The LNM Institute of Information Technology, Jaipur

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Supplementary Copy

Name Saurabh Kumar Gupta

Roll No 19UCS085 Subject SNA

Date 10/03/22 Signature Saurabh

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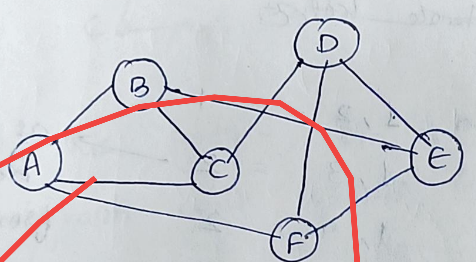


2

(a) yes, this graph has hamiltonian Cycle.
If we start from A, we can ~~Reach~~ cover all the vertices & reach again at A.

A B C D E F A

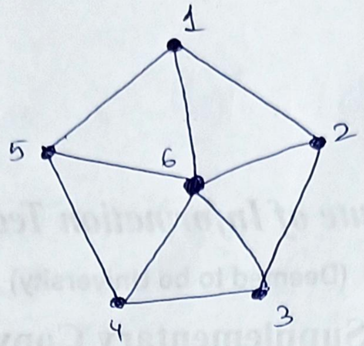
(b) No, this graph does not have Eulerian Circuit

~~there is no path~~

As it is not possible to cover all the Edges without repeating them.

Why?

(2) (a)



Diameter: It the the longest shortest path with any pair of nodes.

As there is a vertex ~~between~~ ~~the~~ in between which is Connecting all the nodes. ~~So the~~

~~longest possible distance betwe~~

~~Path~~ Distance between 1,2 = 1

1,3 = 2 → as we Can Reach this from 6th Vertex

1,4 = 2

1,5 = 1

1,6 = 1

So the longest shortest path of this graph is 2.

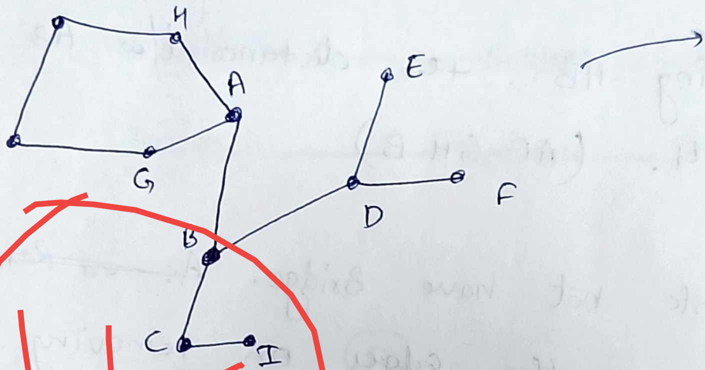
So the Diameter of graph = **2**.

~~(2)(b)~~

2 b

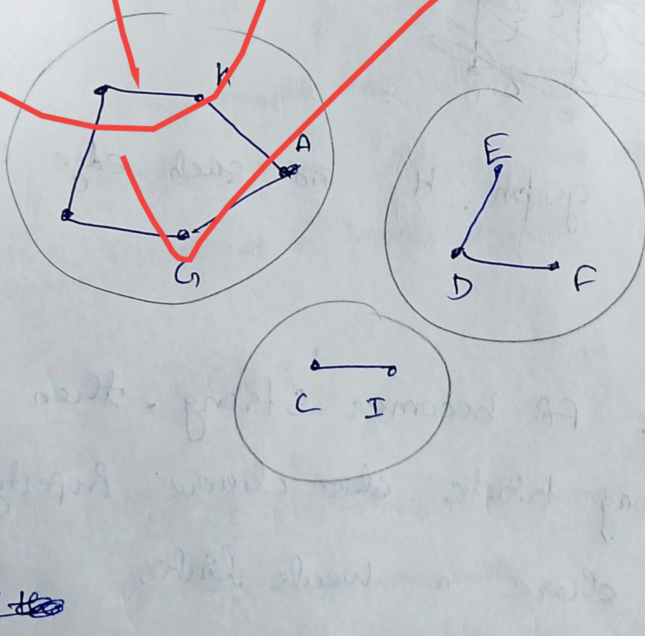
This Statement is **False**.

As Cut vertex is a Vertex, on ~~⊗~~ Removing it, ~~⊗~~ graph will break int two or more Components.



A, B, C, D are ~~the~~ Cut Verteces of this graph.

As in this graph, B is a Cut Vertex, on Removing it graph will break into 3 ~~Vertex~~. Component.



~~Be the~~

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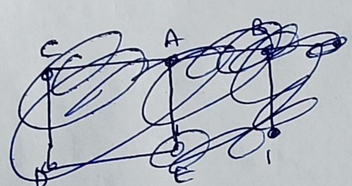
This network has a local Bridge. (A–B)

local Bridge are the Edges on removing them, the nodes will not have any friends in Common or in other words distance b/w them is strictly greater than 2.

On Removing AB, the distance b/w AB will become 4. (AF GH B)

This network not have Bridge. ~~As on Removing~~ As Bridges are the Edges on removing them the graph breaks in two Components.



~~Th the~~

In this graph H no such edge Exists so no Bridge.

If the Edge FA becomes Strong, then According to the strong triadic ~~clos~~ closure Property. GA will share a weak link.

P.T.O

(1)

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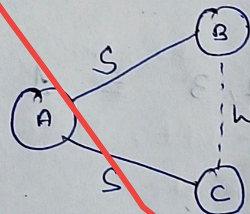
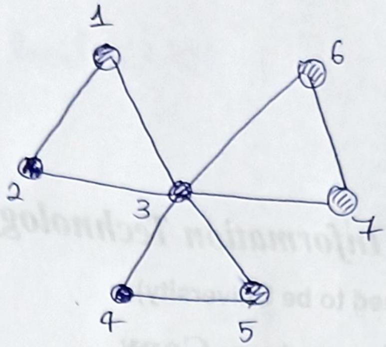
(3) In Continuation

Acc. to Strong triadic closure property, if A node share a strong link with B & C then B,C will share weak link.



(6)



local clustering Coefficient $(C_i) = \frac{2 L_i}{k_i(k_i - 1)}$

L_i = number of links between the neighbours of node i.

k_i = degree of i.

As for the node 1,

it has two neighbours 2, 3.

So $k_1 = 2$

& Link between 2, 3 = 1

$L_1 = 1$

$$C_1 = \frac{2 \times 1}{2(2-1)} = 1$$

Same for node 2,

it has ~~node~~ two neighbours, 1, 3

So $k_2 = 2$ $L_2 = 1$

$$C_2 = \frac{2 \times 1}{2(2-1)} = 1$$

~~On Node~~

Similarly for node 6, 7, 4, 5

$$C_6 = \frac{2 \times 1}{2(2-1)} = 1$$

$$C_7 = 1$$

$$C_4 = 1$$

$$C_5 = 1$$

For node 3,

It has 6 neighbours 1, 2, 4, 5, 6, 7

So $k_3 = 6$

& Link between these neighbours are 3

(1 2), (4, 5), (6 7)

$L_3 = 3$

$$C_3 = \frac{2 \times L_3}{k_3(k_3-1)} = \frac{2 \times 3}{6(5)} = \frac{1}{5}$$

$$\boxed{C_3 = 0.2}$$

local Clustering Coefficients (C_i) of all nodes :-

$C_1 = C_2 = C_4 = C_5 = C_6 = C_7 = \underline{1}$

$C_3 = 0.2$

$$\text{Average local Clustering} = \frac{C_1 + C_2 + C_3 + C_4 + C_5 + C_6}{N}$$

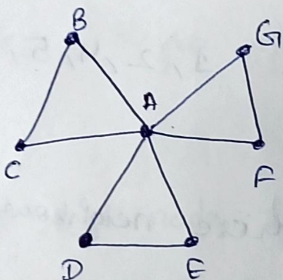
$$= \frac{1}{N} \sum_{i=1}^{n} C_i$$

$$= \frac{1 + 1 + 0.2 + 1 + 1 + 1 + 1}{7}$$

$$= \frac{6.2}{7}$$

3

$$\text{Global Clustering Coefficient} = \frac{3 \times \text{numbers of triangles}}{\text{no. of triplets}}$$



number of $\Delta = 3$

triplets.

A → BAC, BAD, BAE, BAF, BAG, CAD, CAE, CAF, CAG, DAE, DAF, DAG, EAF, EAG, FAG

B → ABC

C → BCA

D → ADE

E → DEA

F = AFG

G = FGA

total no. of triplets = 21.

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6 PnCont.

$$\text{Global Clustering Coefficient} = \frac{3 \times 3}{21}$$

$$= \frac{3}{7} = 0.421$$

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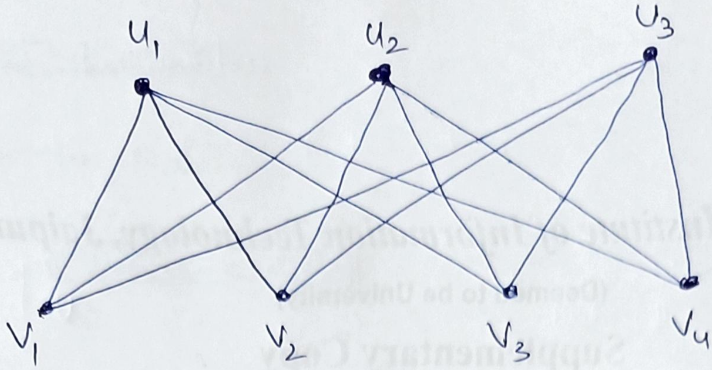
Closeness Centrality is ~~how~~ How quickly we Can Reach to other nodes from a perticular node.

$$\text{Closeness Centrality} = \frac{1}{l_i}$$

$$l_i = \frac{1}{N-1} \sum \text{shortest distance to reach node from node } i.$$

$$l_i = \frac{\sum I_{i \neq j}}{N-1}$$



Closeness Centrality for $(u_1) = C_{u_1}$

$$l_{u_1} = \frac{\sum \text{shortest distance to reach other nodes}}{N-1}$$

$$l_{u_1} = \frac{u_1v_1 + u_1v_2 + u_1v_3 + u_1v_4 + u_1u_2 + u_1u_3}{N-1}$$

u_1v_1 = shortest dis to reach v_1 from u_1

$$l_{u_1} = \frac{1+1+1+1+2+2}{7-1} = \frac{8}{6}$$

$$\boxed{\text{Closeness Centriality for } (u_1) = C_{u_1} = \frac{6}{8}}$$

Similarly $\boxed{C_{u_2} = C_{u_3} = \frac{6}{8}}$

As we can see that we can reach the other nodes in same Partion with distance 2 & in other partion with distance 1.

$$C_{v_1} = \frac{1}{L_{v_1}}$$

$$L_{v_1} = \frac{V_1V_2 + V_1V_3 + V_1V_4 + V_1U_1 + V_1U_2 + V_1U_3}{N-1}$$

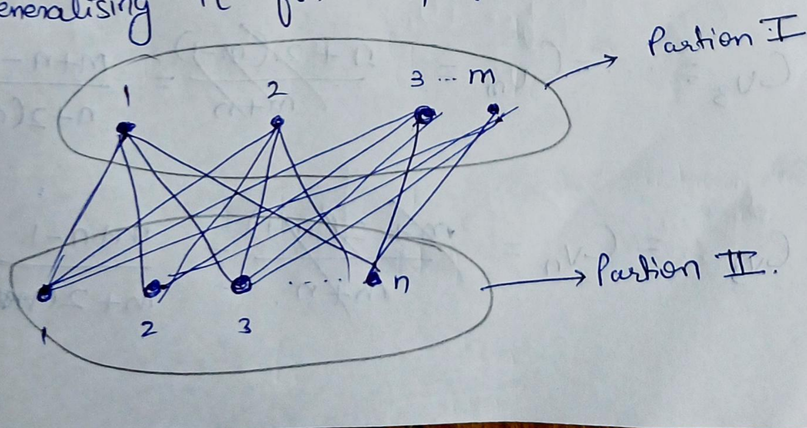
$$= \frac{2+2+2+1+1+1}{6} = \frac{9}{6}$$

$$\boxed{C_{v_1} = \frac{6}{9}}$$

Closeness Centrality for $V_1 = \frac{6}{9}$

Similarly $\boxed{C_{v_1} = C_{v_2} = C_{v_3} = C_{v_4} = 6/9}$

Generalising it for $K_{m,n}$.



~~For Partion I:~~

For the node in Partion I,

$$l_{v_i} = \frac{\sum \text{shortest distance to reach node in Partion II} + \sum \text{shortest distance to reach node in Partion I}}{\text{total no. of nodes} - 1}$$

$$= \frac{n + 2*(m-1)}{m+n-1}$$

Partion I.

$$\boxed{\text{Closeness Centrality} = \frac{1}{l_{v_i}} = \cancel{\frac{n+2(m-1)}{m+n-1}}} = \frac{m+n-1}{n+2*(m-1)}$$

For the nodes in Partion II,

$$\text{Closeness Centrality} = \left(\frac{1}{\frac{2*(n-1)+m}{m+n-1}}\right)$$

Partion II.

$$\boxed{\text{Closeness Centrality} = \cancel{\frac{m+2(n-1)}{m+n-1}}} = \frac{m+n-1}{m+(2)(n-1)}$$

For $K_{m,n}$

$$C_{U_1} = C_{U_2} = C_{U_3} = \ldots = C_{U_m} = \cancel{\frac{n+2(m-1)}{m+n}} = \frac{m+n-1}{n+2(m-1)}$$

$$C_{V_1} = C_{V_2} = C_{V_3} \ldots = C_{V_n} = \cancel{\frac{m+2(n-1)}{m+n}} = \frac{m+n-1}{m+2(n-1)}$$

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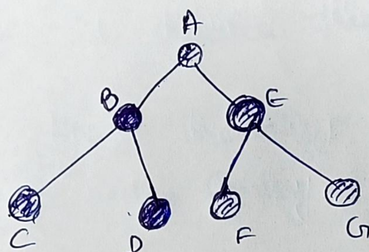

Graph (T)

Betweenness Centrality is ~~the~~ How important the node is to Connect other nodes.

$$\text{Betweeness Centrality} = \sum_{s \neq t \neq v_i} \frac{\sigma_{st}(v_i)}{\sigma_{st}}$$

root node is that Central node.

Betweenness Centrality of node A = 9 $\begin{bmatrix} BE, BF, BG \\ CE, CF, CG \\ DE, DF, DG \end{bmatrix}$

As to reach from Left side to Right side we need to pass through A. (root)

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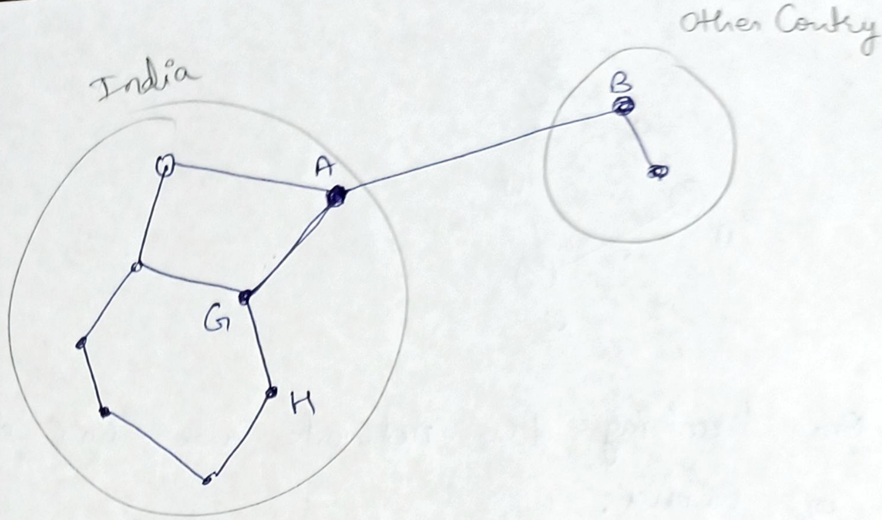

As Corona was spreading with coming in contact. Government take some ~~steps~~ to stop it.

Like it breaks the Connection between Contries

Like breaking Edge AB, seperates India from other Contry.

AB is Bridge.

GH is local Bridge. It is a weak ties as If we break it distance between them will grater than 2 which helps in spread of Virus.

If there are many strong ties in network then acc. to strong triadic Closure Property the A people who are in contact with B, C, came positive then there are many chance that B C will be true.

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