Qs 1.

In the discussion of strong and weak ties, we considered the undirected case: both A and B agree that the tie between them is either strong or weak. In a real-life situation, it is possible that A may consider its tie with B as a strong one (A –s–> B; A considers B a close friend), while B may consider its tie with A as weak (B –w–> A; B considers A as an acquaintance).

Motivate and justify your definitions for directed links with strength (why are you defining it as you are?) and state any assumptions clearly. In this directed setting, consider the following questions:

✗ a) Show all combinations of directed edge combinations between a pair of nodes. Is any combination invalid? 1/2

A –s–> B B –s–> A
A –s–> B B –w–> A
A –w–> B B –s–> A
A –w–> B B –w–> A

✗ b) Define directed local bridge. 1.5/2

Directed weak links are local bridges if the removal of edge increases the effective distance by 2. or does not have any common neighbor.

✗ c) Define directed strong triadic closure (DSTC). Draw an example graph which satisfies DSTC and another which does not satisfy DSTC. (The notation A—s—>B denotes a strong link from A to B). 0/3

satisfy DSTC. (The notation A—s—>B denotes a strong link from A to B).

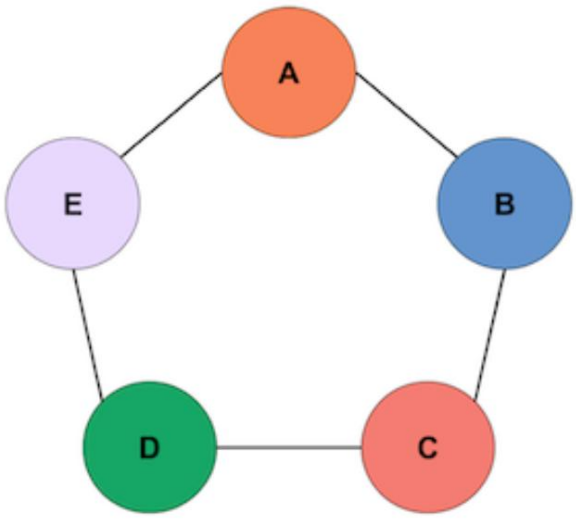
✓ d) Is there a connection between directed weak links and local bridges? If yes, what is it? 2/2

Yes, directed weak links are local bridges, if removal of them increases the effective path distance.

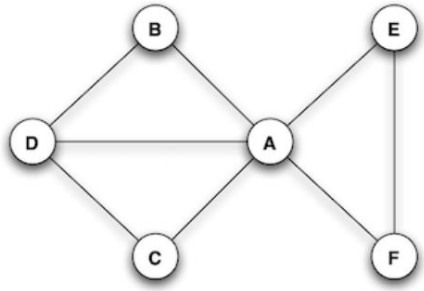
Qs 2.

Consider the following definitions:
(a) A node X is 2-pivotal (2P) for a pair of distinct nodes Y and Z if X is the only common neighbour of Y and Z. In the figure below, each node is 2-pivotal for its single pair of neighbours.
(b) A node X is a gatekeeper (GK) if for some other two nodes Y and Z, every path from Y to Z passes through X.
(c) A node X is a local gatekeeper (LGK) if there are two neighbors of X, say Y and Z, that are not connected by an edge.

Each node is 2-pivotal for its single pair of neighbours



Gatekeeper & Local Gatekeeper



Node A is a gatekeeper. Node D is a local gatekeeper but not a gatekeeper.

✓ a) Show an example where a node X is 2P, LGK and GK for a pair of nodes Y, Z. 2/2

Example -

(1)--(Y)--(X)--(Z)--(5)

✓ b) Prove or disprove: “If a node X is 2P for Y and Z, then it is LGK for Y and Z". 2/2

By definition of local gatekeeper - A node X is a local gatekeeper (LGK) if there are two neighbors of X, say Y and Z, that are not connected by an edge, which means X should have exactly 2 neighbors which are directly not connected. reversing the definition X is the only common neighbor of Y and Z, this forms the definition for 2 Pivotal. Hence, the above statement is proved.

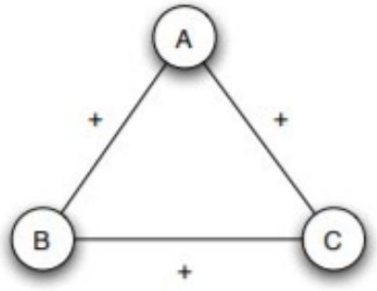
✗ c) Prove or disprove: : “If a node X is LGK for Y and Z, then it is 2P for Y and Z.” 0/2

✗ Qs 3 a) What is meant by local properties 2/3

✗ Qs 3 a) What is meant by local properties implies global properties in the context of graphs? Justify this statement with respect to Balanced and Weakly Balanced Networks. 2/3

The structural balanced property is the local property which takes into account only the triangle formed by the three edges, while if all the triangles formed satisfies the structural balance property then we can apply the balanced theorem that it divides the nodes into two subsets X and Y, which is a global property and hence in this way the local property implies the global property.

b) Consider the 3-node social network in the figure below, in which all pairs of nodes know each other, and all pairs of nodes are friendly toward each other.



✓ Now, a fourth node D wants to join this network, and establish either positive or negative relations with each existing node A, B, and C. It wants to do this in such a way that it doesn't become involved in any unbalanced triangles. Present all the ways it can be done (if possible). 2/2

Node D can do this in 2 ways.
1. D can make all positive ties with all of its 3 neighbors A, B and C.
2. D can make all negative ties with all of its 3 neighbors A,B and C.

✓ Qs 4 a) Give a scenario where force-based layout is not suitable. Why? 2/2

Force based layout require to calculate the equation of repulsion to estimate the position for each node and also for a node with its neighbors. So this makes the computation more heavy, and if computation is a issue then force layout should not be used.

✗ b) Give a scenario where you will prefer a Matrix-based Visualization over Node & Link visualization. 1/2

When graph is a dense graph or suppose (Complete Graph) then in that case the number of links to draw will be maximum and it will take a lot of space. In that scenario a matrix based visualization will be very effective.

✗ c) In hierarchical visualization, which technique shows structure well? 0/1

Tree Map ✗

✗ d) In hierarchical visualization, which technique shows attributes well? 0/1

✗

✓ e) What is the problem of zooming? How can you overcome the problem? 2/2

Zooming causes loss in the contextual information and this can be prevented by using the fish eye view in which we show others point of interest by calculating their degree of

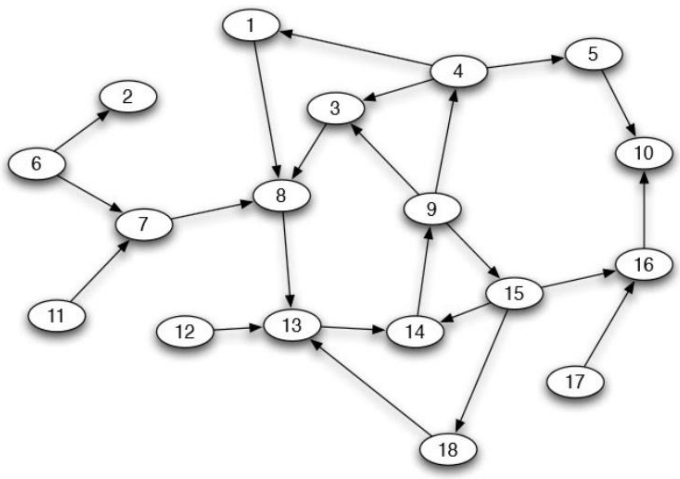
✓ e) What is the problem of zooming? How can you overcome the problem? 2/2

Zooming causes loss in the contextual information and this can be prevented by using the fish eye view in which we show others point of interest by calculating their degree of interest and map those points also within the focus using concave monotonic function.

✓ f) Give an advantage and a disadvantage of 3D visualization 2/2

Advantage - It provides aesthetic beauty to the representation and utilize the effective area more judiciously.
Disadvantage - It causes occlusion for some other nodes and hence require animation techniques to play with the orientation to rotate and move, in order to view those nodes which gets occluded.

Qs 5, Assume that the graph above shows the Bow-Tie structure



✓ a) How many nodes are there in the Giant SCC component? 2/2

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✓ b) Which nodes belong to the set IN? 2/2

6,7,11,12

✓ c) Which nodes belong to Tendrils from IN nodes? 2/2

2

✓ d) Give an example of an edge that can be deleted to increase the size of IN. 2/2

edge (4,1)

✗ e) How can we form a Tube in this graph? 1/2

add an edge (7,5)