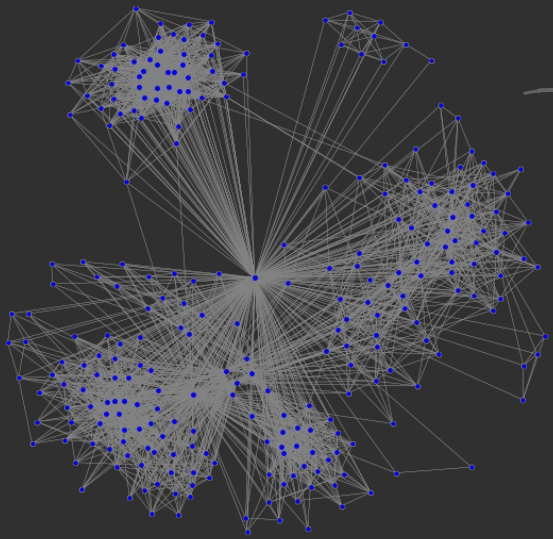
Sorry for a little delay, will start by 9:07 PM

L81
Intro to Graphs and Generic Trees

Join Discord - https://bit.ly/ly-discord

RECAP

Facebook Friends



→ facebook user

⇒ User A & user B are friends on fb.

A few more examples

1) Network of roads

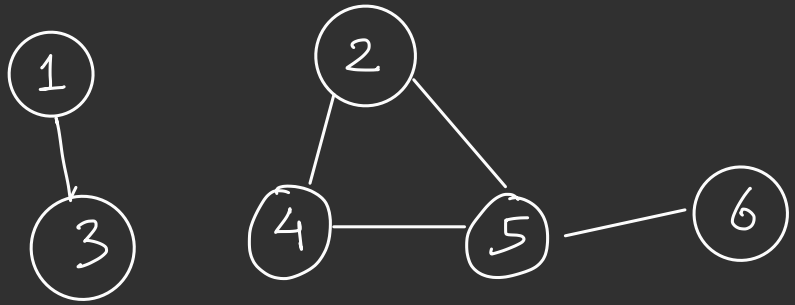
2) Flights Network

What is a graph?

1.) graph can be seen as a network of objects called **NODES**

2.) Some of these nodes may be connected with each other via **EDGES**

Graph of 6 nodes



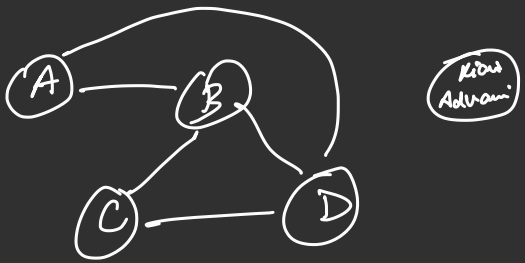
A few types

On the basis of edge direction

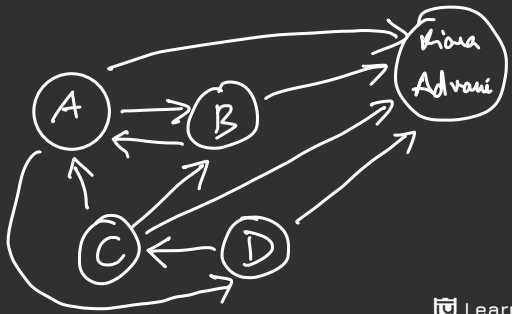
a.) undirected → Bidirectional edges

b.) directed → Unidirectional edges

Facebook



Insta

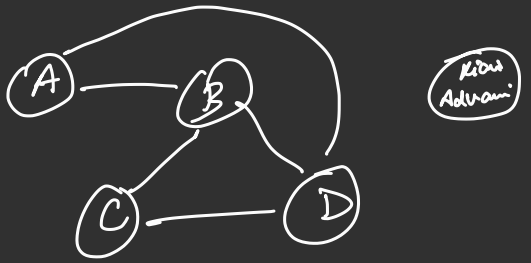


On the basis of edge weight

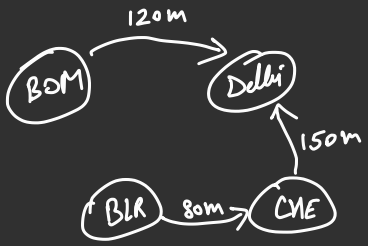
a) Unweighted

b) weighted

Facebook

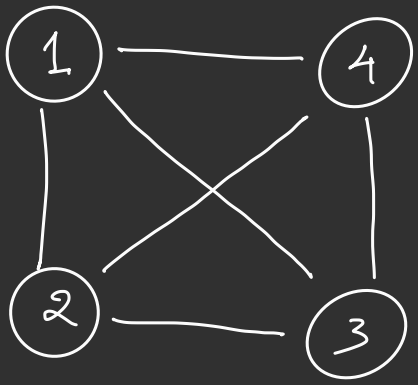


Airline network



- Undirected unweighted graphs
- No self-loops or multiple edges

On the basis of certain conditions



There is an edge b/w each pair of nodes

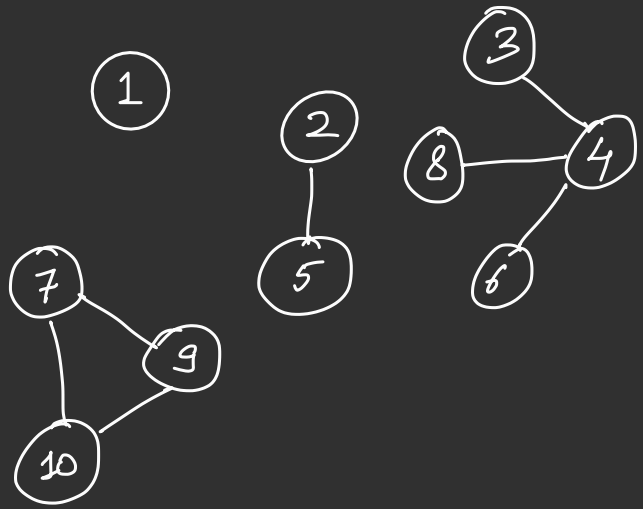
↓

Complete Graph

N nodes $\Longrightarrow$ ${}^{N}C_{2} \Rightarrow N*(N-1)/2$

A few terminologies

Connected Components



No. of Connected components = 4

If the no. of connected components in a graph = 1

Connected graph

Graph with N nodes

min. components

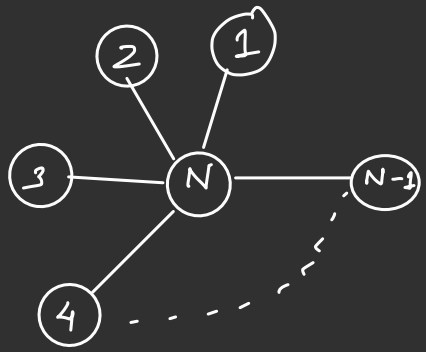
1

max. components

N

N Nodes. Min. edges required for the graph to be connected?

Bamboo graph



Star graph

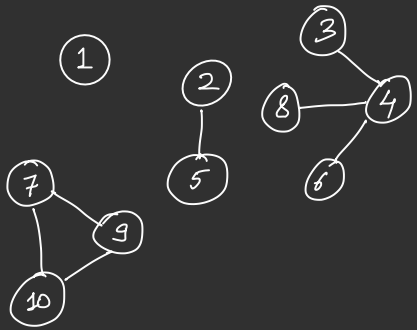
Degrees of Nodes

No. of edges of a node

For directed

in-degree ⇒ no. of incoming edges

out-degree ⇒ no. of outgoing edges



deg(1) = 0

deg(2) = 1

deg(3) = 1

deg(4) = 3

deg(5) = 1

deg(6) = 1

deg(7) = 2

deg(8) = 1

deg(9) = 2

deg(10) = 2

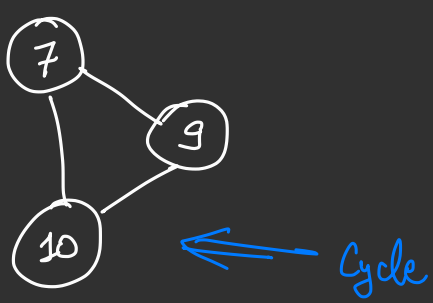
N nodes, M edges

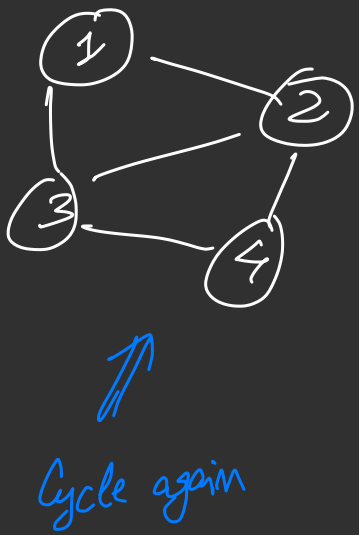
$$\sum_{i=1}^{N} deg(i) = 2 * M$$

Q. Let's say there are a few nodes with an odd degree. No. of such nodes will be:

a) Always a multiple of 3
b) Always be even
c) Always be odd
d) None of these

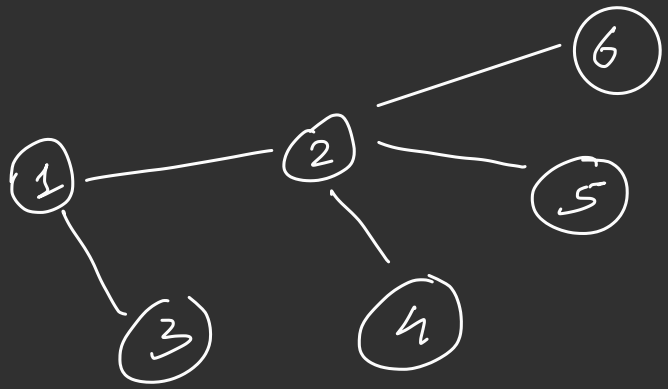
Cycles





Q. A connected graph with N nodes and N - 1 edges:

a) Will definitely have a cycle
b) Will NOT have a cycle for sure
c) May or may not have a cycle



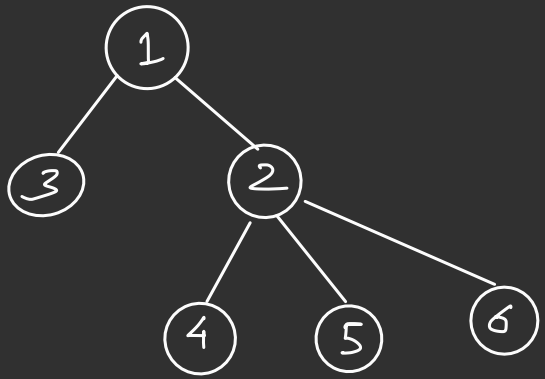
What is a tree?

A connected graph with NO cycles is called a tree.

N nodes

↓

N-1 edges



Again, a tree can be:

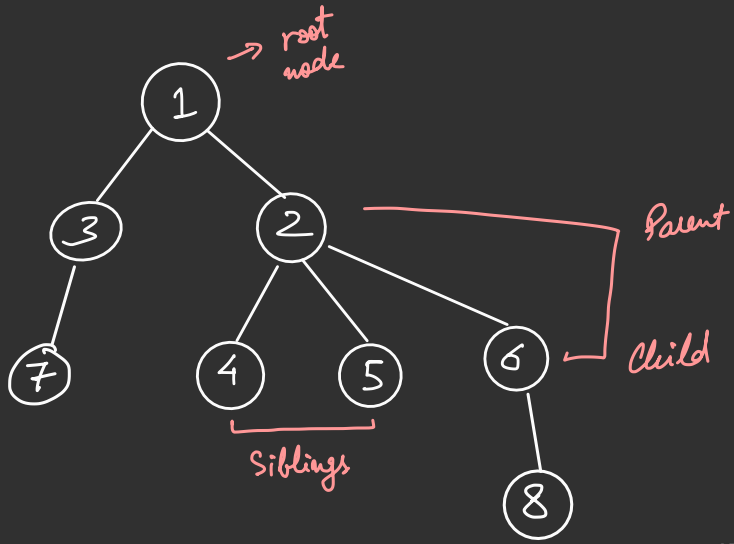
1. Binary / generic
2. Weighted / unweighted
3. Rooted / unrooted

A few terminologies

(in case of a rooted tree)

8, 6, 2, 1 are ancestors of 8

1, 2, 6, 8 are descendants of 1



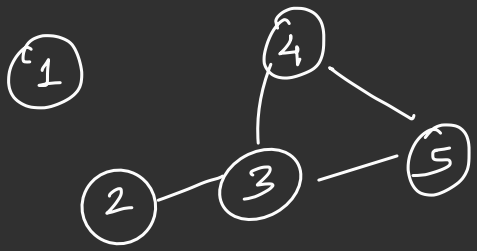
For a generic rooted tree having N nodes, what is the min. & the max. height?

```
if(N == 1) {
    min => 1
    max => 1
}
else {
    min => 2
    max => N
}
```

Ways to represent graph / tree

Adjacency Matrix

5 nodes



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

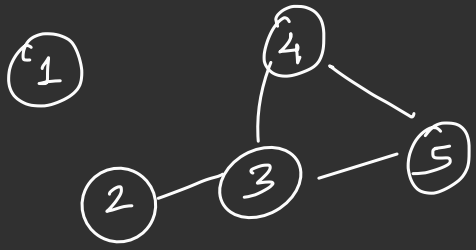
adj[i][j]

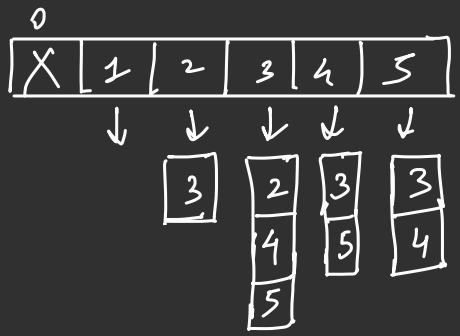
Problem ⇒ Lot of initial time taken

Benefit ⇒ Checking for a specific edge is $O(1)$

Adjacency List

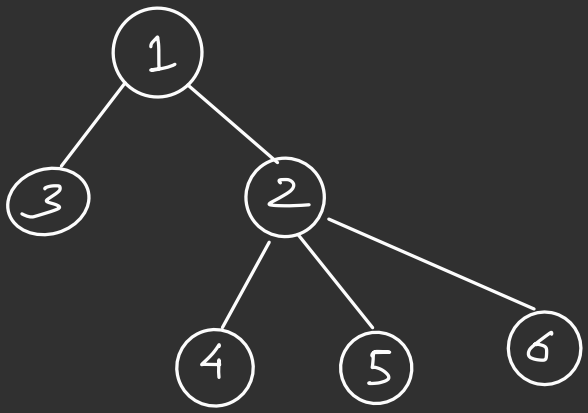
5 nodes





Parent Array (just for tree)

root id



1	2	3	4	5	6
X	-1	1	1	2	2	2

Taking Input

Thank You!

Reminder: Going to the gym & observing the trainer work out can help you know the right technique, but you'll muscle up only if you lift some weights yourself.

So, PRACTICE, PRACTICE, PRACTICE!