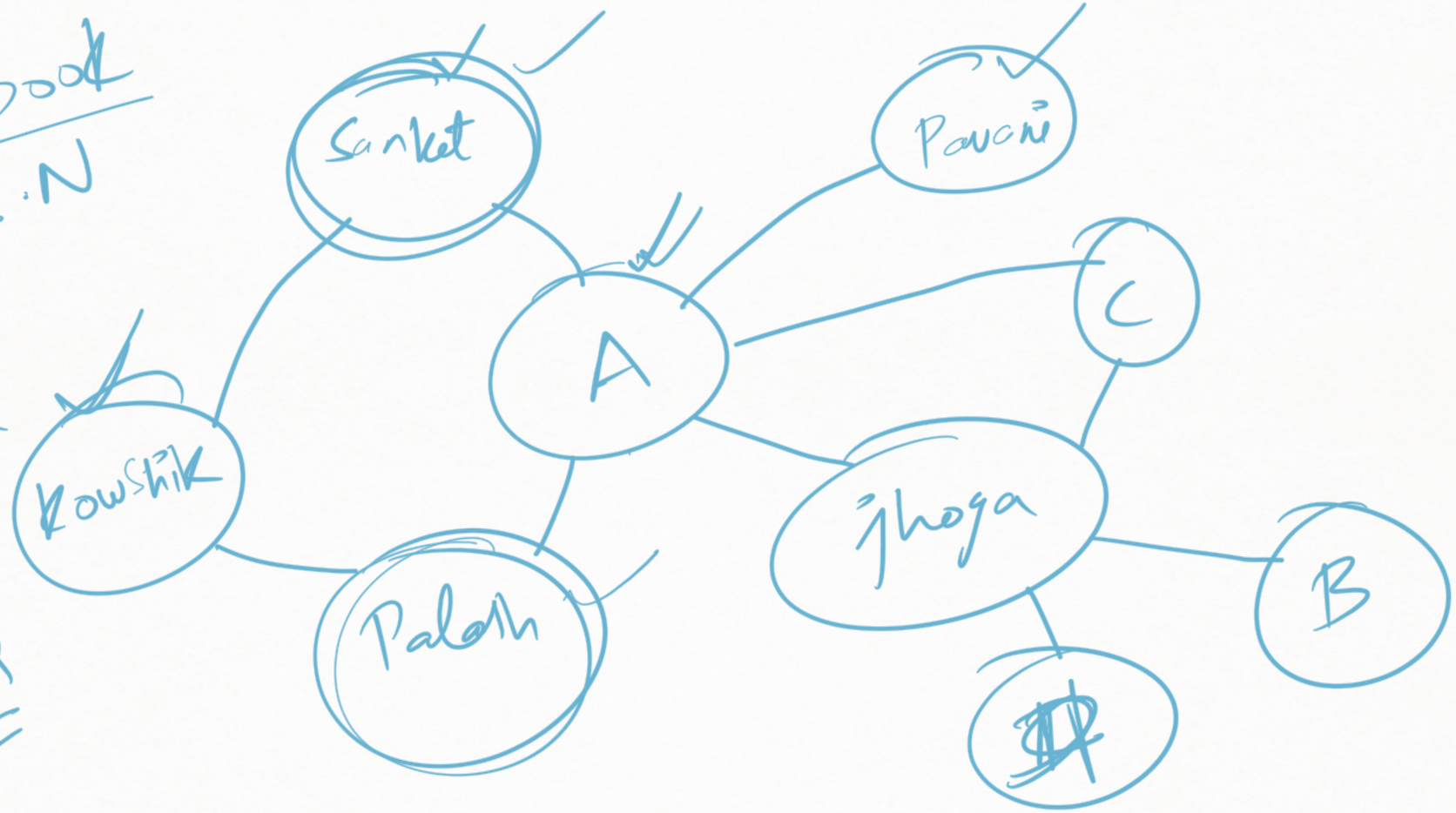
Graph: Data Structure

↳ Graph Theory

ADT

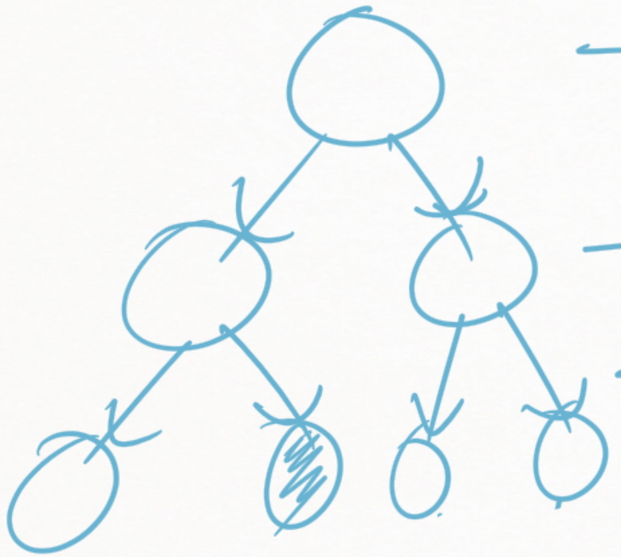
Facebook

S.N



Trees are special type of graphs

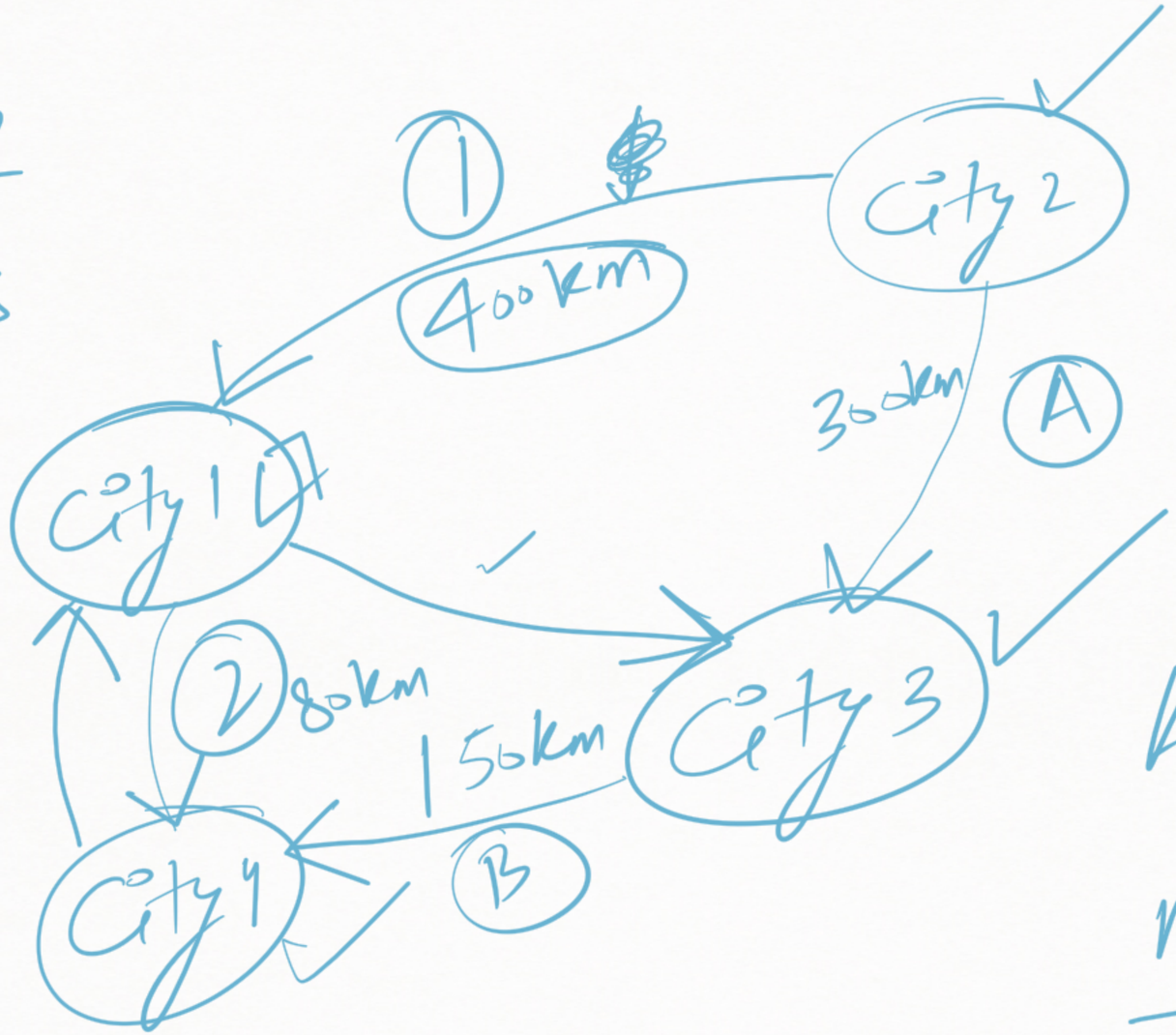
Trees are Special type of Graphs



→ Hierarchical ✓ Parent-Child
⇒ Root → top
→ N nodes, N-1 edges
→ Trees are not Cyclic
→ From Root → You can reach every node
Vice versa

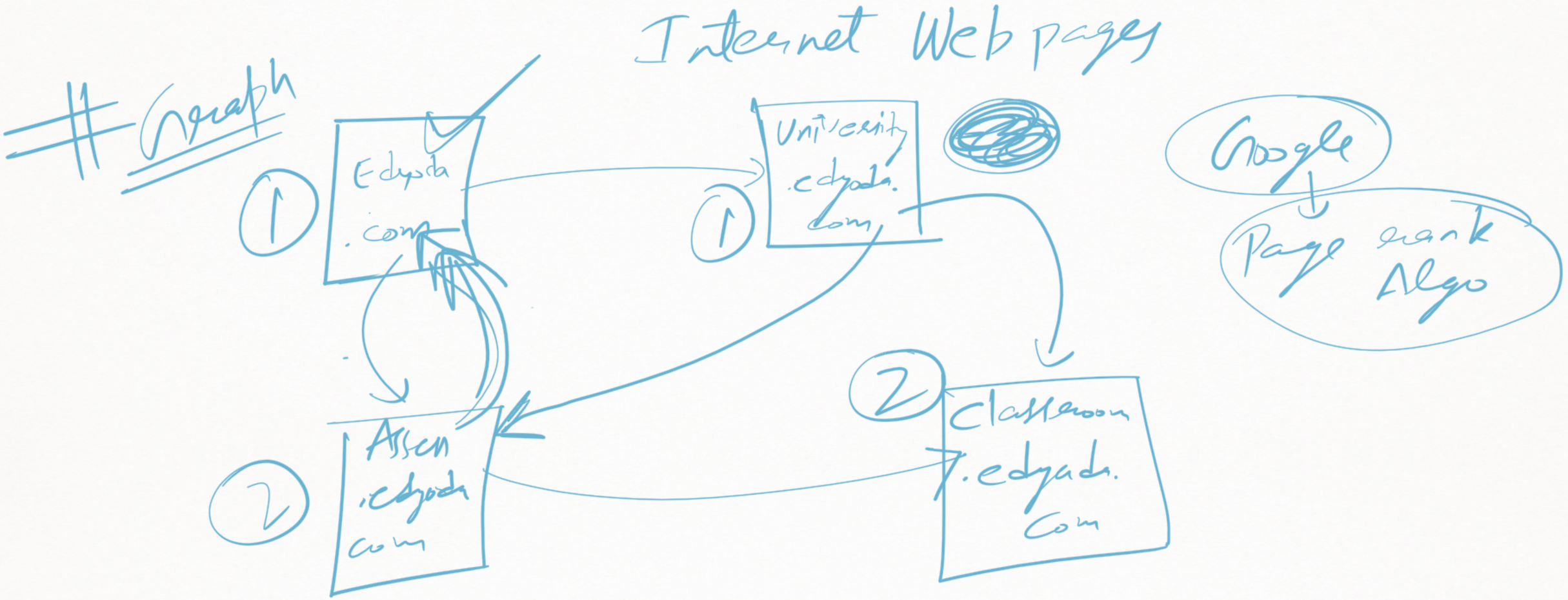
Graphs

→ Maps



Weights

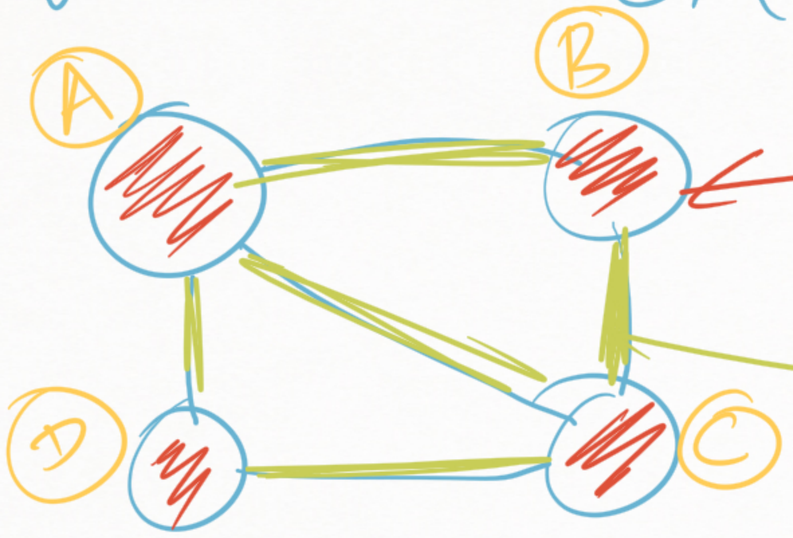
Arrow / Direction Matters


#Graph
Internet Web pages
Edyoda
.com
1
University
.edyoda.
com
1
Google
Page rank
Algo
2
Assen
.edyoda
com
2
Classroom
.edyoda.
com

Graph Definition: Ordered

Collection of V vertices, and E edges (edges and collection)

each of these edges connect a pair of vertices. $G(V, E)$



Vertices

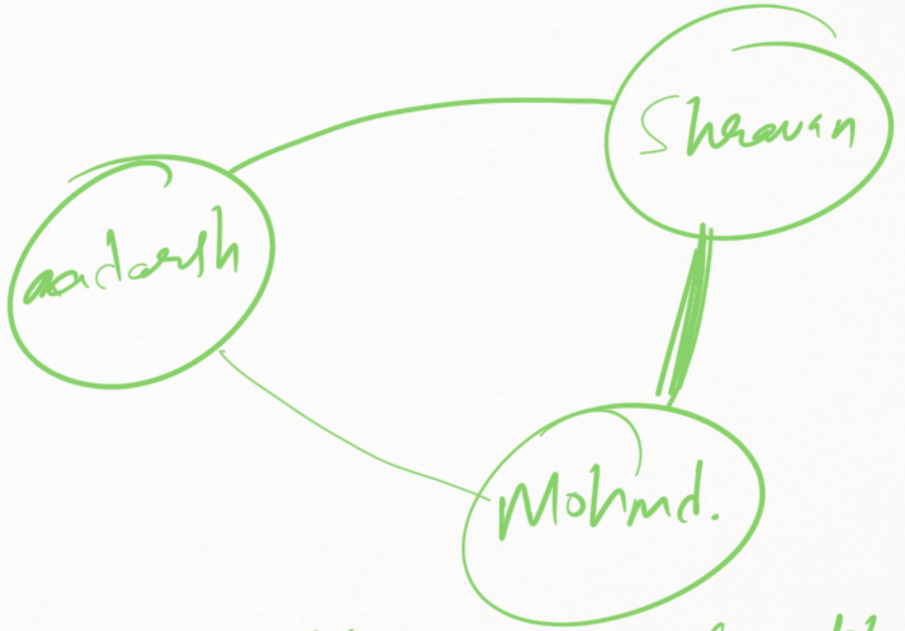
Edges

Undirected graph

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

$E = \{(A,B), (B,C), (C,D), (D,A), (A,C)\}$

Directed & Undirected



Undirected Graph

$V = \{v_1, v_2, v_3, v_4, v_5\}$

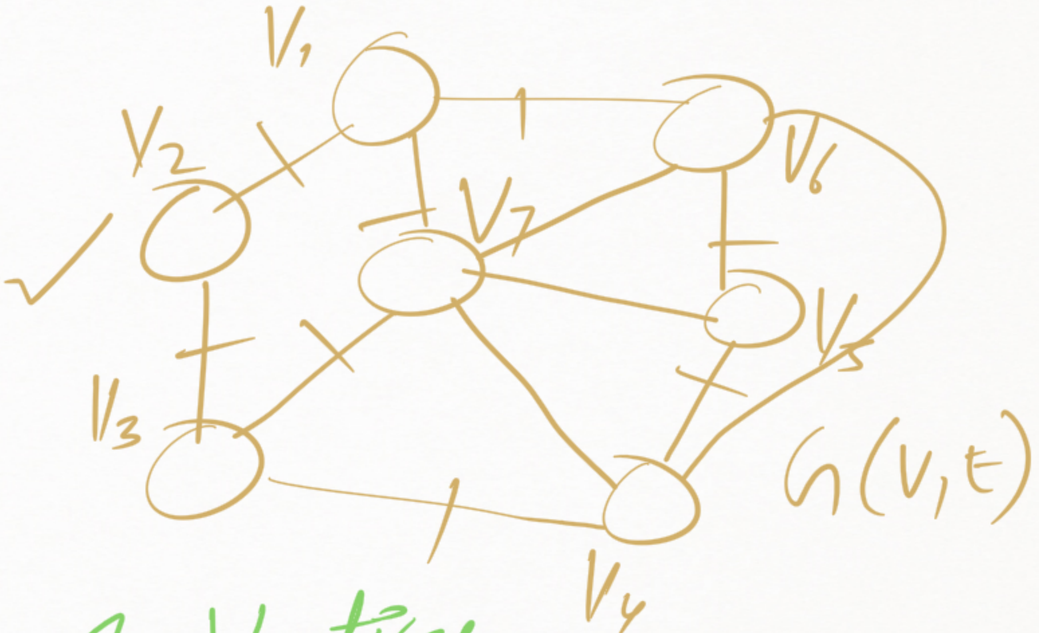
$E = \{(v_1, v_2), (v_2, v_3), (v_5, v_3), (v_4, v_5), (v_1, v_5)$
$(v_4, v_1), (v_1, v_2)\}$

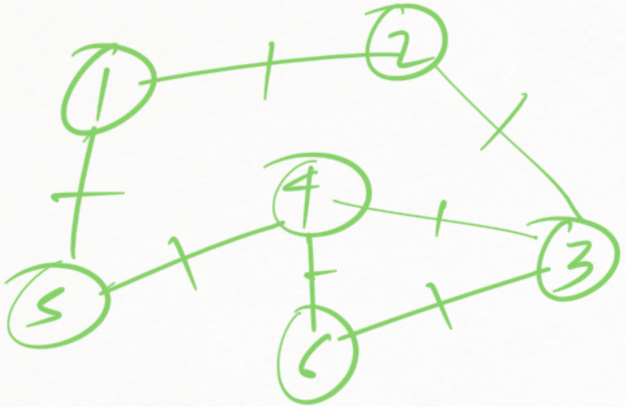
Directed

ex- City Map

Loop

Multiple edges





$|V| = 6, |E| = 7$

$|V|$ = No of Vertices

$|E|$ = No of Edges

Mode

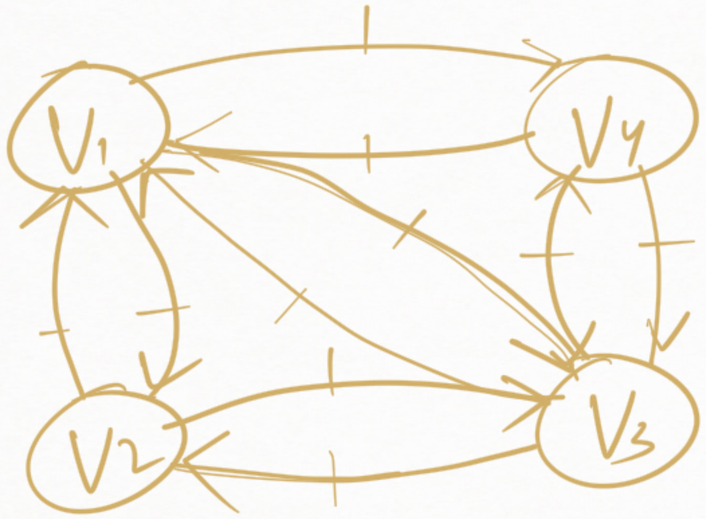
$V = \{v_1, v_2, \ldots\ldots v_5\}$

$E = \{(v_1 v_2), (v_1 v_6)$
$\ldots\ldots$

$|V| = 7$

$|E| = 8$

Graph



$V = \{V_1, V_2, V_3, V_4\}$

$E = \{(V_1, V_4), (V_4, V_1), \ldots\}$

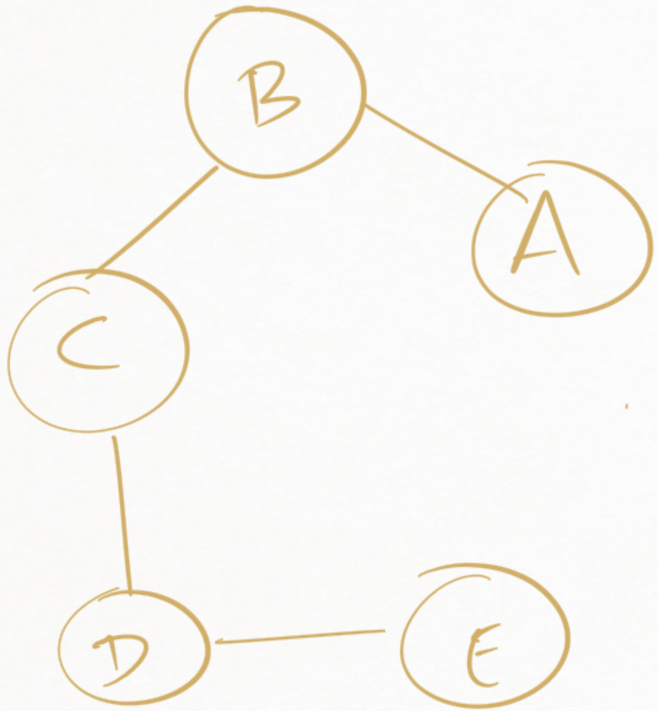
$|V| = 4$

$|E| = 10$

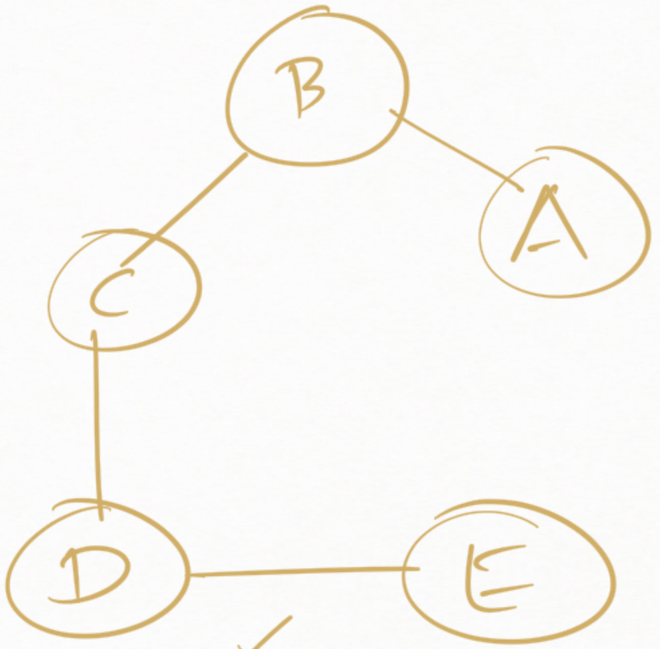
$0 \leq |E| \leq n(n-1)$ [directed graphs]

$0 \leq |E| \leq \frac{n(n-1)}{2}$ [Undirected graphs]

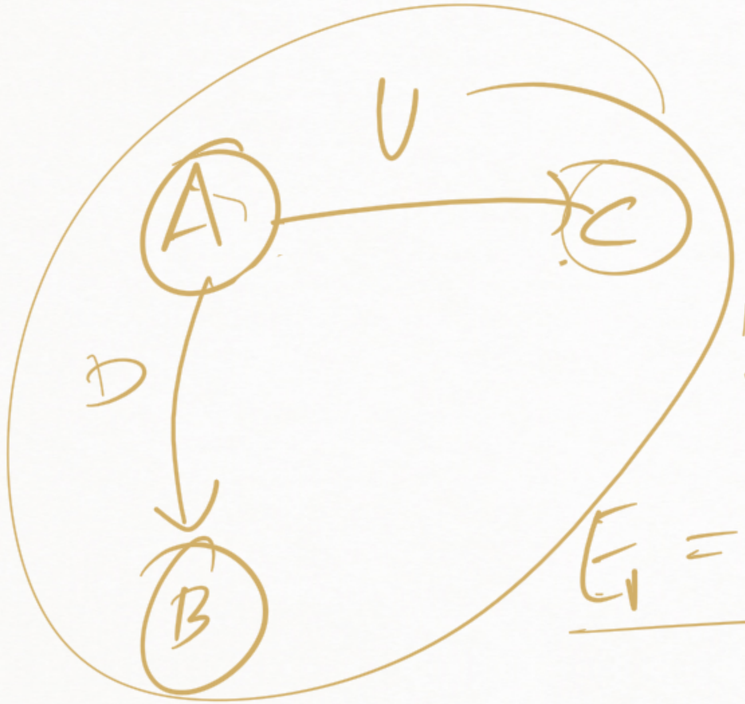
(No self loop or Multi edge)



Connected



Single graph Non Connected



Graph G1

$E_1 = \{(A,C), (A,B)\}$

$V = A, B, C$

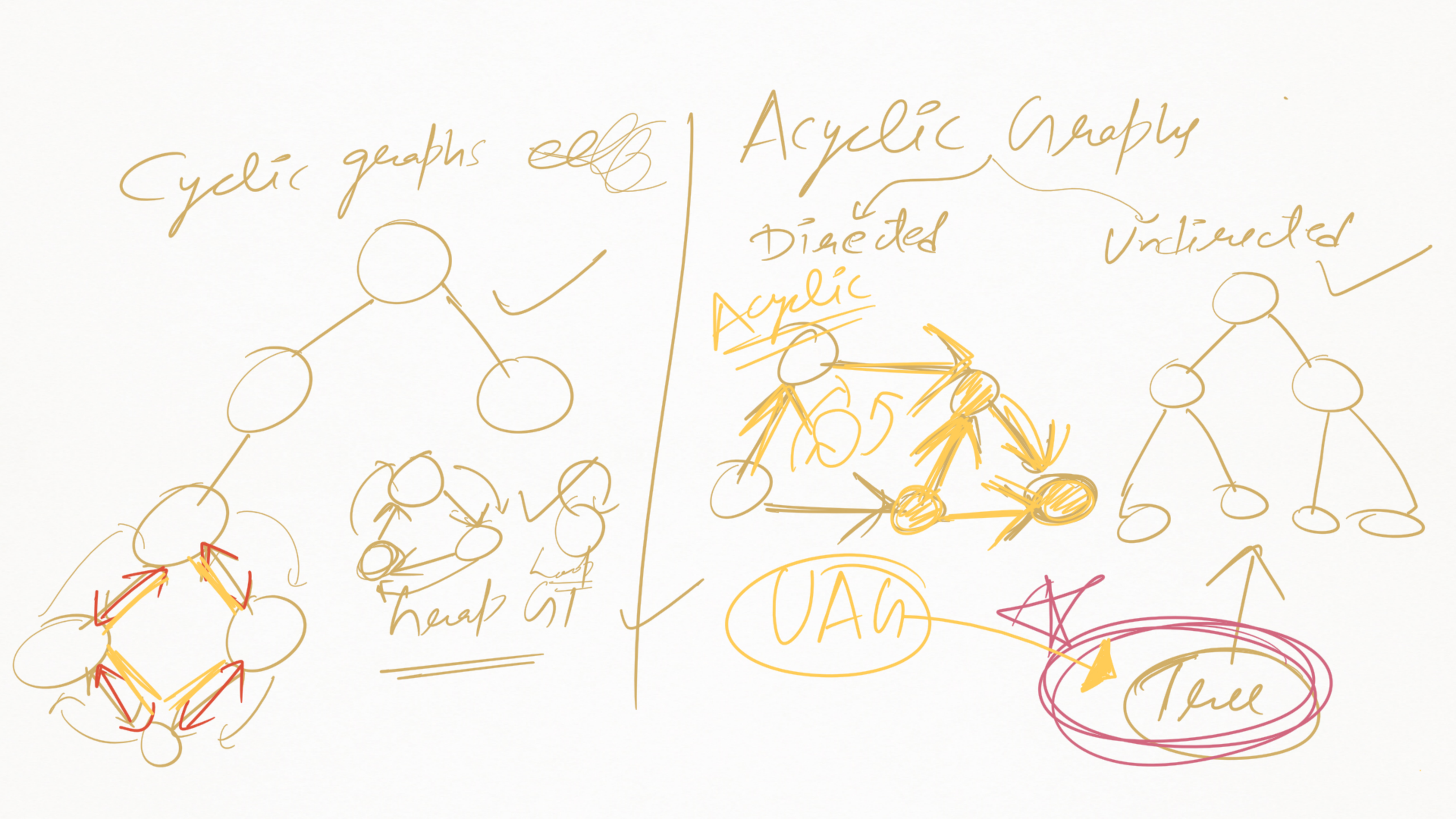
$E_2 = \{\ \}$

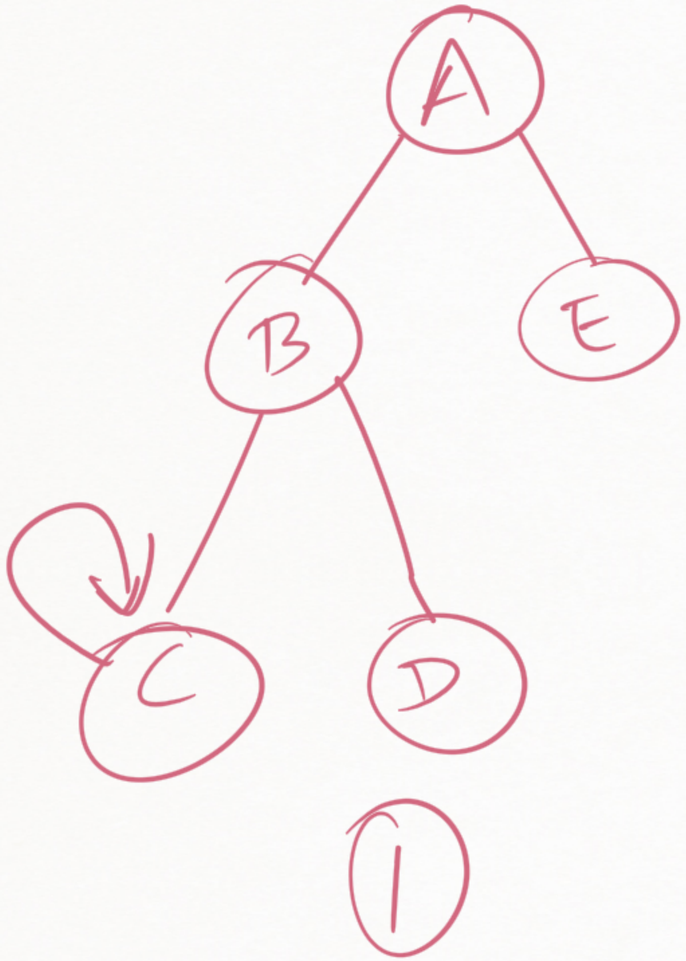
U

D

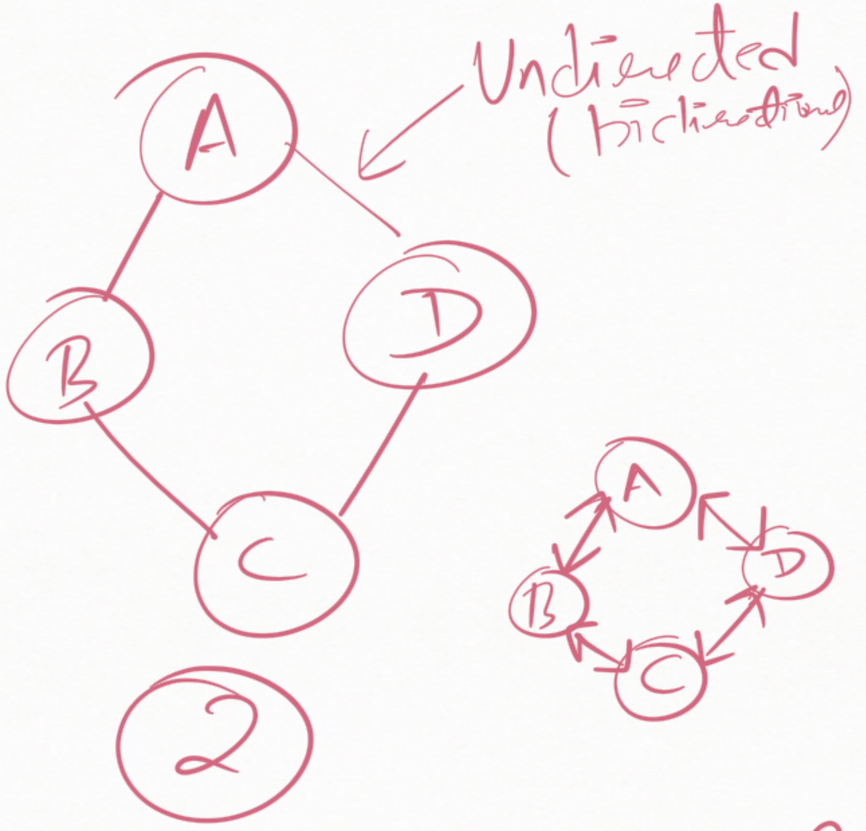
U

Efficiency


Cyclic graphs
Heap
Acyclic Graphs
Directed
Undirected
Acyclic
DAG
Tree

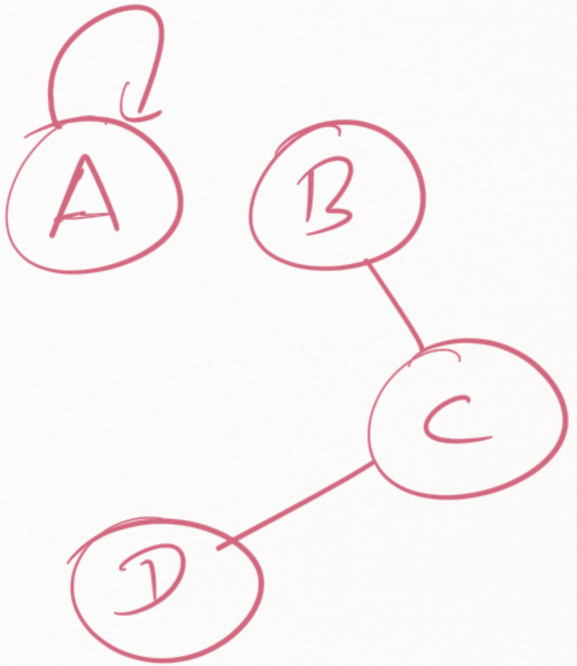


1



Undirected (bidirectional)

2

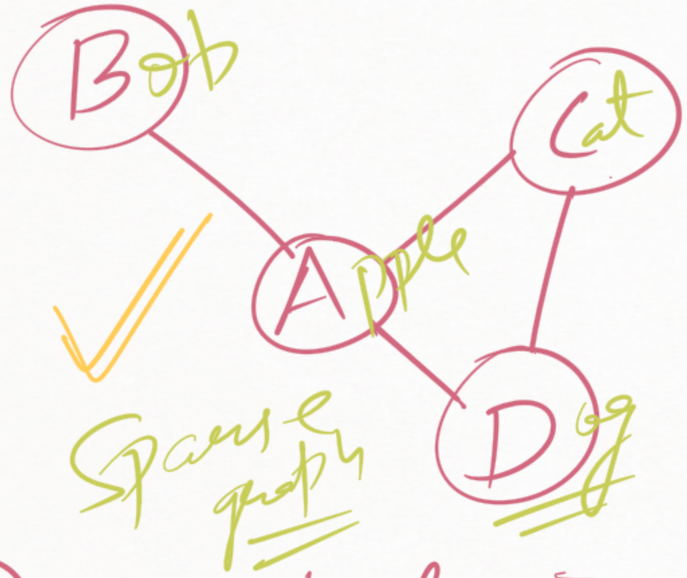


3

Which one is Acyclic?

⇒ None of them

Store / Representation of Graphs



Sparse graph

① Edge List (list of all the edges)

: [(A,B), (A,C), (A,D), (D,C)]

✓ list of tuples in Py

✓ Array in Javascript

② Adjacency Matrix

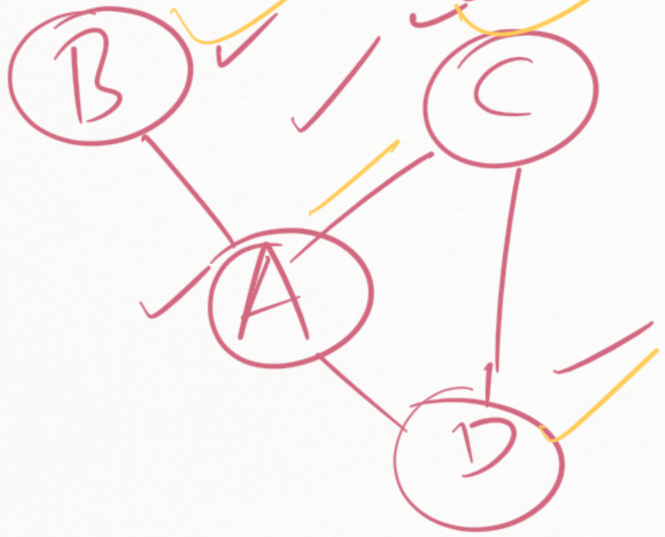
	A	B	C	D
A	0	1	1	1
B	1	0	0	0
C	1	0	0	1
D	1	0	1	0

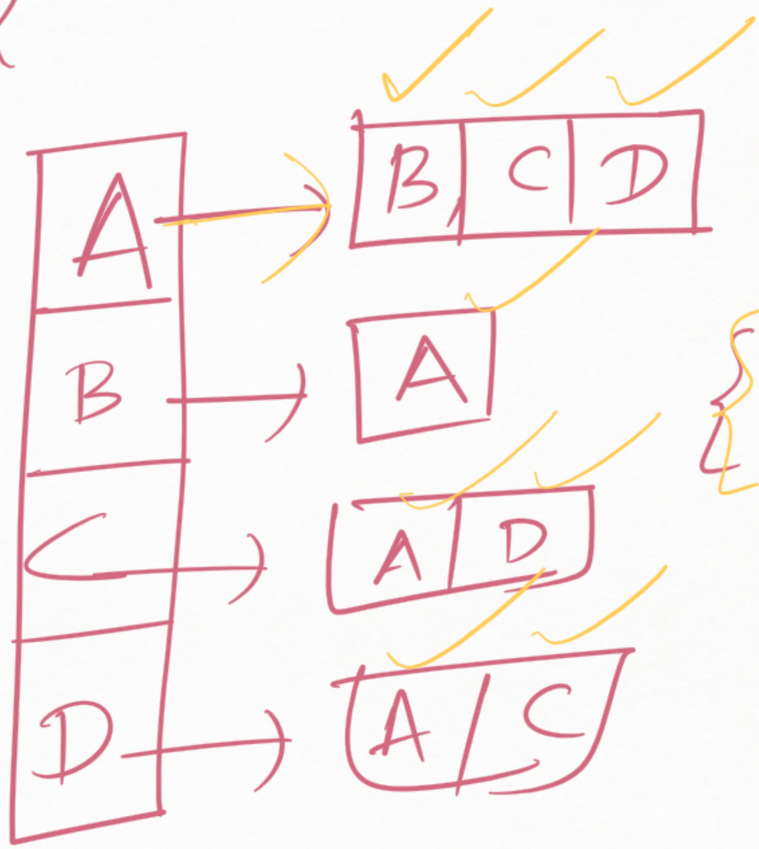
$|V|^2$ values

$|V|^2$

$|E|$

② Adjacency List





Dict / object

```
{A : [B, C, D],
 B : [A], C : [A, D],
 D : [A, C]}
```

① |V| = 10

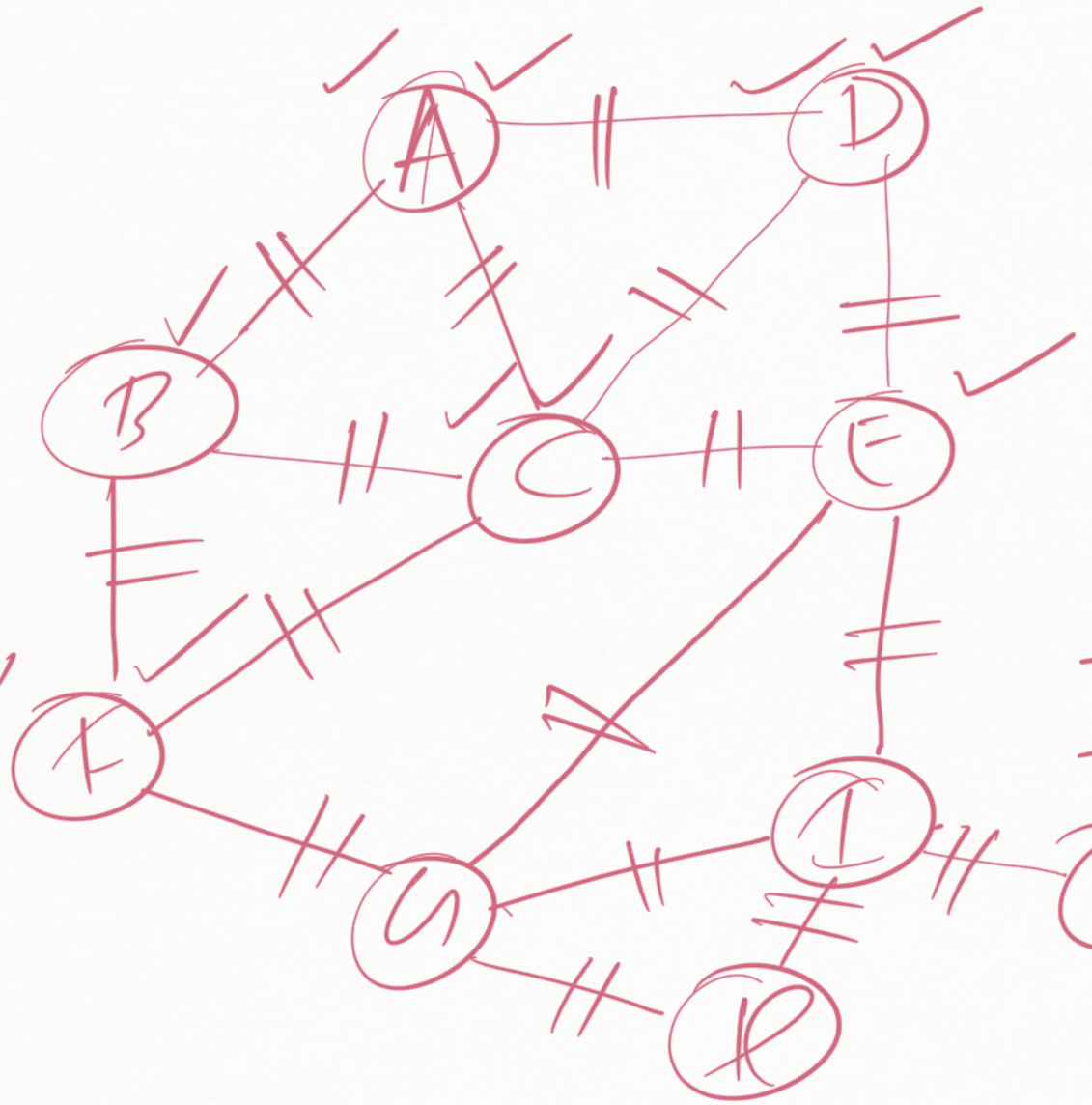
② |E| = 16

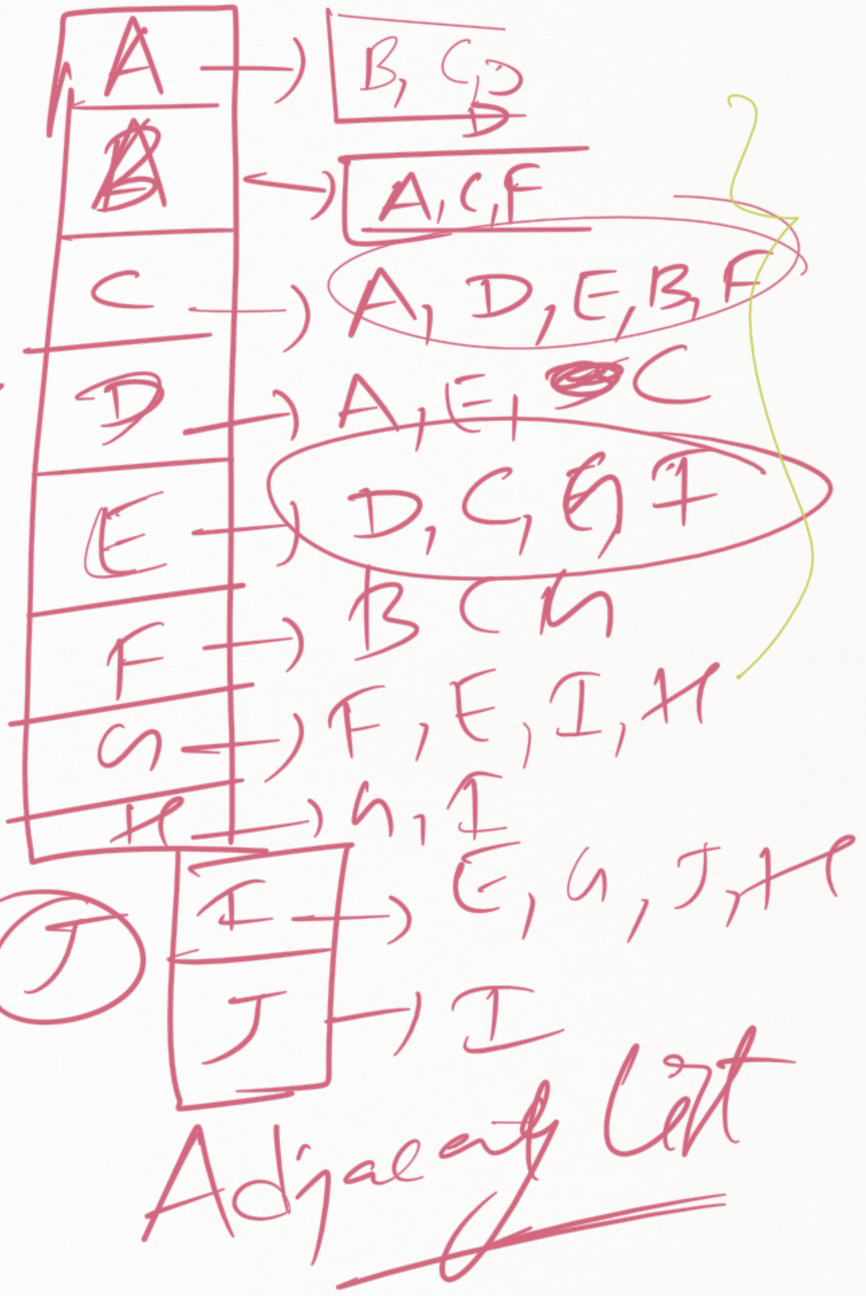
③ V = {A → J}

④ E = {(A,B), (A,C) ... }

⑤ U/D

⑥ C/A

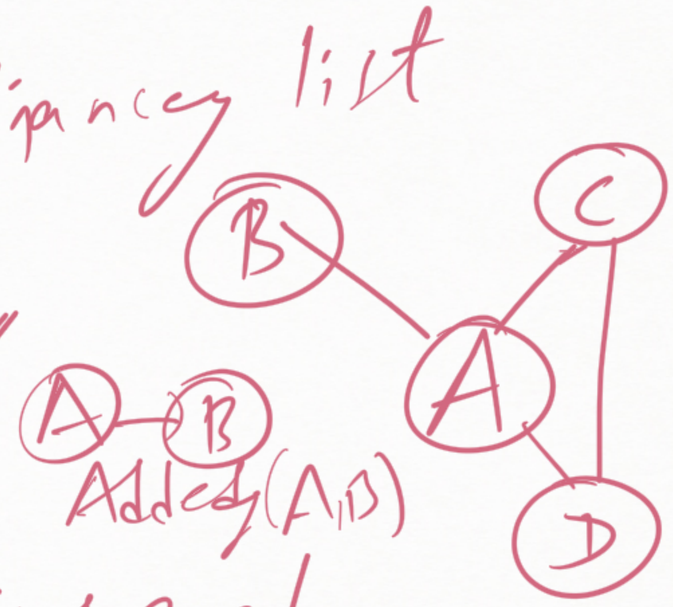




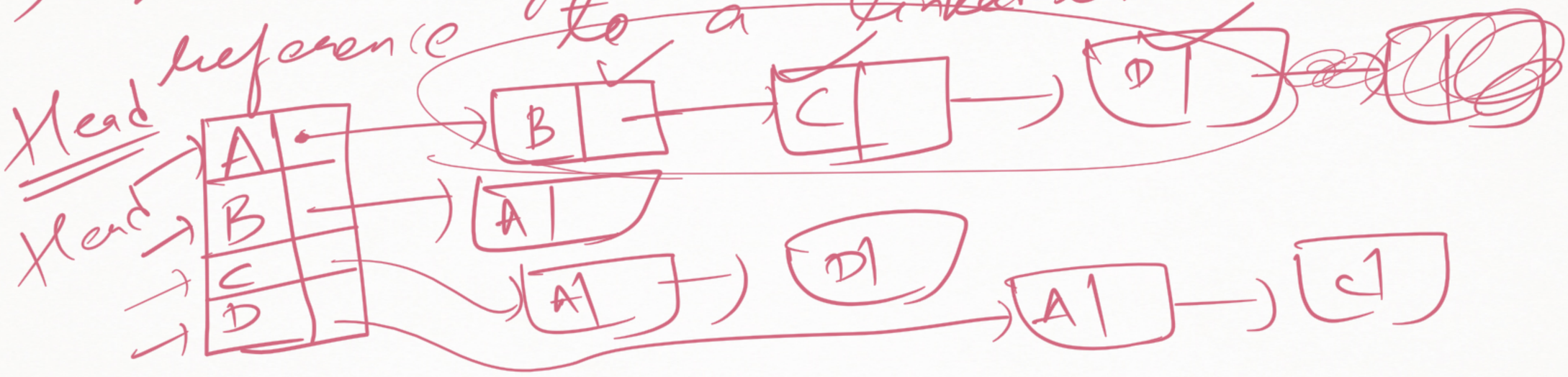
Adjacency List

How Can we Store Adjancy list in PY/JS

→ Dict/Object ✓



→ List Containing Vertices and reference to a Linked list



Op.	Is Edge?	List Edge	List Nbrs.
Adj. Matrix	$\Theta(1)$	$\Theta(\|V\|^2)$	$\Theta(\|V\|)$
Edge List	$\Theta(\|E\|)$	$\Theta(\|E\|)$	$\Theta(\|E\|)$
Adj. List	$\Theta(\deg)$	$\Theta(\|E\|)$	$\Theta(\deg)$