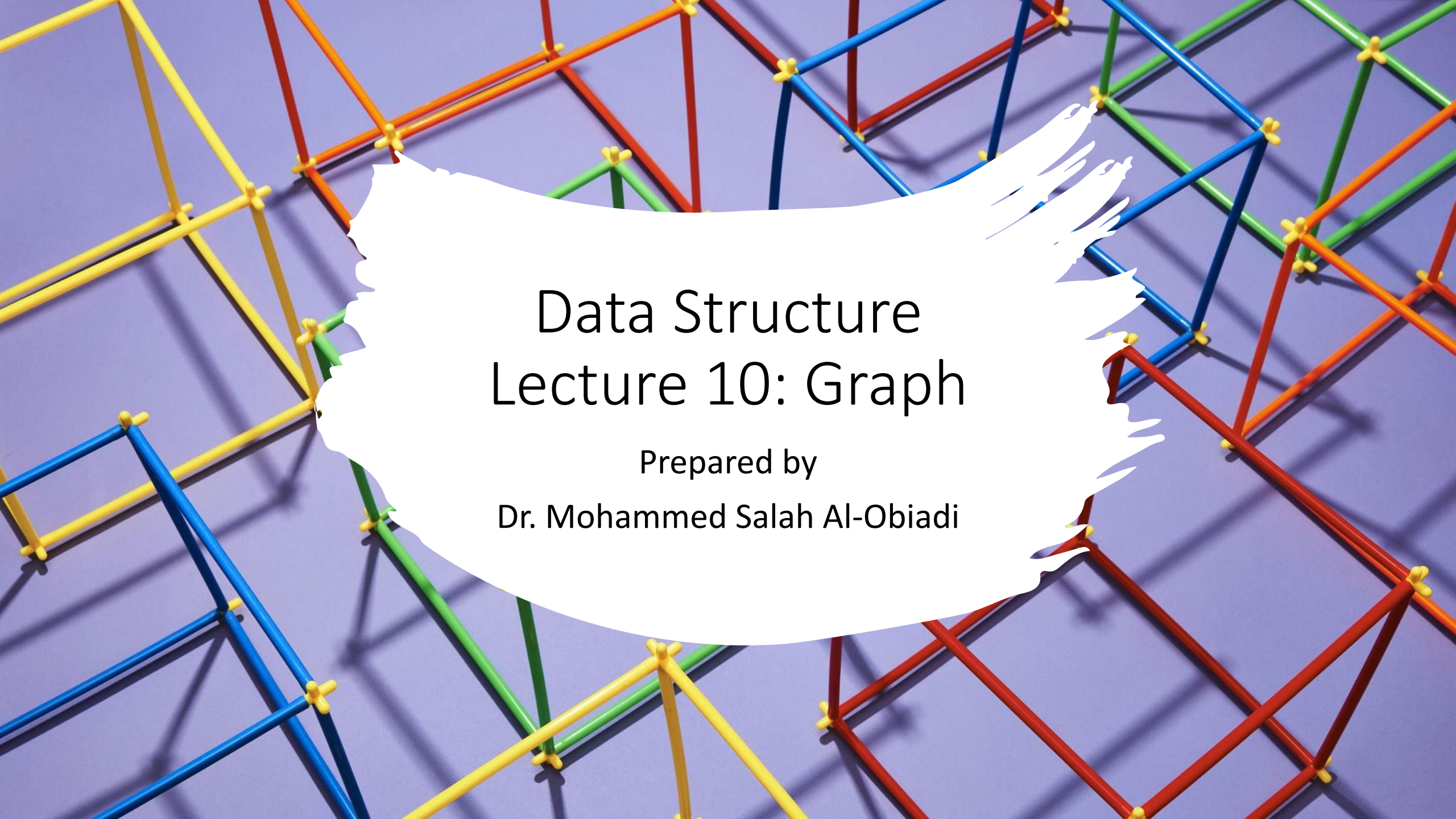

Data Structure
Lecture 10: Graph

Prepared by

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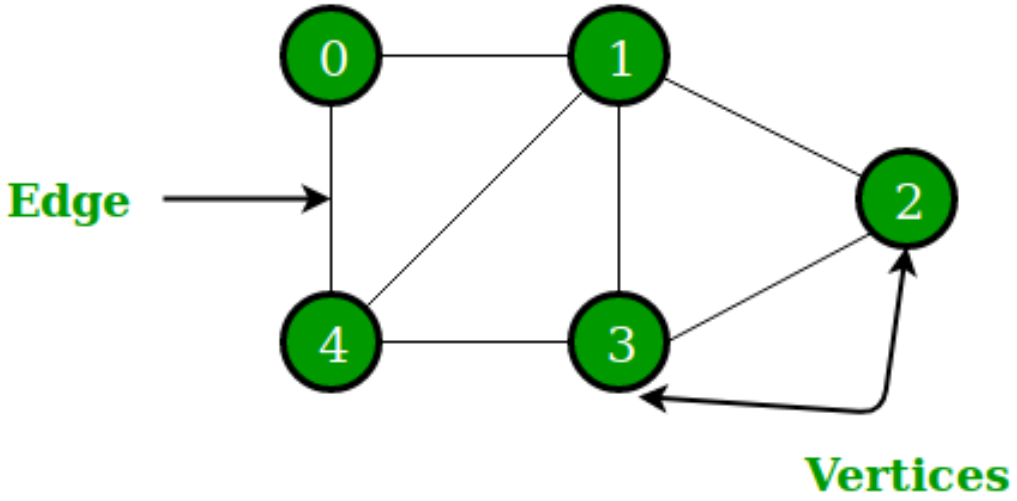
Graph

- GRAPH is a non-linear data structure in which the elements are arranged randomly inside the memory and are interconnected with each other
- A graph G is an ordered pair of sets (V,E) where
  - V is the set of vertices and
  - E is the edges which connect the vertices.

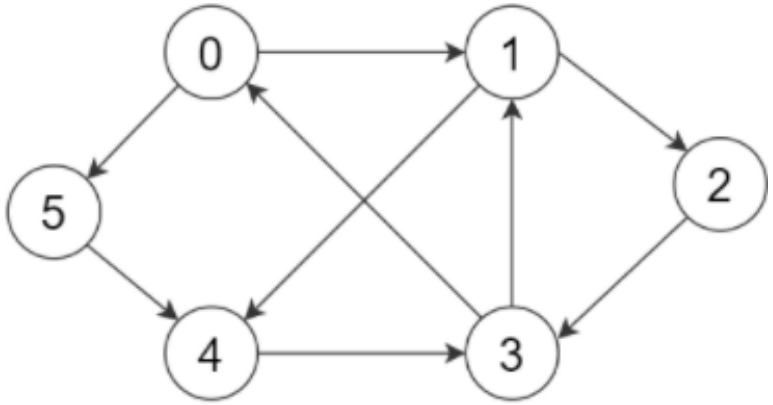


Applications of Graph

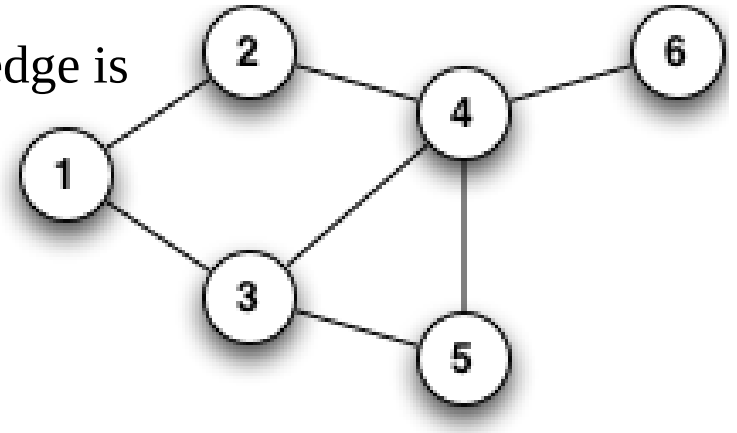
- **Google maps** uses graphs for building transportation systems.
- In **Facebook**, users are considered to be the vertices and if they are friends then there is an edge running between them.
- In **World Wide Web**, web pages are considered to be the vertices. There is an edge from a page u to other page v if there is a link of page v on page u.
- **Path Optimization Algorithms**, Path optimizations are primarily occupied with finding the best connection that fits some predefined criteria.
- **Recommendation Search Engines:** google uses graph to represent pages and their importance.

Graph Terminologies

- Directed Graph: A graph in which every edge is directed is called undirected graph.

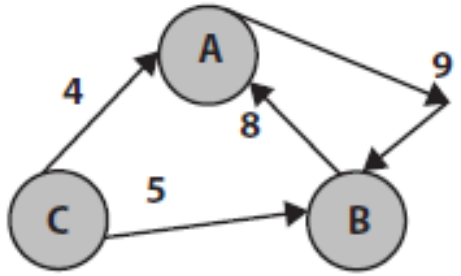


- Undirected Graph: A graph in which every edge is undirected

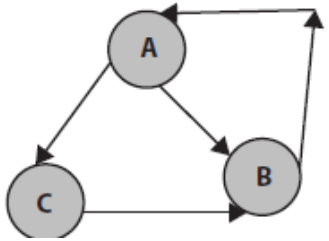


Graph Terminologies

WEIGHTED GRAPH: A graph is said to be weighted if its edges have been assigned some non-negative value as weight.

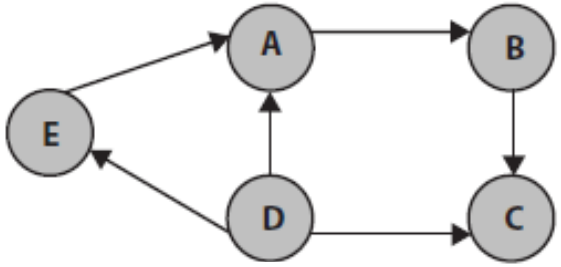


Path is the sequence of consecutive edges from the source node to the destination node.

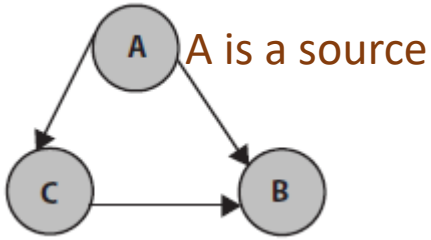


CYCLIC GRAPH A graph that has cycles is called as cyclic graph.

ACYCLIC GRAPH A graph that has no cycle is known as acyclic graph.

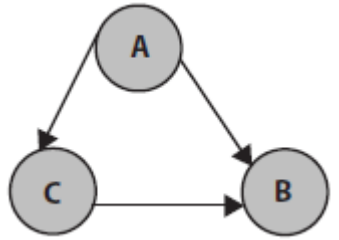


SOURCE A node which has no incoming edges, but has outgoing edges



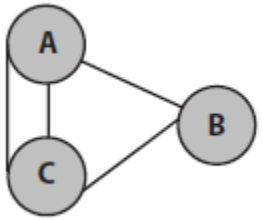
Graph Terminologies

SINK A node, which has no outgoing edges but has incoming edges

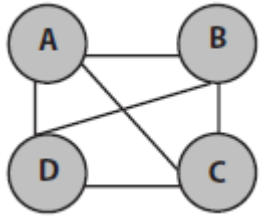


B is a Sink node

DEGREE In an undirected graph the number of edges connected to a node is called the degree of that node. In graph-3 the degree of the node A is 3 and the degree of the node B is 2.



REGULAR GRAPH A graph is regular if every node is adjacent to the same number of nodes



Representation of Graph

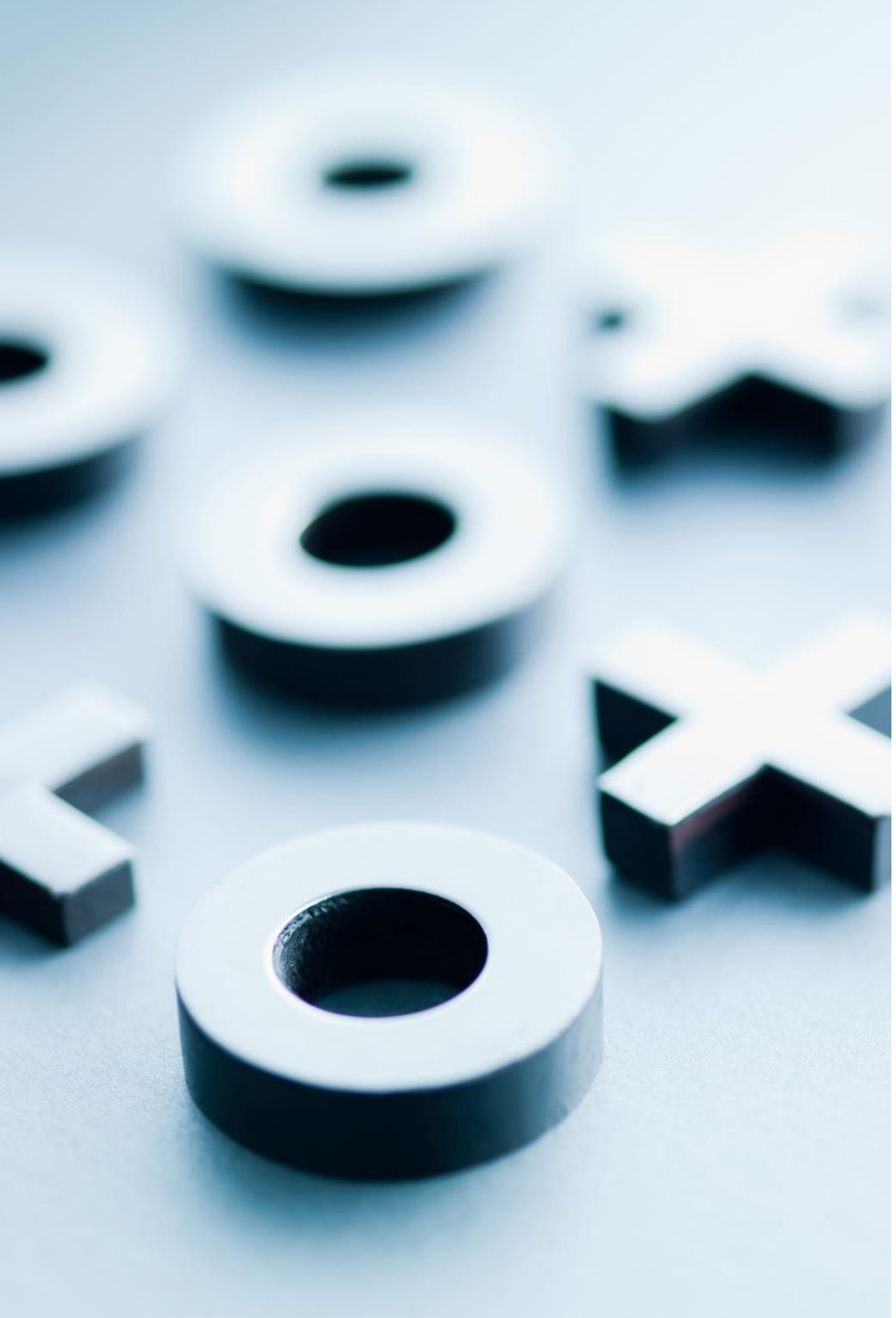
The major components of the graph are node and edges.

Like tree the graph can also be represented in two different ways such as

- ARRAY REPRESENTATION
- LINKED REPRESENTATION

Overall, there are four major approaches to represent the graph as

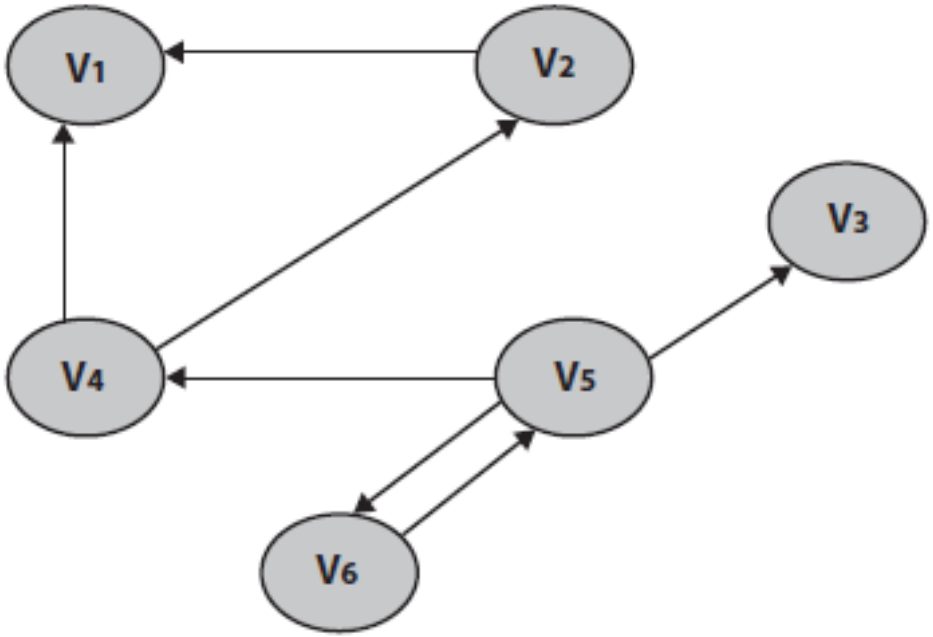
- Adjacency Matrix
- Adjacency Lists
- Adjacency Multilists
- Incedince Matrix



Adjacency Matrix

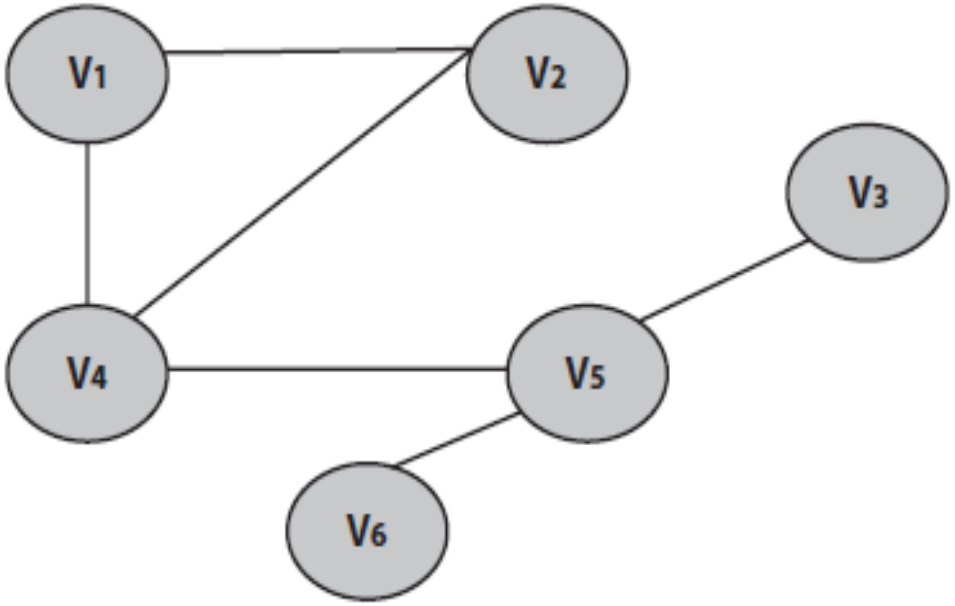
- The nodes that are adjacent to one another are represented as matrix.
- The adjancy matrix of the graph G is a two-dimensional array of size n * n(Where n is the number of vertices in the graph) with the property that A[I][J] = 1, if the edge (VI, VJ) is in the set of edges and A[I][J] = 0 if there is no such edge

Example:



	V1	V2	V3	V4	V5	V6
V1	0	0	0	0	0	0
V2	1	0	0	0	0	0
V3	0	0	0	0	0	0
V4	1	1	0	0	0	0
V5	0	0	1	1	0	1
V6	0	0	0	0	1	0

If the graph was Undirected:



	V1	V2	V3	V4	V5	V6
V1	0	1	0	1	0	0
V2	1	0	0	1	0	0
V3	0	0	0	0	1	0
V4	1	1	0	0	1	0
V5	0	0	1	1	0	1
V6	0	0	0	0	1	0

Traversal of Graph

- The Graph Traversal is of two types such as
  - Breadth First Search (BFS).
  - Depth First Search (DFS).