Graph Mining CSF426
Lab session 10
Time: 5pm-7pm
Date: 14-11-2024
Instructor IC – Vinti Agarwal

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) A multi-relational graph with 50 nodes and three distinct kinds of relations is given to you. For each of the three relations, there will be one adjacency matrix. Thus, the final shape of adjacency matrix will be (3 x 50 x50).

(b) You can start with random values for the embeddings and the relation matrix (Use random seed 1 to generate the values).

(c) 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 to calculate the loss as shown in equation (ii). *Use gradient descent optimizer to learn optimized node embeddings and relation matrices.* (For more reference, consult the research paper, GRL book)

$$DEC(u,\tau,v) = Z_u^T . R_\tau . Z_v \qquad ----(i)$$

$$L = \sum_{u\in V} \sum_{v\in V} \sum_{\tau\in R} ||DEC(u,\tau,v) - A[u,\tau,v]||^2$$

$$= \sum_{u\in V} \sum_{v\in V} \sum_{\tau\in R} ||Z_u^T . R_\tau . Z_v - A[u,\tau,v]||^2 \quad ----(ii)$$

(d) Reconstruct the adjacency matrix from the learned node embeddings and relation matrix. (use 0.7 as threshold)

(e) Compute the difference between the reconstructed adjacency matrix and original adjacency matrix using Frobenius norm.

Frobenius norm (A, A') = $\sqrt{\sum_{i,j} \left(A_{ij} - A'_{ij}\right)^2}$

NOTE: A higher Frobenius norm indicates more discrepancies, i.e., more edges that differ between the matrices. (Value of norm ranges between 0 and $\sqrt{n \times m}$, where $n \times m$ is size of A and A'.