Graph Mining CSF426
Lab session 10
Time: 2pm-4pm
Date: 04-11-2023

Instructions: All questions need to be answered. **You are required to write programs in a jupyter notebook and submit .ipynb**. For theoretical questions, you can type answers in the jupyter notebook itself. There is no need to create a separate text file. You are free to choose any library package (unless you are explicitly asked to implement a module) in python for the implementation of the programs. Class notes support is allowed during lab sessions.

[Total Marks =10]

(a) You are given multi-relational graph with 3 different types of relations and 50 nodes. There will be 3 adjacency matrices corresponding to the 3 relations.
You can start with random values for the embeddings and the relation matrix (Use random seed 1 to generate the values). Optimize the embeddings and the relation matrix using RESCAL decoder as shown in equation (i) and use the true values from the adjacency matrix of the graph given below to calculate the loss as shown in (ii). Use gradient descent optimizer to learn optimized node embeddings and relation matrices.

$$\text{DEC}(u, \tau, v) = \mathbf{z}_u^\top \mathbf{R}_\tau \mathbf{z}_v, \quad \text{--------- (i)}$$

$$\begin{aligned}\mathcal{L} &= \sum_{u \in \mathcal{V}} \sum_{v \in \mathcal{V}} \sum_{\tau \in \mathcal{R}} \|\text{DEC}(u, \tau, v) - \mathcal{A}[u, \tau, v]\|^2 \\ &= \sum_{u \in \mathcal{V}} \sum_{v \in \mathcal{V}} \sum_{\tau \in \mathcal{R}} \|\mathbf{z}_u^\top \mathbf{R}_\tau \mathbf{z}_v - \mathcal{A}[u, \tau, v]\|^2,\end{aligned}$$

- ---------- (ii)