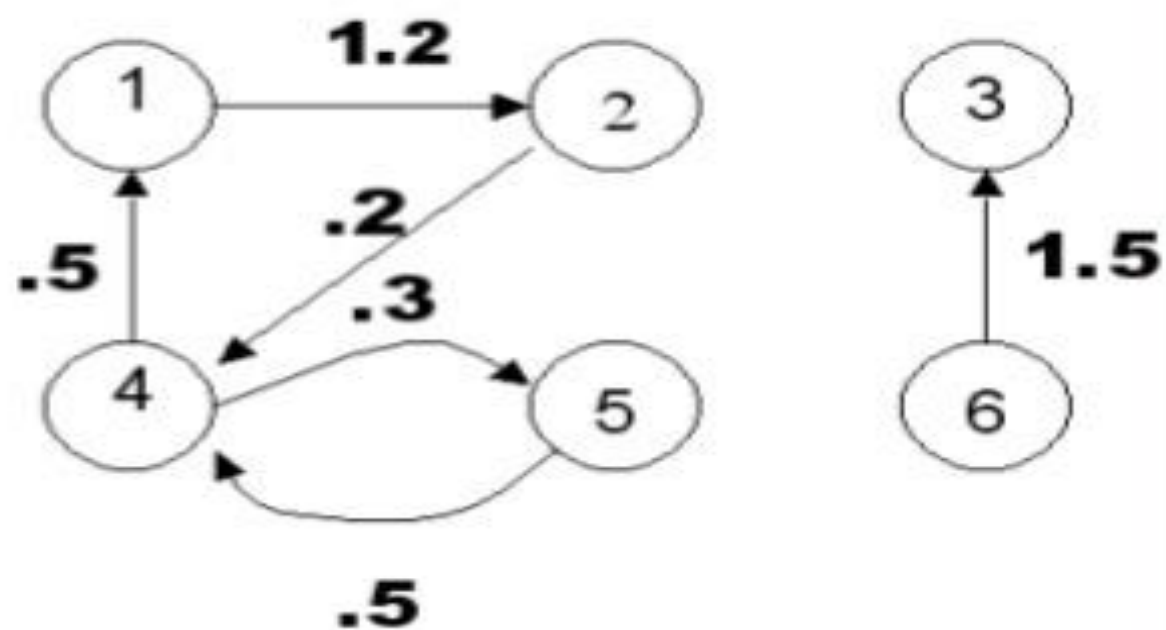


- Adjacency List (node list)

Node List

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

Edge Lists for Weighted Graphs



Edge List

```
1 2 1.2  
2 4 0.2  
4 5 0.3  
4 1 0.5  
5 4 0.5  
6 3 1.5
```

Graph Terminologies



Classification of Graph Terms



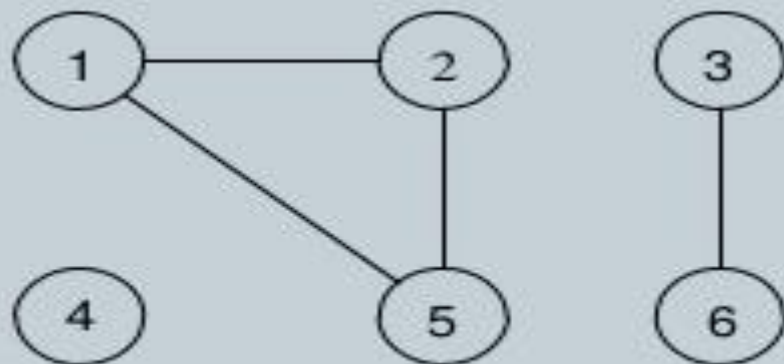
- Global terms refer to a whole graph
- Local terms refer to a single node in a graph

Connected and Isolated vertex



- Two vertices are **connected** if there is a path between them
- Isolated vertex – not connected

isolated vertex



Adjacent nodes



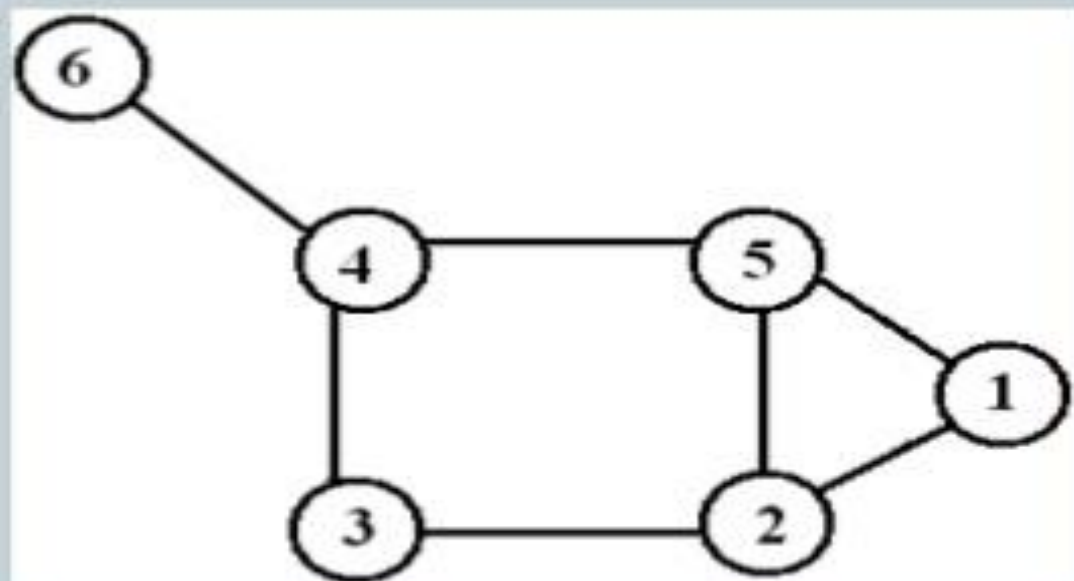
- **Adjacent nodes** - Two nodes are adjacent if they are connected via an edge.
 - If edge $e = \{u, v\} \in E(G)$, we say that u and v are **adjacent** or **neighbors**
- **An edge where the two end vertices are the same is called a loop, or a self-loop**



Degree (Un Directed Graphs)

- Number of edges incident on a node

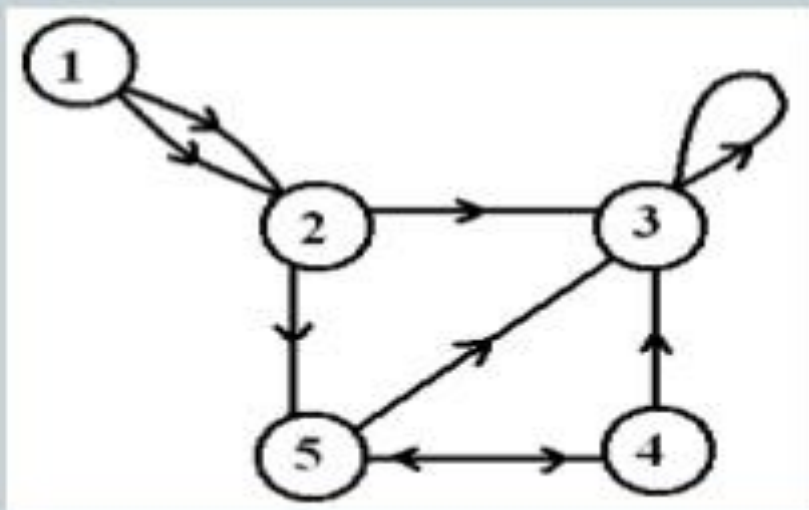
The degree of 5 is 3



Degree (Directed Graphs)



- In-degree: Number of edges entering
- Out-degree: Number of edges leaving
- Degree = $\text{indeg} + \text{outdeg}$



$\text{outdeg}(1)=2$
 $\text{indeg}(1)=0$

$\text{outdeg}(2)=2$
 $\text{indeg}(2)=2$

$\text{outdeg}(3)=1$
 $\text{indeg}(3)=4$

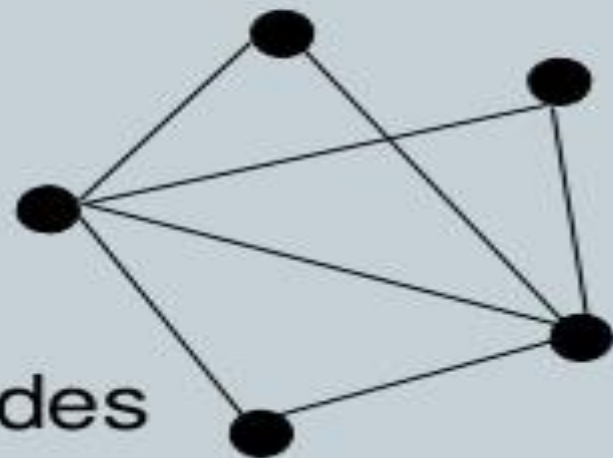
Walk



- **trail:** no edge can be repeat
a-b-c-d-e-b-d

- **walk:** a path in which edges/nodes
can be repeated.
a-b-d-a-b-c

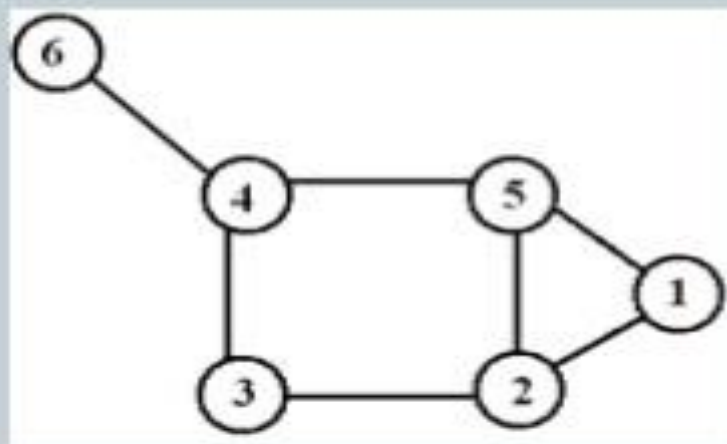
- A walk is **closed** is $a=c$



Paths



- **Path:** is a sequence P of nodes $v_1, v_2, \dots, v_{k-1}, v_k$
- No vertex can be repeated
- A closed path is called a **cycle**
- **The length of a path** or cycle is the number of edges visited in the path or cycle



Walks and Paths

1,2,5,2,3,4
walk of length 5

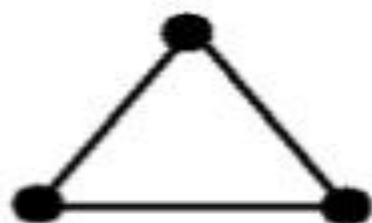
1,2,5,2,3,2,1
CW of length 6

1,2,3,4,6
path of length 4

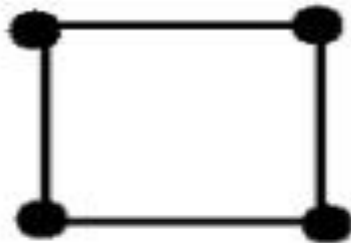
Cycle



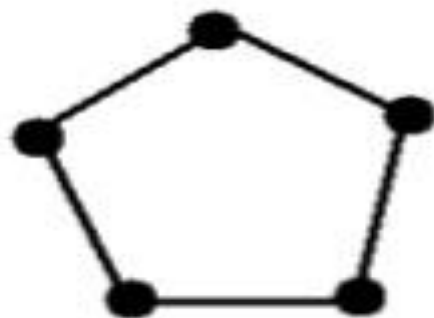
- Cycle - closed path: **cycle (a-b-c-d-a)** , closed if $x=y$
- Cycles denoted by C_k , where k is the number of nodes in the cycle



C_3



C_4



C_5

Shortest Path



- **Shortest Path** is the path between two nodes that has the shortest length
- **Length** – number of edges.
- **Distance** between u and v is the length of a shortest path between them
- The **diameter** of a graph is the length of the longest shortest path between any pairs of nodes in the graph

QUESTIONS:-

- 1. What is path ,walk and cycle in a graph theory?**
- 2. What the representation of graph?**
- 3. What is the edge weighted graph?**
- 4. What is the connected and isolated vertex?**

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Thanks