

Social Networks: Assignment #1

Due on Monday, December 15, 2025

Dr. Masoud Asadpour 15:00am

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Question 1

Distances and Neighbors

(a) Consider the below network.

For each of the following scenarios, indicate which node would be the best choice, giving reasons:

1. The mayor wants to install a radio broadcast station so that, in a crisis, a single nationwide message can reach all areas. The goal is that every node's distance to the station (independently of other nodes) is as small as possible –in other words, the maximum distance from any node to the station should be minimized.

To determine the optimal node for placing the broadcast station, we use **closeness centrality**, which measures how close a node is on average to all other nodes in the graph. By choosing the node with the highest closeness centrality, we ensure that the station can reach all other nodes as quickly as possible on average.

The formula for closeness centrality of a node v is:

$$C(v) = \frac{n - 1}{\sum_{u \in V} d(v, u)}$$

where $d(v, u)$ is the shortest-path distance between nodes v and u , and n is the total number of nodes.

For our 15-node graph, the closeness centrality values are:

$$\begin{bmatrix} 0.4667 & 0.4667 & 0.4667 & 0.4 & 0.4516 \\ 0.4516 & 0.4667 & 0.4242 & 0.4516 & 0.4375 \\ 0.4118 & 0.4 & 0.5185 & 0.3684 & 0.2745 \end{bmatrix}$$

Node $i = 13$ (value 0.5185) has the highest closeness centrality, so we choose it as the location for the broadcast station to ensure efficient nationwide coverage.