National University of computer and emerging sciences

CL461-INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Lab#4

Graphs with python

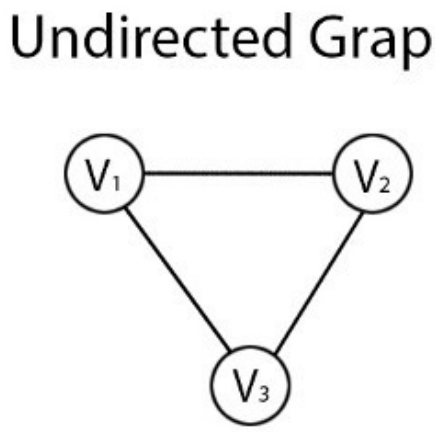
Components of Graph

Nodes/Vertices & Edges

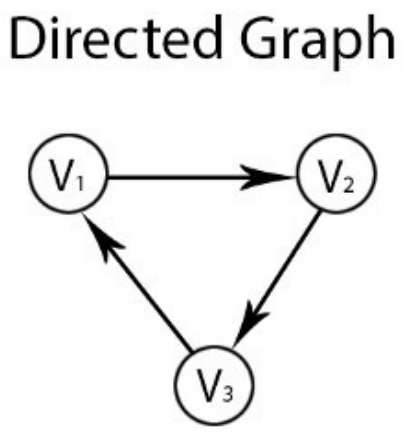
When computer scientists talk about graphs, they don't use the terms "dots" and "lines."
Instead, each dot is called a **node** or a **vertex** (plural "vertices").
Each line is called an **edge** or an **arc**.
By far, the most common combination of these terms is vertex and edge. When you see someone represent a graph with the notation `G(V, E)` it literally means "a **graph with vertices and edges**."

Types of graphs

1)



2)



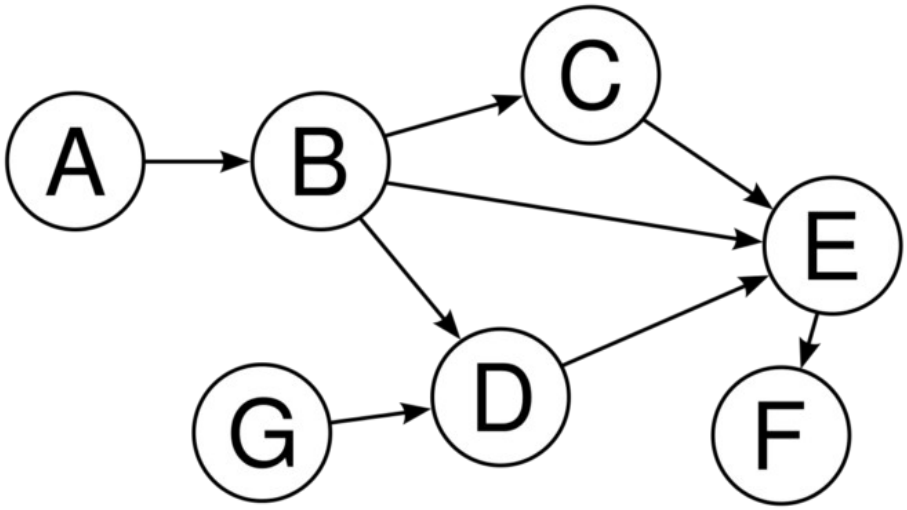
3)Cyclic vs. 4)Acyclic

If your undirected graph contains a loop where you can follow the edges and return to a point, then you have a **cyclic graph**.

If your directed graph has a loop where you can follow the edges in the correct direction and return to a point, then that graph is also cyclic.

An acyclic graph, on the other hand, has no loops.

For instance, this graph is acyclic because it has no loops. **While the vertices are well-connected**, they only go in one direction.



There are 7 other certain types/forms of graphs which we discussed in lab in detail with examples.

5) Complete Graph

6) Incomplete Graph

7) Connected Graph

8) Disconnected Graph

9) Null Graph

10) Trivial Graph

11) Bipartite Graph

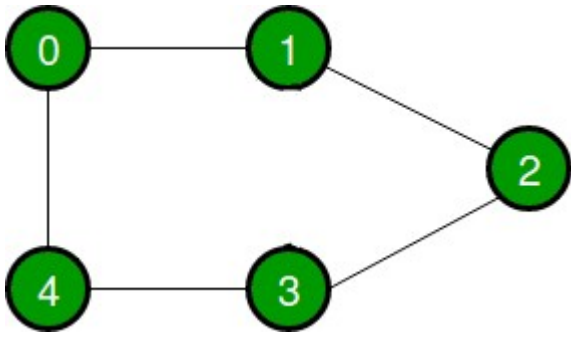
Ways To Store Graph

1) Adjacency List: An Adjacency list is an array consisting of the address of all the linked list. The first node of the linked list represents the vertex and the remaining lists connected to this node represents the vertices to which this node is connected. This representation can also be used to represent a weighted graph. The linked list can slightly be changed to even store the weight of the edge.

2) Adjacency Matrix: An Adjacency matrix is a 2D array of size V x V where V is the number of vertices in a graph. Let the 2D array be adj[][], a slot adj[i][j] = 1 indicates that there is an edge from vertex i to vertex j. Adjacency matrix for undirected graph is always symmetric. Adjacency Matrix is also used to represent weighted graphs. If adj[i][j] = w, then there is an edge from vertex i to vertex j with weight w.

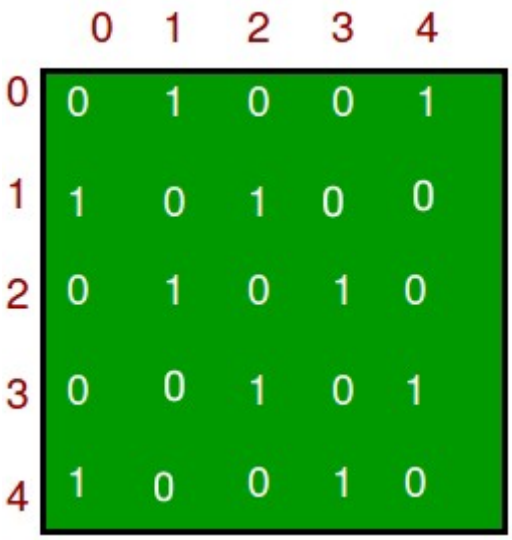
Example

Let us consider a graph to understand the adjacency list and adjacency matrix representation. Let the undirected graph be:

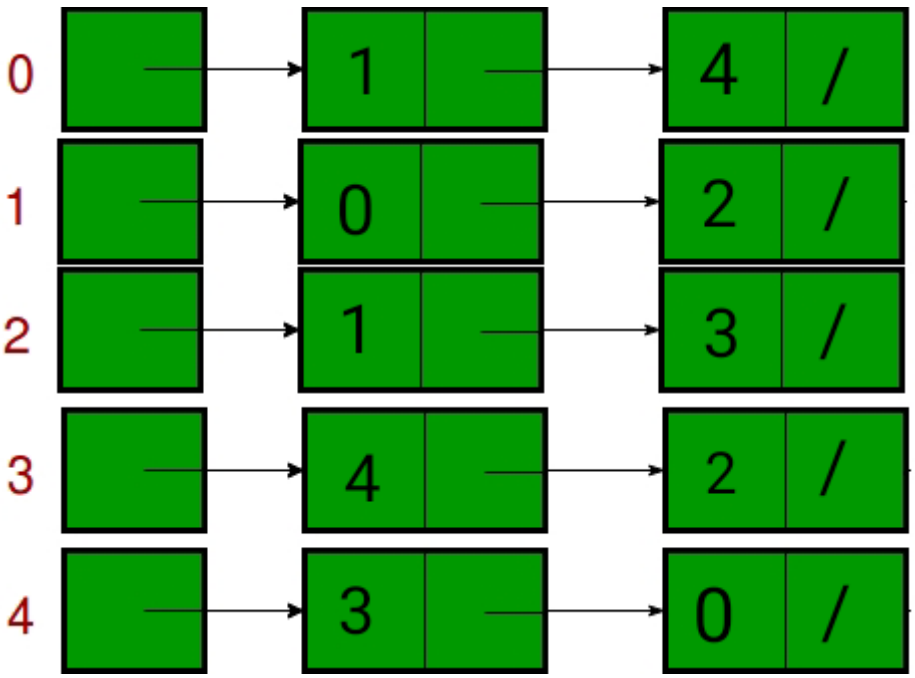


The following graph is represented in the above representations as:

Adjacency Matrix: In the adjacency matrix representation, a graph is represented in the form of a two-dimensional array. The size of the array is **V x V**, where V is the set of vertices. The following image represents the adjacency matrix representation:



Adjacency List: In the adjacency list representation, a graph is represented as an array of linked list. The index of the array represents a vertex and each element in its linked list represents the vertices that form an edge with the vertex. The following image represents the adjacency list representation:



Lab Task

Python Notebook **graph.ipynb** is already provided you and we discussed in detail about following operation of graph with implementation in **Adjacency List ,** you are required to built same graph, discussed in Graph.ipynb and implement same operation with **Adjacency Matrix.**

1) Generate Edges / Insert Edges
2) Find Path (Start,end)
3) Find All Paths (Start,end)
4) Find Shortest Path (Start,end)