



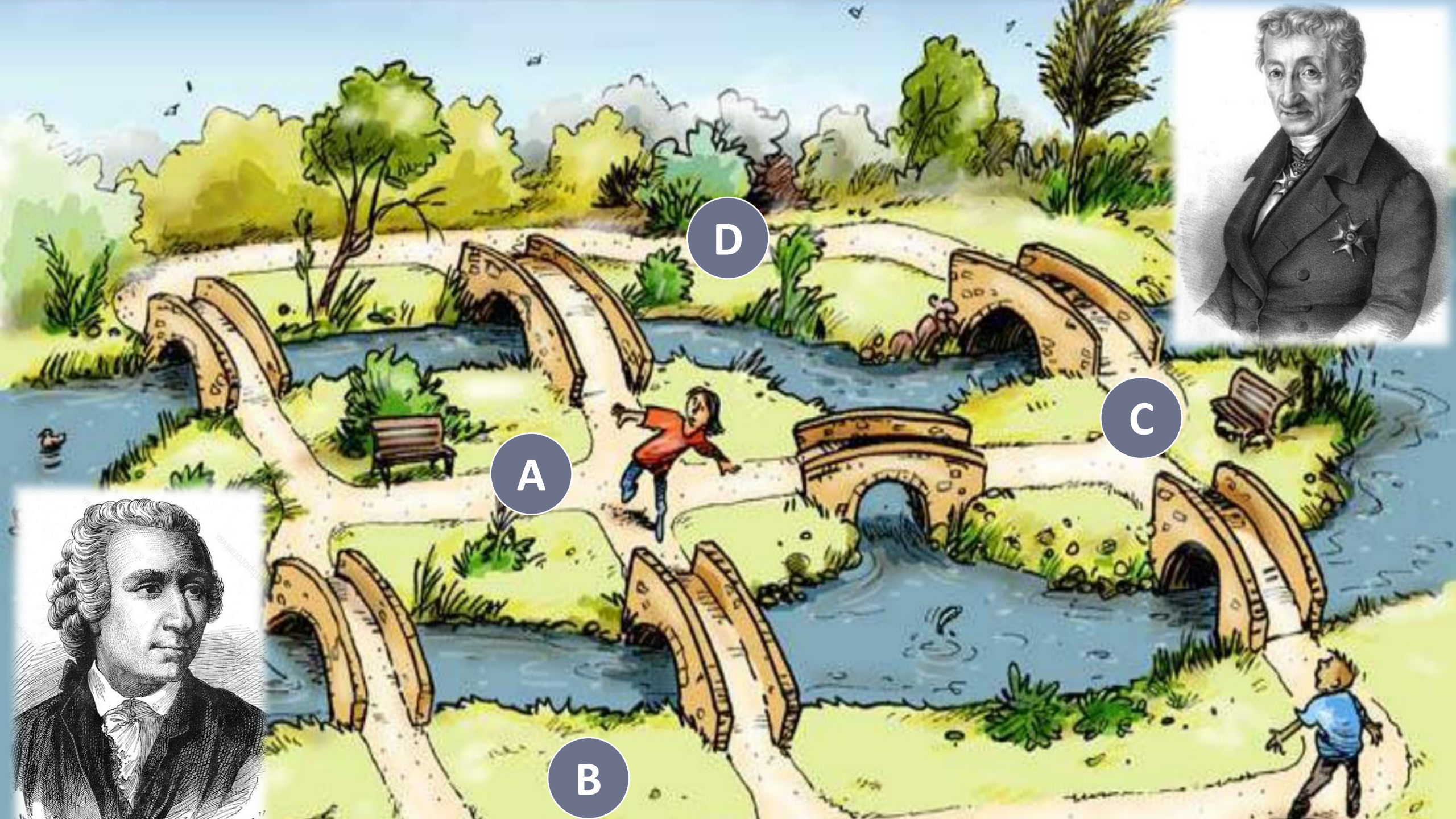
GRAPH THEORY

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Lecturer (Former)

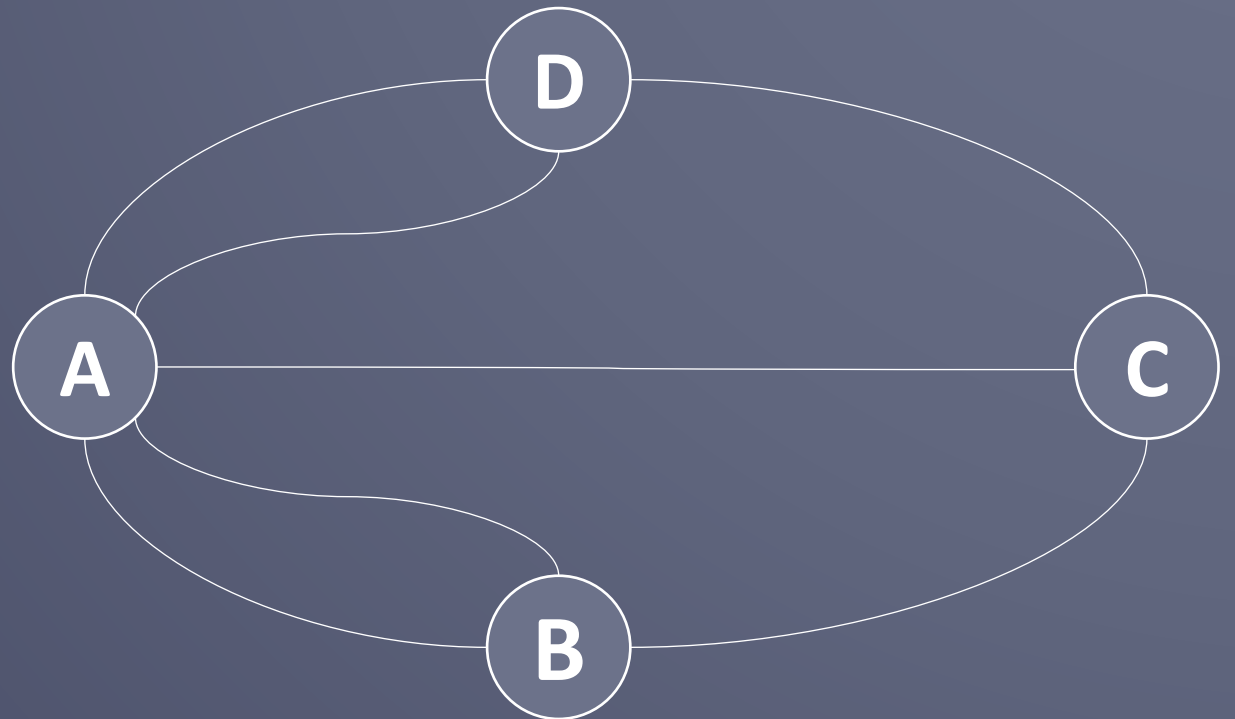
Department of Computer Science and Engineering

Varendra University



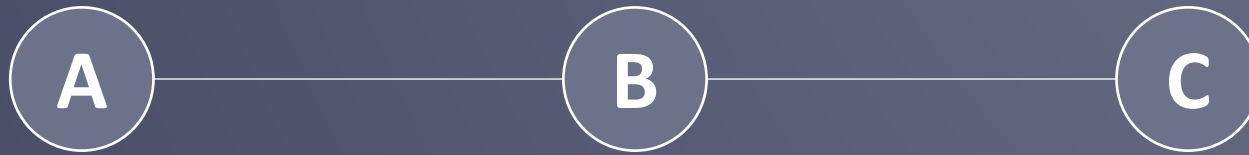
Bridge Of **Konigsberg**

DEGREE OF A : 5
DEGREE OF B: 3
DEGREE OF C: 3
DEGREE OF D: 3



Euler Path and Circuit

- A graph has an Euler path if and only if there are at most two vertices with odd degree.



- A graph has an Euler circuit if and only if the degree of every vertex is even.



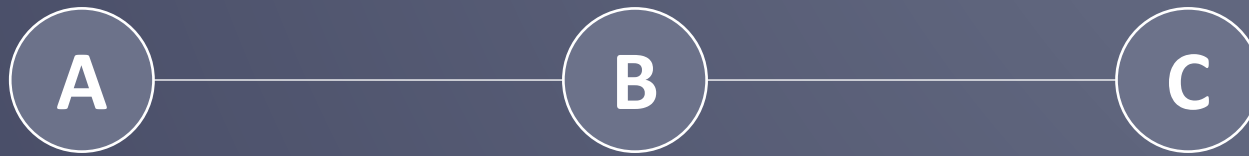
The Geometry of **Position**

The Geometry of Position aka Graph Theory is the study of graphs, which are mathematical structures used to model pairwise relations between objects.

A graph is a collection of **vertices** (also called nodes or points) which are connected by **edges** (also called links or lines) to represent complex problems in a simpler manner.

Adjacent Node

Any two nodes connected by an edge or any two edges connected by a node are said to be adjacent.



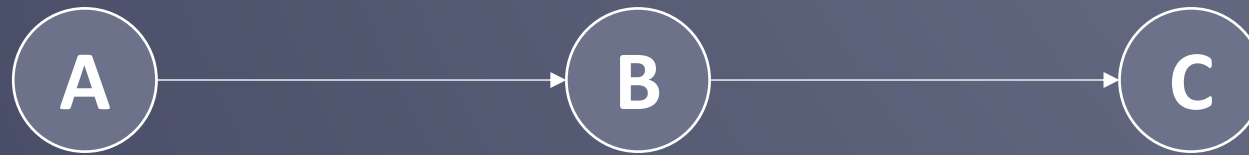
In this graph, A & C both are the adjacent node of B.

B is the adjacent node of A

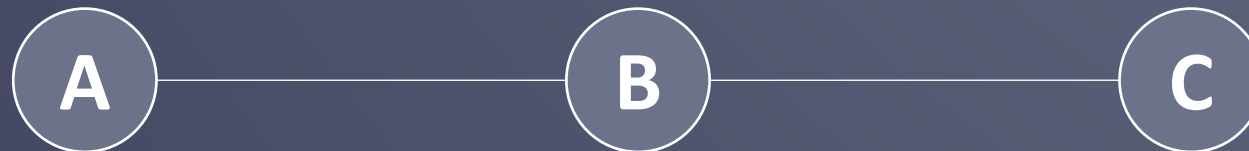
Also, B is the adjacent node of C

Directed & Undirected Graph

Directed graph are the ones with unidirectional edges.

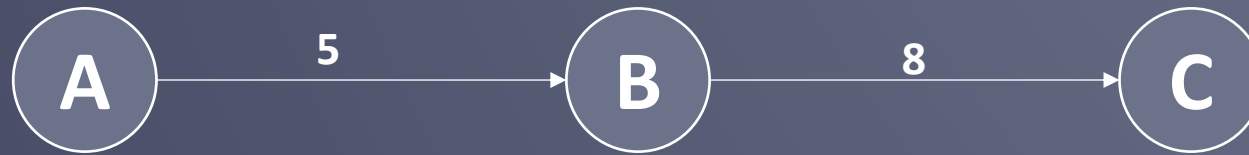


Undirected graph are the ones with bidirectional edges.

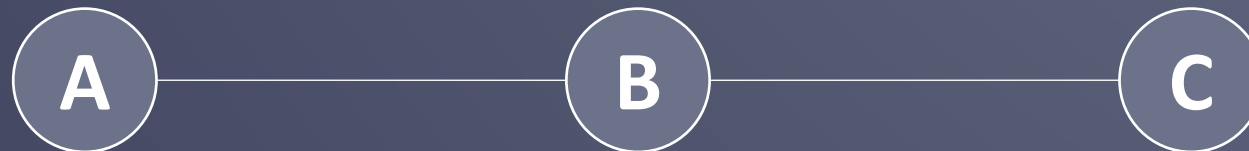


Weighted & Unweighted Graph

If the edges has a weight or cost it is called weighted graph.

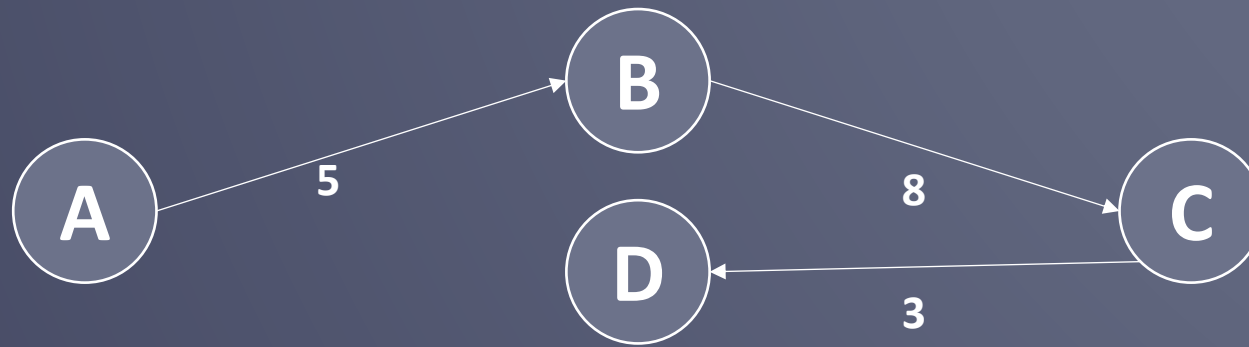


If the edges has no weight or cost it is called unweighted graph.



Path

Path can be defined as the list of edges by which we can visit one node to another.

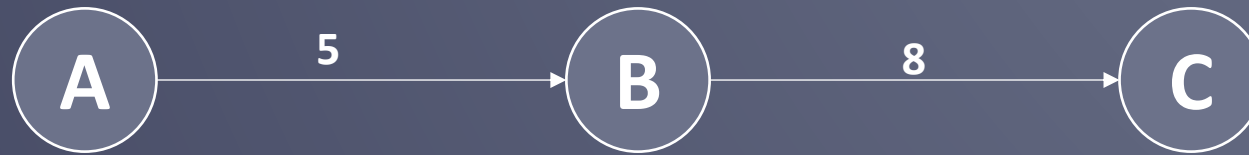


In this graph, To visit D from A. The path will be:

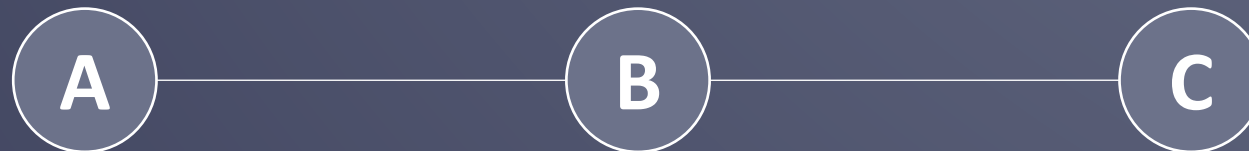
A -> B -> C -> D

Degree

It is the number of vertices adjacent to a vertex V . In directed graph, the number of head ends adjacent to a vertex is called the indegree of the vertex and the number of tail ends adjacent to a vertex is its outdegree

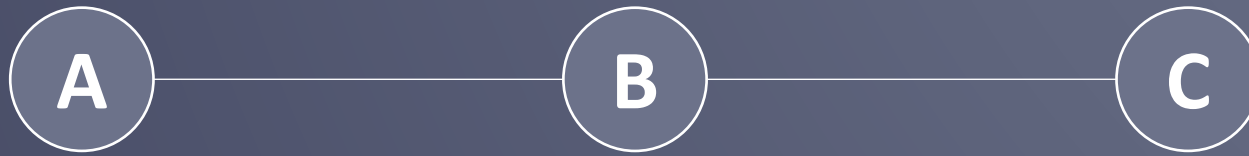


In undirected graph, indegree = outdegree



Tree

A tree is an undirected graph in which any two vertices are connected by exactly one path.



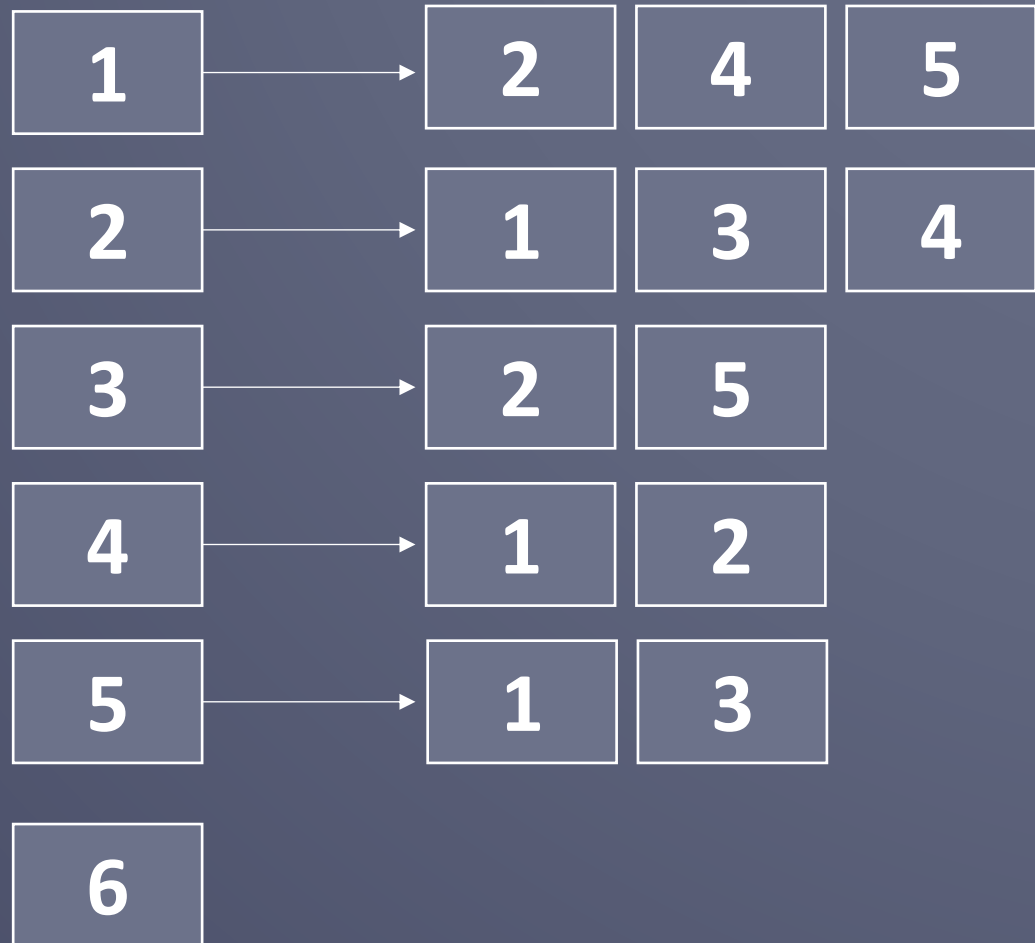
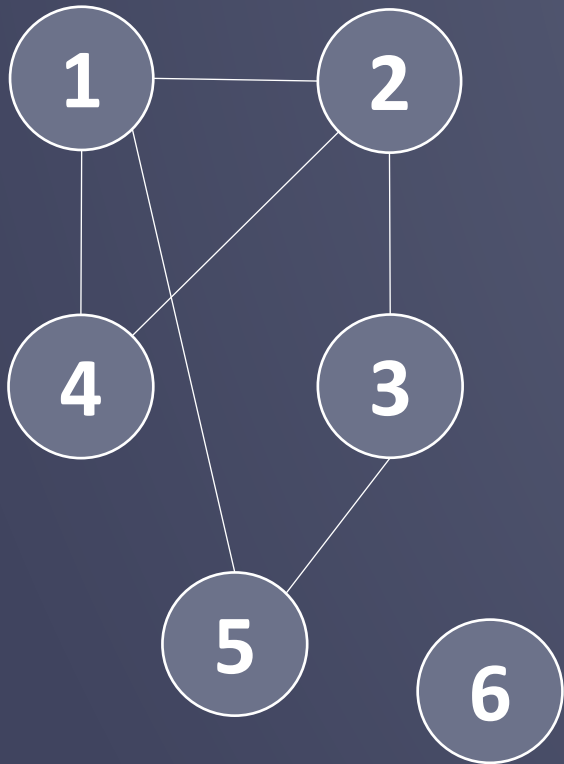
In Tree, for **n-node there will be exactly (n-1) edges**. We can also create a forest combining two or more trees.

Graph Representation

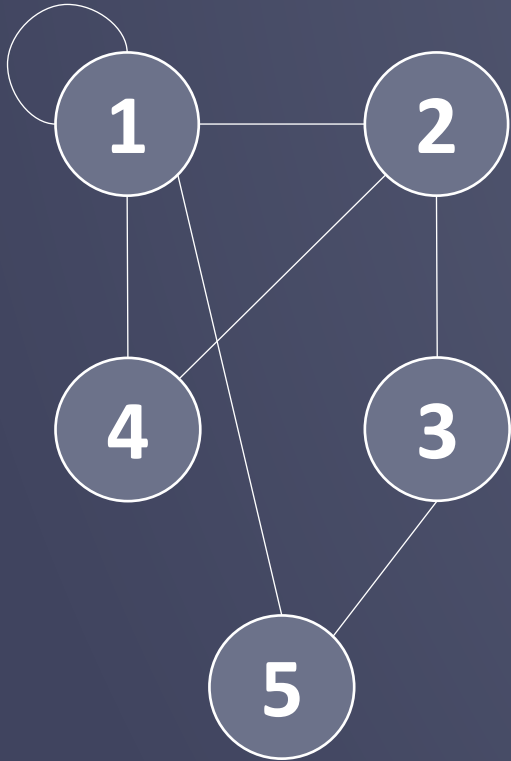
In code , we can represent graph with

- Adjacency Matrix (2D Array)
- Adjacency List (STL Vector/List)

Adjacency List



Adjacency Matrix



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

Level

