COURSE NAME: ALGORITHMS
COURSE CODE: CIS 212

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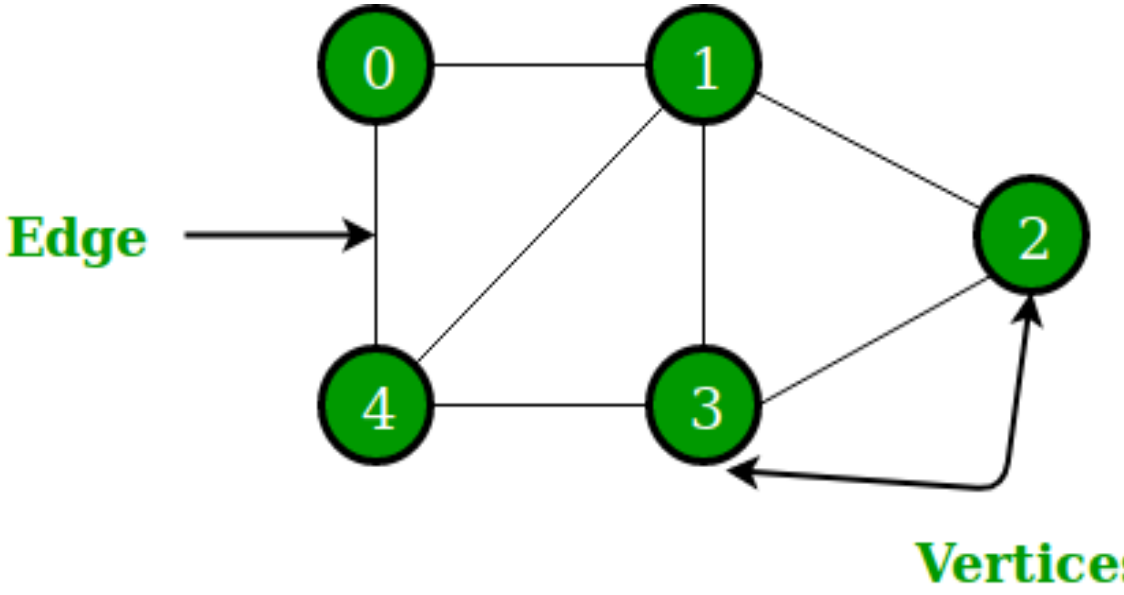
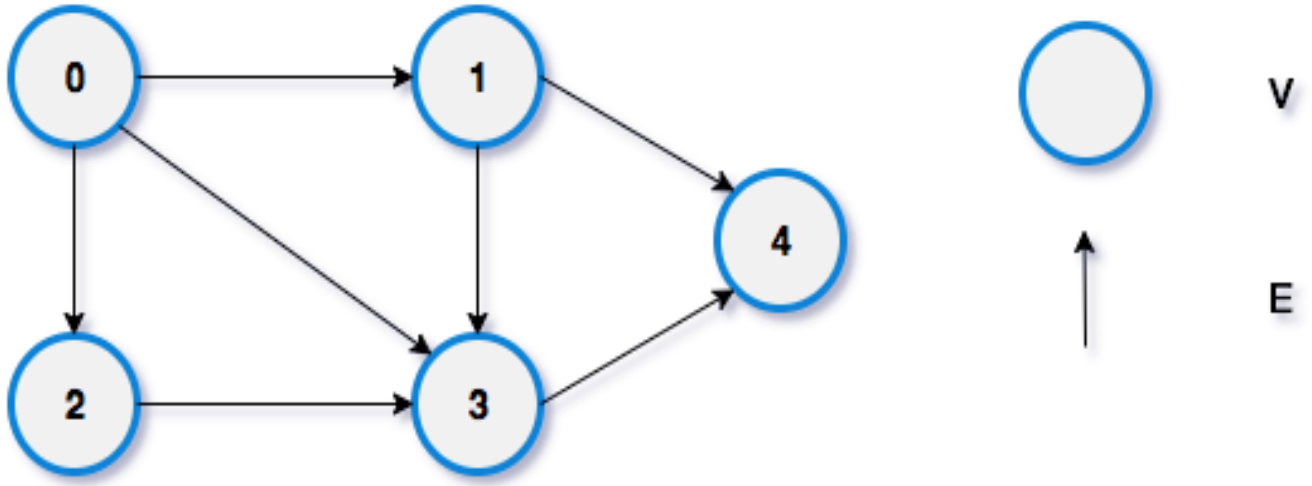
GRAPHS

- **Graph:** A Graph consists of a finite set of vertices(or nodes) and set of edges which connect a pair of nodes.
- In the below graph, the set of vertices, V={0,1,2,3,4} and the set of edges, E={01,12,23,34,04,14,13}
- G=(V,E)

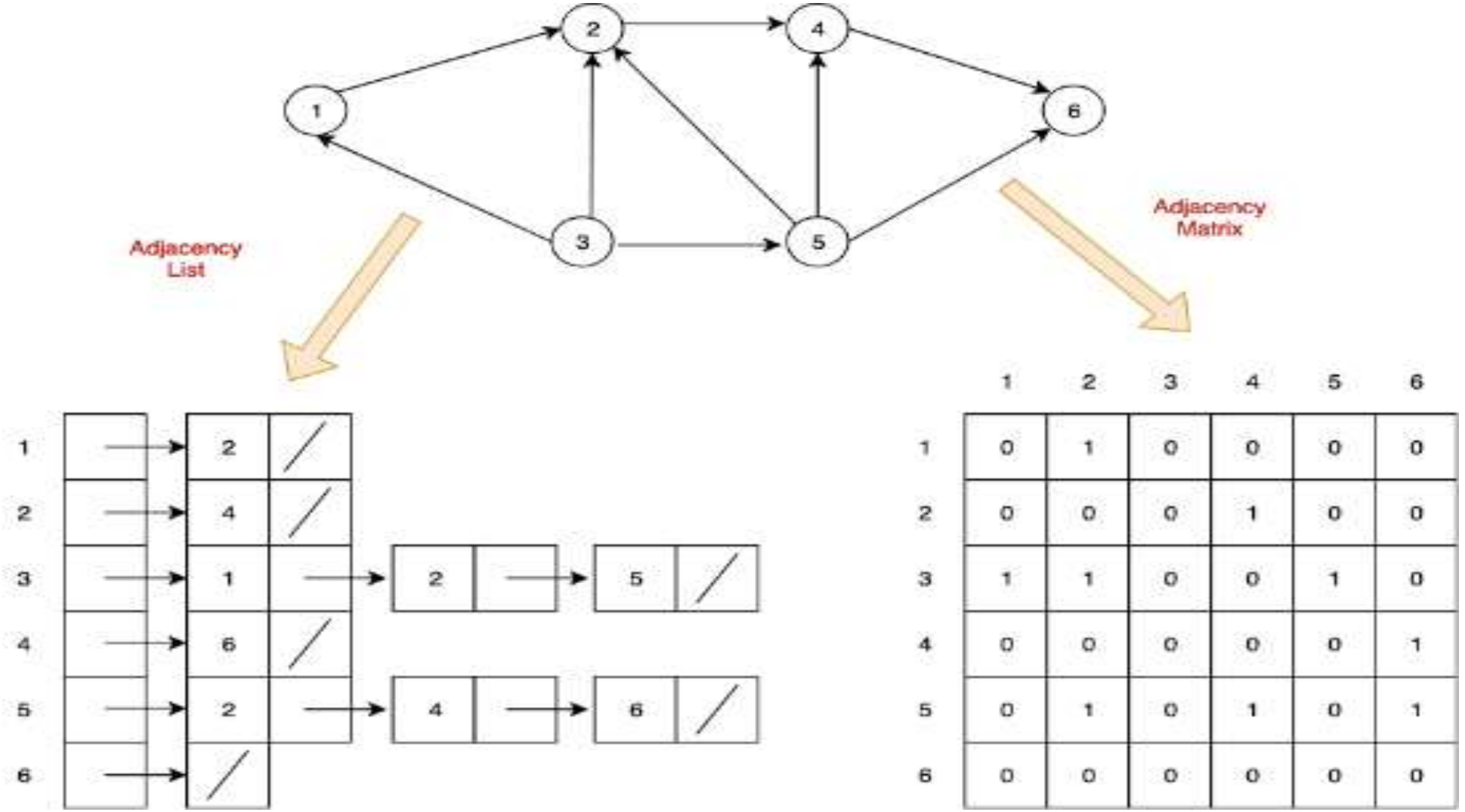


DIRECTED GRAPHS

- **Directed Graph:** A directed graph is a set of vertices connected by edges, with each node having a direction associated with it.



DIRECTED GRAPHS ADJACENCY MATRIX & LIST



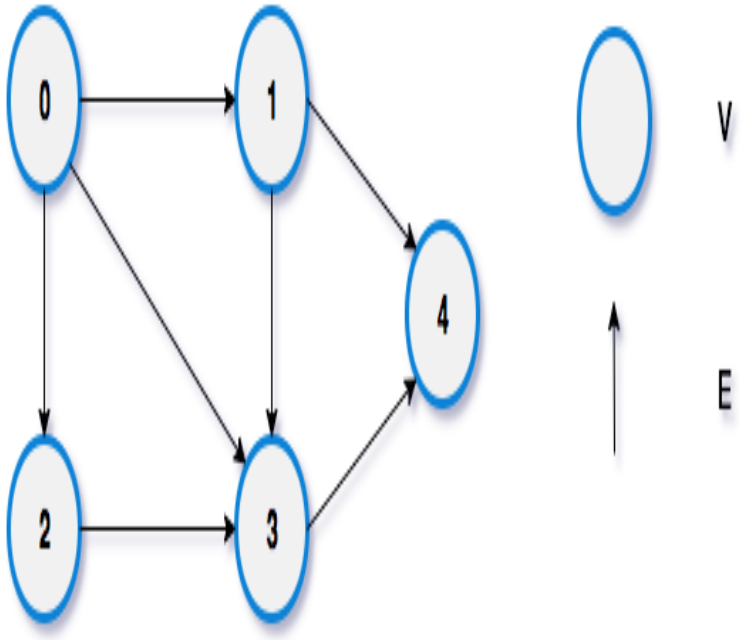
INDEGREE/OUTDEGREE

- **DEGREE OF VERTEX:** It is the number of vertices adjacent to a vertex V.
- Degree of vertex can be considered under two cases of graphs: Undirected Graph, Directed Graph.
- But in Directed Graph degree of vertex has an **Indegree** and **Outdegree**.
- **INDEGREE:** Indegree of vertex V is the number of edges which are coming into the vertex V.
- **OUTDEGREE:** Outdegree of vertex V is the number of edges which are going out from the vertex V.

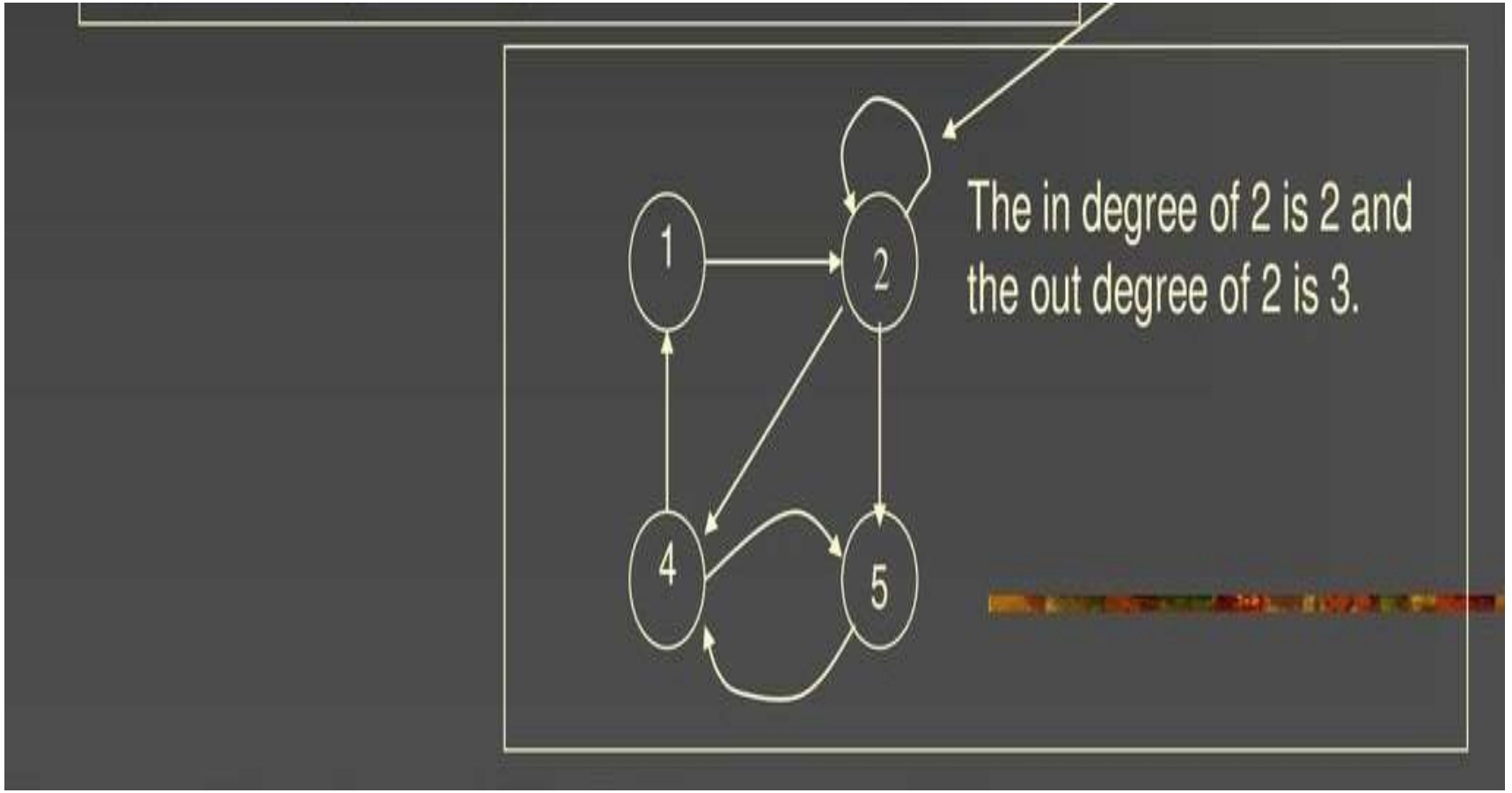
DIRECTED GRAPHS (INDEGREE/OUTDEGREE)

- **INDEGREE:**
- In-degree of vertex 0 = 0
- In-degree of vertex 1 = 1
- In-degree of vertex 2 = 1
- In-degree of vertex 3 = 3
- In-degree of vertex 4 = 2

- **OUTDEGREE:**
- Out-degree of vertex 0 = 3
- Out-degree of vertex 1 = 2
- Out-degree of vertex 2 = 1
- Out-degree of vertex 3 = 1
- Out-degree of vertex 4 = 0

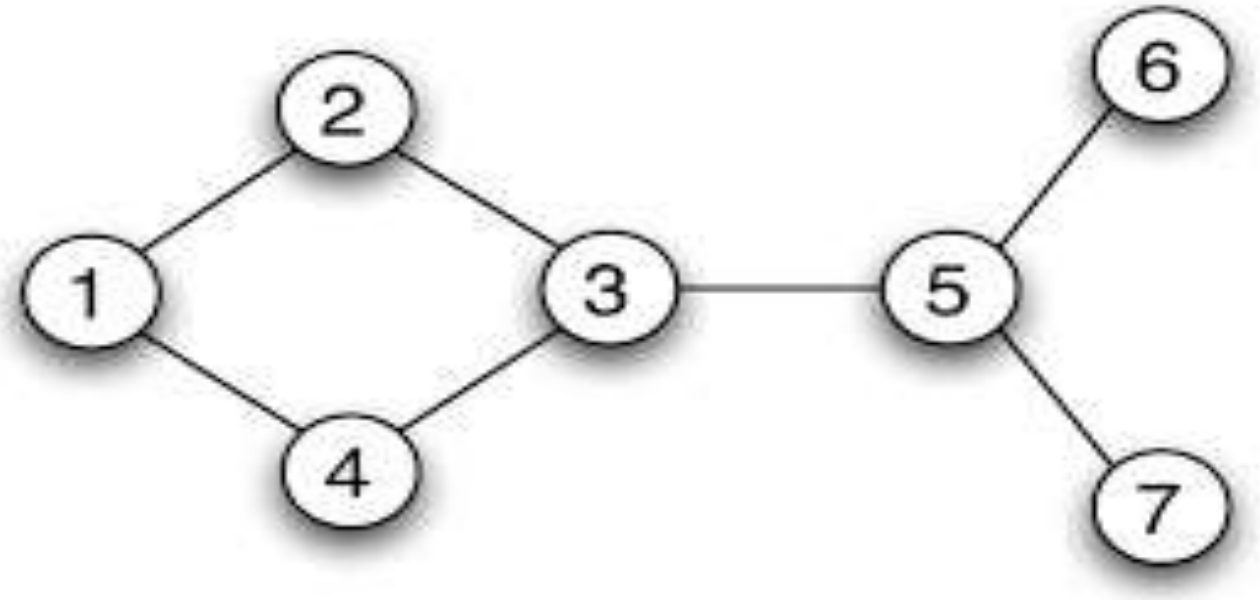


DIRECTED GRAPHS (SELF LOOP)

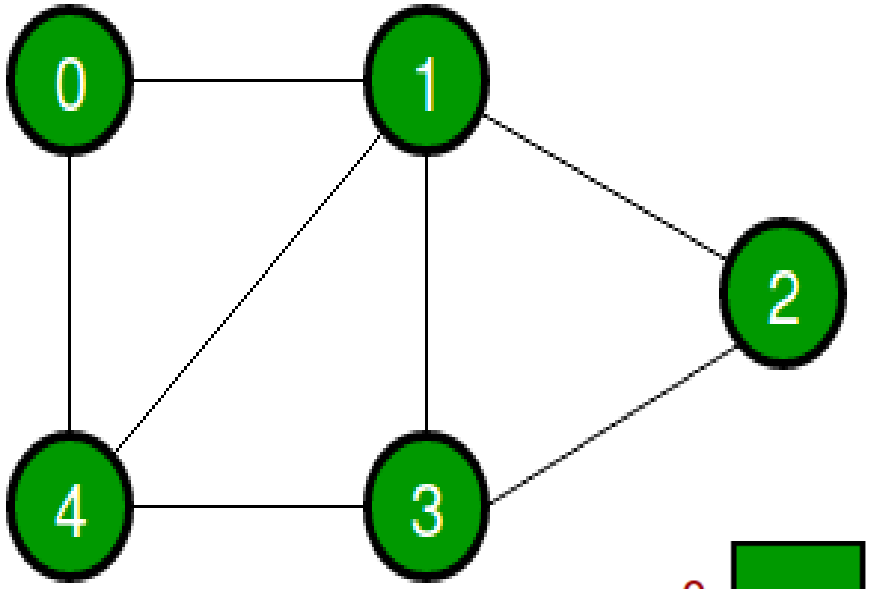


UNDIRECTED GRAPH

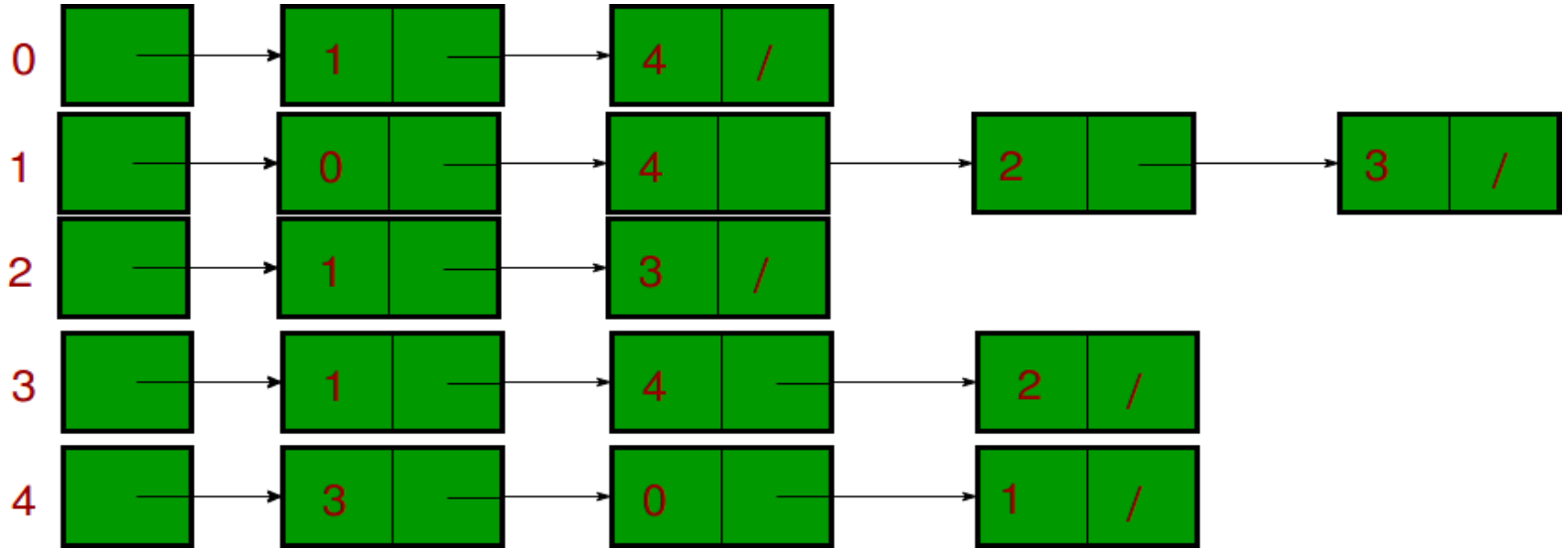
- **Undirected Graph:** In an Undirected Graph the edges are bidirectional, with no direction associated with them.



UNDIRECTED GRAPH (ADJACENCY MATRIX & LIST)



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

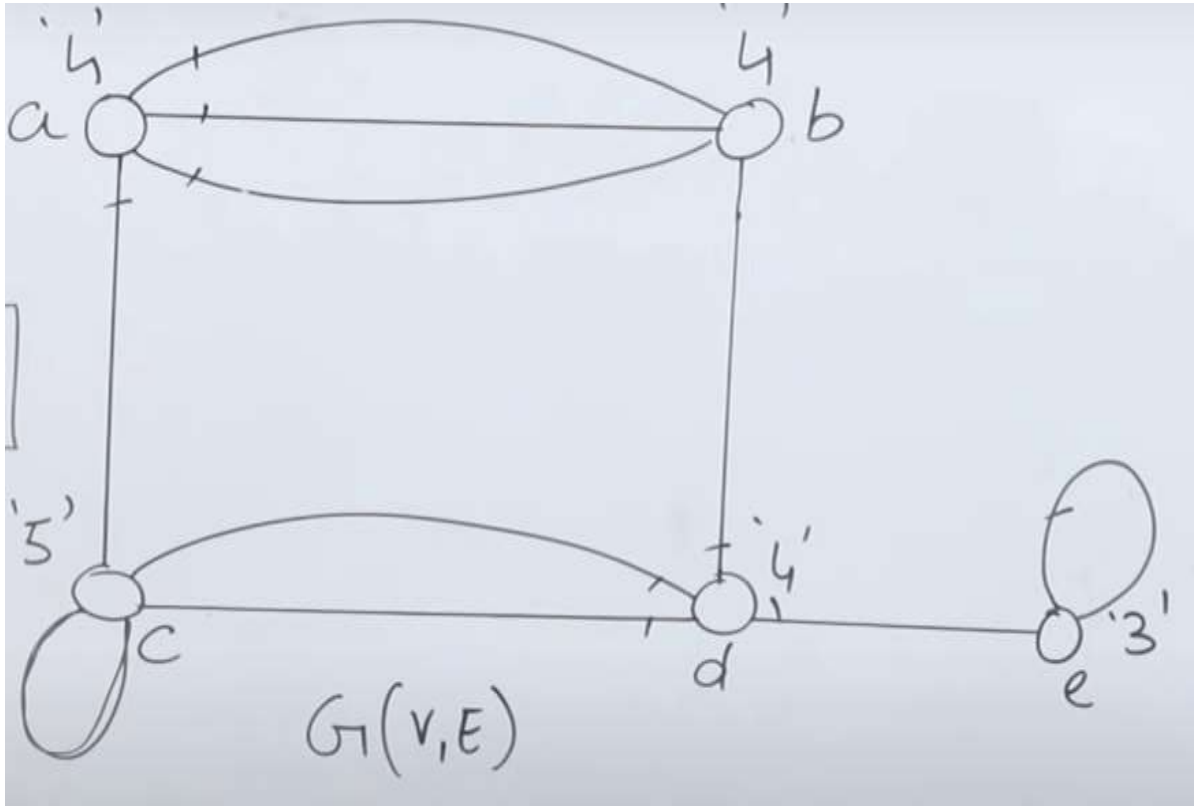


HANDSHAKING LEMMA

- **Handshaking Lemma:** Handshaking Theorem is also known as Handshaking Lemma or Sum of Degree Theorem. In graph theory, Handshaking Theorem states in any given graph, sum of degree of all the vertices is twice the number of edges contained in it.

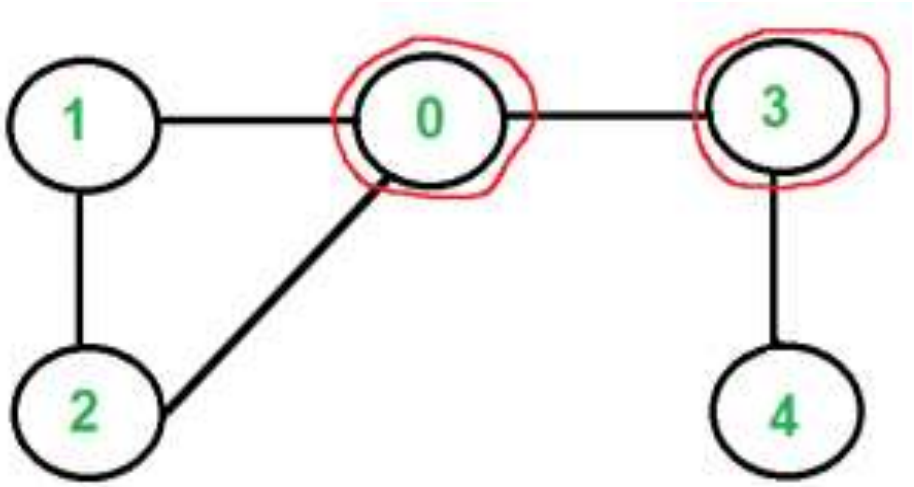
$$\sum_{i=1}^{n} d(v_i) = 2 \times |E|$$

Handshaking Theorem

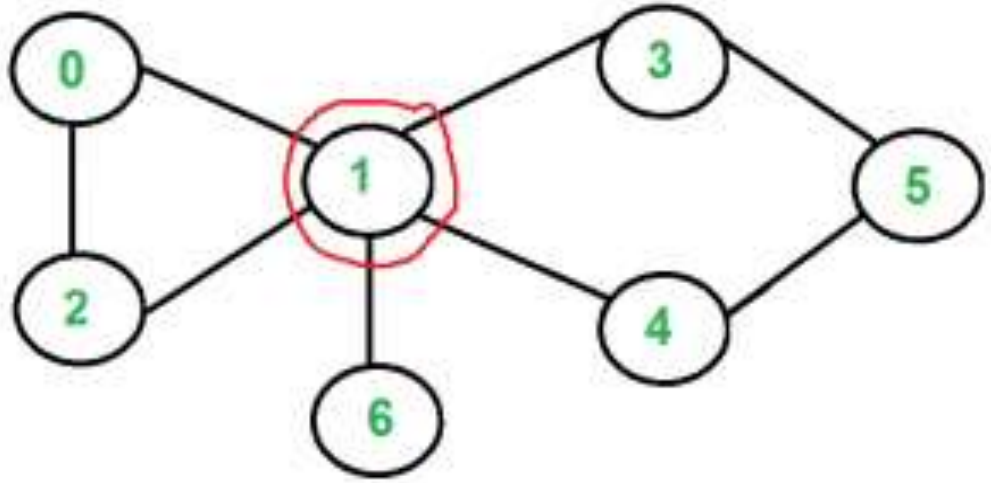


ARTICULATION POINT

- **Articulation Point:** A vertex in an undirected connected graph is an articulation point if removing it disconnects the graph.



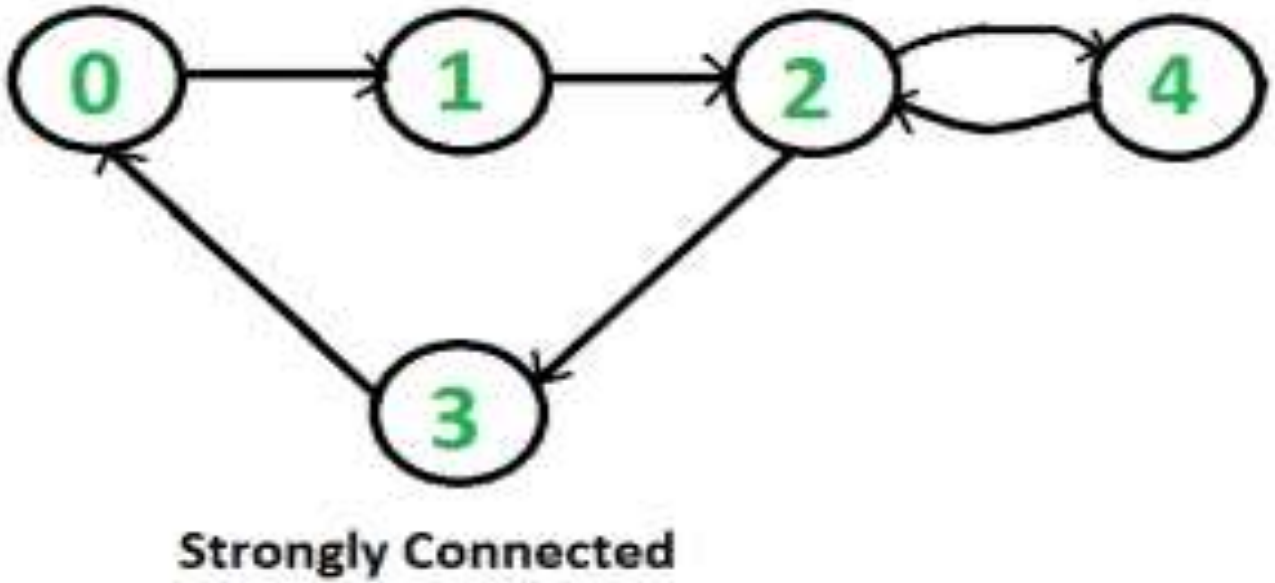
Articulation points are 0 and 3



Articulation Point is 1

STRONGLY CONNECTED GRAPH

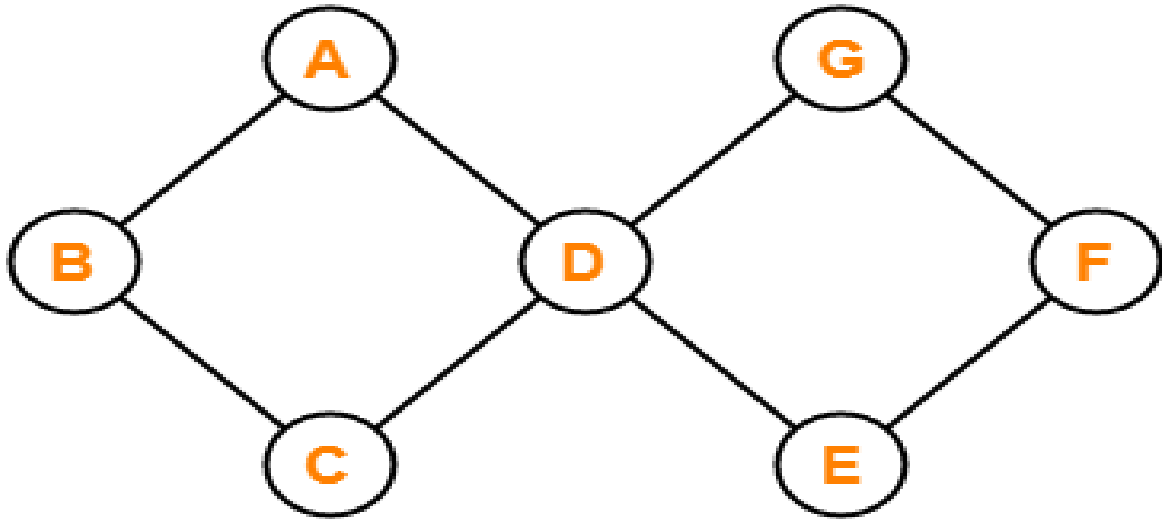
- **Strongly Connected Graph:** A directed graph is called strongly connected if there is a path in each direction between each pair of vertices of the graph.



Strongly Connected

CYCLIC GRAPH

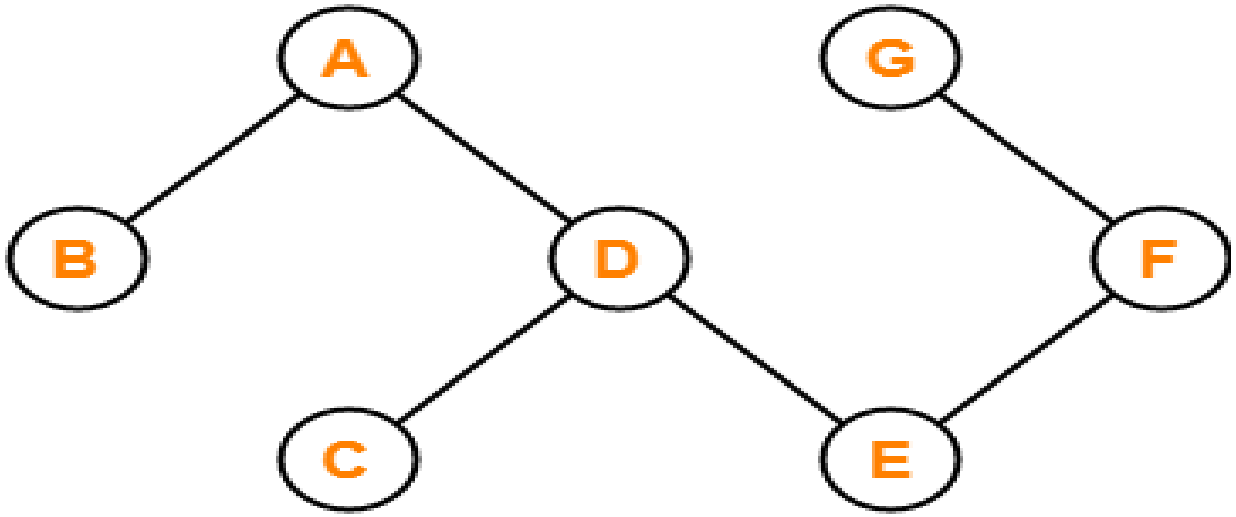
- **Cyclic Graph:** A graph containing at least one cycle in it is called as a cyclic graph.



Example of Cyclic Graph

ACYCLIC GRAPH

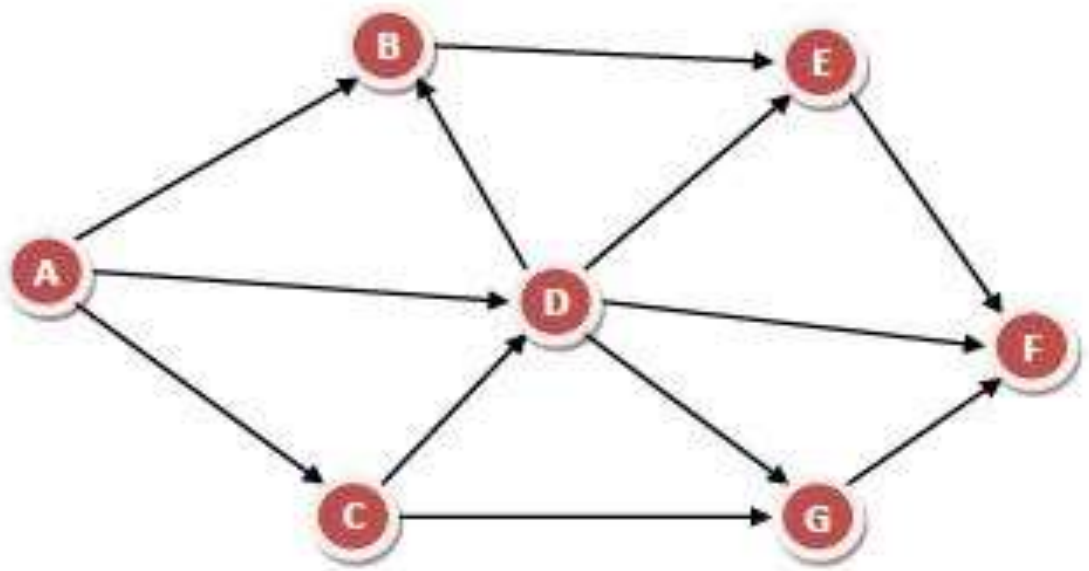
- **Acyclic Graph:** A graph not containing any cycle in it is called as an acyclic graph.



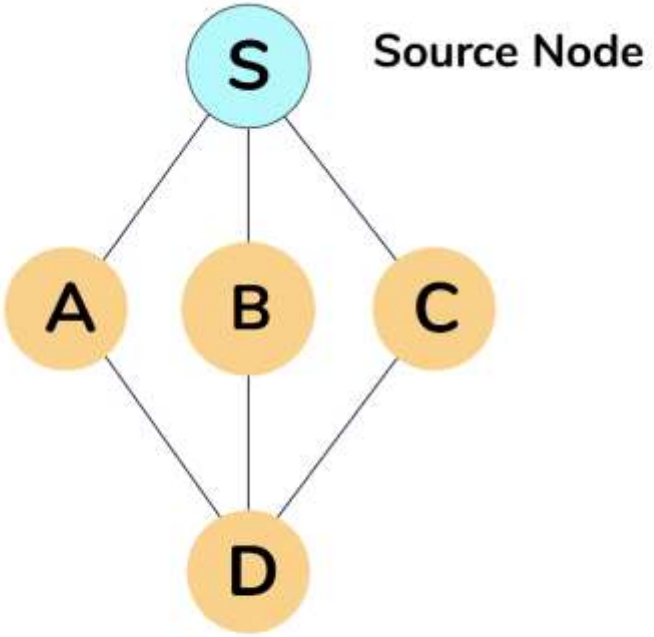
Example of Acyclic Graph

DIRECTED ACYCLIC GRAPH

- **Directed Acyclic Graph:** A directed acyclic graph refers to a directed graph which has no directed cycles.



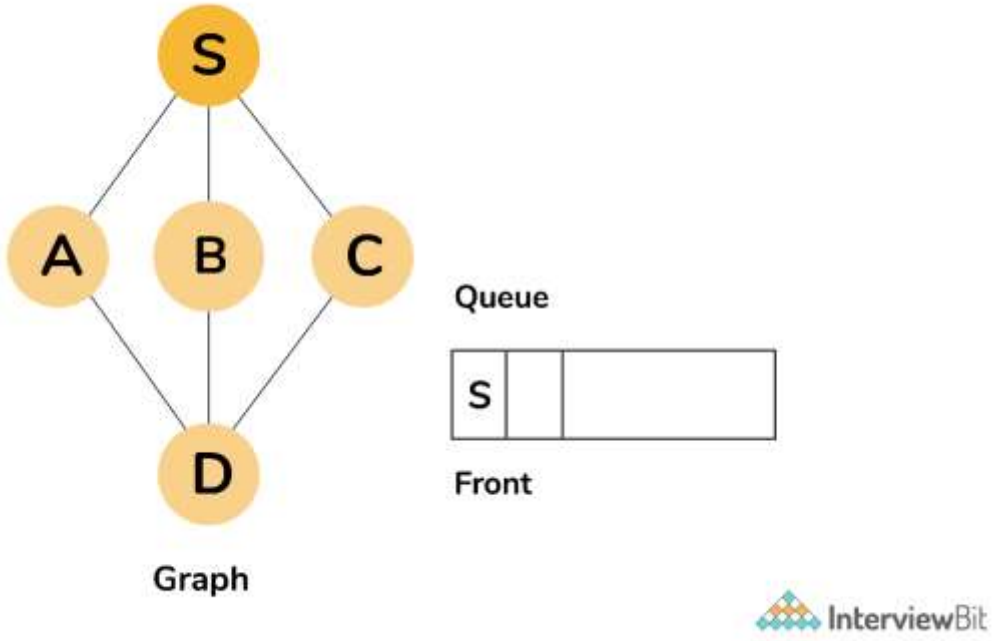
BFS



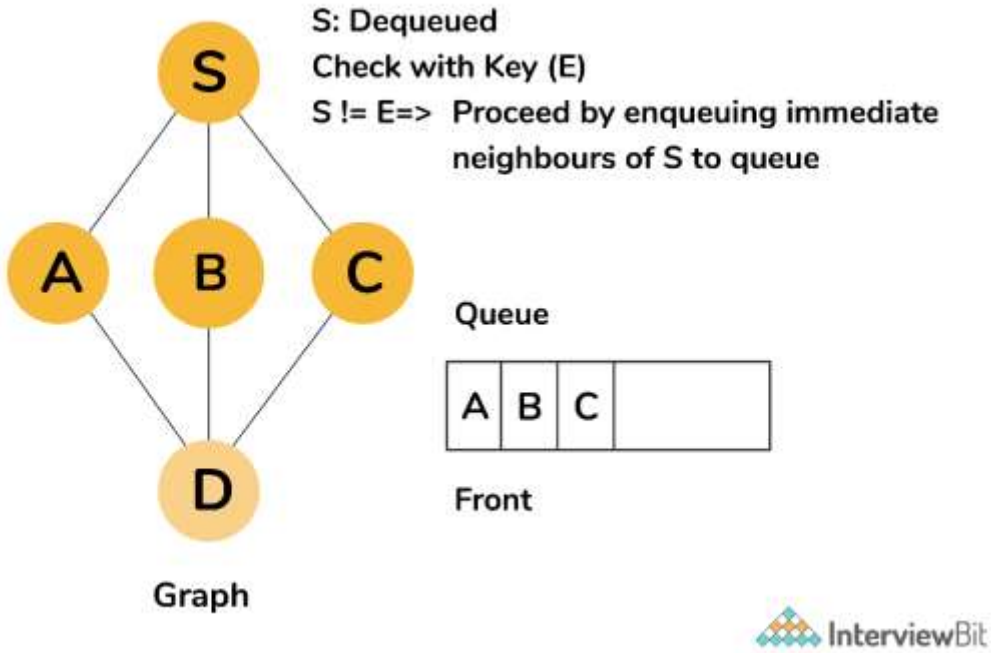
Graph

InterviewBit

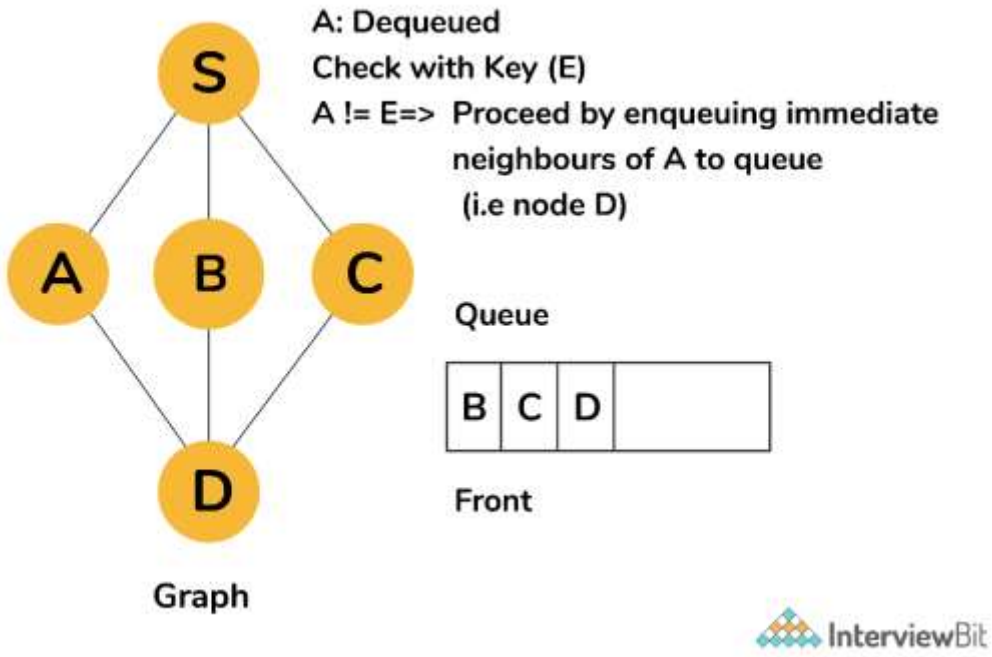
BFS



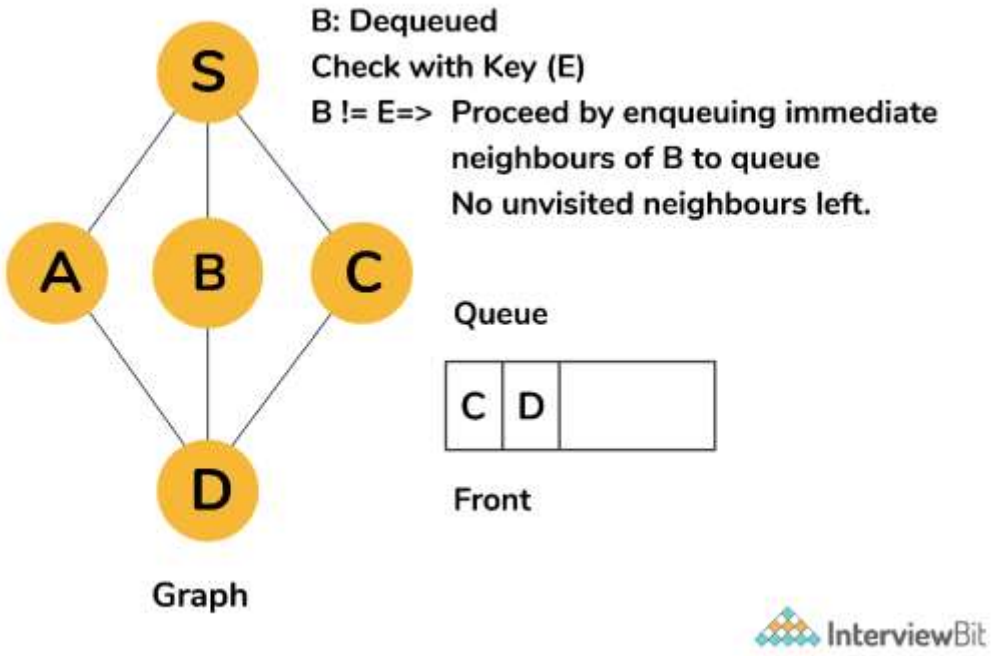
BFS


S
A
B
C
D
S: Dequeued
Check with Key (E)
S != E=> Proceed by enqueuing immediate neighbours of S to queue
Queue
A
B
C
Front
Graph
InterviewBit

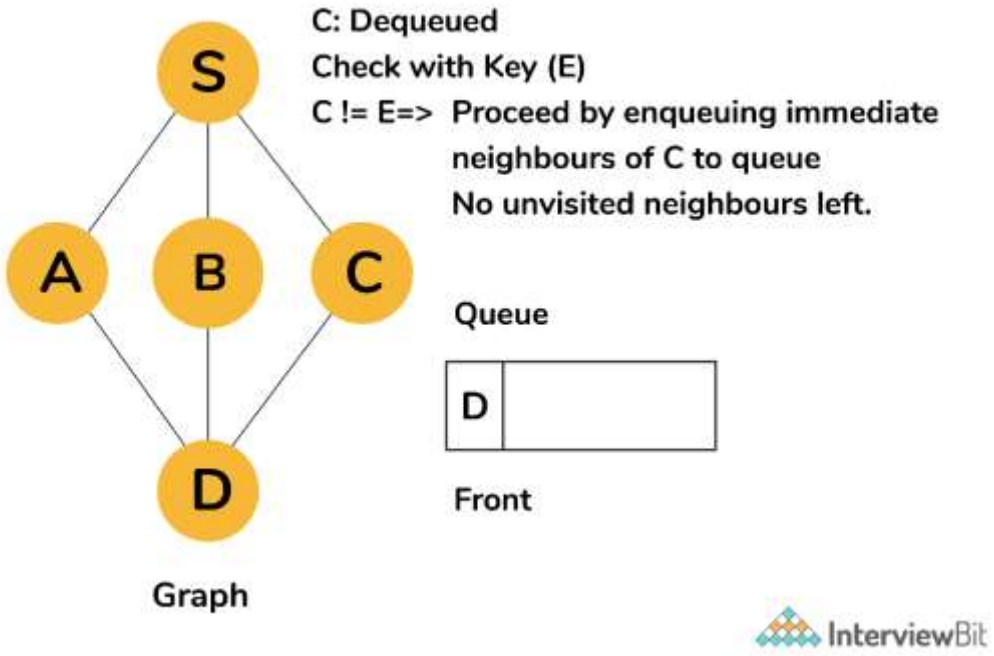
BFS


S
A
B
C
D
Graph
A: Dequeued
Check with Key (E)
A != E=> Proceed by enqueuing immediate neighbours of A to queue (i.e node D)
Queue
B
C
D
Front
InterviewBit

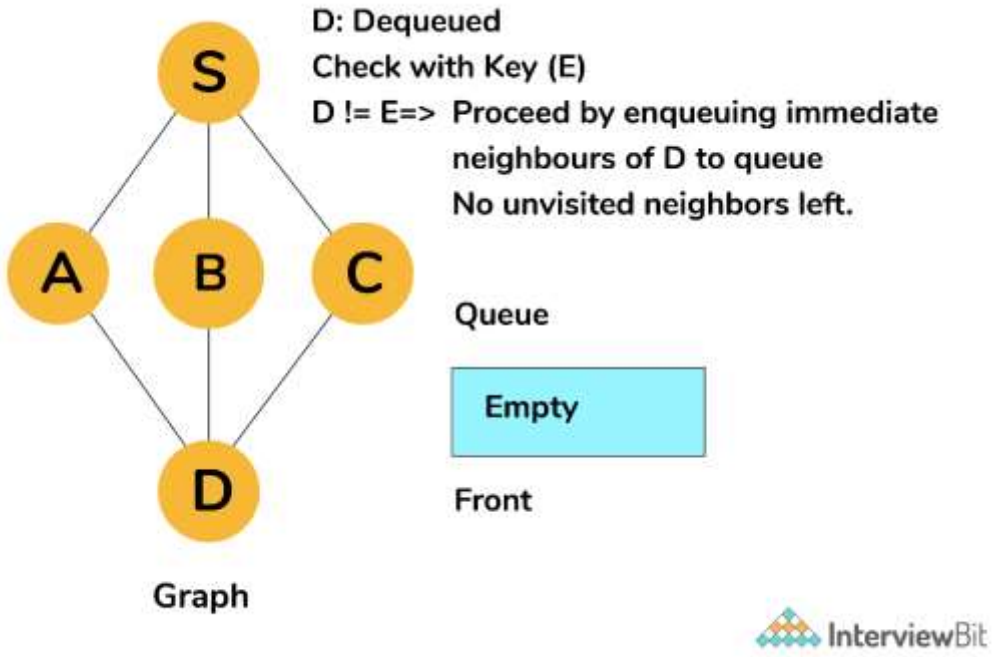
BFS


S
A
B
C
D
Graph
B: Dequeued
Check with Key (E)
B != E=> Proceed by enqueuing immediate neighbours of B to queue
No unvisited neighbours left.
Queue
C
D
Front
InterviewBit

BFS


S
A
B
C
D
Graph
C: Dequeued
Check with Key (E)
C != E=> Proceed by enqueuing immediate neighbours of C to queue
No unvisited neighbours left.
Queue
D
Front
InterviewBit

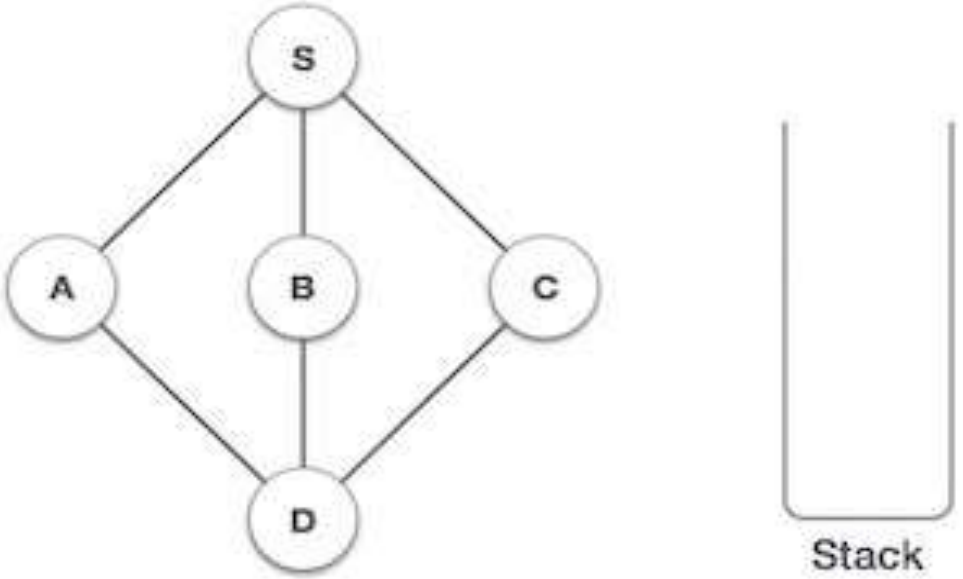
BFS


S
A
B
C
D
Graph
D: Dequeued
Check with Key (E)
D != E=> Proceed by enqueuing immediate neighbours of D to queue
No unvisited neighbors left.
Queue
Empty
Front
InterviewBit

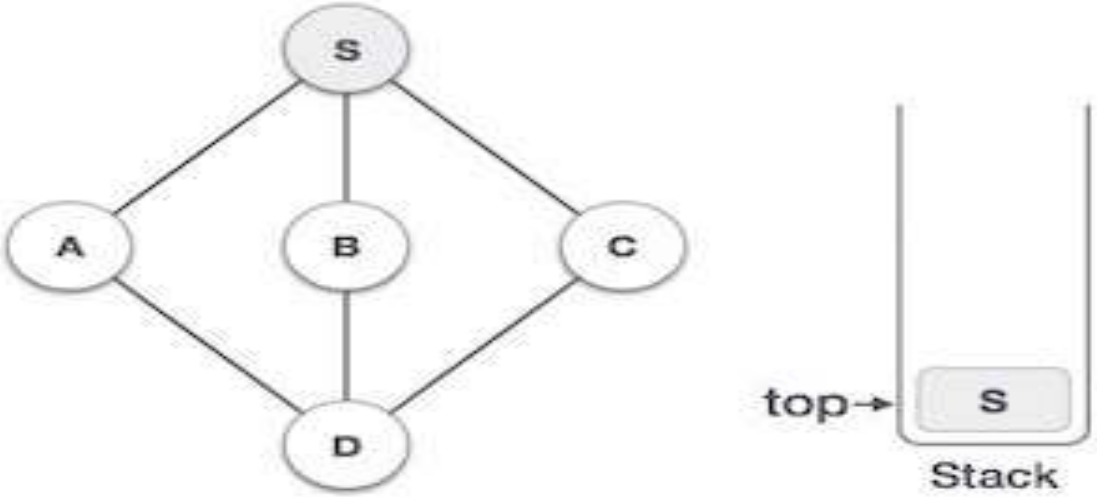
S,A,B,C,D

DFS

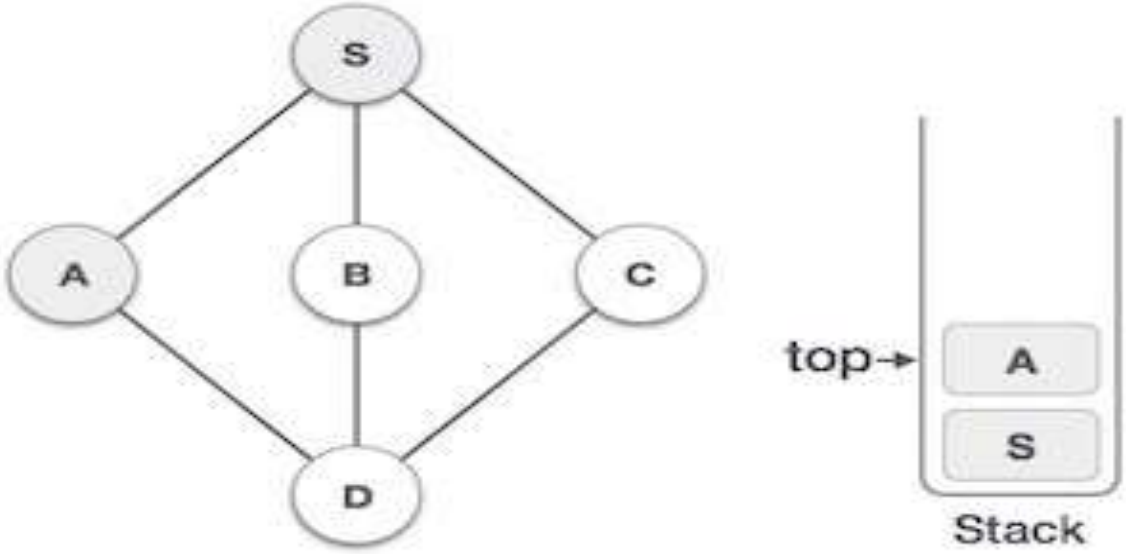
READING FROM THIS WEBSITE: https://www.tutorialspoint.com/data_structures_algorithms/depth_first_traversal.htm



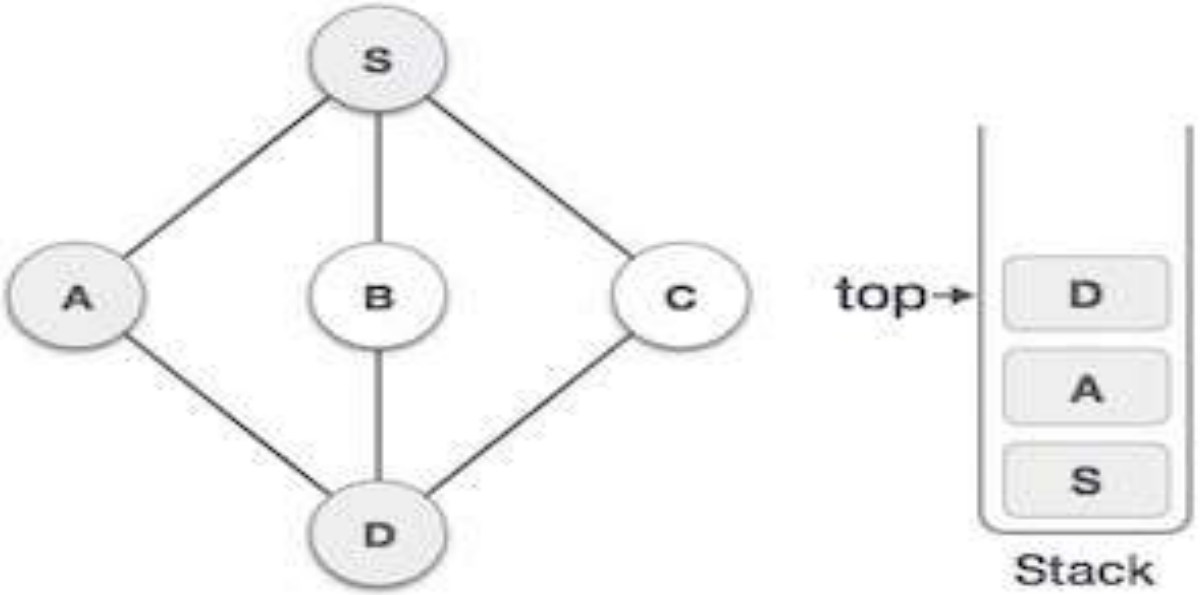
DFS



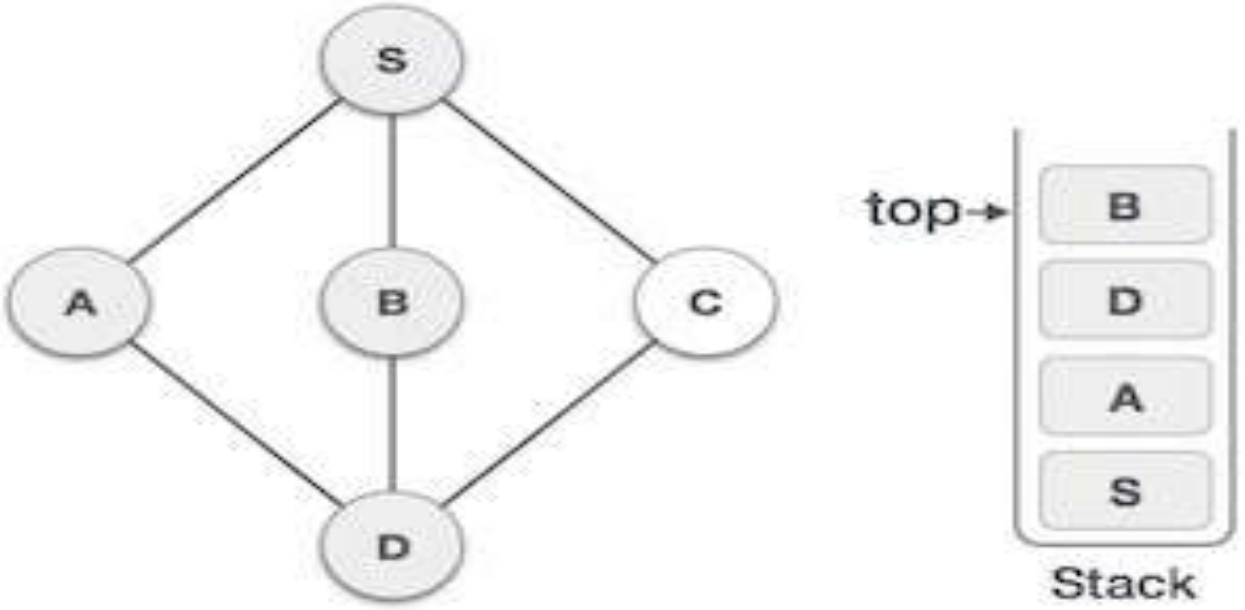
DFS



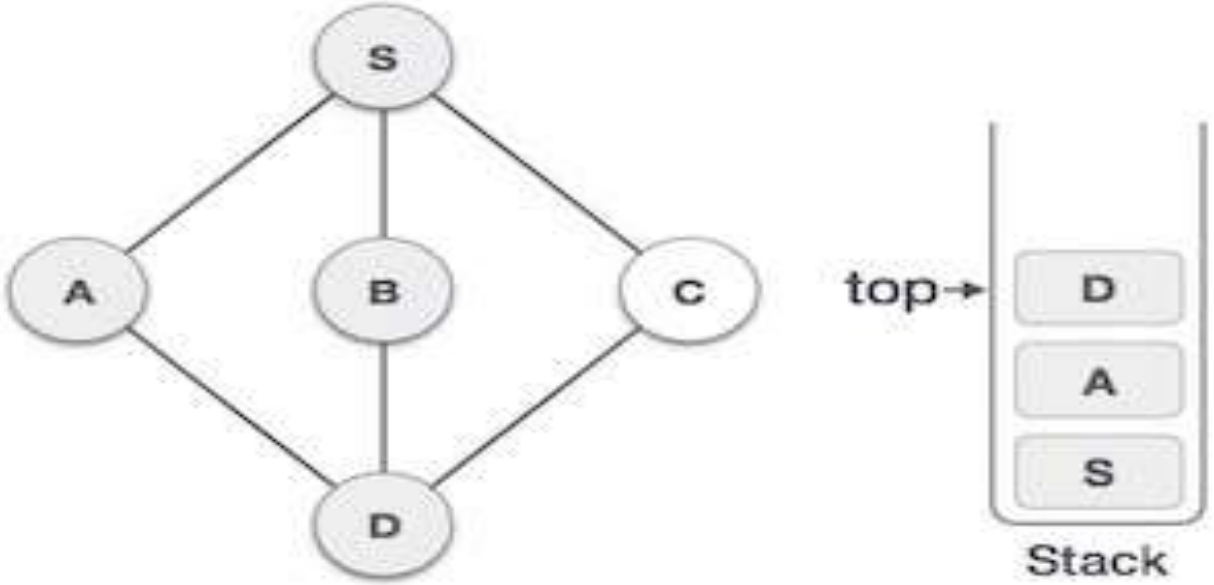
DFS



DFS



DFS



DFS