Social Network Analysis - Fall 2021

Total points 24/40

Minor Total Marks: 40 Time: 1 hour

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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). We denote A-X->B as the absence of an edge from A to B.

Motivate and justify your answers/definitions for directed strong and weak links and state any assumptions clearly. In this directed setting, consider the following questions:

✗ a) Consider the following combinations of directed edges between a pair of nodes: (i) A-s->B ; B-s->A (ii) A-s->B; B-w->A (iii) A-s->B; B-X->A (iv) A-w->B; B-w->A. (v) A-w->B; B-X->A (vi) A-X->B; B-X-A Which of these combinations are valid? Why? (Justify your answer) 1/3

1,4,6 are valid
1 is considered as the strong case relation.
4 is considered as the weak case relation.
6 is valid as both doesn't know about each other.

Individual feedback

why not (ii) A --s--> B, and B --w--A ?

✗ b) Define directed local bridge. 0/3

Directed local bridges are edges which are weak ties in the graph and any removal such edge will result in the increase of span of more than 2 or they should not have any common neighbour.

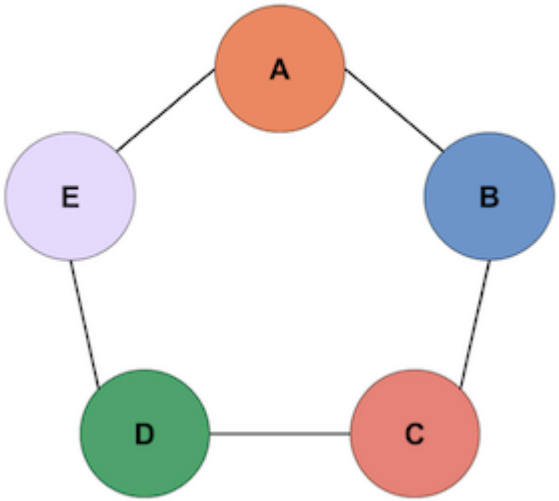
✗ c) According to your definition of directed local bridge (answer to part b above): Is it possible that the link from A -> B (weak or strong) is a directed local bridge, but the link from B -> A (weak or strong) is not? If yes, give an example. If not, give a proof. 0/3

True by the above definition

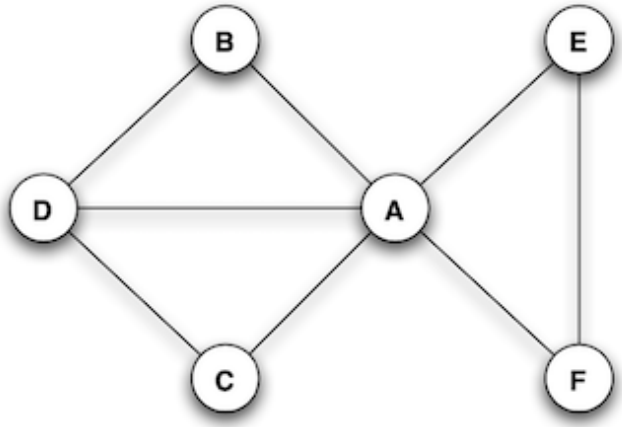
Qs 2.

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 graph G (having at least 5 vertices) where (i) no node is 2P (ii) no node is GK, and (iii) every node is LGK. 0/3

1-Y-X-Z-2

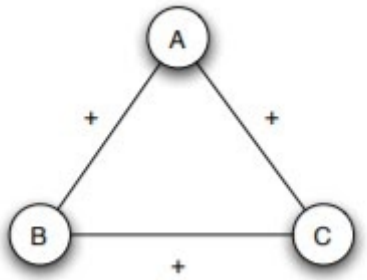
✗ b) Prove or disprove: “If a node X is GK for nodes Y and Z, then there exist nodes S and T for which X is 2P". 0/3

We know that local gatekeeper definition says that A node X is a LGK if there are two neighbours of X, for eg Y and Z,that are not connected by an edge,that means X should have exactly 2 neighbours which are directly not connected. If we reverse the definition of X, X is the focal point or common neighbour of Y and Z. this forms 2p. Hence, the above statement is proved.

✗ 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 with respect to one triangle formed by its edges. If we consider all the triangles and they satisfy structure balanced property then we can apply balanced theorem such that it divides into two subsets X and Y, which is a global property and thus in this way local property implies 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 perform this task in two ways:
1) D can make all positive ties with all A,B and C.
2) D can make all negative ties with all A,B and C.

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

Forced based layout require to calculate the equation of repulsion to estimate the position of node and its neighbours. So, this computation heavy, and if computation is an issue ,then force layout is not used.For Nodes more than 1000 ,it is not computationally feasible.Time Complexity O(n^3).

✓ b) Give a scenario where you will prefer a Matrix-based Visualization over Node & Link visualization for a graph. Why? 2/2

We will use the matrix visualization for neighbourhood related Topology Tasks. We can easily distinguish neighbours in the Matrix-Based Visualization.

✗ c) What is the difference between nested and non-nested tree maps? 1/2

Nested Tree maps uses visualization for hierarchial data. They make nested use of nested fill areas to represent hierachies. Non-nested tree map are not good for good performance.

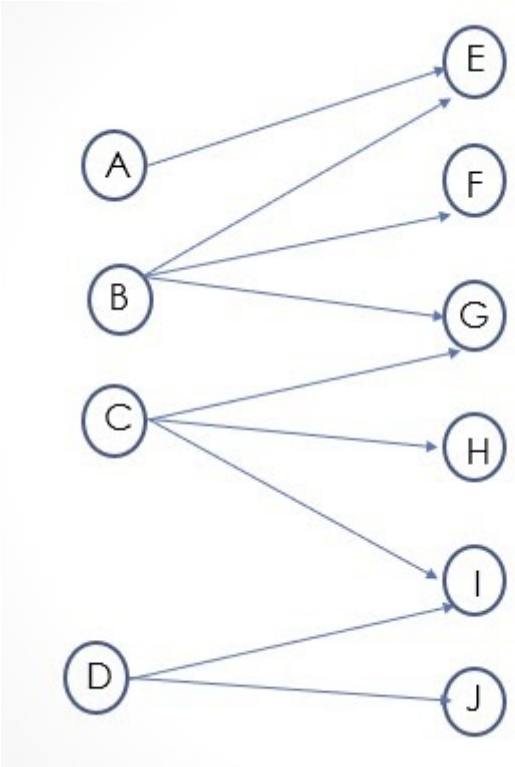
✓ d) Give an advantage and a disadvantage of using hyperbolic geometry in visualization. 2/2

Advantages of Hyperbolic Geometry- It generally provides detailed view blended with a global view. Disadvantages- When a node is removed ,its children relative orientation doesn't stay as Euclidean plane, they have rotated and changed.

✓ e) What is the disadvantage of pan & zoom? Give 2 techniques to overcome the problem. 2/2

Disadvantage- The object may move out of the position temporarily while zooming. To avoid or overcome this problem, we can use fisheye and hyperbolic technique.

Qs 5. Suppose you run two rounds of HITS algorithm on the network of Web pages in the graph below: (That is, the values computed by the k-step hub-authority computation when we choose the number of steps k to be 2.)



✓ a) Show the Hub values for Nodes A, B, C and D after 1st and 2nd rounds of the HITS algorithm, (Normalization is not required). 4/4

After 1st Round:

A=2,B=5,C=5,D=3

After 2nd Round:

A=7,B=22,,C=23,D=11

Feedback

Node 1st iteration 2nd iteration
A 2 7
B 5 22
C 5 23
D 3 11

✓ b) Show the Authority values for Nodes E, F, G, H, I and J after both the 1st and 2nd rounds of the HITS algorithm. (Normalization is not required). 6/6

After 1st Round:

E=2,F=1,G=2,H=1,I=2,J=1

After 2nd Round:

E=7,F=5,G=10,H=5,I=8,J=3

Feedback

Node 1st iteration 2nd iteration
E 2 7
F 1 5
G 2 10
H 1 5
I 2 8
J 1 3