

# CS & IT ENGINEERING

Data Structure &  
Programming

Graphs  
In One Shot



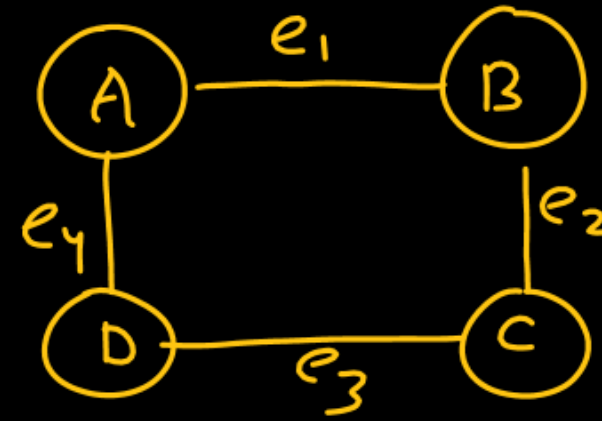
By- Pankaj Sharma sir

TOPICS TO BE  
COVERED

Graphs

Non-linear data structure :

Graph



$G(V, E)$   
↓ set of vertices  
↘ set of Edges

$V = \{A, B, C, D\}$

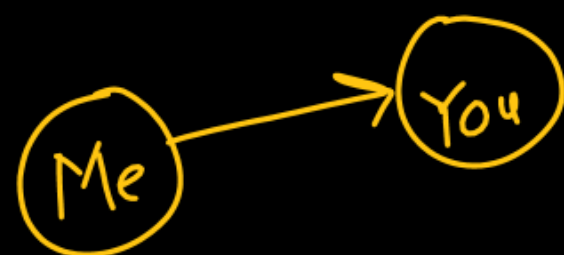
$E = \{e_1, e_2, e_3, e_4\}$

CS

WWW

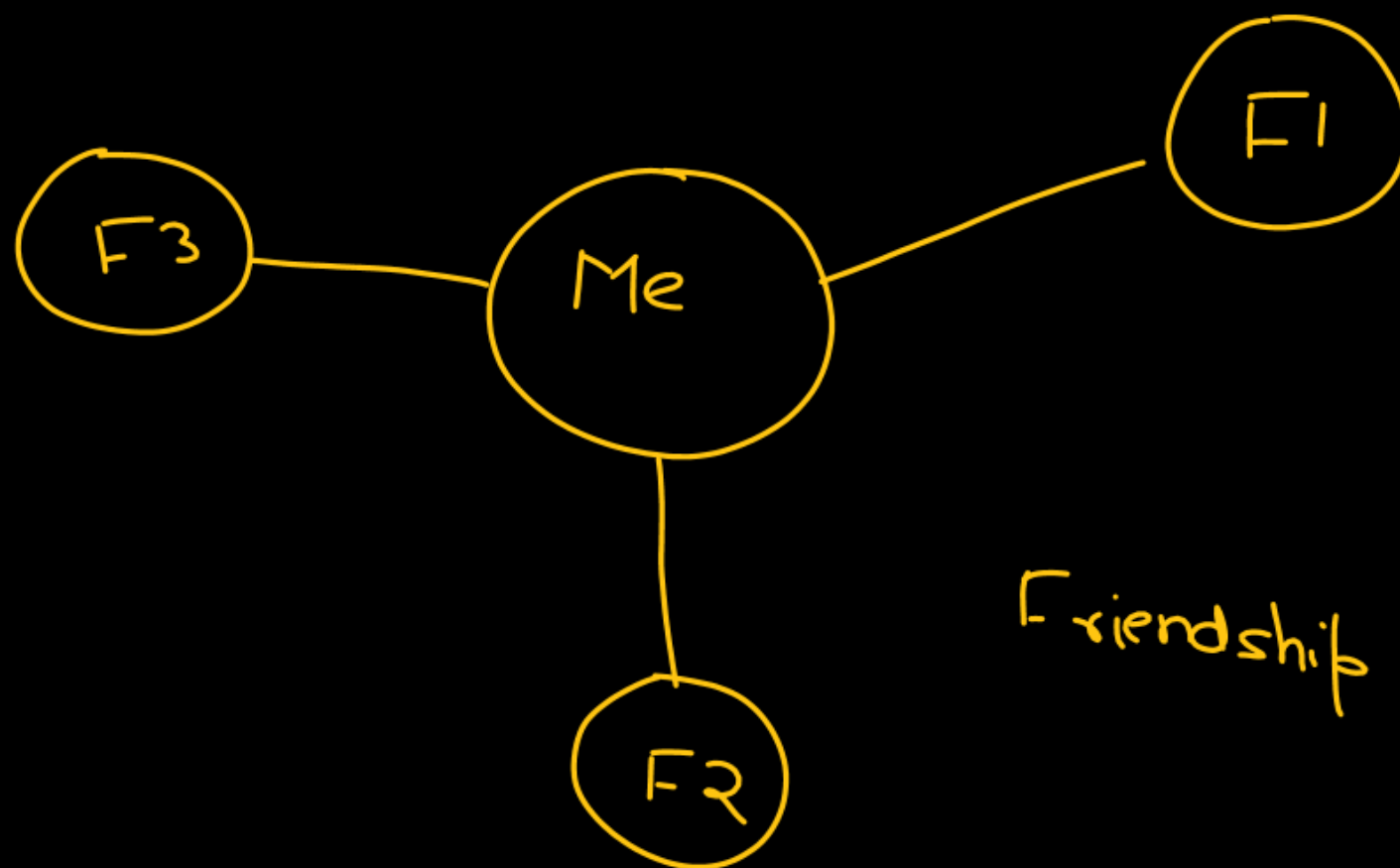




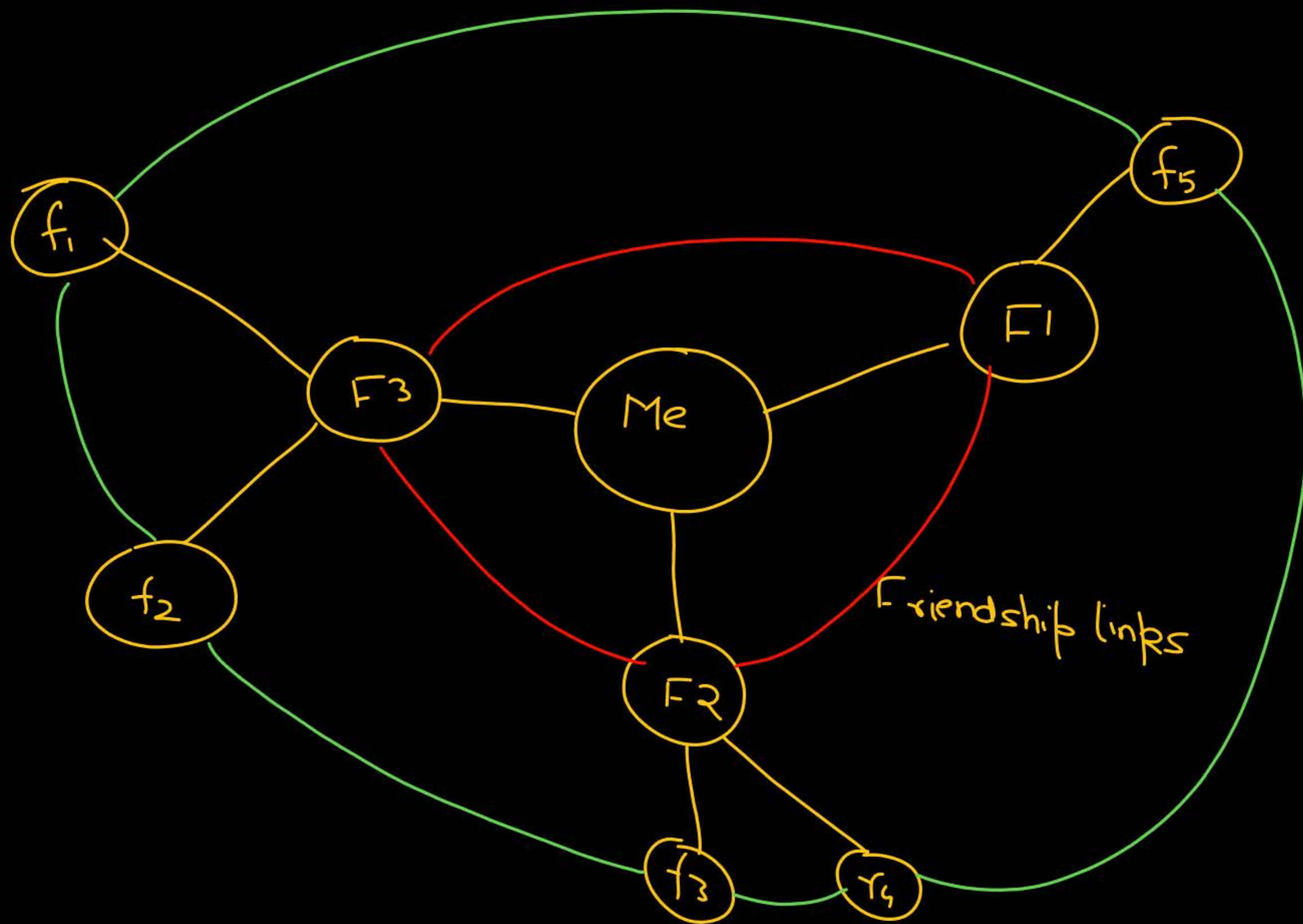


Social N/w

FB



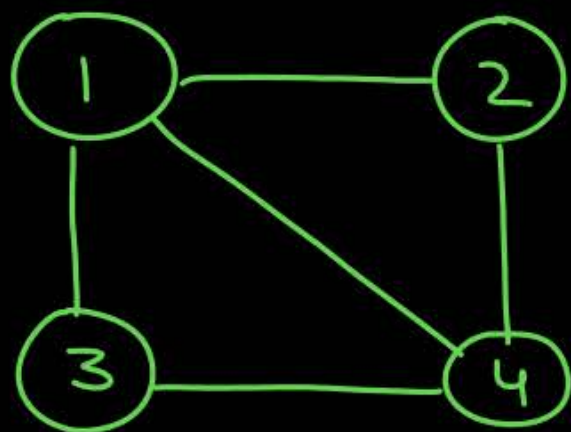
Friendship links



# Graph Representation



$n=4$



$n \times n$  Matrix

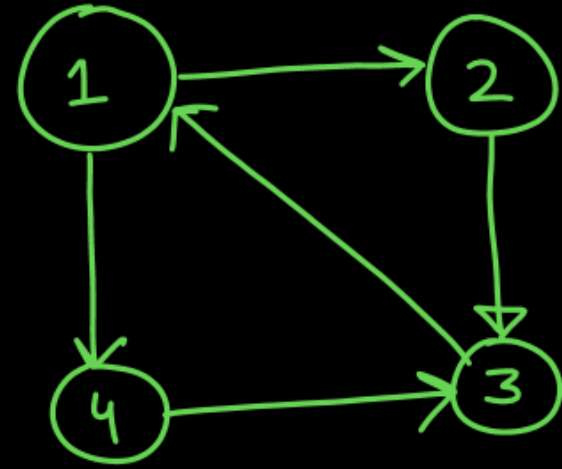
in which Each entry  
is either 0 or 1

Undirected

$\hookrightarrow 2|E|$

$$A = \begin{matrix} & \begin{matrix} 1 & 2 & 3 & 4 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \end{matrix} & \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix} \end{matrix}$$

$A_{ij} = 1$  if node  $i$  is adjacent to  
node  $j$   
 $= 0$ , otherwise



$$\begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{bmatrix} & 1 & 2 & 3 & 4 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}$$

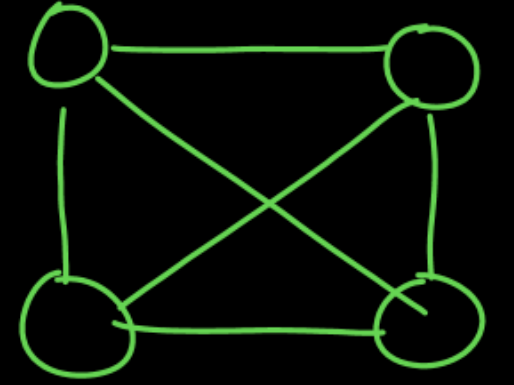
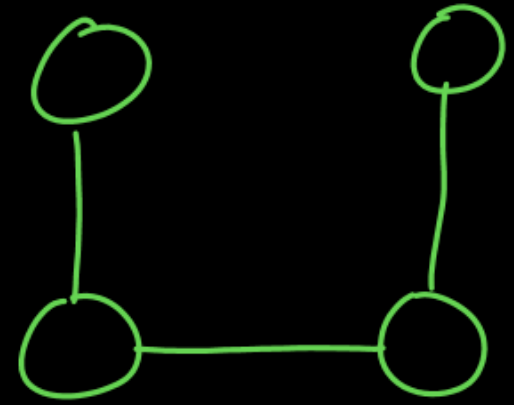


$10^{10}$   $\Rightarrow$  users

$10^{10} \times 10^{10}$

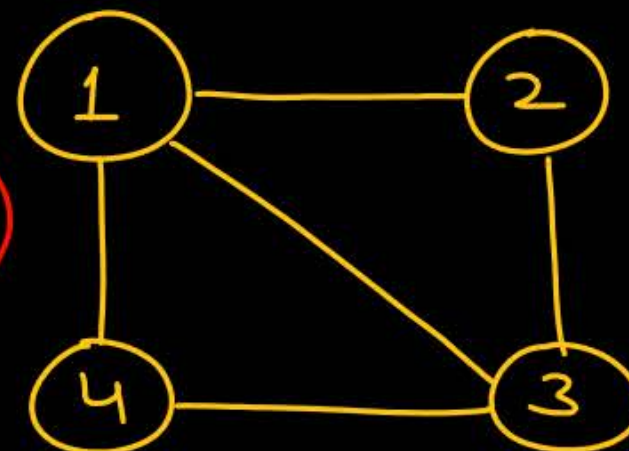
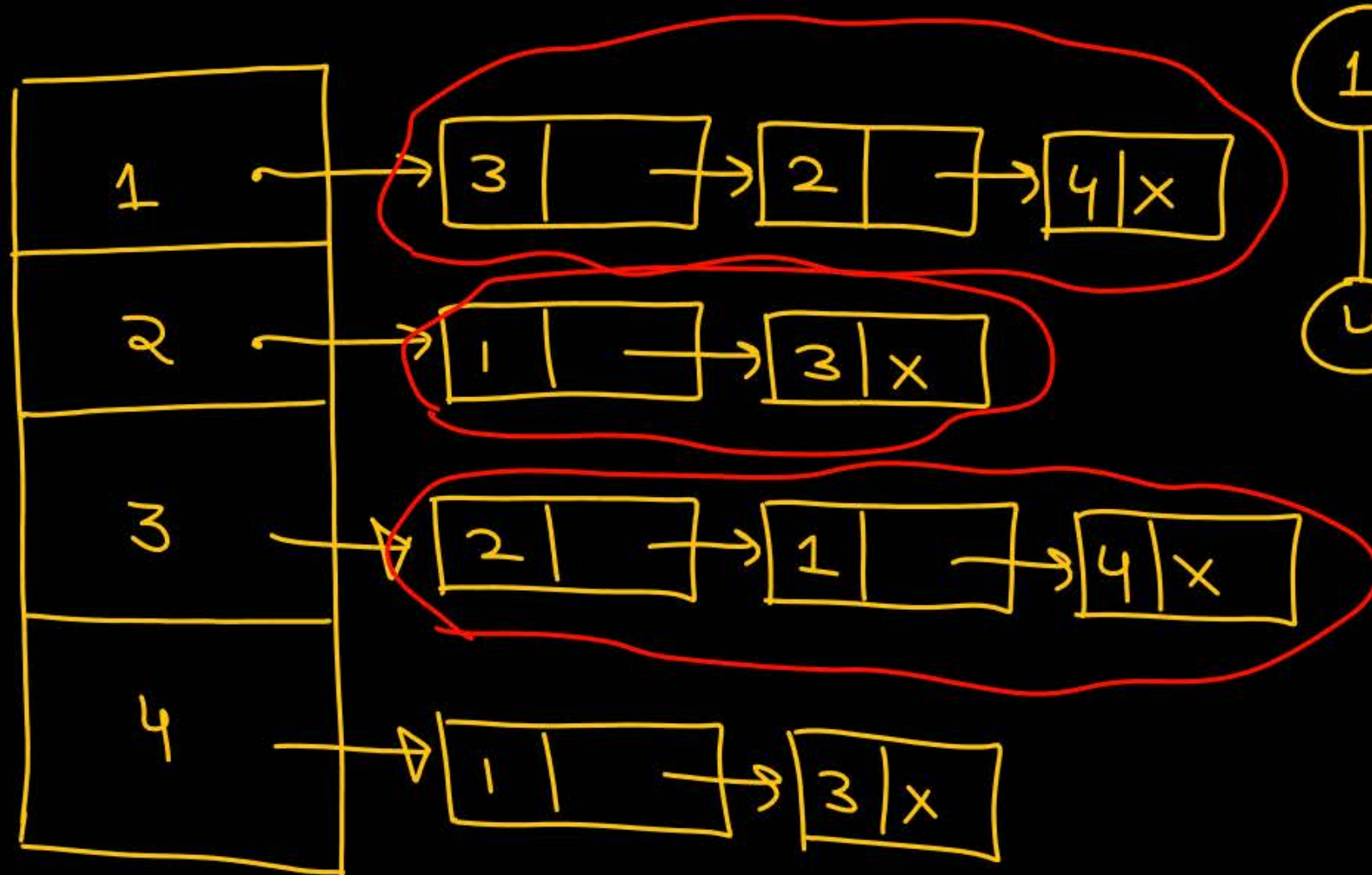
Adj. Matrix

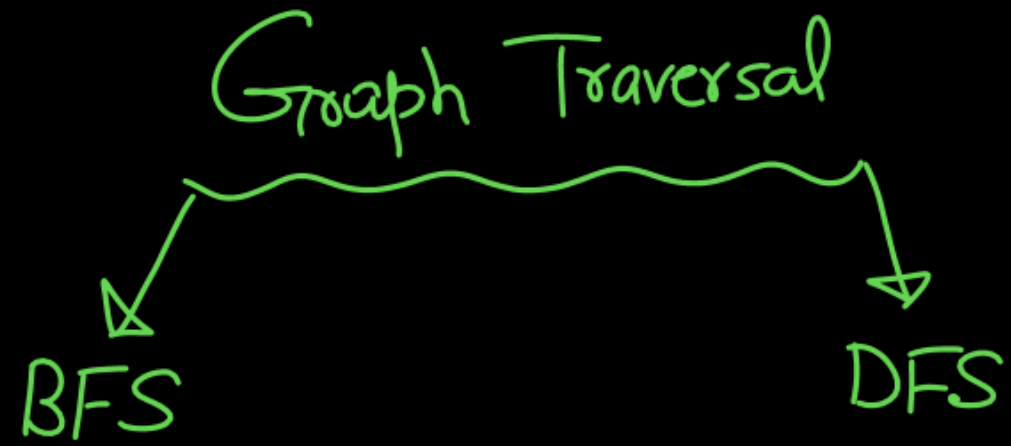
Sparse  
Entry 1



C++  $\Rightarrow$  array of vector

## Adjacency List





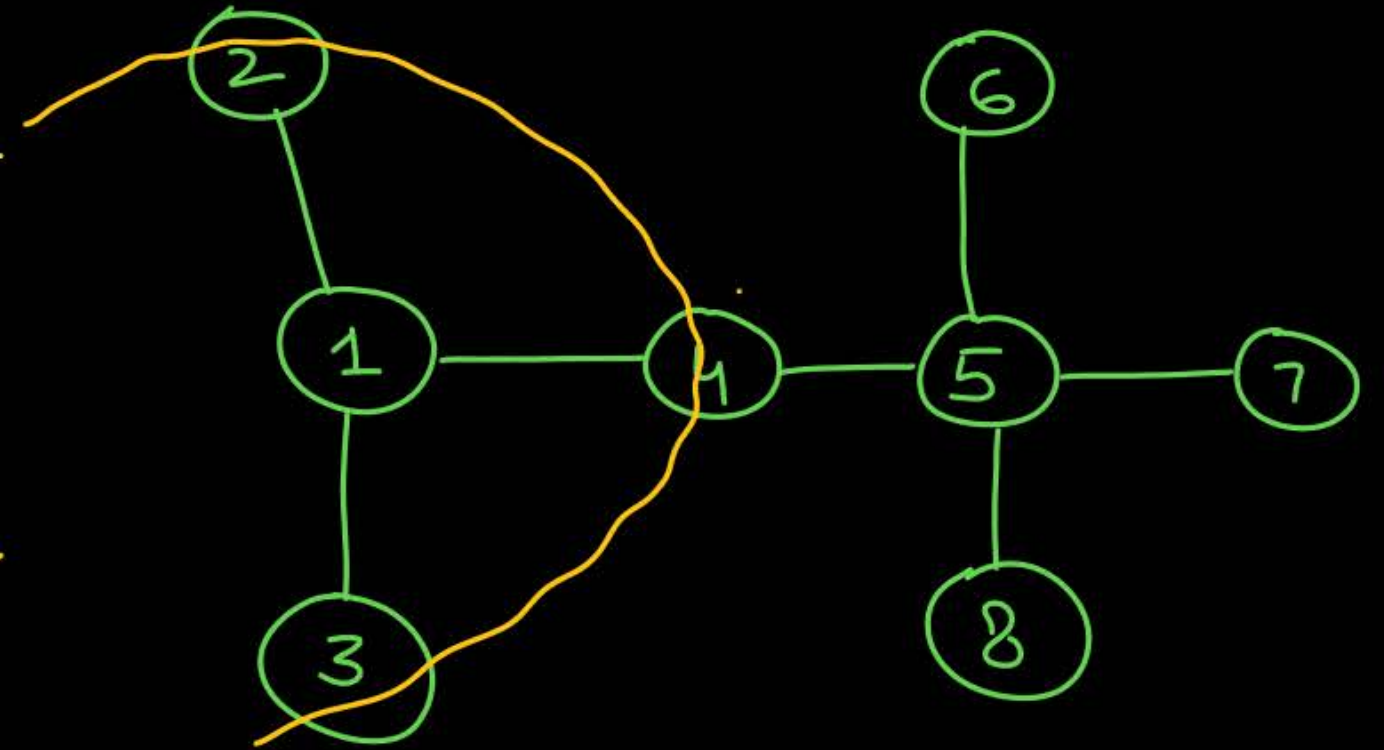
visiting a node :

Exploring a node :

Queue  
BFS

✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓  
(1) (2) (3) (4) (5) (6) (7) (8)

1 2 3 4 5 6 7 8  
-----  
1 distance 2 3 distance  
distance



Queue  
BFS

1, 4, 5

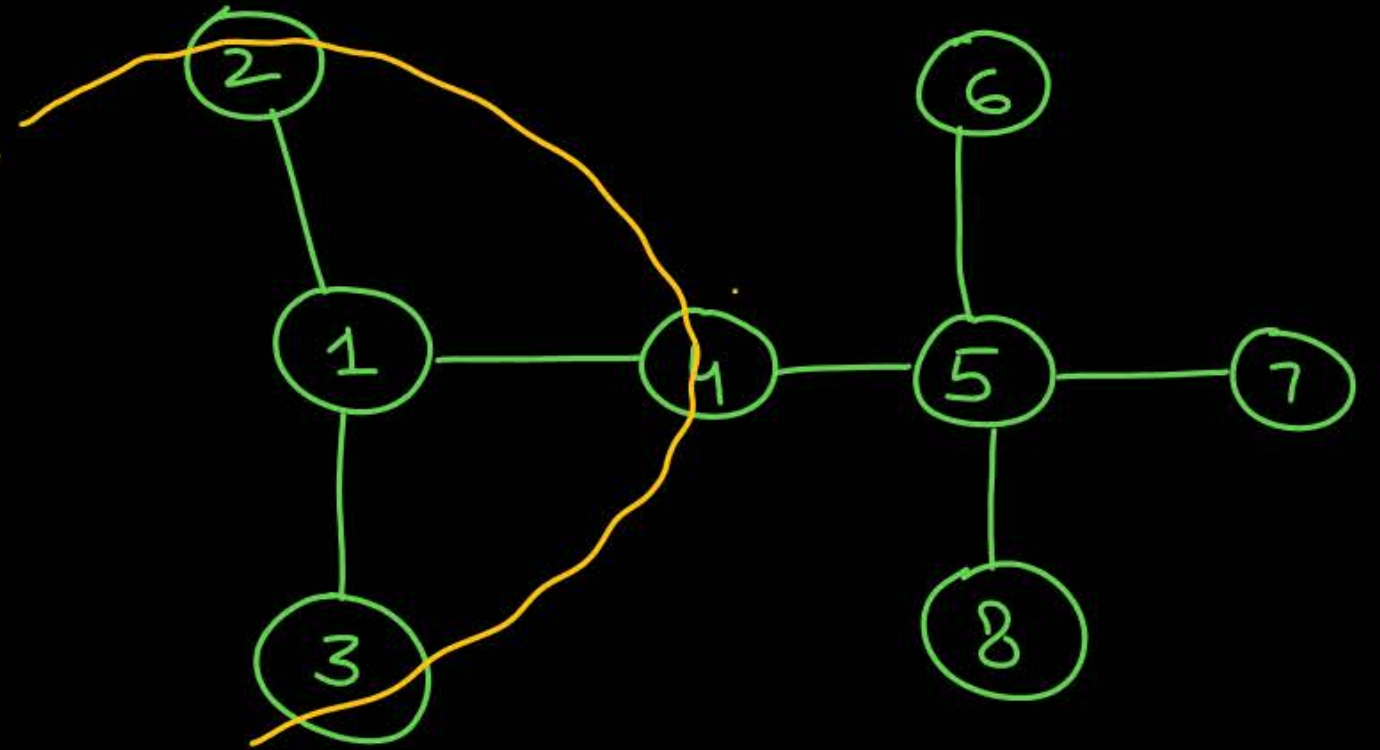
1, 3, 2, 4, 5, 6, 7, 8

1, 3, 2, 4, 5, 6, 8, 7

1, 3, 2, 4, 5, 7, 6, 8

1, 3, 2, 4, 5, 7, 8, 6

1, 2, 3, 4, 5, 6, 7, 8



1 2 3 4 5 6 7 8

1 distance

2  
distance

3 distance



1, 2

Explore Explore  
start start

Explore  
stop

✓  
x

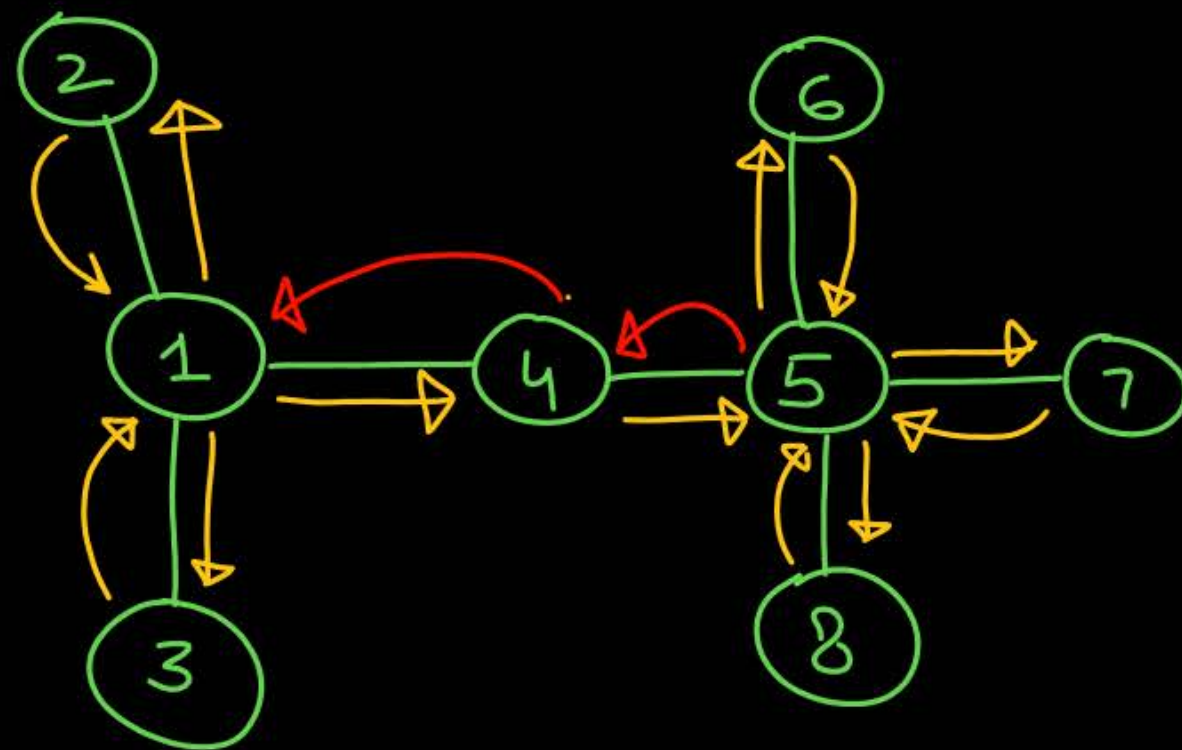
✓

✓

✓

✓

1, 2, 3, 4, 5, 6, 7, 8



1, 2, 6, 5, 7, 8, 4, 1, 3

Source node

① Hashing

② Hashing

8:30

