Question Paper

Exam Date & Time: 12-Jan-2024 (02:30 PM - 05:30 PM)



DEPARTMENT OF INFORMATION & COMMUNICATION TECHNOLOGY Program Elective VI

Social Network Analysis [ICT 4054]

Des

Marks: 50

Duration: 180 mins.

Answer all the questions.

1A)

Section Duration: 180 mins

Consider a sample network depicted in Fig.Q.1A with corresponding thresholds shown for each node. Assume node 1 (5) as the initial adopter of a new technology. Determine the nodes that are easily influenced by 1 in each subsequent step. Will this lead to a complete cascade? Justify.



Fig.Q.1A

- 1B) Consider a digraph (Fig. Q.1B) showing "Who is friends with whom at work" and answer the following:
 - a. Determine all walks between Susan Hockfield and Zach.
 - b. Determine a path between Susan Hockfield and Zach.
 - c. Determine all walks between Arthur Levenson and Musk.
 - d. Determine number of reciprocal & unreciprocal ties
 - e. Identify an isolate node
 - f. Determine a path between Arthur Levenson and Musk



(3)



Fig.Q.1B

- 1C) "Informational effects help people to observe the decisions of their network neighbors and get indirect information that (2) led them to try the innovation". Justify the statement by considering any real time experiment/scenario.
- 2A) Analyze a decentralised search by considering a clustering exponent q=1. Compare decentralised search with (5) shortest path by considering a suitable example.
- 2B) Justify the statement "The network data may be directed/undirected or binary/valued data which could be an issue to (3) be considered while gathering network data" with example and provide possible solutions to handle these issues.
- 2C) Illustrate the idea of "six degrees of separation" based on Milgram's emperical study of the small world (2)
- 3A) Elaborate how did the researchers compared the observed curve of link formation probabilities based on triadic closure (5) with a simplified baseline model based on the graph depicted in Fig.Q.3A. What did they find out from this comparison? Explain the difference between the real data curve and the baseline curve.



Fig. Q.3A Quantifying the effects of triadic closure in an e-mail dataset

Illustrate a model for the effect of knowledge on collective action for the three scenarios depicted in fig.Q.3B. Each (3) node represents one of the senior vice-president at a company, each of whom must decide whether to actively confront the unpopular CEO during the board meeting. Assume each node in the network has a threshold for participation but only knows the threshold of itself and its neighbours.

Fig. Q.3B

- 3C) How does the deterministic approximation calculate the probability that node t + 1 links to node j in the rich-get-richer (2) process?
- 4A) Develop a simple general cascade model to describe the ingredients of a sequential decision model with private (5) information, where a group of people are making decisions to accept or reject an option. Explain how the states of the world, the payoffs, and the signals affect the decision-making process.
- 4B) What is the main difference between the power laws view and the Long Tail view in terms of the focus on the popularity (3) curve?
- 4C) How does the presence of network effects change the factors that determine a consumer's willingness to pay for a (2) good?.
- 5A) Assume you are analyzing a market where a fraction of the population (denoted by z) purchases a certain good. The (5) equilibrium price of the good is p^* , and the value of the good for a purchaser named z is r(z)f(z), where r(z) is a decreasing function and f(z) is an increasing function. There are three equilibrium quantities: z=0, z, and z^{*} , and 0 < z

< 1 as shown in Fig.Q.5A. Explain why any value of z that is not equal to 0, z`, or z`` would not constitute an equilibrium. Use the concepts of downward pressure and upward pressure to illustrate your answer.

3B)

- 5B) In the dynamic view of market how does the equation $r(x)f(z) \ge p^*$ help to determine whether a consumer x will want to (3) purchase the product based on their belief about the fraction of the population, z, who will use it?
- 5C) How can the strength of friendship links on Facebook be measured by using different types of communication? (2)

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