

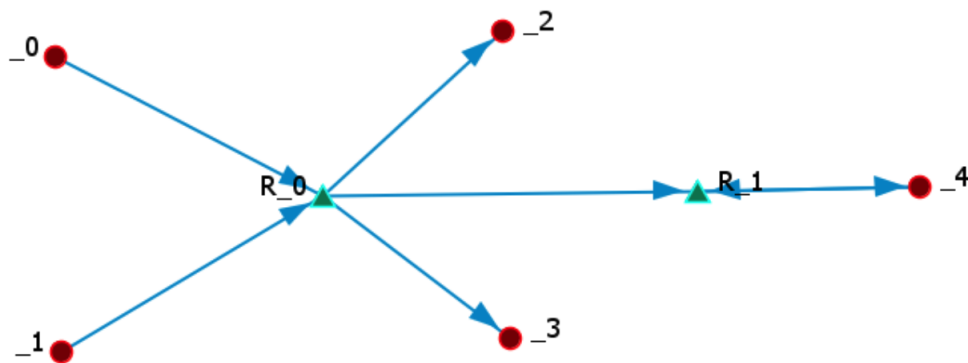
# Social Media Analytics

## Module 5 Assignment

Paras Ahuja

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Use the following meta-network for problems 1-6. The red circles are agents and the blue triangles are resources.



1. Write the adjacency matrices for each of the following networks:

a.  $X = \text{Agent} \times \text{Resource}$

$$X = \begin{matrix} & \begin{matrix} R_0 & R_1 \end{matrix} \\ \begin{matrix} 0 \\ 1 \\ 2 \\ 3 \\ 4 \end{matrix} & \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \end{matrix}$$

b.  $Y = \text{Resource} \times \text{Agent}$

$$Y = \begin{matrix} & \begin{matrix} 0 & 1 & 2 & 3 & 4 \end{matrix} \\ \begin{matrix} R_0 \\ R_1 \end{matrix} & \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \end{matrix}$$

c.  $Z = \text{Resource} \times \text{Resource}$

$$Y = \begin{matrix} & \begin{matrix} R_0 & R_1 \end{matrix} \\ \begin{matrix} R_0 \\ R_1 \end{matrix} & \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \end{matrix}$$

2. Use matrix algebra to calculate the following values by hand:

a.  $XX^T$

$$\begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

b.  $XY$

$$\begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

c.  $Y^T X^T$

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

d.  $Y^T Y$

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

3. How many agent  $x$  agent links emerge in each of the four calculations in number 2 above?

We notice that in matrix  $XX^T$  we have a total of 5 links. Furthermore, we notice this same trend in other matrices as well. Therefore, we can conclude that in total 5 agent  $x$  agent links emerge in each of the four calculations in question 2.

4. Determine what relational algebra is necessary to connect agent "\_0" with agent "\_4". HINT: You must use the Z matrix. Carry out the operation and show your work.

We are required to connect agent 0 and agent 4. Note that matrix  $XY$  provided in answer for question 2 above shows agent  $x$  agent. Furthermore, we witness that  $XY$  connects agent 0 to agent 2, and agent 3. In order to connect agent 0 to agent 4, we would need to use matrix  $Z$ . Since matrix multiplication will not be possible if we perform  $XYZ$ , we instead perform  $XZY$ . We obtain the following result:

$$\begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \times \begin{bmatrix} 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

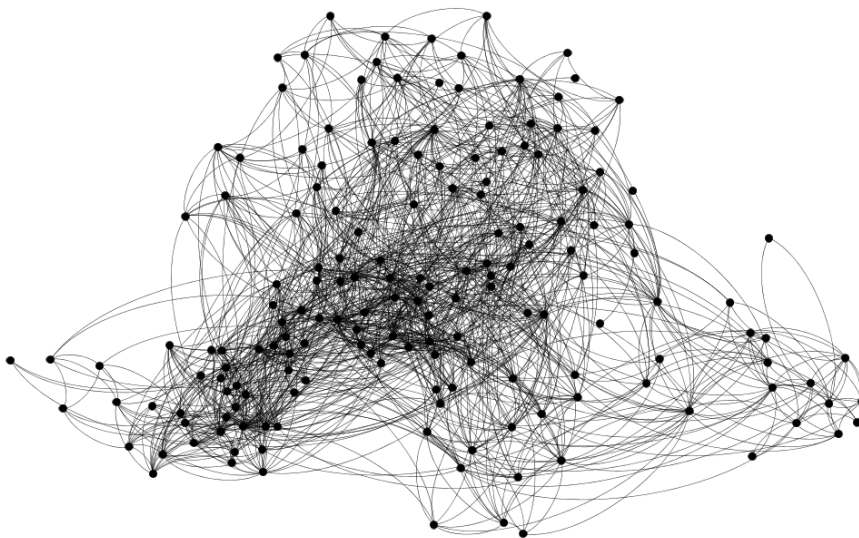
5. What relational algebra is required to connect agent "\_0" to agents "\_1" and "\_3"? Which other agents become connected as well, as a result of the required relational algebra?

In answer for question 2 we notice that the matrix  $XX^T$  connects agent 0 to agent 1. We notice here that no other agents get connected to agent 0. In order to connect agent 0 to agent 3, we have matrix  $XY$  to accomplish the task. Matrix  $XY$  also connects agent 0 to agent 2.

6. What relational algebra is required to connect agents "\_2" and "\_3"?

Matrix  $Y^TY$  connects agent 2 to agent 3.

Extract a structured data set from a social media of your choice. For example, you might have user\_ID associated with forum\_ID. Use relational algebra to extract a social network (or forum network) from your structured data. Create a visualization of your extracted network. What observations do you have in regards to the network structure of your data?



I chose to extract structured data set from Twitch. The file consists of approximately 7000 edges, and approximately 6000 nodes. When the network was graphed it was a web and information was not discernible at all. However, the graph above of degree range 50 shows us that there is only a smaller number of people with high reach.