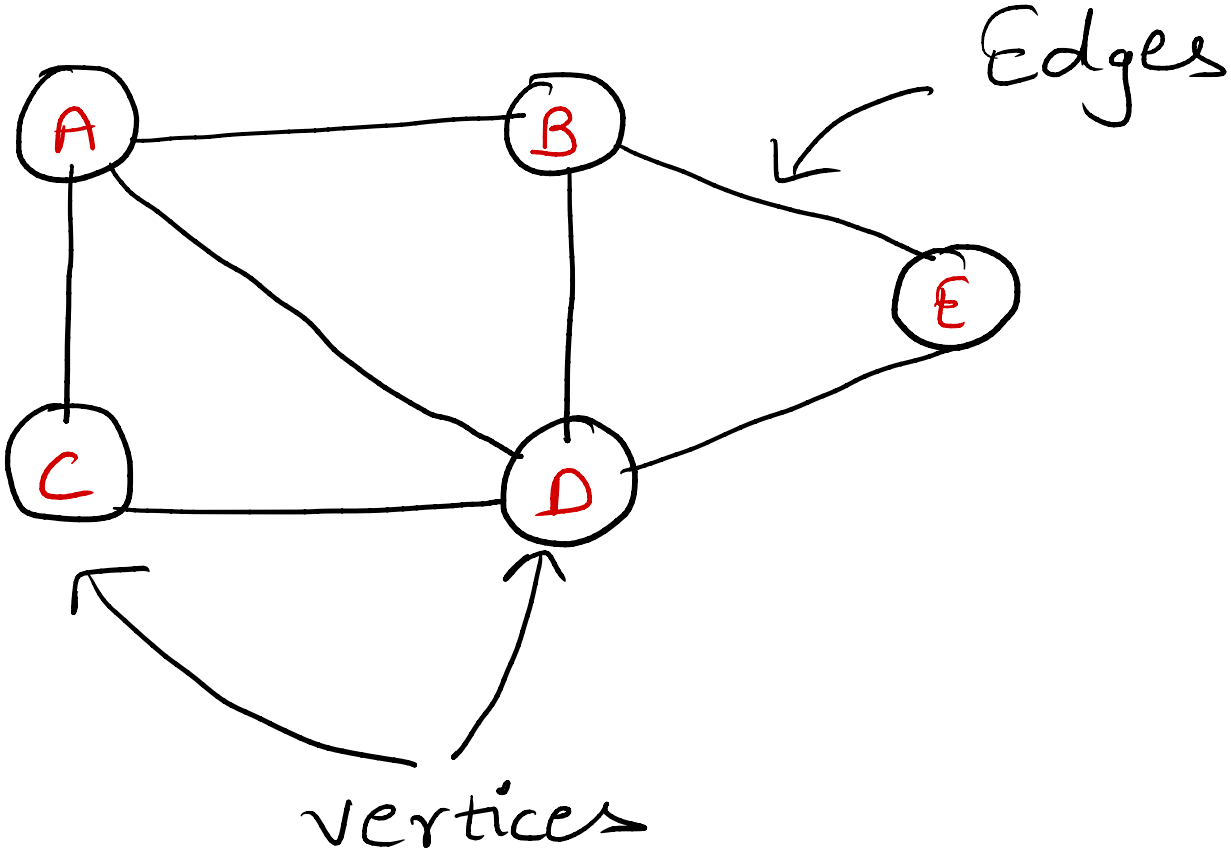
Graphs

→ Non-linear data structure



Eg: 1) Google Maps – Landmark
– Roads

2) Social Networks – People
– Connections

3) Routing Algorithms

4) Amazon Delivery Vans

Trees vs Graphs

Trees

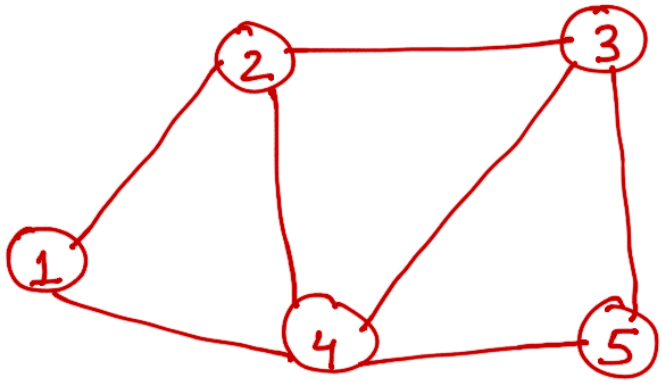
* Only one path - Exists b/w any two nodes/vertices
* Root node as the Starting node.
* No loops.
* No. of edges: n-1 (n is the no. of nodes)
* Hierarchical Structure
* All trees are graphs.

Graphs

* More than one path — Exists b/w any two nodes
* Any node can be treated as the Start node.
* Can have loops
* No. of edges not defined.
* Graph looks like network
* All graphs not tree

→ Representation

1) Adjacency Matrix
2) Adjacency List



Adjacency Matrix

Size = $n \times n$

↓

No. of vertices

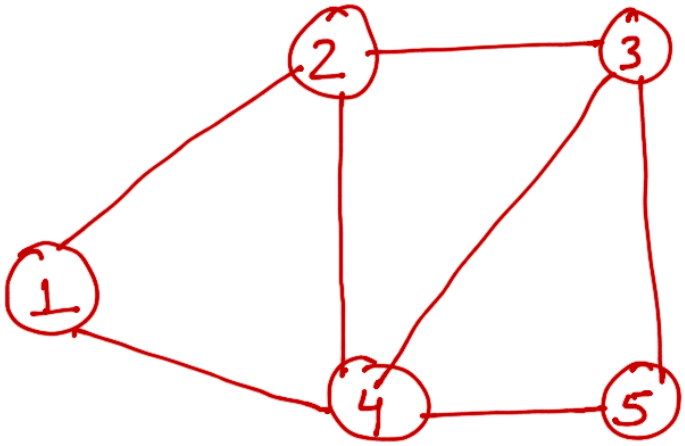
$$a[i][j] = \begin{cases} 1 & \text{if } i \text{ \& } j \text{ are adj} \\ 0 & \text{otherwise} \end{cases}$$

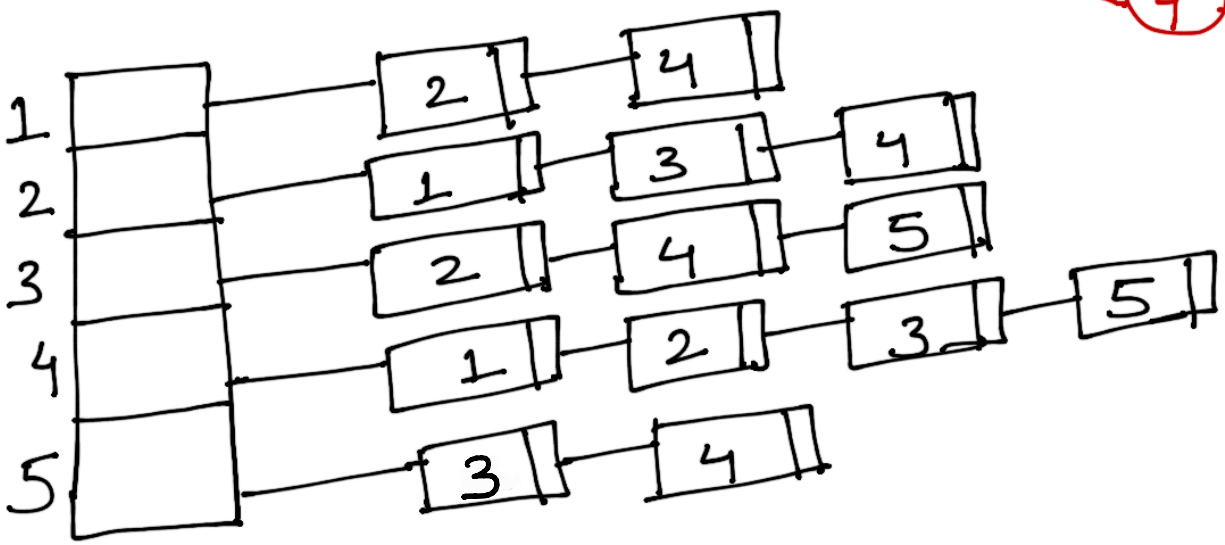
	1	2	3	4	5
1	0	1	0	1	0
2	1	0	1	1	0
3	0	1	0	1	1
4	1	1	1	0	1
5	0	0	1	1	0

5x5

Space Complexity → $O(n^2)$

Adjacency List





Space → $\Theta(n+2e)$

Complexity

→ If dense graph then use Adjacency Matrix

→ If Sparse graph, use Adjacency List