Question Paper

Exam Date & Time: 21-Nov-2022 (09:00 AM - 12:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

DEPARTMENT OF INFORMATION & COMMUNICATION TECHNOLOGY SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOVEMBER 2022

Social Network Analysis [ICT 4054]

Marks: 50

A)

B)

A

Answer all the questions.

Missing data, if any, may be suitably assumed

1)

Consider the network given below. There is an edge between each pair of nodes, with five of the edges corresponding to (5) positive relationships, and the other five of the edges corresponding to negative relationships. Each edge in this network participates in three triangles: one formed by each of the additional nodes who is not already an endpoint of the edge. For each edge, identify all the triangles it participates to determine how many are balanced, and how many are unbalanced. Justify.



Identify different forms of closures present in the graph depicted in the following figure. Find all possible new links by (3) considering the existing closures.



Duration: 180 mins.



C) Is the walk from 1 to 6 represented by the dashed lines (1,2,3,4,5,3,6) as given in following figure is a path or a cycle or neither cycle nor (2) path? Justify the answer.



2)

A)

Consider the following simple NLP problem where, you can detect spam e-mails in your inbox. Assume that the word 'offer' (5) occurs in 70% of the spam messages in your account. Also, let's assume 'offer' occurs in 20% of your desired e-mails. If 40% of the received e-mails are considered as a scam, and you will receive a new message which contains 'offer', what is the probability that it is spam?

B) In the social network depicted below, with each edge labelled as either a strong or weak tie, which two nodes violate the (3)
Strong Triadic Closure Property? Justify.



C) What determines the success of a asocial network within a given country? Why do network effects for social networks often (2) fail to translate across national borders?

involving a taxi states that the cab involved was yellow. Suppose that eyewitness testimony is imperfect (i.e. witnesses sometimes misidentify the colors of cabs). If a taxi is yellow then a witness will claim it is yellow after the fact 80% of the time and if it is black, they will claim it is black 80% of the time. What is the probability that the cab is yellow (or black), given that the witness says it is yellow?

B) Consider a product that has network effects as shown in the following figure. Consumers are named using real numbers (3) between 0 and 1; the reservation price for consumer x when a z fraction of the population uses the product is given by the formula r(x)f(z), where r(x) = 1 - x and f(z) = z. Find a price p for which there are two equilibrium numbers of purchasers, and determine the stability of each equilibrium.



- C) The fact that social networks are so rich in short paths is known as the small-world phenomenon, or the "six degrees of (2) separation," and it has long been the subject of both anecdotal and scientific fascination. Illustrate the significance of small world effect in social network analysis.
- Assume that every node in an infinite network starts with the default behavior B, and a finite set S of initial adopters begins (5) using A. In each of time steps t= 1,2,3,..., each node outside S chooses the strategy that will provide it the highest payoff given, what its neighbors were doing in the previous step. Demonstrate how nodes will choose strategies as time progresses, and which nodes eventually decide to switch permanently from B to A or AB by considering a linear network with nodes in the order as "a, b, c, d, e, f, g, h" where each node has 1 neighbour towards its leftside and another towards

its rightside. Assume nodes d & e are the initial adopters of behaviour A with payoff for following the behaviour A is 4, behaviour B is 2, and a cost c=1 for being a bilingual. Draw a neat diagram depicting the network in each time step.

B) Assume there are two competing products that both have network effects. Assume that for each product:

(i) If no one is expected to use the product, then no one places a positive value on the product.

(ii) If one-half of the consumers are expected to use the product, then exactly one-half of the consumers would buy the product.

(iii) If all of the consumers are expected to use the product, then all consumers would buy the product.

Using an analysis of network effects, describe the possible equilibrium configurations of numbers of consumers using each product and briefly discuss which of these equilibria you would expect to be stable and which you would expect to be unstable.

C) Suppose that some researchers studying educational institutions decide to collect data to address the following two (2) questions.

(i) As a function of k, what fraction of Cornell classes have k students enrolled?

(ii) As a function of k, what fraction of 3rd-grade elementary school classrooms in New York State have k pupils?

Which one of these would you expect to more closely follow a power-law distribution as a function of k? Give a brief explanation based on power-law distributions

5)

4

A)

Consider a set of nodes arranged on a one-dimensional ring structure as shown in the following figure. Determine the (5) optimal shortest path and the path based on Myopic search for the following:

- A) i. source node = a & target node = i
 - ii. source node = o & target node = f

Whather the myonic search is able to find the shortest naths in these two cases? Justify

(3)



- B) Consider an online news site, such as cnn.com or nytimes.com, which consists of a front page with links to many different (3) articles. The people who operate such sites generally track the popularity of the various articles that get posted, "As a function of k, what fraction of all articles have been viewed by k people?" Let's call this the popularity distribution of the articles. Suppose that the operators of such a news site are considering changing the front page, so that next to each link is a counter showing how many people have clicked on the link. (E.g., next to each link it will say something like, "30,480 people have viewed this story," with the number getting updated over time.) What effect do you think this change will have on the behaviour of people using the site? Do you expect that adding this feature will cause the popularity distribution of the articles to follow a power-law distribution more closely or less closely, compared to the version of the site before these counters were added? Justify.
- C) Gephi allows its users to alter graphs on-the-fly by offering capabilities such as adding node(s) to the graph in just one (2) click. Illustrate the procedure to add a new node to the graph.

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