Question Paper

Exam Date & Time: 07-Dec-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

DEPARTMENT OF INFORMATION & COMMUNICATION TECHNOLOGY
SEVENTH SEMESTER B.TECH (IT/CCE) END SEMESTER EXAMINATIONS, DECEMBER 2023

Social Network Analysis [ICT 4054]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions. Section Duration: 180 mins

Missing data, if any, may be suitably assumed

1) Consider two competing products A & B with payoffs of 3 & 2 respectively. (5)

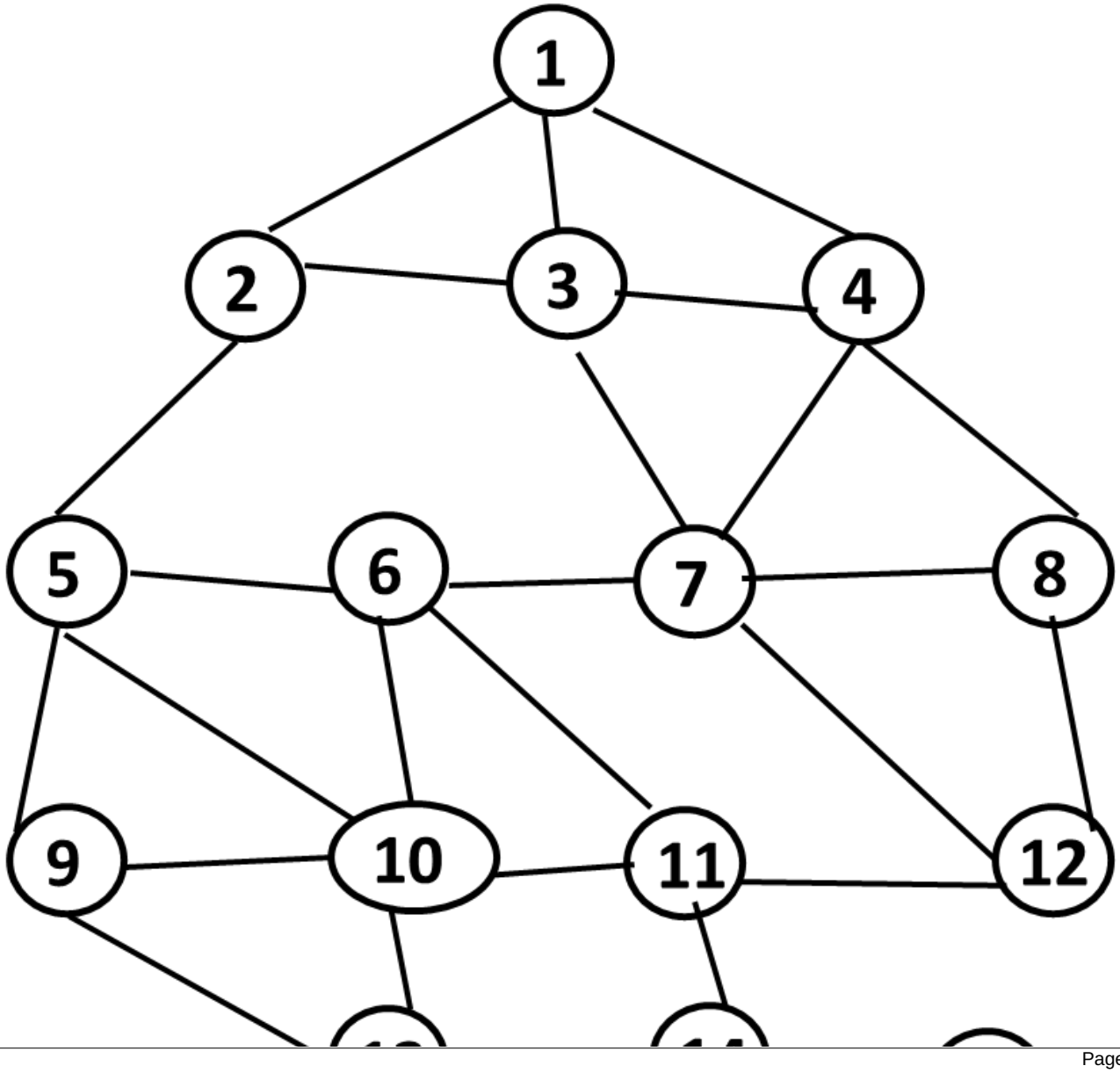
A)

a. If 5 and 10 are initial adopters of product A, identify the nodes that switch to product A at every subsequent step.

b. Determine the nodes that switch to A, if marketer convinces nodes 3 or 7

c. Determine the nodes that switch to A, if marketer convinces nodes 2 or 12

d. Determine the nodes that switch to product A if the initial payoffs are 4 & 2 for A & B respectively



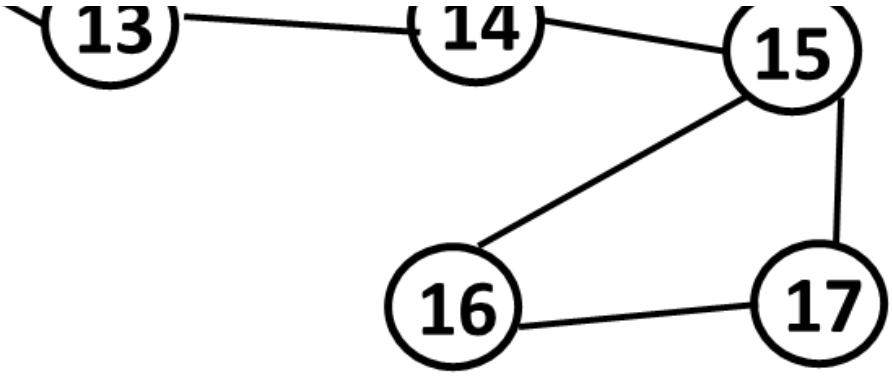


Fig.Q.1A

B) Justify the use of asymmetric and symmetric matrix in social networks. Demonstrate the usage of adjacency & incidence matrices by considering a small social network with 4 actors and 6 events. (3)

C) Social network can be considered at two conceptually very different levels of resolution: view the network as a relatively amorphous population of individuals and look at effects in aggregate. Diffusion in network focuses more on the fine structure of the network as a graph and look at how individuals are influenced by their network neighbours. Write any 2 major uses of this focus. (2)

2) A) Consider a model with set of 12 (1,2,..., 12) nodes arranged on a one-dimensional ring structure with each node connected by directed edges to the two other immediately adjacent nodes. They also have directed edges connecting them to their long-range contacts. Tha long-range contact of node 1 is 4, node 2 is 10, node 3 is 7, node 4 is 8, node 5 is 9, node 6 is 2, node 7 is 5, node 8 is 10, node 9 is 7 and node 10 is 6 & 12. Draw a neat diagram depicting the complete network. Determine the myopic path from node 1 to 7 and node 3 to 10. Compare both paths to their respective shortest paths. (5)

B) Illustrate any three common theories tested in deductive approach to social network analysis. (3)

C) Identify all the foci to which node v (Fig.Q.2C) belongs along with size of each focus. (2)

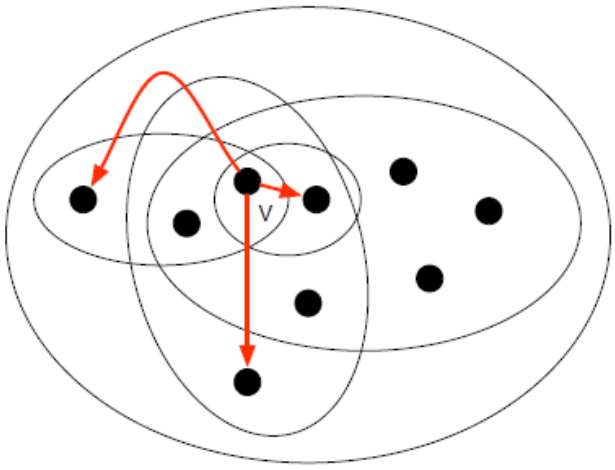


Fig.Q.2C

3) A) Identify to what extent does homophily in the context of Wikipedia editors arise primarily from selection (editors forming connections with others who have edited the same articles) or social influence (editors being led to articles by those they communicate with). How can the graph illustrating the average similarity of two editors on Wikipedia, relative to the time they first communicated, be used to quantify the interplay between selection and social influence? Demonstrate through a graph that the average similarity increases both before and after the first contact at time 0, indicating the presence of both selection and social influence. (5)

B) Consider a coordination game with a bilingual option with 3 strategies as shown in Table Q.3B, where (a, b)+ denotes the larger of a and b, and payoff will be equal to the sum of its payoffs in its game with each neighbor, minus a single cost of c if v chooses to play the strategy AB. (3)

Table Q.3B

Table. Q.3B

v \ w	A	B	AB
A	a, a	$0, 0$	a, a
B	$0, 0$	b, b	b, b
AB	a, a	b, b	$(a, b)^+, (a, b)^+$

Consider a network with 8 nodes (1,2,3,4,5,6,7,8) arranged sequentially in the order 1,2,3,4,5,6,7,8. Assume nodes 4 and 5 as initial adopters of behaviour A and payoffs as 5 and 3 for behaviour A and default behaviour B respectively with cost c=1 for being bilingual. Determine the pattern of behaviour changes by considering 1st three steps.

C) Illustrate with an example how does the power law distribution differ from the normal distribution in terms of the frequency of occurrence of large values? (2)

4) Assume you have a box filled with red and blue marbles. You know that 70% of the marbles in the box are red, and the remaining 30% are blue. Now, you have a friend who is colorblind, and their accuracy in identifying the color of a marble is 60%. One day, your friend randomly selects a marble from the box and claims that it is red. Using Bayes' Rule, calculate the probability that the marble is actually red (5)

A)

B) How do search engines like Google, use popularity measures to rank web pages and create a positive feedback loop for the rich-get-richer dynamics? (3)

C) How does the number of users or participants in a network affect the value or benefit for individual users? Demonstrate with reference to positive externalities. (2)

5) Consider a book club with 5 members and the ratings given by them to 4 books as shown in Table.Q.5A. It is observed that the rating given by USER-3 for Book-2 is missing. Use user-based collaborative filtering method to predict the missing value based on the ratings given by other book club members who have similar reading preferences as User-3. (assume neighborhood size =2) (5)

A)

Table. Q.5A

	Book-1	Book-2	Book-3	Book-4
USER-1	**5**	**4**	**0**	**2**
USER-2	**3**	**0**	**3**	**3**
USER-3	**3**	**?**	**1**	**0**
USER-4	**1**	**2**	**4**	**2**
USER-5	**2**	**2**	**0**	**1**

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B) How is the price p* that corresponds to the equilibrium fraction of purchasers z with network effect determined by the reservation prices of consumers? (3)

C) In a social network, consider a person named Alice who is actively involved in various relationships. If Alice satisfies the Strong Triadic Closure Property and has at least two close friends, what can we infer about any distant acquaintances she may have? Specifically, what is the relationship between Alice's involvement in local bridges and the strength of those connections? (2)

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