CSL7390: Social Network Analysis (January-May, 2024)

The Minor-2 Exam, 23rd March 2024

Department of Computer Science and Engineering

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Duration: 1 hour   **Full Marks: 30**

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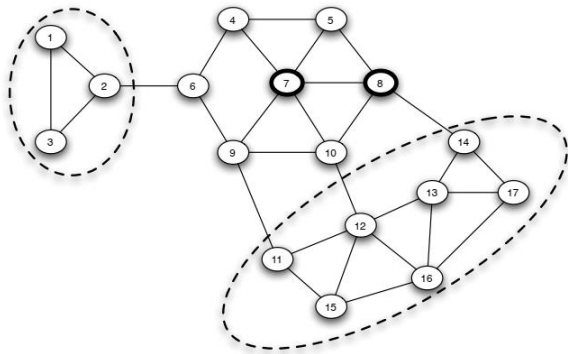
Question 1.   [6+5+5]=16

i. You are the Chief Data Scientist of Amazon. The company is attempting to enter a new market where the underlying social structure has the following three clusters (two shown inside dashed regions and one outside). Among these clusters, for which cluster would you recommend investing most of the advertisement budget and why?

ii. The Kleinberg small-world model suggests that the probability of friendship between two people tends to be inversely proportional to their 'distance'. It could be their geographical distance or some other types of distance. In the age of the Internet, what could be a suitable measure(s) of distance and why?

iii. In the 'branching processes' epidemiological model, the expected number of new cases in the t-th wave is pe^{-kt} where k = the expected number of uninfected individuals to come in contact with an infected individual, p = the probability that an uninfected individual will get infected after coming in contact with an infected individual, and e = Euler's number (approx. 2.71828). Prove or disprove the statement.

Question 2.   [1+10+3]=14

i. Why is the Poisson distribution used to approximate the degree distribution of a random graph?

ii. The Watts-Strogatz algorithm can produce a social network where the average distance between two vertices is small (known as the Watts-Strogatz model). However, it does not take growth and preferential attachment into account. Can you please extend the Watts-Strogatz algorithm by designing an algorithm that can produce a social network with (a) a small average distance, (b) growth, and (c) preferential attachment.

iii. Please find the largest value of k for which there exists a k-core with multiple vertices in the following

graph.