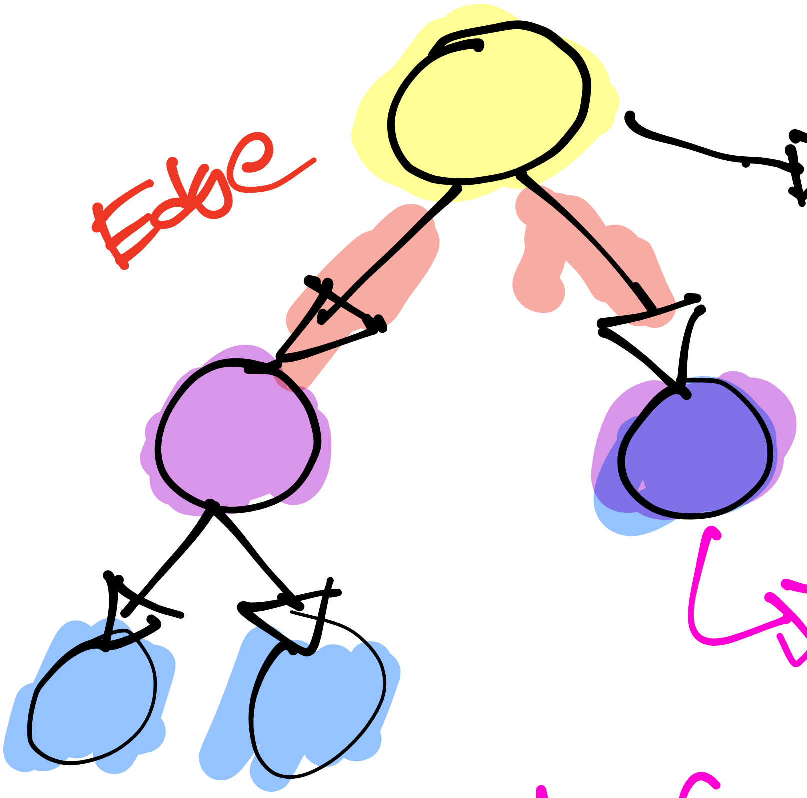
Tree (Data structure

- Collection of nodes that point to other nodes

Binary Tree



Root node
- Entry point to get to child nodes.

Child nodes

Leaf nodes
- Do not have child nodes.

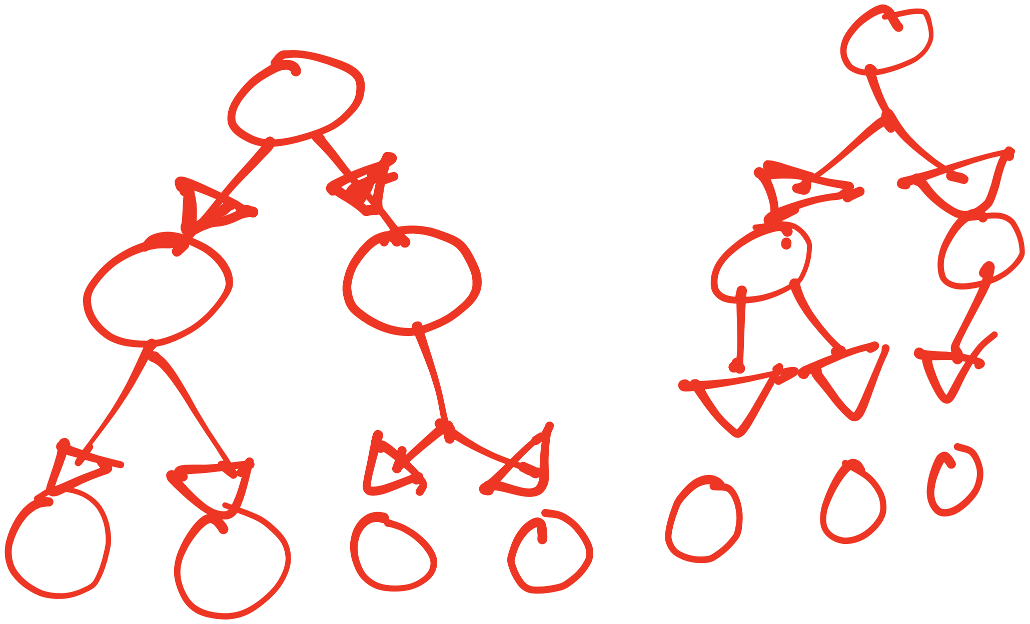
② Binary Tree

- Where it can have at most 2 children

Different type of Binary Trees

Complete

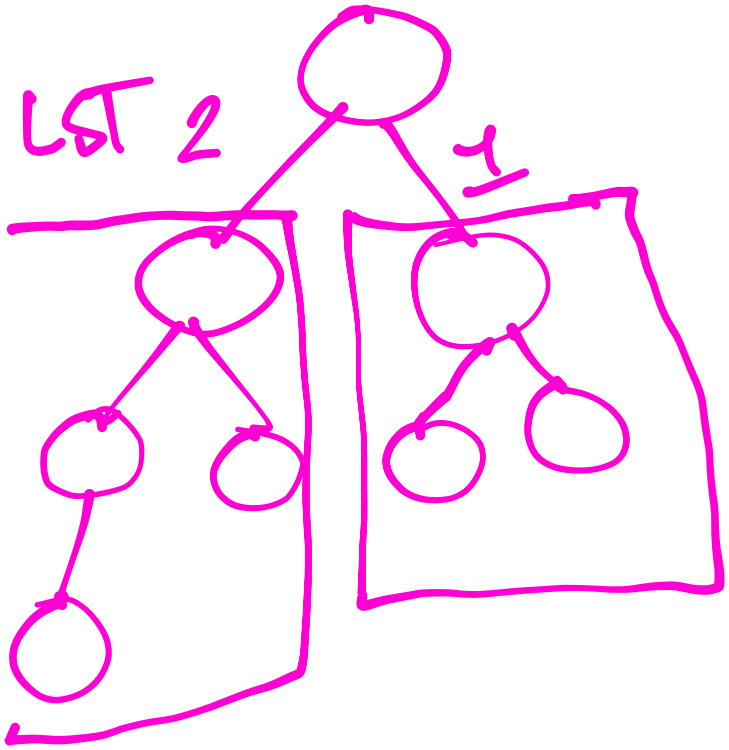
- A Tree where all levels are completely full and pushed to the left



Balanced Tree

- where the height of left subtree & RST differ 1 at most

- Height(BT) is the path from a node to the deepest leaf node

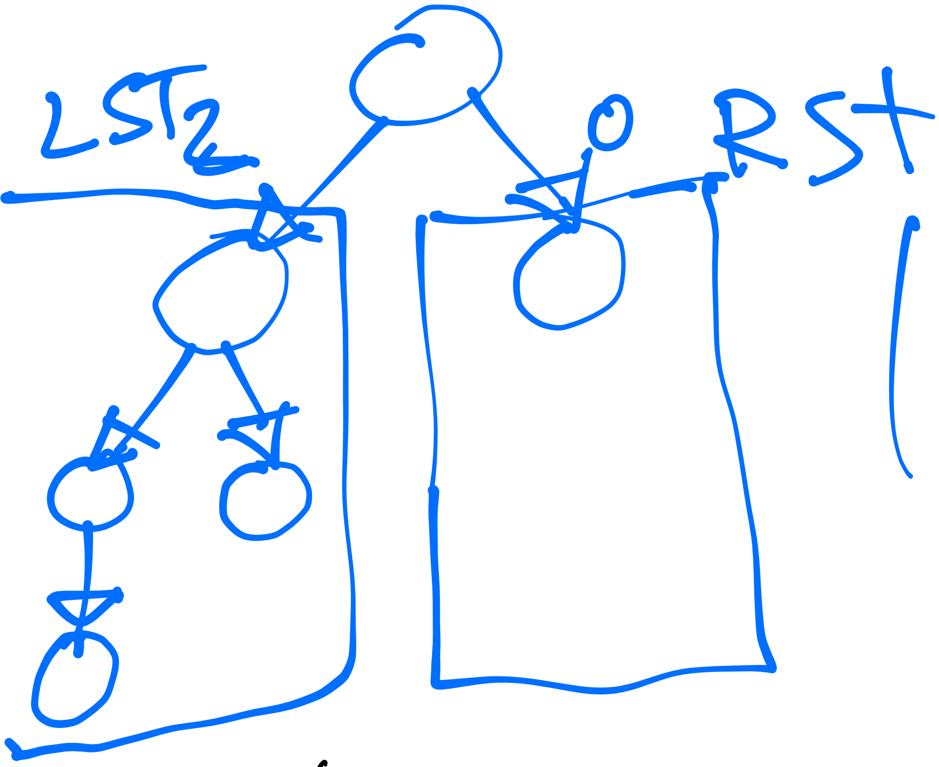


Formula:

| height of LST - height of RST |

=> |2 - 1|

Unbalanced



$|2-0|$

$= 2$

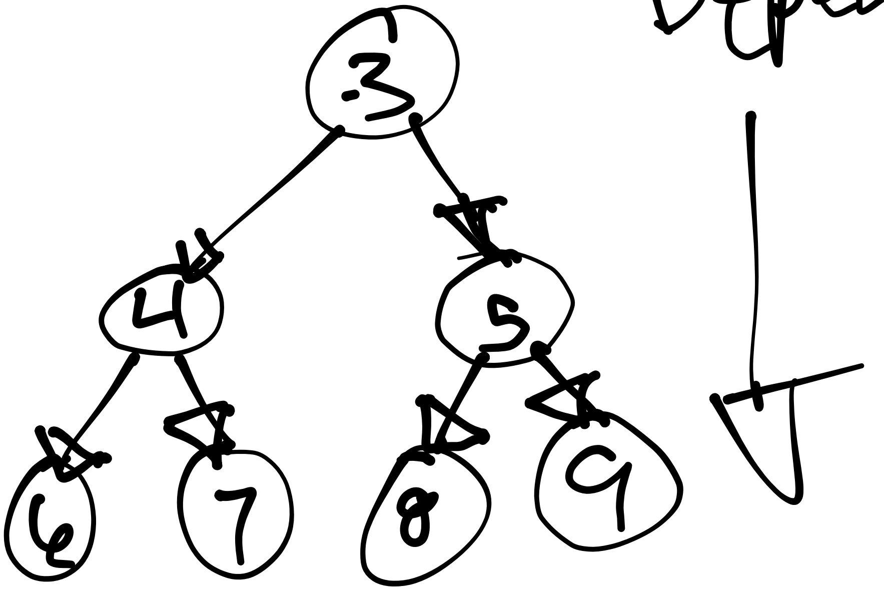
Depth

- Path from node to root

Depth of 9? 2

4? 1

3? 0



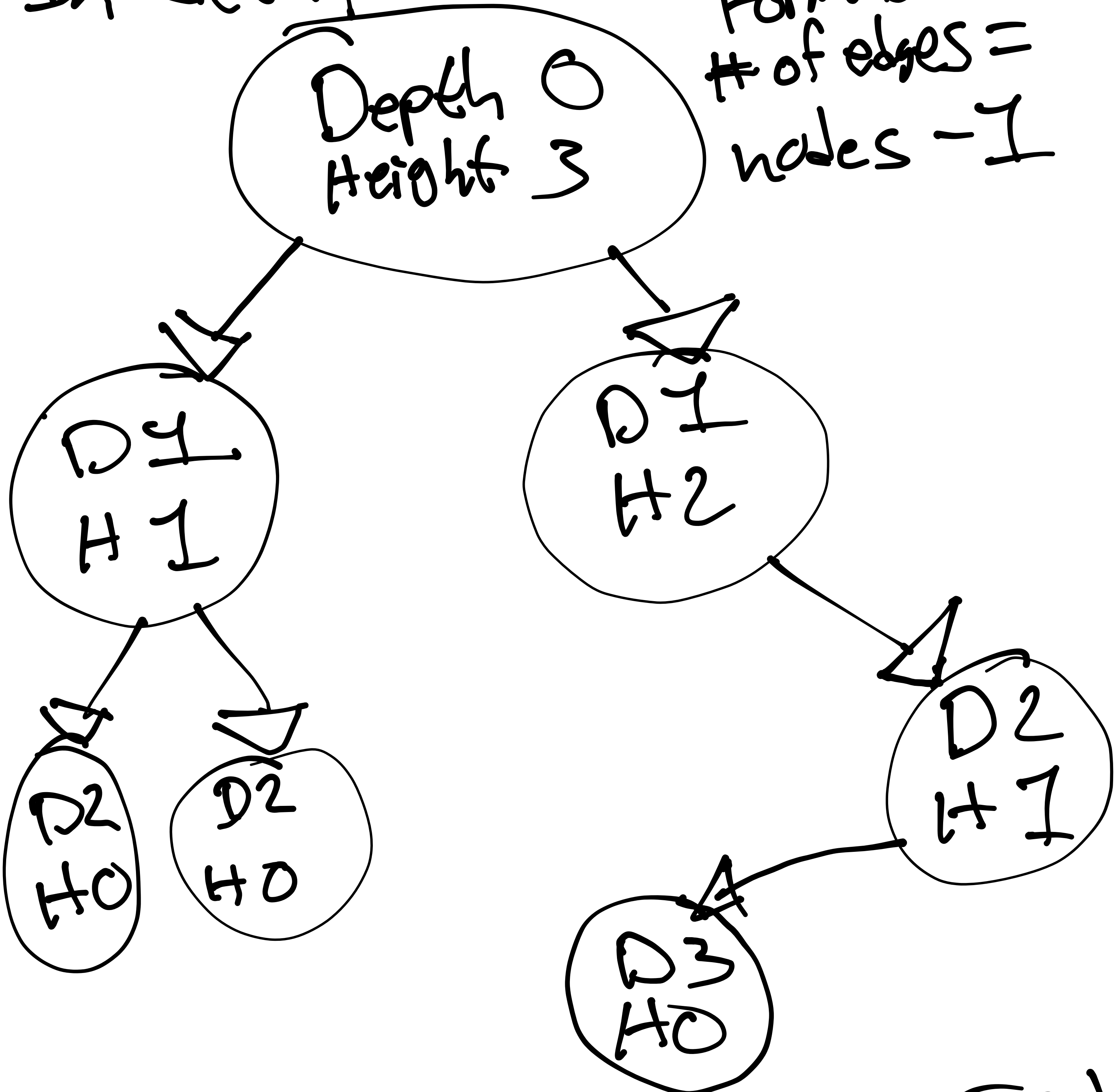
Height of 9? 0

3? 2

4? 1

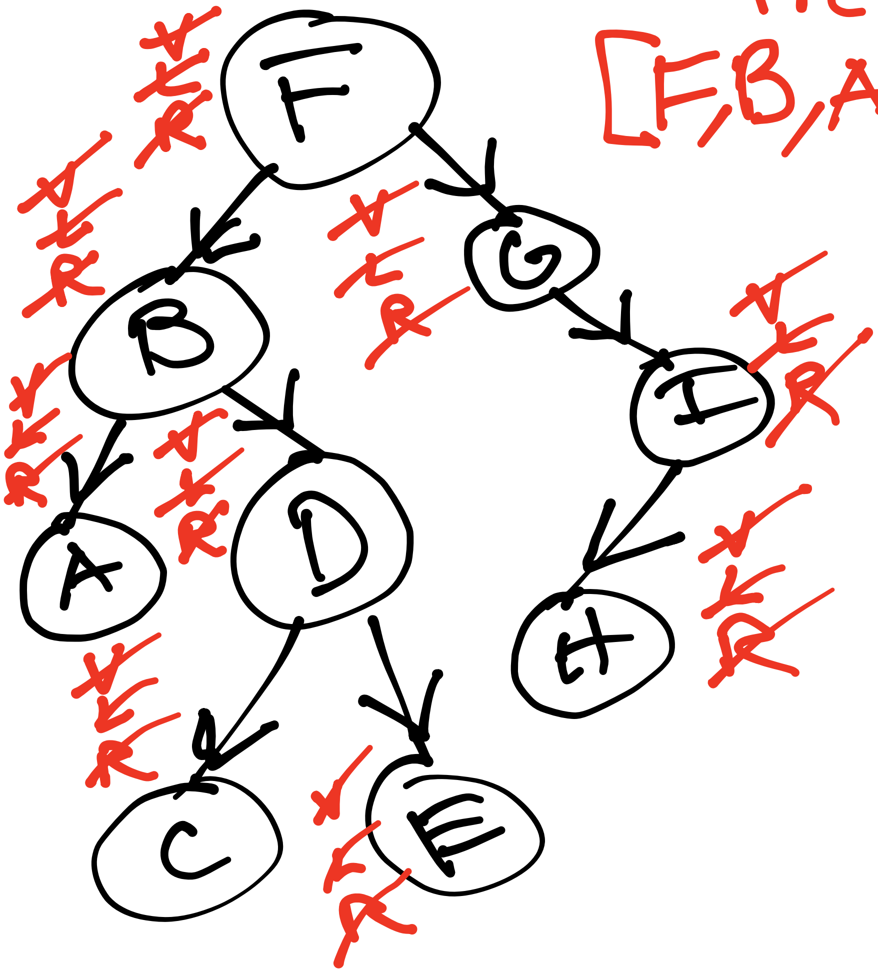
In detail

Formula
# of edges = nodes - 1

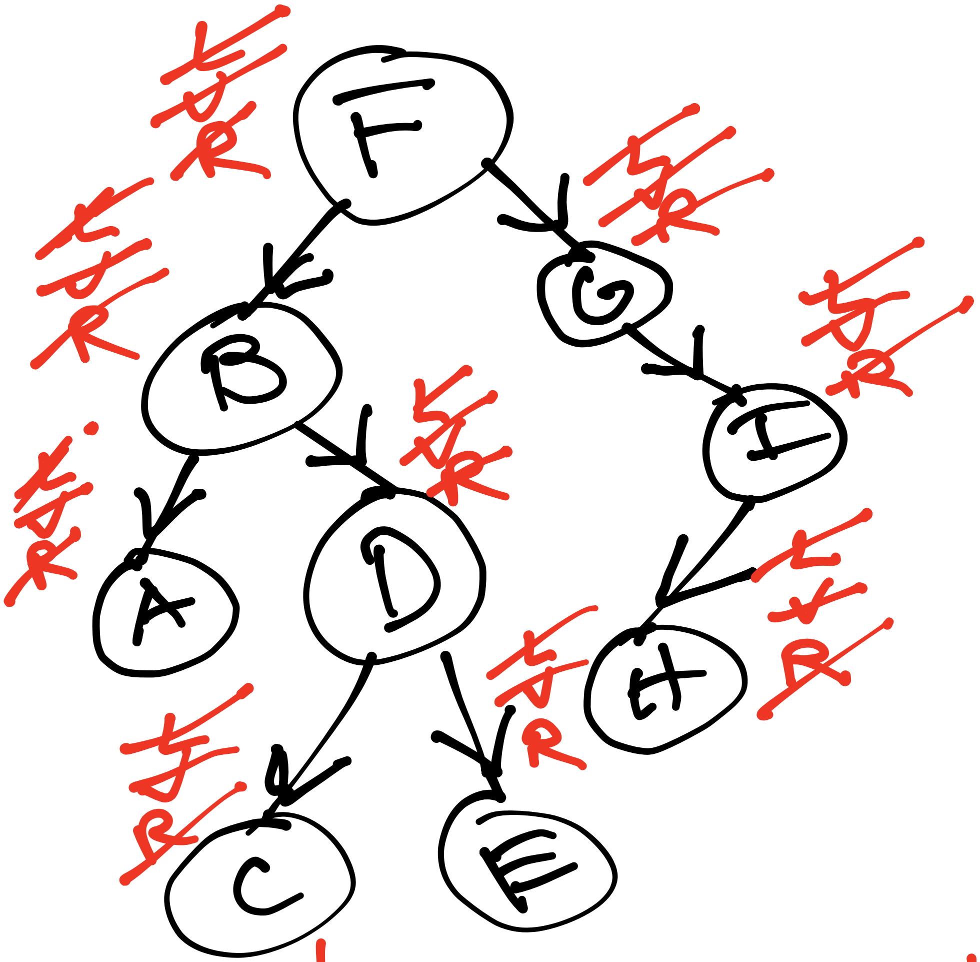


3 Binary Tree Traversals (DFS)

Pre-order	In-order	Post-order
Vist	Traverse L	Traverse L
Traverse left	visit	Traverse R
Traverse Right	Traver R	visit

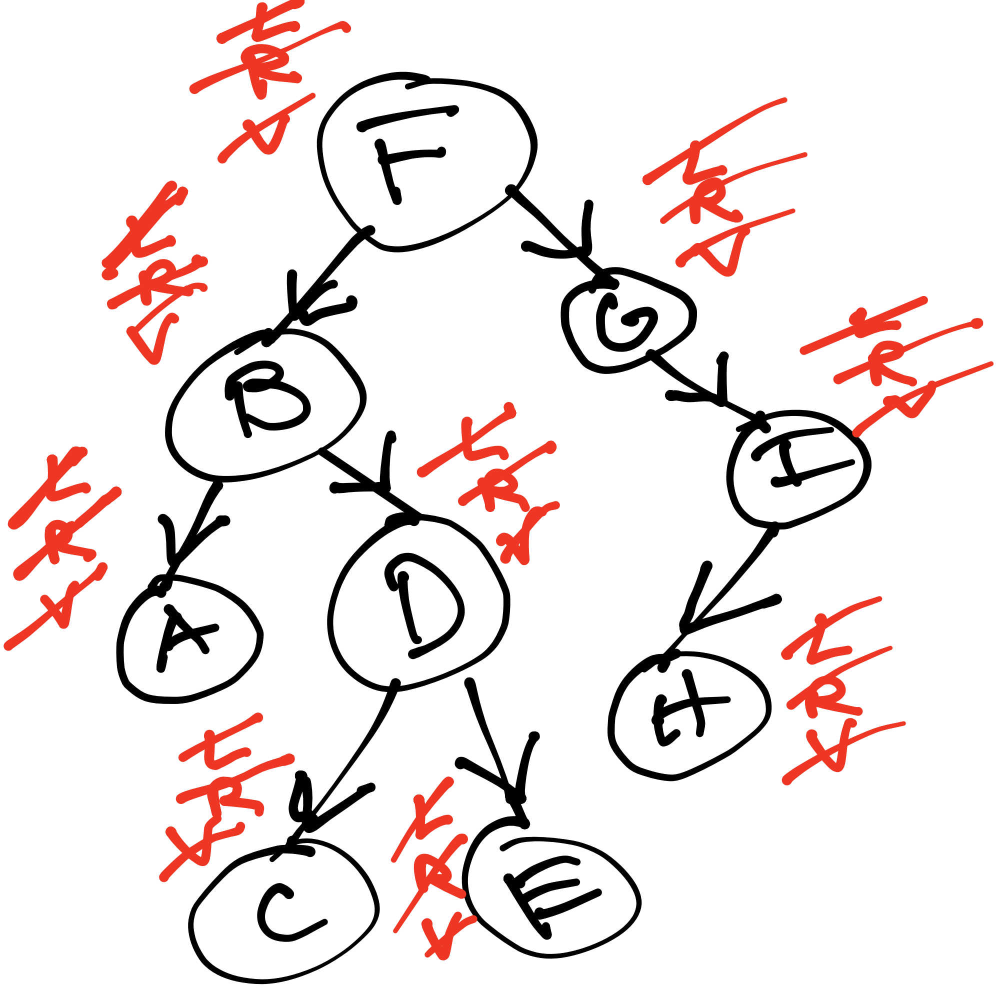


Pre-order
[F, B, A, D, C, E, G, I, H]



In-order

[A, B, C, D, E, F, G, H, I]



O(n)

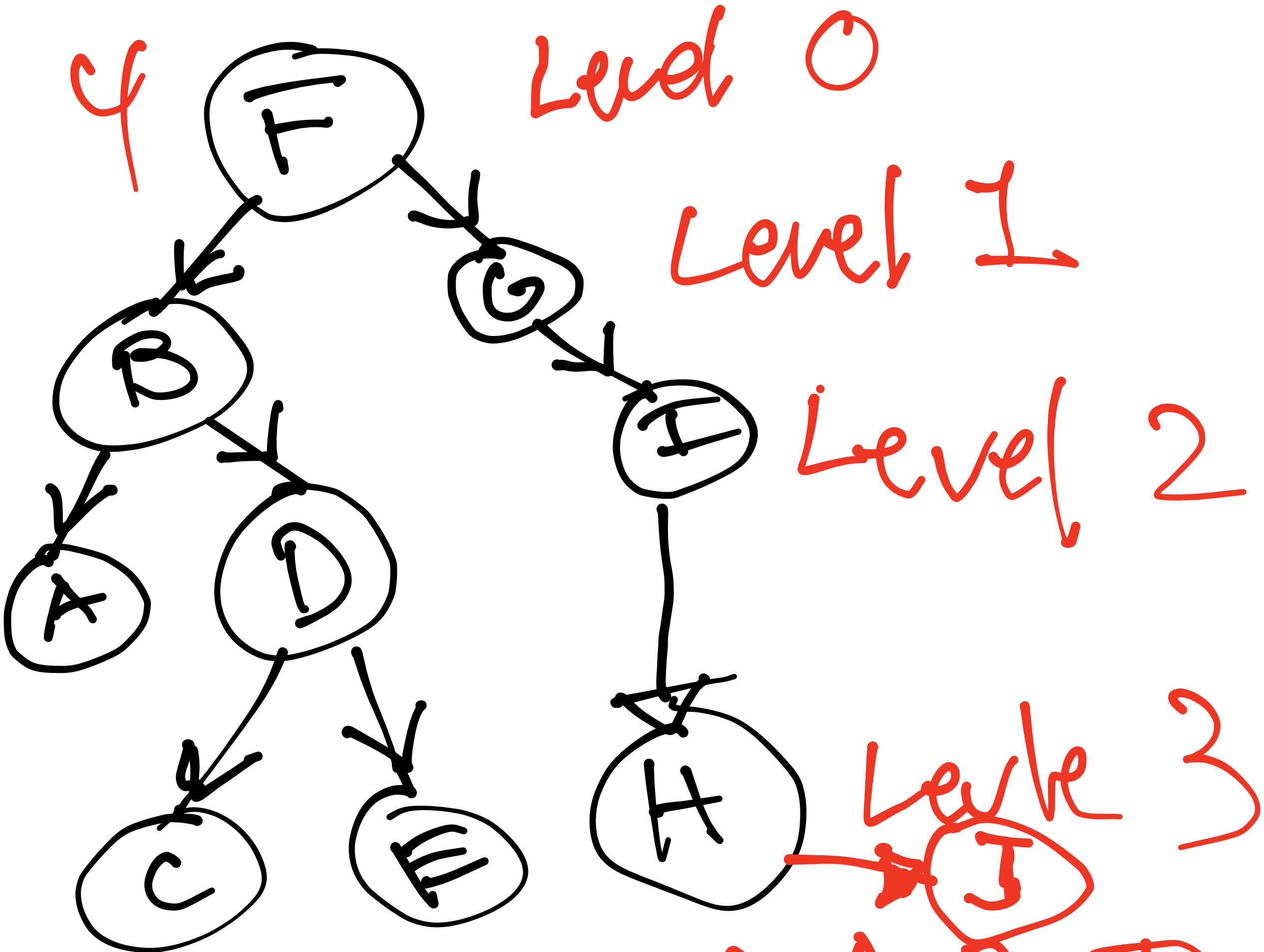
O(h)

Post-order

[A, C, E, D, B, H, I, G, F]

Breadth First Search

(level order)



[F, B, G, A, D, I, C, E, H]

value
leftPtr
rightPtr

Usually implemented as

QS (FIFO)

2 Queue DS (FIFO)

→ [~~F~~, ~~B~~, ~~G~~, A, D, I

Queue

Traverse

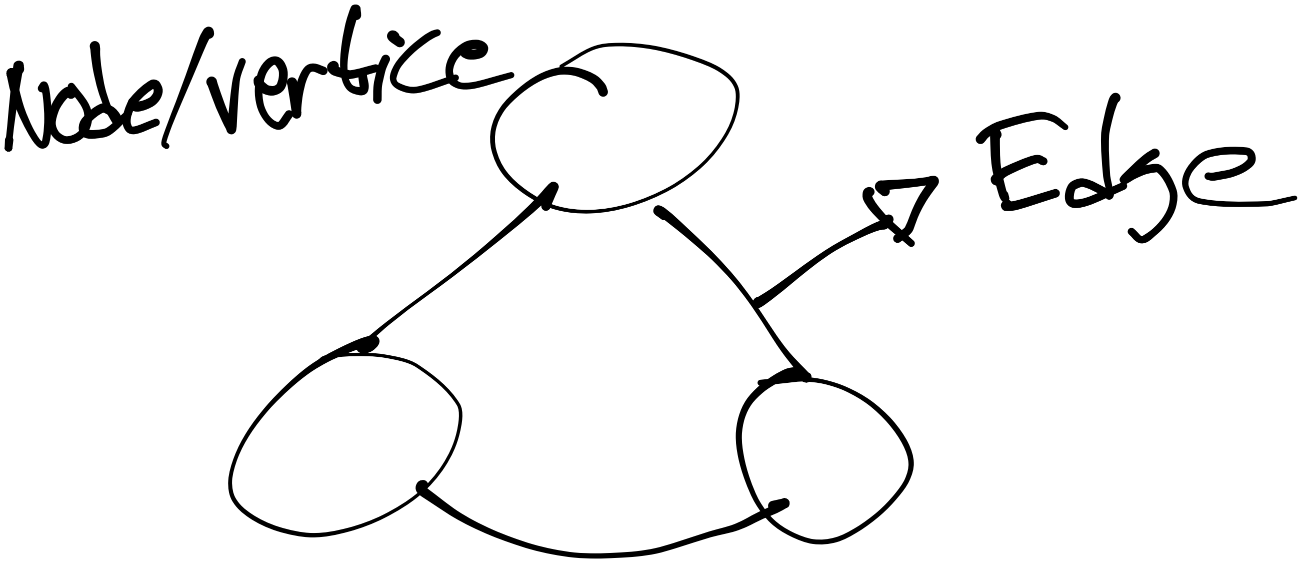
[F, B, G

5 Graphs

- Show how things are connected

Node/vertices ⇒ Data

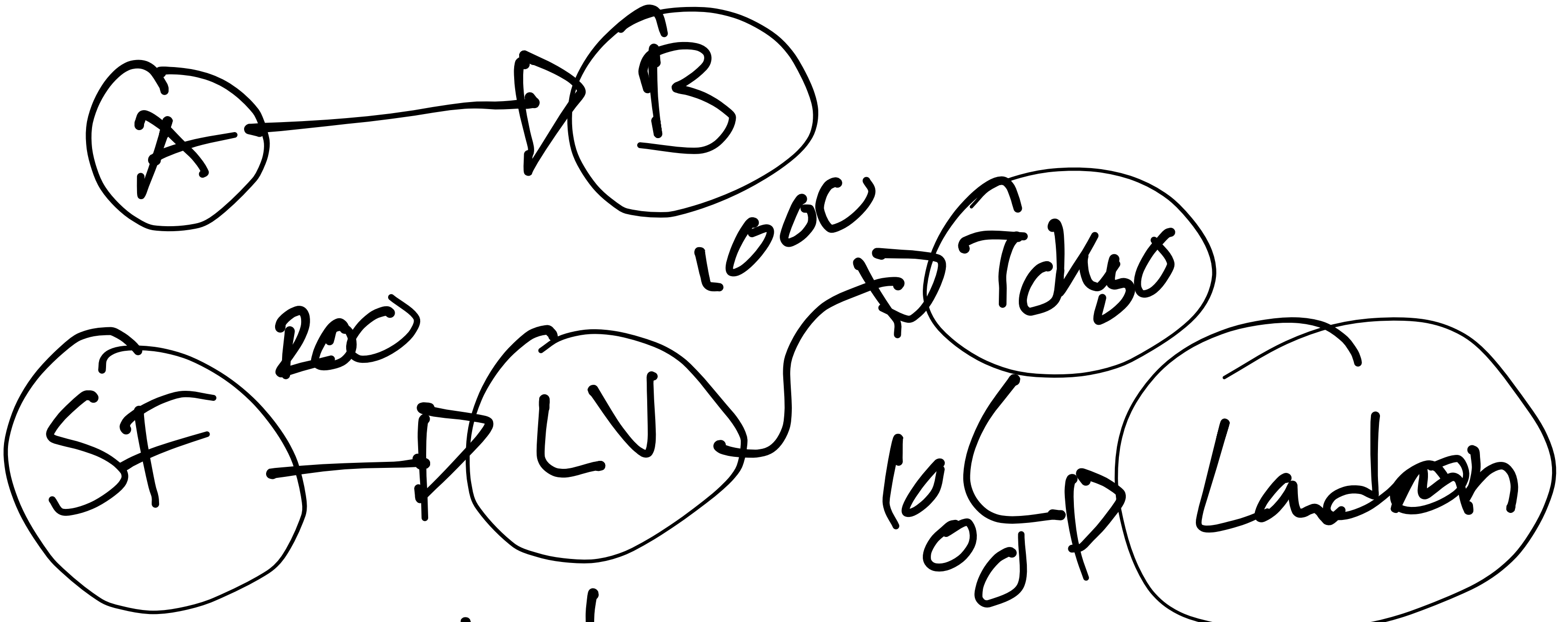
- No root Nodes



Directions and cycles

Edges can have a direction and also data

*Directed graph

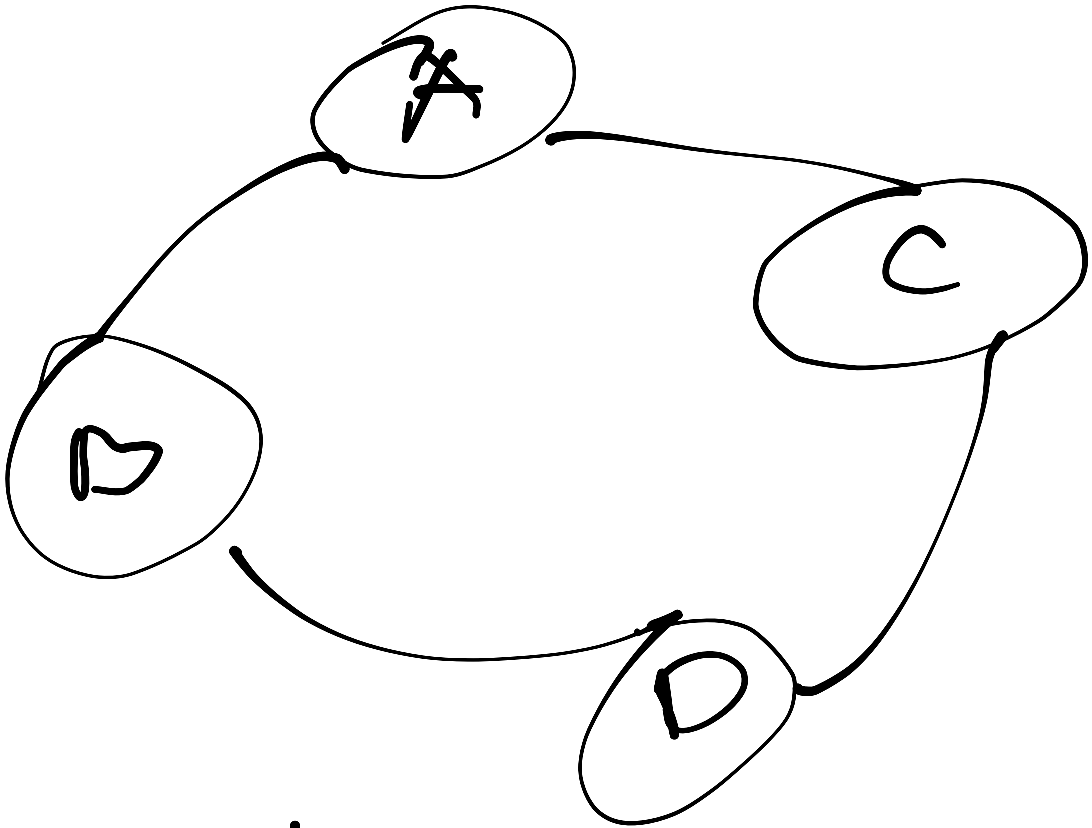


weighted

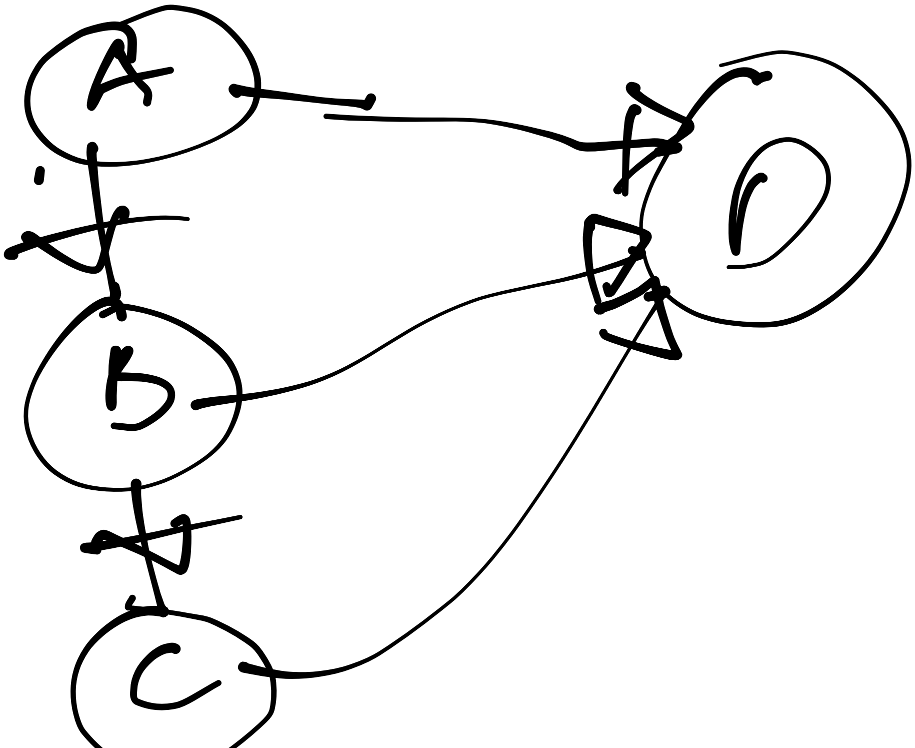
== when an edge has data

Undirected graph == Bidirectional

Cycle



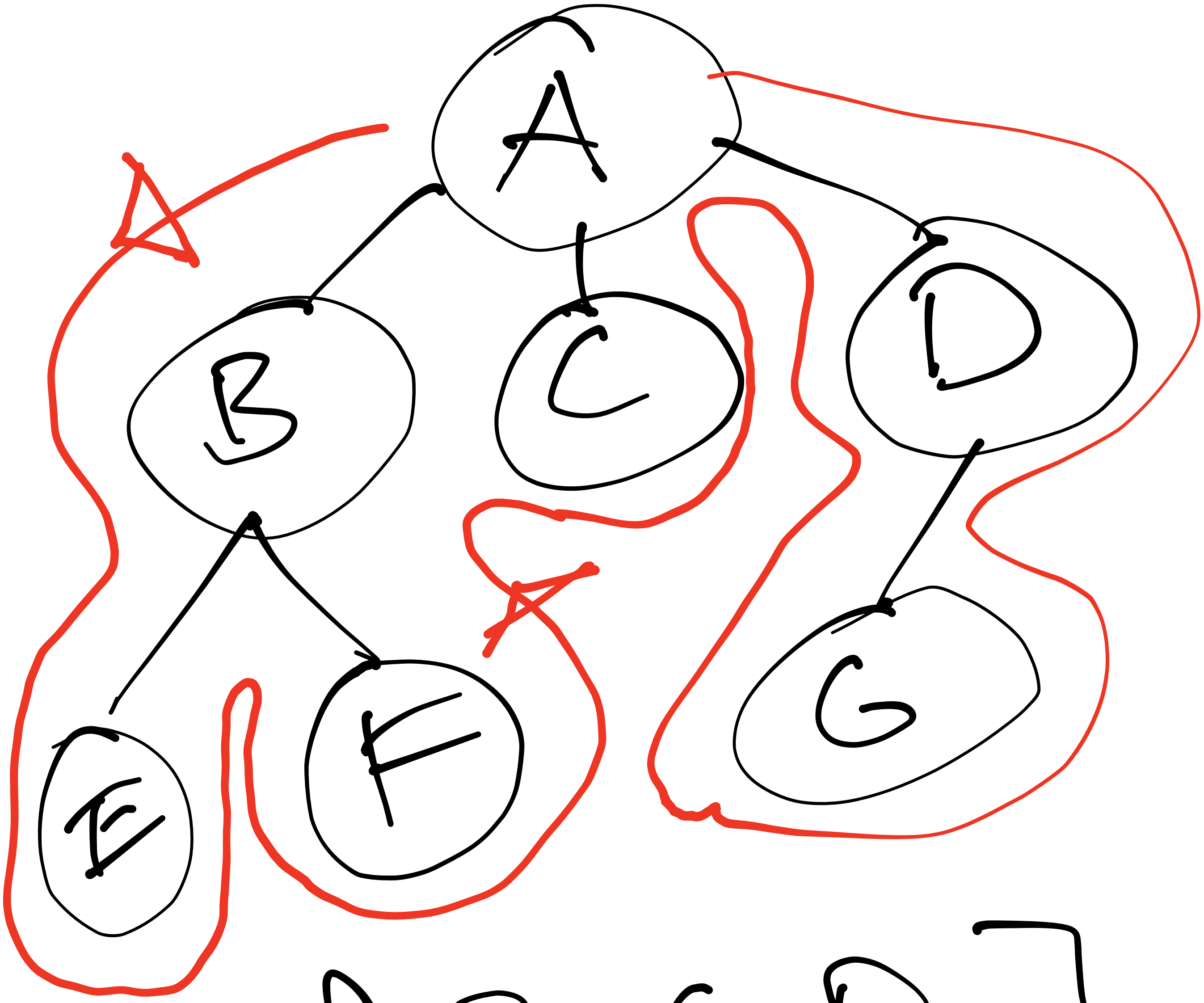
Acyclic



(1) Graph representation

④ Graph representation,

Edge List, Adj list, Adj matrix



A : [B, C, D],

B : [E, F]

C : [ ]

D : [G]

BFS Implementation

-need a queue

steps q=[~~A~~,B,C,D

1.) Add 'A' to queue

2.) Mark as visited

3.) Pop from queue

4.) Put in traversal order

5.) Add all adj nodes to
queue

Repeat

t = [A, B, C, D, E, F, G]

q = [~~A~~, ~~B~~, ~~C~~, ~~D~~, ~~E~~, ~~F~~, ~~G~~]

DFS Implem.

- Use stack or recursion

Diameter of Binary Tree