Social Network Analysis

Exercises

1. For each of the following data collection scenarios, indicate whether or not a network could represent the information. If a network could be used, would you prescribe either a weighted or a directed approach?

   a. You use an application to download your list of “friends" and all of their mutual friends from Facebook.

   b. You survey an organization, giving each employee a roster and asking them to grade their willingness to work closely with each of their co-workers.

   c. You survey an elementary school and ask the children to list their 5 best friends.

   d. You take a sample of college graduates from across the nation and inquire about their current job title.

2. For the following data set, illustrate the corresponding network and specify the adjacency matrix. Is the graph directed? weighted? How many cliques of 3 (i.e. triangles) are present in the undirected version of this graph?

Student	Best Friends
Jay	David, Hylan
David	Hylan, Sarah
Sarah	Jay, Laura
Hylan	Laura
Laura	Sarah, David

3. When an adjacency matrix is not symmetric, what does this mean about the underlying network?

4. If an adjacency matrix is binary (i.e. every element is either 1 or 0) what does this mean about the underlying network?

5. If, under some renumbering of nodes, the adjacency matrix is block diagonal with 3 blocks on the diagonal (an example of which is given below) what does this say about the underlying network?

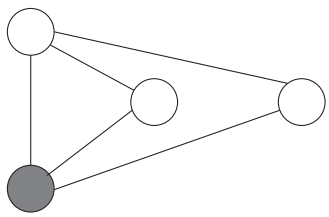
$$\mathbf{A} = \begin{pmatrix} a_{11} & a_{12} & a_{13} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & a_{23} & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & a_{44} & a_{45} & a_{46} & 0 & 0 & 0 \\ 0 & 0 & 0 & a_{54} & a_{55} & a_{56} & 0 & 0 & 0 \\ 0 & 0 & 0 & a_{64} & a_{65} & a_{66} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{77} & a_{78} & a_{79} \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{87} & a_{88} & a_{89} \\ 0 & 0 & 0 & 0 & 0 & 0 & a_{97} & a_{98} & a_{99} \end{pmatrix}$$

If the network represented by $\mathbf{A}$ is unweighted, what is the degree distribution?

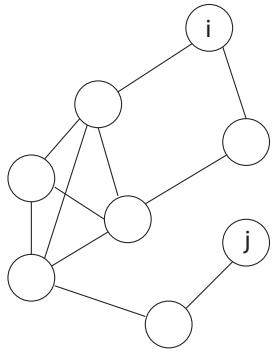
6. List a property of a scale-free network.

7. What is the name of the family of algorithms that is most popular for graph layout and visualization?

8. What is the clustering coefficient of the shaded node in the following graph? What is the eccentricity of the shaded node? What is the density of the whole graph? What is the diameter?



9. What is the geodesic distance between vertices i and j in the graph below?



10. What is the biggest disadvantage to snowball sampling?

List of Key Terms

Network

Graph

Node/Vertex

Edge/Link

Directed Graph

Weighted Graph

Adjacency Matrix

Network Data Formats

Force Directed Drawing

Connected

Components

Bridges

Brokers

Clique

N-Clique

Degree

Degree Distributions

Scale-Free

Power Law

Density

Clustering Coefficients

Geodesic Distance

Diameter

Eccentricity

Snowball Sampling

Transitivity

Edge

Directed Graph

Weighted Graph

Adjacency Matrix