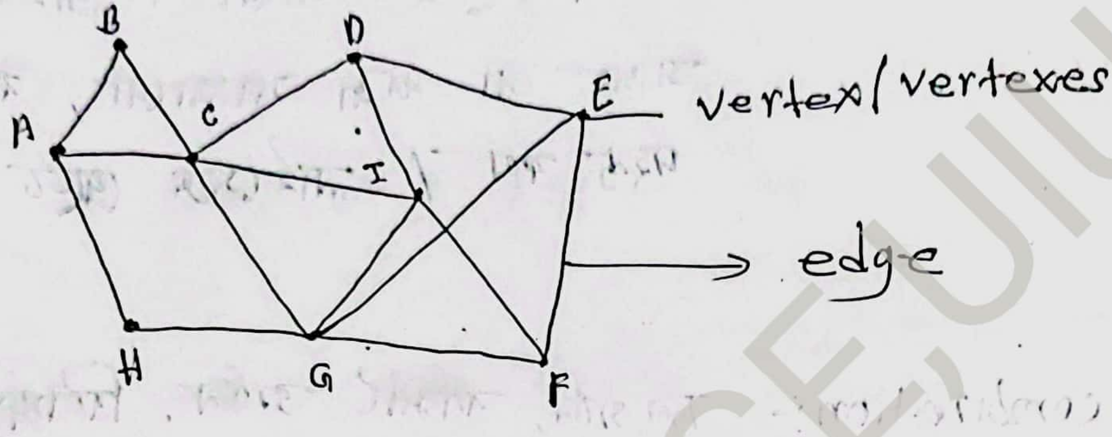
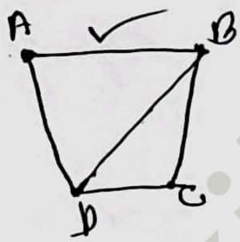
Graph

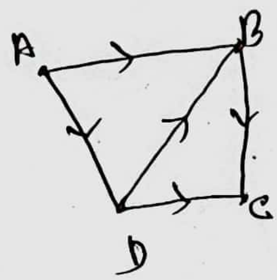


গ্রাফ ২ প্রকার

Undirect

Direct





$\{A, B\} = \{B, A\}$

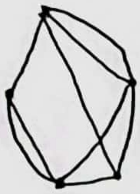
unorder pair

$(A, B) \neq (B, A)$

order pair

Undirect graph

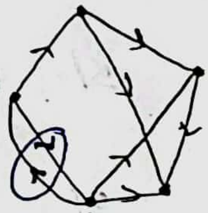
১। simple →  কোন লুপ বা ডাবল edge থাকবে না।

২। Multi graph →  ডাবল edge থাকবে

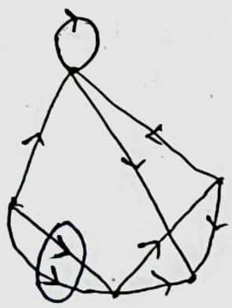
৩। Pseudo graph → 

লুপ থাকবে এক বা একাধিক

Directed

১। simple directed graph →  or 

২। Directed Multi graph



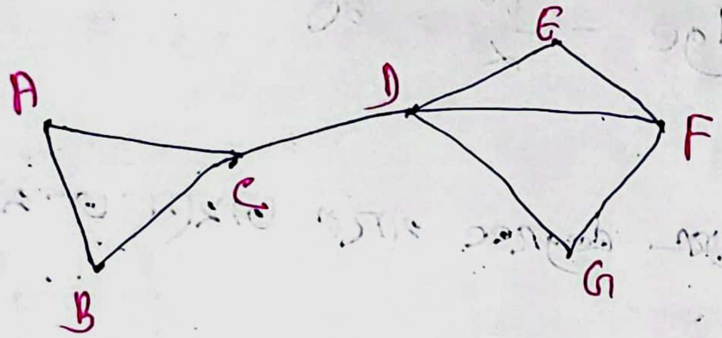
Loop বা multiple edge থাকবে কিন্তু ~~অ~~ multiple edge কে একই দিকে হতে হবে।

Undirected

Adjacent যারা একই edge এর ২ মাথায় থাকে,
হয়; বলে তাদেরকে Adjacent

Handshaking theorem.

Degree সব সময় edge এর দ্বিগুন হইবে (Always)



Degree $A = 2$, $B = 2$, $C = 3$, $D = 4$, $E = 2$
$F = 3$, $G = 2$

sum of degree $= 2 + 2 + 3 + 4 + 2 + 3 + 2$
$= 18$
$= 2 \times 9$

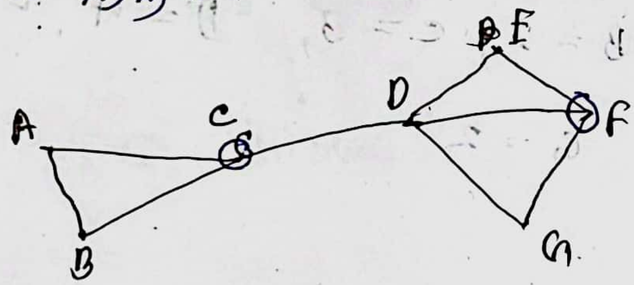
The edge in this graph $= 9$

How many edges are there in a graph with 10 vertex each of degree ~~xt~~ six?

The sum of degree $= 6 \times 10$
$= 60$

$\therefore$ no of edge $= \frac{60}{2} = 30$

যদি odd ~~সংখ্যক~~ degree থাকে তাহলে তা থাকবে even সংখ্যক।



এখানে – odd degree আছে even সংখ্যক

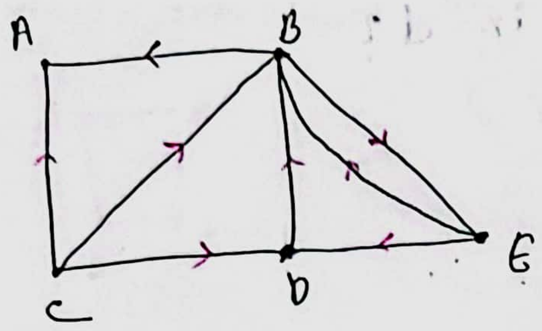
How many edge are there in ~~po~~ this 7 vertex each of degree 13?

~~so~~ sum of ~~theor~~ degree $=$ ~~F~~ $7 \times 13 = 91$

no of edge $= 45.5$

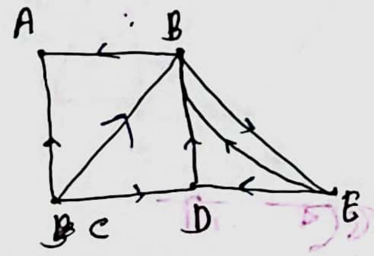
This is not a valid discription

Directed



vertices C is adjacent to B, } দিক বুঝাবে
and B is adjacent from C

degree



[দিক খেয়াল রাখতে হবে]

~~A = 2, B = 3;~~

degree =	in	out
A =	2	0
B =	3	2
C =	0	3
D =	2	1
E =	1	2

The sum of in degree's is 8

The sum of out degrees is 8

$\therefore$ No edge = 8

[সব সমান হবে]

How many degree have in d?

$a \rightarrow 3$
$b \rightarrow 4$
$c \rightarrow 1$
$d \rightarrow n$
$e \rightarrow 5$
$F \rightarrow 3$

edge = 11

$\therefore$ We know

$2 \times \text{edge} = \text{degree}$

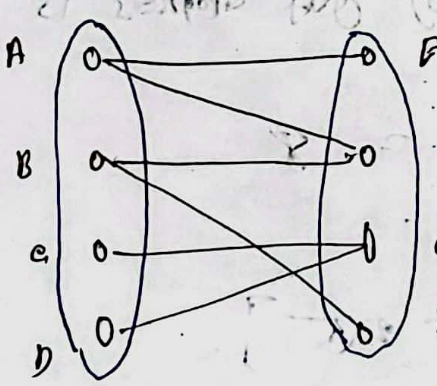
$2 \times 11 = n + 16$

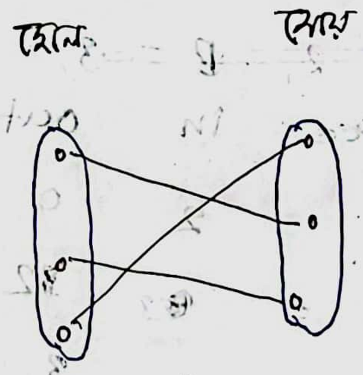
$\Rightarrow n = 22 - 16$

$= 6$ Ans

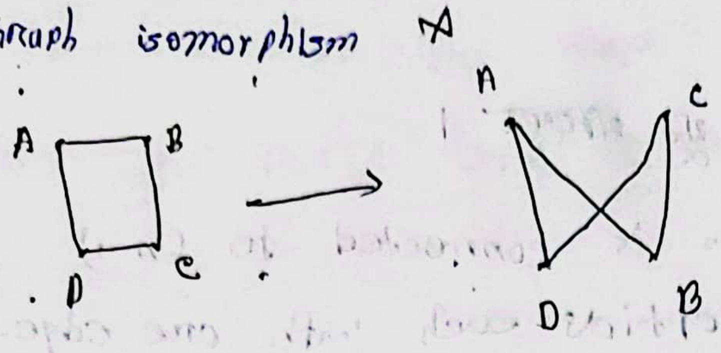
Bipartite Graph

নিজেদের মধ্যে কখনো edge থাকবে না

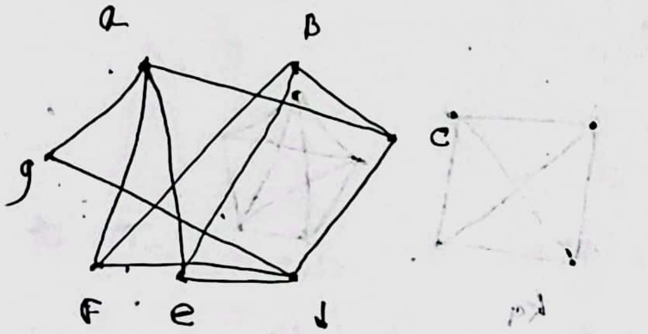




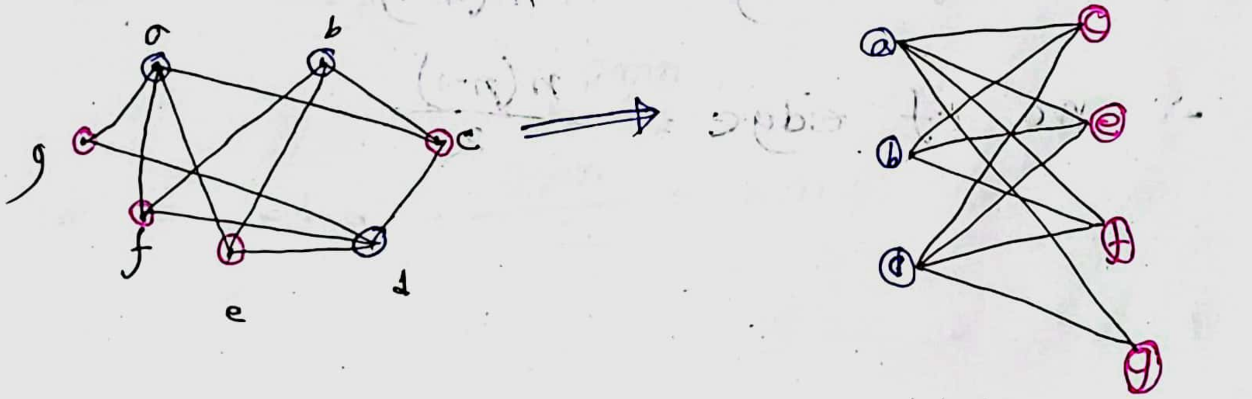
Graph isomorphism



Is this graph Bipartite



এই কালার্স আলাদা . a এক কালারে হবে অন্যটা অন্য কালারের
হিসেবে হবে যাবা a থেকে শুরু



নিজেদের মধ্যে নাই

Some special simple graph

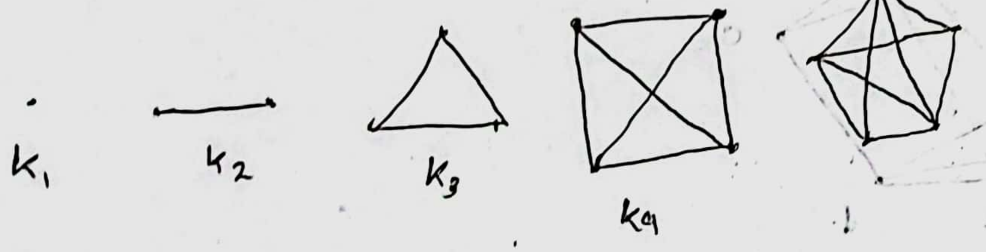
Complete graph

সবাই সবার সাথে যুক্ত থাকবে।

Here, every vertex is connected to $(n-1)$ remaining ~~vertex~~ vertices each with one edge..

~~$\therefore$ Degree of every vertex $= (n-1)$~~

~~$\therefore$ sum of degree~~



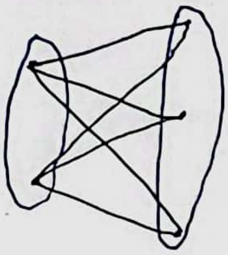
$\because$ degree of every vertex $= n-1$

$\therefore$ Sum of degree $= n(n-1)$

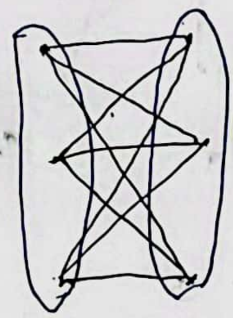
$\therefore$ no. of edge $= \frac{n(n-1)}{2}$

Complete Bipartite Graph

এক গ্রুপের সবাইকে অন্য গ্রুপের সবার সাথে যুক্ত থাকতে হবে।



$K_{2,3}$



$K_{3,3}$

In $K_{m,n}$ m vertices of one side are each completed to the n vertices of the other side

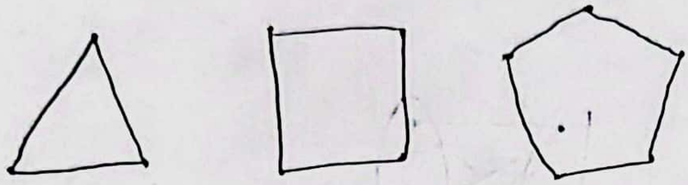
sum of degree $= mn + nm$

$= 2mn$

no. of edge $= \frac{2mn}{2} = mn$

cycle graph

যতগুলো vertex তত-গুলো edge



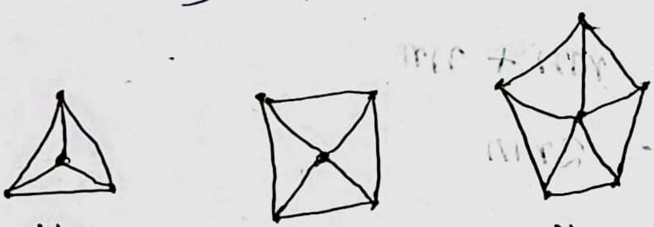
C_3 C_4 C_5

Minimum vertex 3

~~en~~ sum of degree = $n \times 2$

so no. of edge = $\frac{n \times 2}{2} = n$

wheels graph



W_3 W_4 W_5

~~no of degree~~ =

11 degree of each outer vertex = 3

$\therefore$ sum of outer degree = $3n$

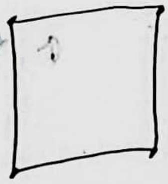
$\therefore$ total number of degree = $3n + n$

$\therefore$ no. of edge = $\frac{4n}{2} = 2n$

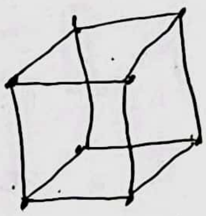
n- cubes

Every vertex represents 2^n bit string of lenght n

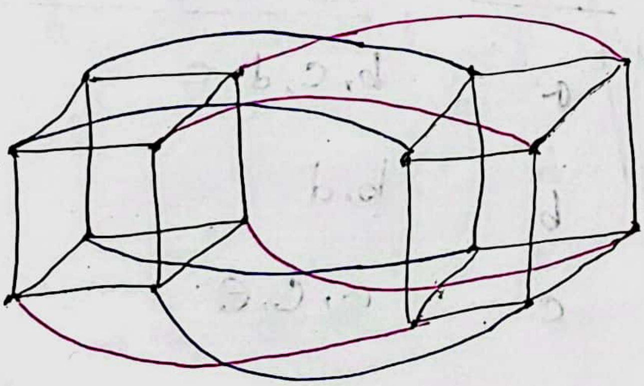
Q_1



Q_2



Q_3



Q_4

$\therefore$ The vetex = 2^n

The edge = $n2^{n-1}$

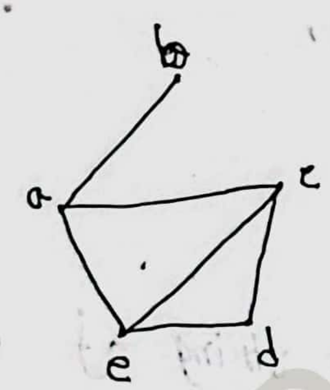
Graph representation

Adjacency List

Undirected

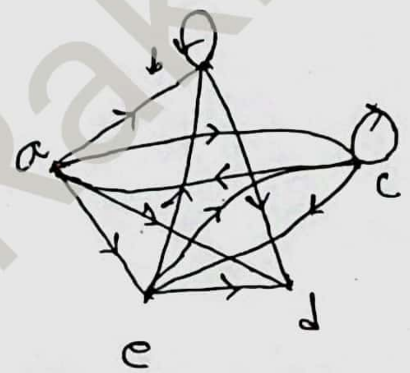
যতগুলো edge থাকবে ততগুলো List এ থাকবে

Loop থাকলেও



Vertex	Adjacency Vertices
a	b, c, e
b	a
c	a, d, e
d	c, e
e	a, c, d

Directed

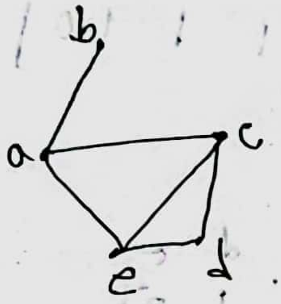


Initial	Terminal vertices
a	b, c, d, e
b	b, d
c	a, c, e
d	~~b~~
e	b, c, d

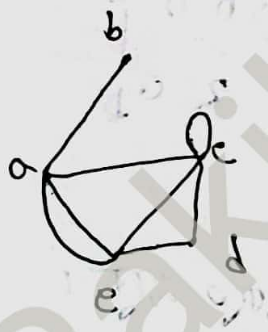
Adjacency Matrix → undirected

যার adjacency তার (1) বাকিগুলো (0) ম্যাট্রিক্স থাকলে edge অনুযায়ী বসবে।

undirected হলে matrix টি প্রতিসম ম্যাট্রিক্স হবে।



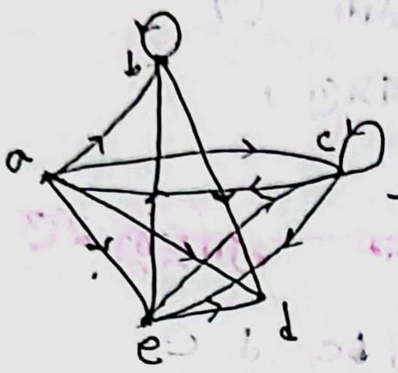
$$\begin{array}{c|c} & \begin{matrix} a & b & c & d & e \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \\ e \end{matrix} & \begin{bmatrix} 0 & 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \\ 1 & 0 & 1 & 1 & 0 \end{bmatrix} \end{array}$$



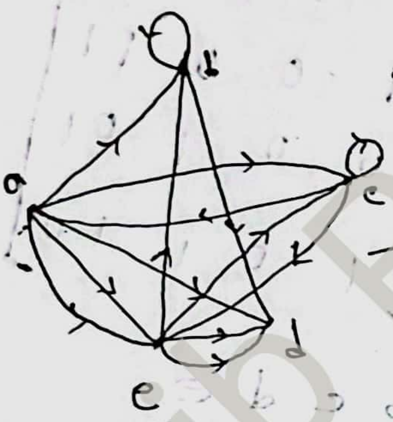
$$\begin{array}{c|c} & \begin{matrix} a & b & c & d & e \end{matrix} \\ \begin{matrix} a \\ b \\ c \\ d \\ e \end{matrix} & \begin{bmatrix} 0 & 1 & 1 & 0 & 2 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \\ 2 & 0 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

প্রতিসম

Adjacency Matrix → Directed



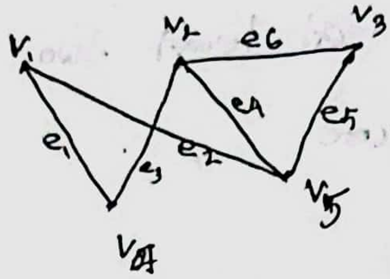
$$\begin{array}{c|ccccc} & a & b & c & d & e \\ \hline a & 0 & 1 & 1 & 1 & 1 \\ b & 0 & 1 & 0 & 1 & 0 \\ c & 1 & 0 & 1 & 0 & 1 \\ d & 0 & 0 & 0 & 0 & 0 \\ e & 0 & 1 & 1 & 1 & 0 \end{array}$$



$$\begin{array}{c|ccccc} & a & b & c & d & e \\ \hline a & 0 & 1 & 1 & 1 & 2 \\ b & 0 & 1 & 0 & 1 & 0 \\ c & 1 & 0 & 1 & 0 & 1 \\ d & 0 & 0 & 0 & 0 & 0 \\ e & 0 & 1 & 1 & 2 & 0 \end{array}$$

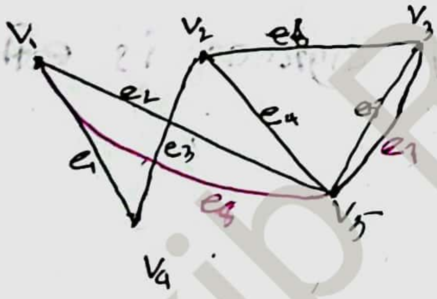
যার দিকে যায় তাকে count cot করতে হবে।

Incidence Matrix



$$
\begin{array}{c}
 \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5
\end{array}
\begin{array}{c}
\begin{array}{cccccc} e_1 & e_2 & e_3 & e_4 & e_5 & e_6 \end{array} \\
\begin{bmatrix}
1 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 0 & 1 \\
0 & 0 & 0 & 0 & 1 & 1 \\
1 & 0 & 1 & 0 & 0 & 0 \\
0 & 1 & 0 & 1 & 1 & 0
\end{bmatrix}
\end{array}
$$

সব সময় (0,1) Matrix থাকবে
ede বাড়লে নতুন ভাবে আগাগোড়া হবে।



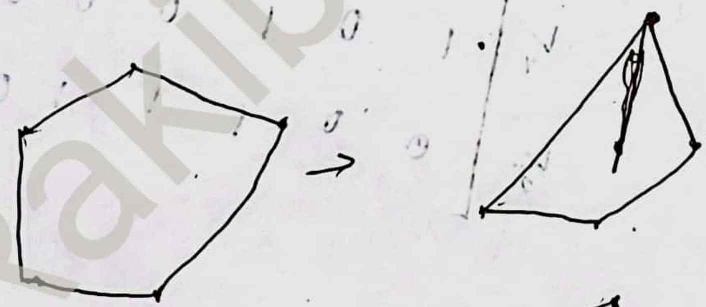
$$
\begin{array}{c}
 \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5
\end{array}
\begin{array}{c}
\begin{array}{cccccccc} e_1 & e_2 & e_3 & e_4 & e_5 & e_6 & e_7 & e_8 \end{array} \\
\begin{bmatrix}
1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 1 & 1 & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 \\
1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 1 & 1 & 0 & 1 & 1
\end{bmatrix}
\end{array}
$$

show that in a simple graph with at least two vertices, There must be at least two vertices with the same degree

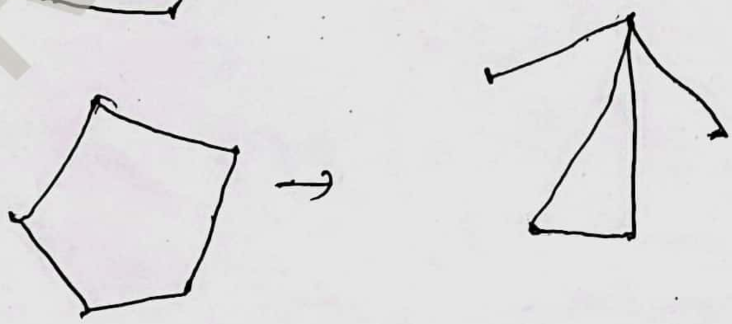
1) since the graph is simple, The possible values of the degrees is (0 to 1)

2) not that a graph cannot have vertices of degrees both 0 and $n-1$

3) so the possible values of digrees is either 0 to $n-2$, or 1 to $n-1$



→ 0 to $n-1$



1 to $n-2$