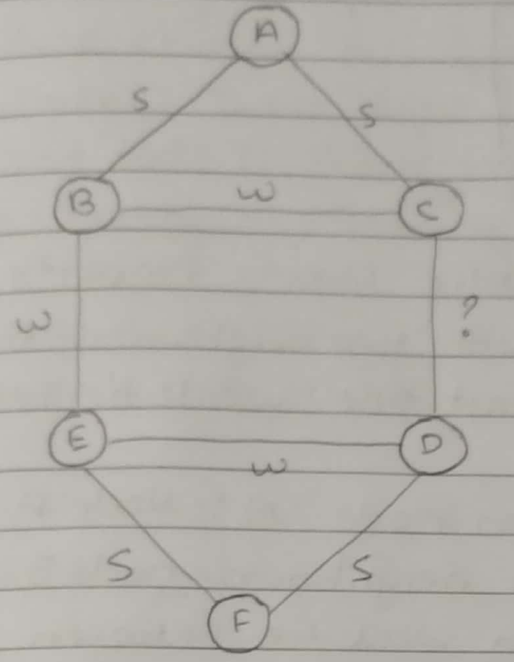
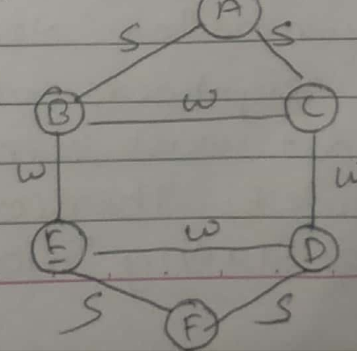
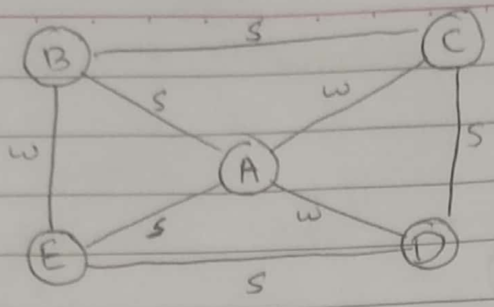
Q.1



- As per strong Triadic Closure Property, if a node has strong ties with two neighbours, then these nodes must have atleast a weak tie between them.
- Assuming that node C and node D have a strong tie in between them, then node C will have two neighbours (i.e. node A & node D) with which it shares strong ties. Then, there must be atleast a weak tie between node A and node D.
- But, there is not even a weeak tie between node A and D, this will contradict the property of Strong Triadic Closure.
- The only possible tie in between node D & node C is a weak tie.
- Following is correct diagram.



Q.2



- As per the Strong Triadic Closure Property, if a node has strong ties with two neighbours, then these nodes must have atleast one weak tie between them.
- Checking Property for node A :- Node A has two strong ties with neighbours node B and node E. There exist a weak tie between node B and node E. Therefore node A satisfies the property of Strong Triadic Closure.

- Checking Property for node B :- Node B has two strong ties with neighbour node A and node C. There exist a weak tie between node A and node C. Therefore node B satisfies the property of Strong Triadic Closure.

- Checking Property for node C :- Node C has two strong ties with neighbours node B and node D. There doesnot even exist a weak tie between node B and node D. Therefore node C ~~does~~ violates the property of Strong Triadic Closure.

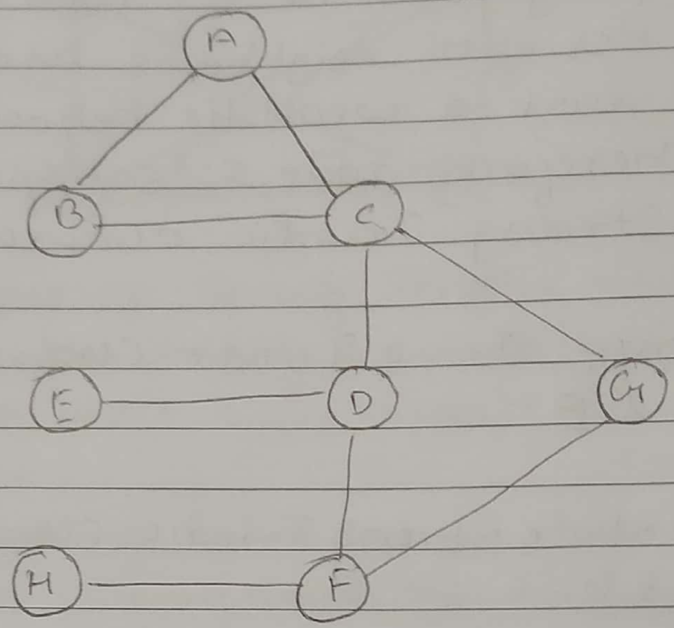
- Checking Property for node D :- Node D has two strong ties with neighbours node C and node E. there doesnot exist even a weak tie between node C & node E. Therefore node D violates property of Strong Triadic Closure.

- Checking Property for node E :- Node E has two strong ties with neighbours node A & node D. There exist a weak tie between node A and node D. Therefore node E satisfies the property of Strong Triadic closure.

Node that satisfy Strong Triadic Closure property are :- A, B & E

Node that violate Strong Triadic Closure Property are :- C and D.

Q.3



a. • Finding clustering co-efficient of node A.
node A has two neighbour nodes. (i.e. B & C)
There is one edge between neighbour nodes of node A.
Formula for finding ~~nei~~ clustering coefficient (C_i) is

$$C_i = \frac{2e_i}{k_i(k_i-1)}$$

e_i → number of edges between neighbour of A that is 1
k_i → number of neighbour nodes of A (i.e. 2)

$$C_i = \frac{2\times1}{2\times1} = 1$$

∴ Clustering co-efficient for A is 1

• Finding Clustering co-efficeient of node C.
Node C has 4 neighbour node (i.e. A, B, D & G)
There is only one edge between neighbour nodes of ~~E~~ C

$$C_i = \frac{2e_i}{k_i(k_i-1)}$$

e_i = number of ~~neighbour~~ edge between neighbours of C (i.e. 1)

k_i = number of neighbours of node C (i.e. 4).

$$C_i = \frac{2 \times 1}{4 \times 3} = \frac{1}{6}.$$

∴ Clustering co-efficient of node C is $\frac{1}{6}$.

b. ~~to~~ Find number of ~~no~~ edges that has smallest neighbourhood overlap.

neighborhood overlap for edge AB

$= \frac{\text{number of nodes who are neighbour of both A \& B}}{\text{number of nodes who are neighbour of atleast A or B}}$

For Edge AB $= \frac{1}{1} = 1$

For edge BC $= \frac{1}{3}$

For edge AC $= \frac{1}{3}$.

For edge FG $= \frac{0}{3} = 0$

For edge CD $= \frac{0}{5} = 0$

For edge. CG $= \frac{0}{4} = 0$.

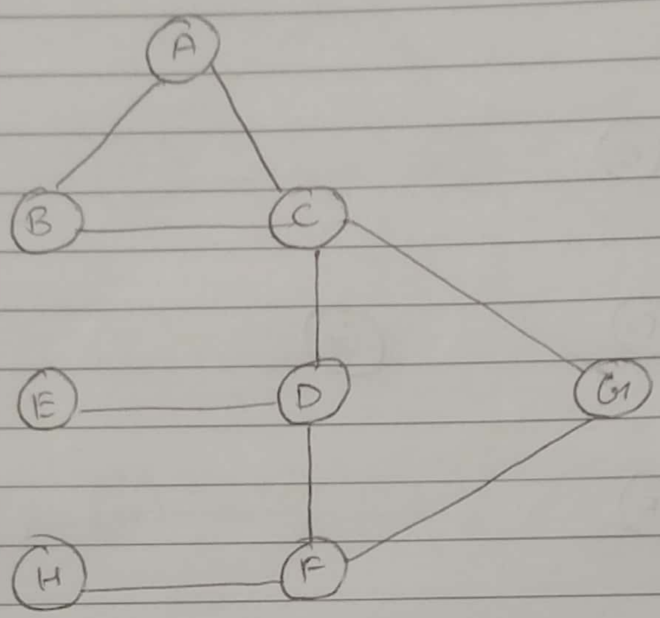
For edge DE $= \frac{0}{2} = 0$

For edge DF $= \frac{0}{4} = 0$

For edge FH $= \frac{0}{2} = 0$

Edges ~~E~~ CD, DE, DF, FH, FG, CG Has smallest neighbourhood overlap (i.e. 0)

C Find the embeddedness of edges ED and BC.

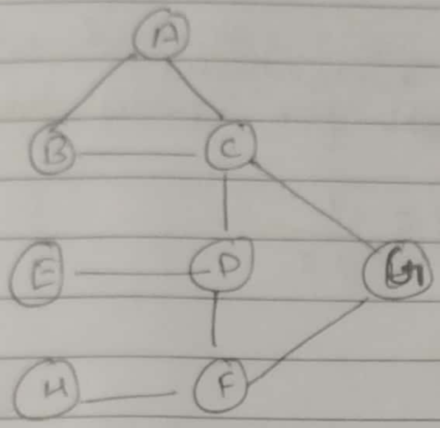


Embeddedness ~~is~~ of the edge is the number of common nodes for both the nodes of an edge.

Considering ED edge :-
Number of common nodes to ~~E~~ node E and node D is 0.
$\therefore$ embeddedness of edge ED = 0.

Considering edge BC.
Number of common nodes to node B and node C is 1 (i.e. node A)
$\therefore$ embeddedness of ~~node~~ edge BC = 1

d Find the betweenness of edges AB and FG.



Edge betweenness is the number of shortest path passing over the edge.

$$C_B(e) = \sum_{s,t \in V} \frac{\sigma(s,t|e)}{\sigma(s,t)}$$

For edge AB.
calculating shortest path from one node to another passing through edge AB.

Pair of Nodes	Value.	Pair of Nodes	Values
AB	1/1	CD	0/1
AC	0/1	CE	0/1
AD	0/1	CF	0/2
AE	0/1	CG	0/1
AF	0/2	CH	0/2
AG	0/1	DE	0/1
AH	0/2	DF	0/1
BC	0/1	DG	0/2
BD	0/1	DH	0/1
BE	0/1	EF	0/1
BF	0/2	EG	0/2
BG	0/1	EH	0/1
BH	0/2	FG	0/1

Pair of nodes	Value
FH	0/1
GH	0/1

Edge betweenness for node AB

$$= \sum_{s,t \in V} \frac{\sigma(s,t \mid \text{node } AB)}{\sigma(s,t)}$$

$$= \frac{1}{1} = 1$$

Calculating ~~for~~ edge beweenness for edge FG.
Sum of all the shortest path from one node to another passing through edge FG.

Pair of nodes	Value.	Pair of nodes	Values
AB	0	CG	0
AC	0	CH	1/2
AD	0	DE	0
AE	0	DF	0
AF	1/2	DG	1/2
AG	0	DH	0
AH	1/2	EF	0
BC	0	EG	1/2
BD	0	EH	0
BE	0	FG	1
BF	1/2	FH	0
BG	0	GH.	1
BH	1/2		
CD	0		
CE	0		
CF	1/2		

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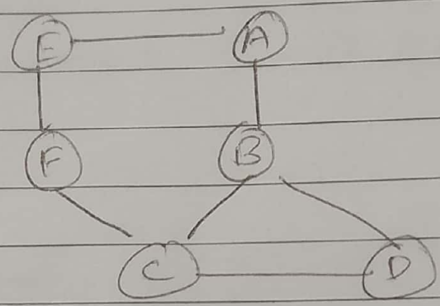
$$\text{Edge betweenness of node FG} = \sum_{s,t \in V} \frac{\sigma(s,t \mid \text{node FG})}{\sigma(s,t)}$$

$$= \frac{12}{2} = 6.$$

Edge betweenness for node AB = 1
Edge betweenness for node FG = 6.

4. Calculate Node-betweenness of node A & C.

Node betweenness = $\dfrac{\text{Shortest path } \cancel{\text{to}} \text{ passing though}}{\text{Total no. of shortest path for nodes other than given node.}}$



All possibles Shortest path	A	B	C	D	E	F
(A,B)	0	0	0	0	0	0
(A,C)	0	1	0	0	0	0
(A,D)	0	1	0	0	0	0
(A,E)	0	0	0	0	0	0
(A,F)	0	0	0	0	1	0
(B,C)	0	0	0	0	0	0
(B,D)	0	0	0	0	0	0
(B,E)	1	0	0	0	0	0
(B,F)	0	0	1	0	0	0
(C,D)	0	0	0	0	0	0
(C,E)	0	0	0	0	0	1
(C,F)	0	0	0	0	0	0
(D,E)	0.5	0.5	0.5	0	0	0.5
(D,F)	0	0	1	0	0	0
(E,F)	0	0	0	0	0	0
	1.5	2.5	2.5	0	1	1.5

Passings through node: A B C D E F

Calculating node betweenness for node 'A'.

Number of shortest path passing through node A = 1.5
Total number of shortest path for nodes other than node A = 10.

Node betweenness of node A = $\frac{1.5}{10}$ = 0.15

Calculating node betweenness for node 'C'.

Number of shortest path passing through node C = 2.5
Total number of shortest paths for nodes other than node C = 10.

Node betweenness of node C = $\frac{2.5}{10}$ = 0.25