DSA through C++

Graph_Data_Structure

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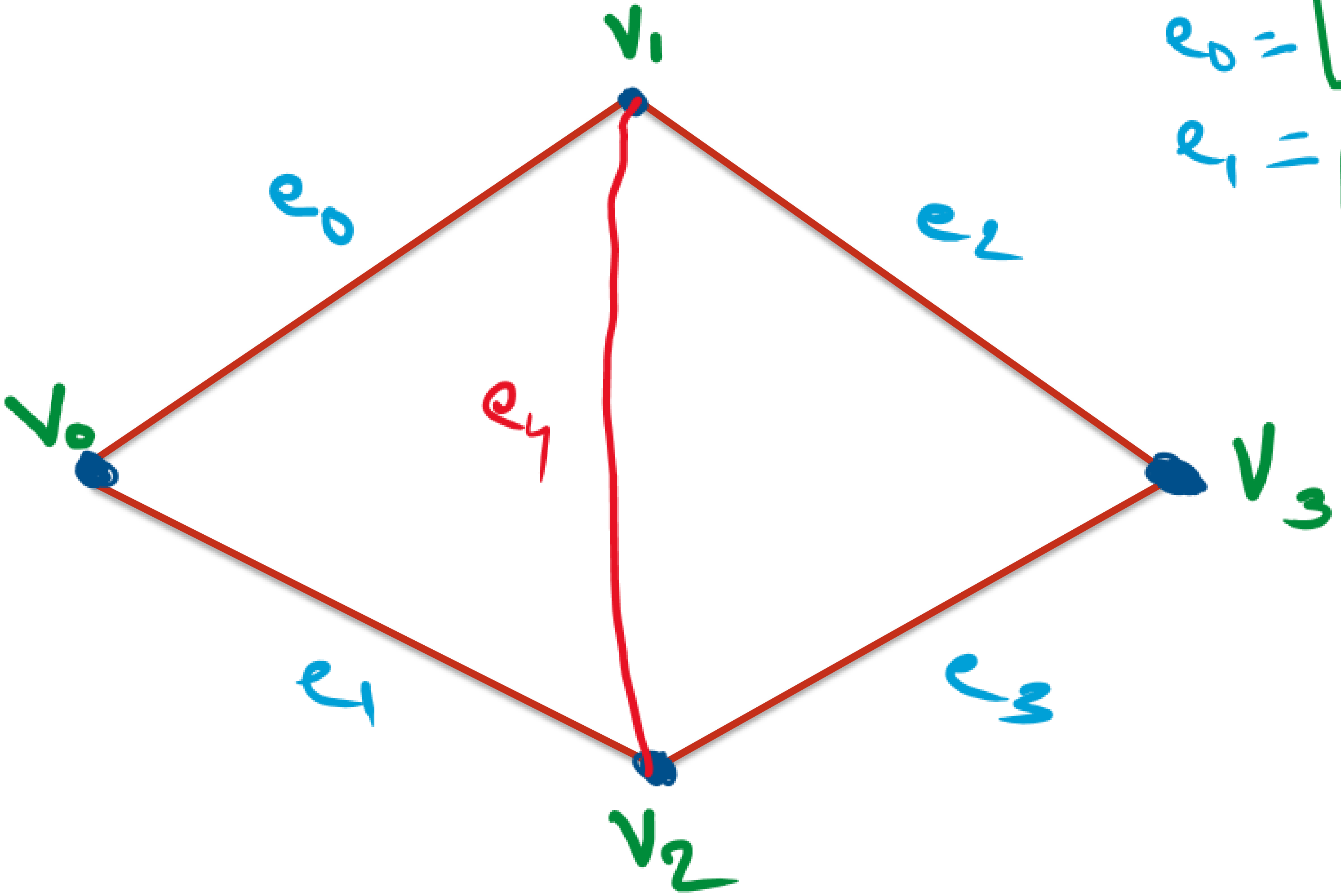
Agenda

- Graph
- Adjacent nodes
- Degree of a node, Path
- Connected Graph
- Labelled & Weighted Graph
- Multi Graph & Directed Graph
- Complete Graph
- Representation of Graph

Graph

- **Graph is a non linear data structure.**
- **A collection of nodes connected by edges, allowing versatile representation of relationships between various entities.**



$e_0 = [v_0, v_1]$

$e_1 = [v_0, v_2]$

$E = \{e_0, e_1, e_2, e_3\}$ $\quad V = \{v_0, v_1, v_2, v_3\}$

- A Graph Consists of two things.
  - A set V of elements called nodes.
  - A set E of edges such that each edge e in E is identified with a unique (unordered) pair [u, v] of nodes in V, denoted by e = [u, v].
  - We indicate the parts of the graph by writing G = (V, E)

Adjacent nodes

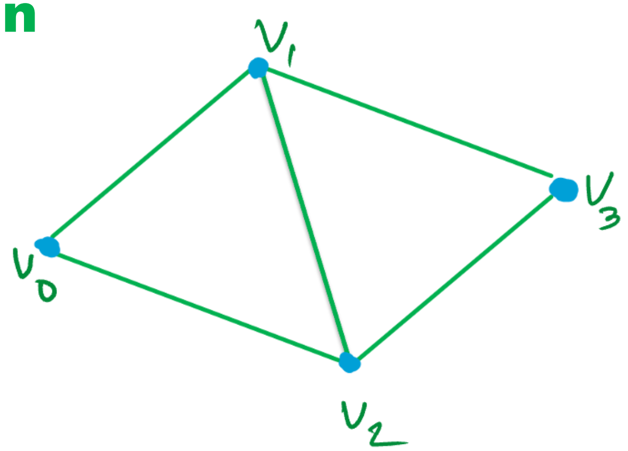
- **If e= [u, v], then u and v are called adjacent nodes or neighbors.**

Degree of a Node

- The degree of node u, written degree (u), is the number of edges containing u.
- If degree(u) = 0, then u is called isolated node.

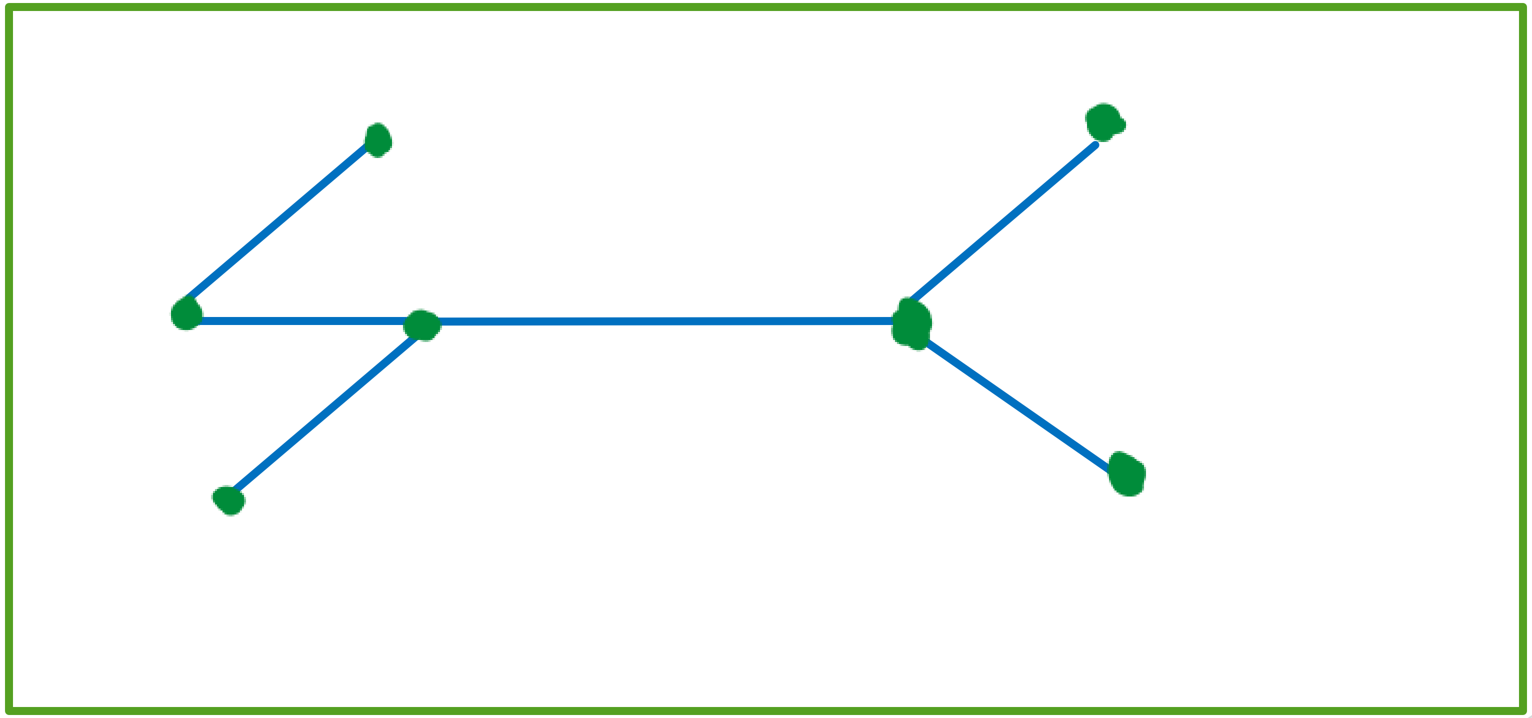
Path

- **A path of length n From a node u to a node v is defined as a sequence of n+1 nodes.**
- **P = (V_0 ,V_1 ,V_2 , ... V_n)**
- **The path is said to be closed**
- **if V_0 = V_n**



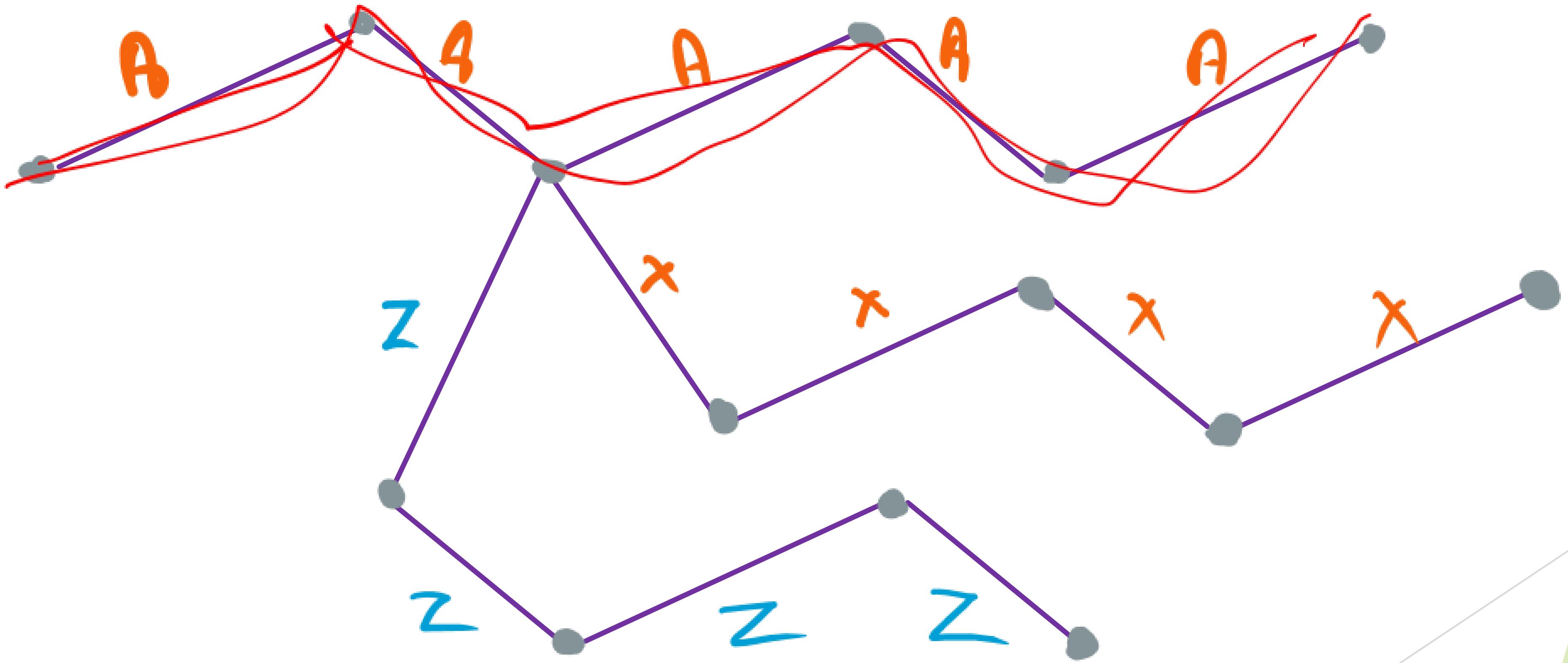
Connected Graph

- **A graph is said to be connected if there is a path between any two of its nodes.**



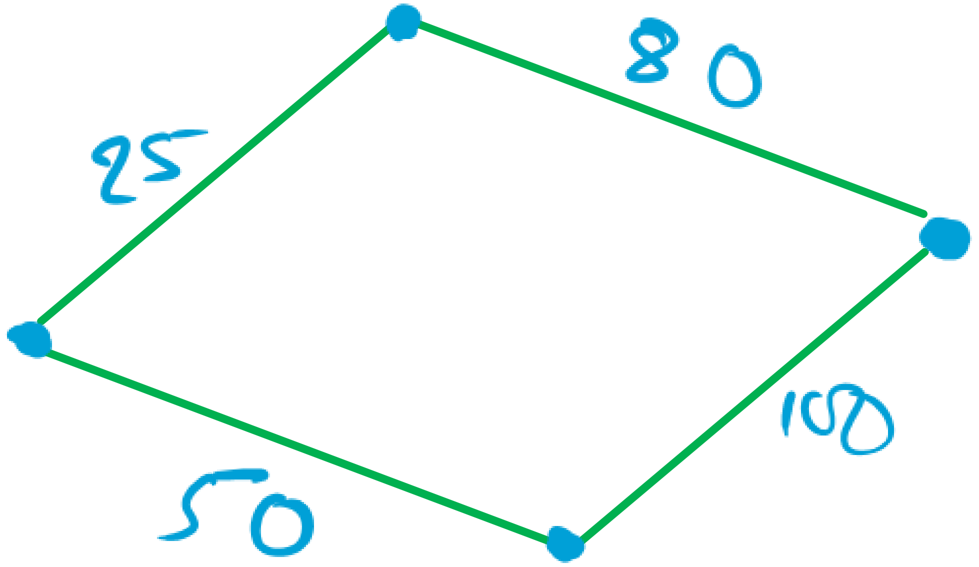
Labelled Graph

- A graph is to be labelled if its edges are assigned data



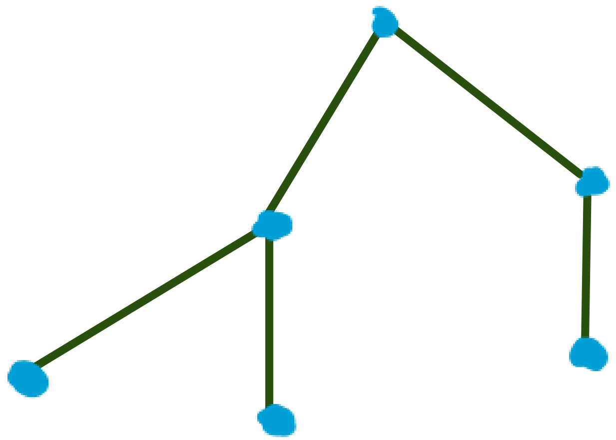
Weighted Graph

- A graph G is said to be weighted if each edge e in G is assigned a non negative numerical value w (e) called the weight or length of e.

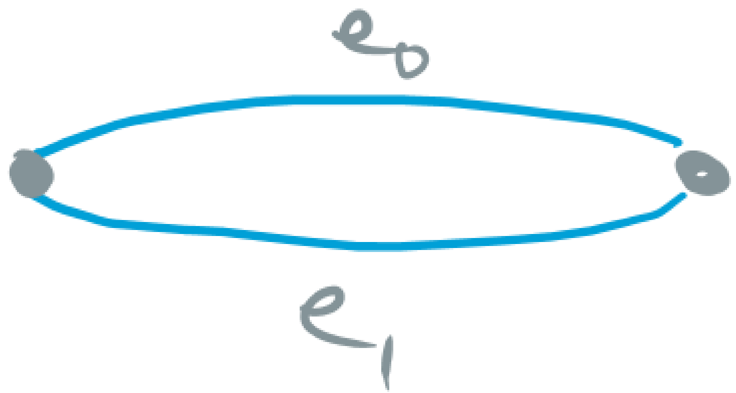


Tree Graph

- **A connected graph T without any cycles is called a tree graph or free tree, or simply a tree.**
- **This means in particular, that there is a unique simple path P between any two nodes u and v.**

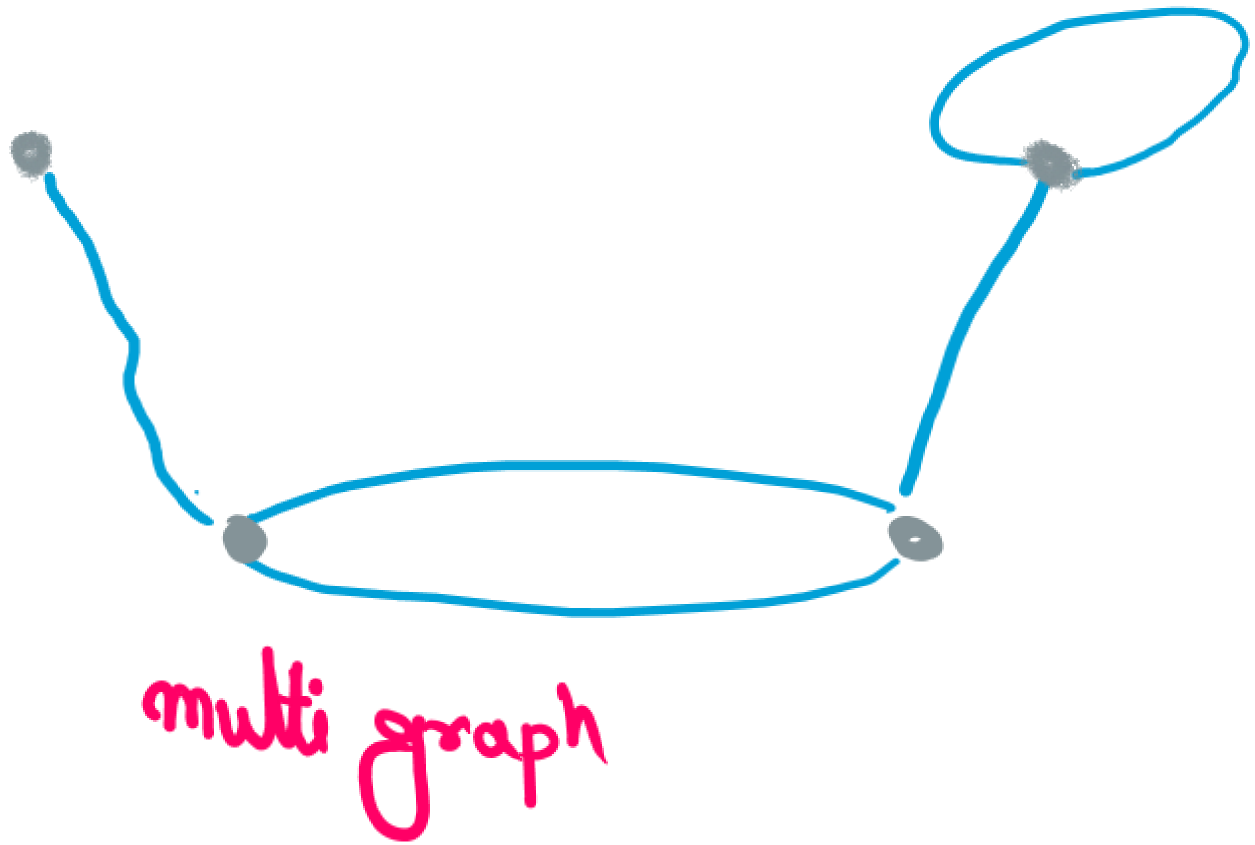


Multiple edges & Loop



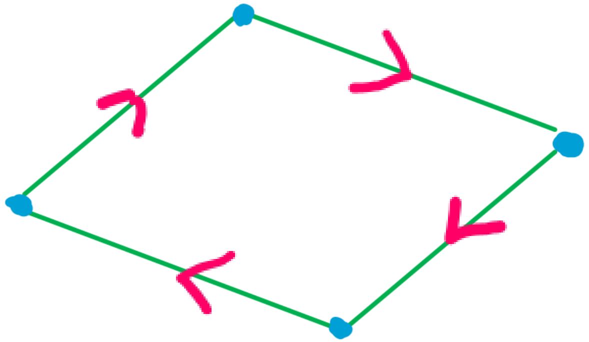
Multi Graph

- **Multi Graph is a graph consisting of multiple edges and loops.**



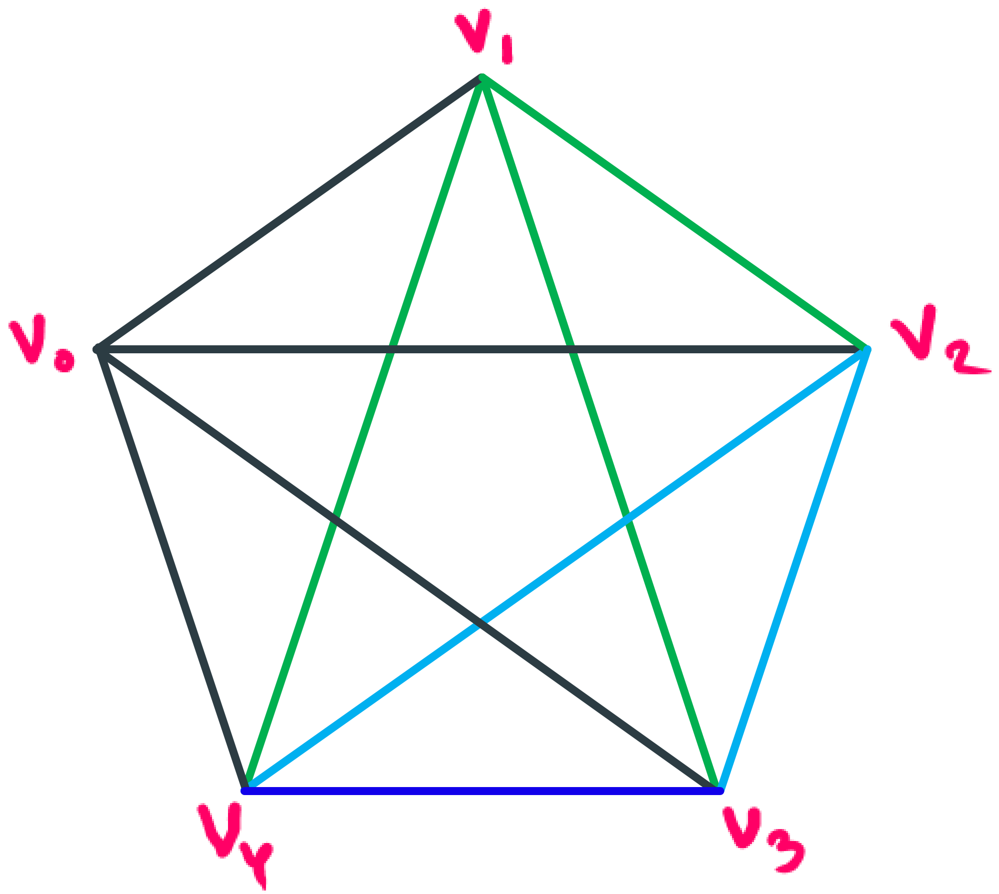
Directed Graph

- **A directed graph G also called digraph is same as multigraph except that each edge e is assigned a direction.**



Complete Graph

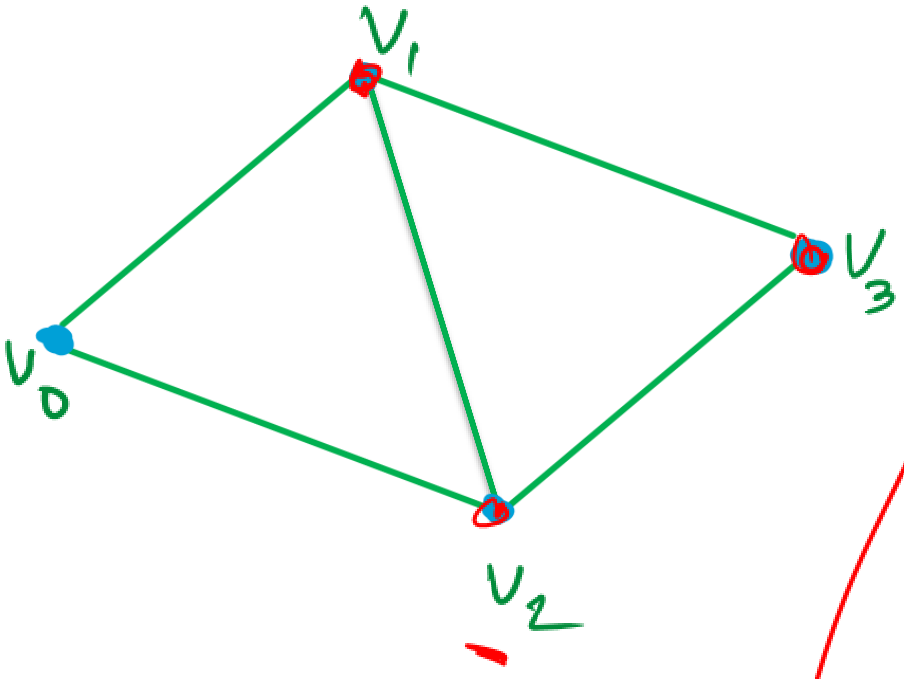
- A simple graph in which there exists an edge between every pair of vertices is called a complete graph.
- It is also known as a universal graph or clique.


V1
V0
V2
V4
V3

Representation of Graph

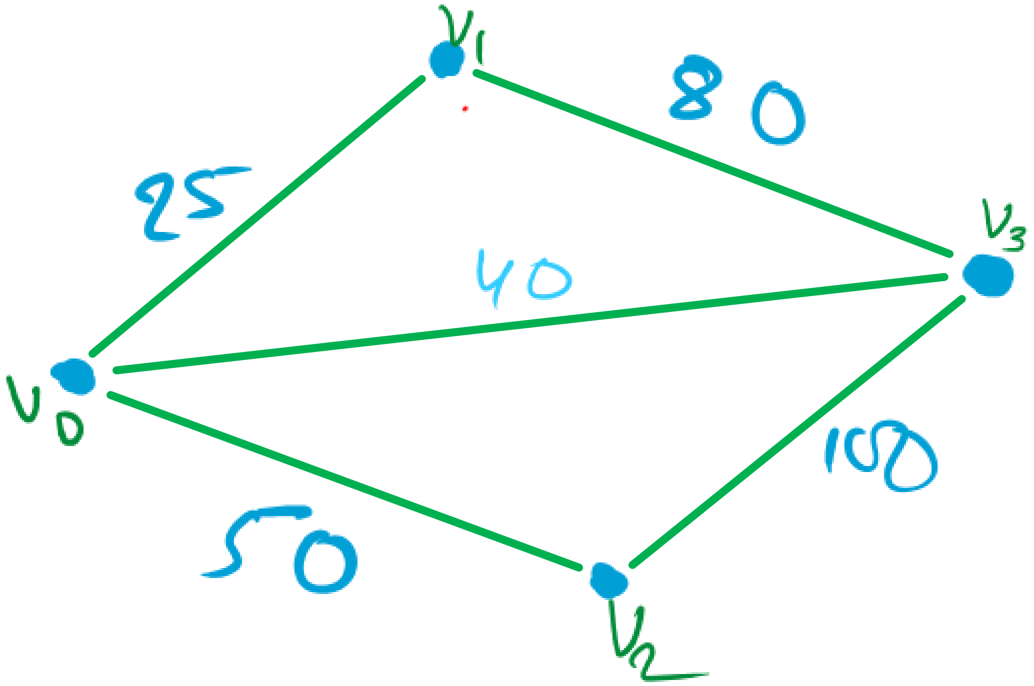
- Adjacency Matrix Representation.
- List Representation.

Adjacency Matrix Representation

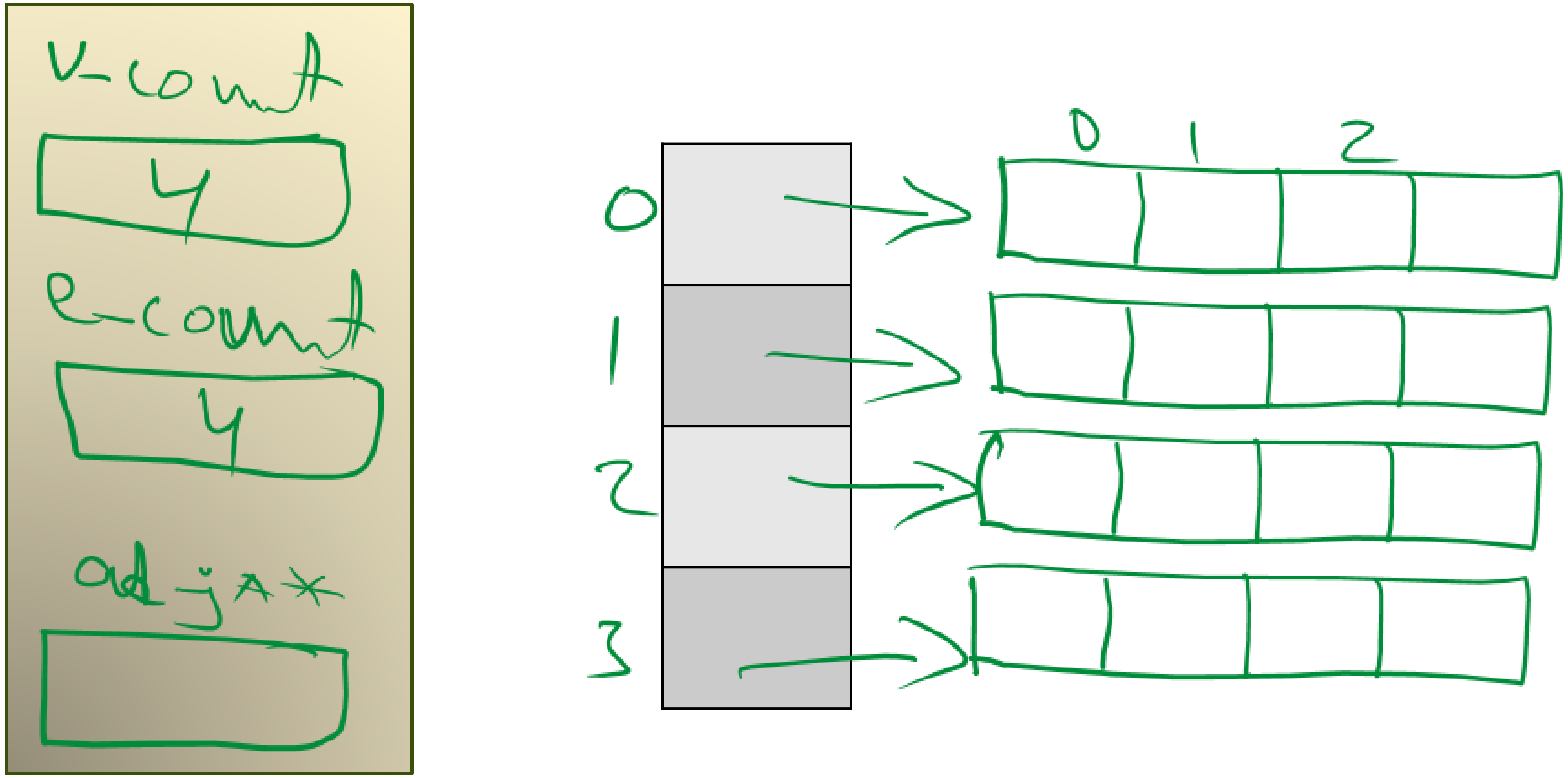


	V0	V1	V2	V3
V0	0	1	1	0
V1	1	0	1	1
V2	1	1	0	1
V3	0	1	1	0

Weighted Graph



	V_0	V_1	V_2	V_3
V_0				
V_1			0	
V_2				
V_3				



v_count
4
e_count
4
adjA*
0
1
2
3
0
1
2

List Representation