COSC 2671 Social Media and Network Analytics

Tute 8

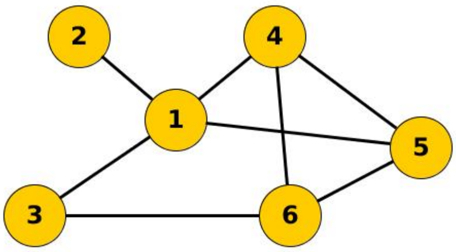
Social Network Analysis

Learning outcomes:

- Revise SNA concepts

Tutorial Questions

1. Consider the following undirected graph. Compute degree sum normalised degree centrality for nodes 1 and 5.



Answer:

The degree sum normalised (degree) centrality of node ‘a’ is defined as:

degree of ‘a’ / 2 * number of edges (or 2m)

Note that m is typically used to denote the number of edges.

Number of edges = 8

Hence answer for node 1 is degree of node 1 / 2*8 = 4 / 16

Answer for node 5 is degree of node 5 / 2*8 = 3 / 16

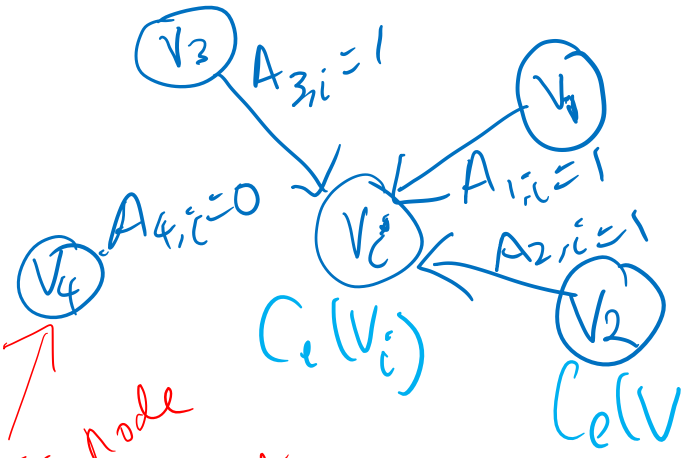
2. What is the equation governing Eigenvector centrality? Explain what each term in the equation corresponds to in real life. Draw a graph to assist.

Answer:

$$C_e(v_i) = \underbrace{\frac{1}{\lambda}}_{\text{normalisation constant}} \sum_{j=1}^{n} \underbrace{A_{j,i}}_{\text{adjacency}} \underbrace{C_e(v_j)}_{\text{eigenvector centrality of node } v_j}$$

$C_e(v_3)$ $C_e(v_1)$

is

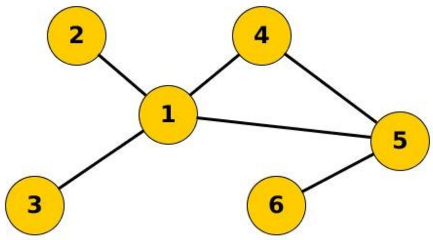


$$A_{ji} = \begin{cases} 1, & \text{if } v_j \text{ an in-neighbour of } v_i \\ 0, & \text{otherwise} \end{cases}$$

this node doesn't contribute towards $C_e(v_i)$ because it is not a neighbour

So equation is saying the eigenvector centrality of node v_i is equal to summing up the eigenvector centrality of in-neighhours (nodes with in-coming edges to v_i), normalised by the constant $\frac{1}{\lambda}$.

3. Compute the betweeness centrality of node 1 and 5 for the following graph.



Answer:

$$C_b(v_i) = \sum_{s \neq t \neq v_i} \frac{\sigma_{s,t}(v_i)}{\sigma_{s,t}}$$

$$C_b(1) = 2\Big(\underbrace{\frac{1}{1}}_{s=2,t=3} + \underbrace{\frac{1}{1}}_{s=3,t=4} + \underbrace{\frac{1}{1}}_{s=3,t=5} + \underbrace{\frac{1}{1}}_{s=3,t=6} + \underbrace{\frac{1}{1}}_{s=2,t=4} + \underbrace{\frac{1}{1}}_{s=2,t=5} + \underbrace{\frac{1}{1}}_{s=2,t=6}\Big)$$

$= 2(7) = 14$

$$C_b(5) = 2\Big(\underset{s=4,t=6}{\frac{1}{1}} + \underset{s=1,t=6}{\frac{1}{1}} + \underset{s=2,t=6}{\frac{1}{1}} + \underset{s=3,t=6}{\frac{1}{1}}\Big)$$

$= 2(4) = 8$

4. Compute the local clustering coefficient of nodes 1 and 5 of the graph of question 3.

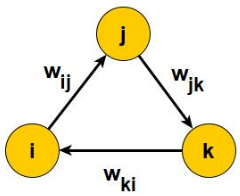
Answer:

$C(1)$ = local clustering coefficient of node 1

$= \dfrac{1}{6}$ ← # closed pairs among neighbours / ← # of pairs among neighbours

$C(5) = 1/3$

5. For social balance theory, explain why $w_{i,j}w_{j,k}w_{k,i} \geq 0$, and $w_{i,j} = 1$ if positive (friendship) and $w_{i,j} = -1$ if negative (enemy) relations.



Answer:
For balance, we must have either:

- 3 positive relationships (hence the product of the three weights hold)
- 1 positive and 2 negative relationships (friend of my enemy is my enemy)

If all negative, enemy of my enemy is my enemy, or 2 positive and one negative, friend of my friend is my enemy, it is unbalanced and unstable configuration.