Graph Mining CSF426
Lab session 3
Time: 2pm-4 pm
Date: Sept 09, 2021

Instructions: All questions need to be answered. **You are required to write programs in jupyter notebook and submit .ipynb and pdf conversion both on canvas**. 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.
Note: Extra 5 minutes will be provided to submit your solutions on canvas.

[Total Marks =20]

Q1. Prove the following proposition by selecting any 1 or 2 graphs of your choice. **[10 marks]**

Proposition: For the given undirected graph G, the multiplicity $k$of the eigenvalue 0 for both L_{rw} and L_{sym} equals the number of connected components $A_1, A_2, \ldots\ldots, A_k$ in the graph. However, for L_{rw}, the eigenspace of 0 is spanned by the indicator vectors 1_{A_i} of those components, whereas for L_{sym}, the eigenspace of 0 is spanned by the vectors $D^{1/2}1_{A_i}$.

Hints: L_{rw} = D^{-1} L

L_{sym} = $D^{-1/2}$ L$D^{-1/2}$

Where L = D-A

Ex: If the eigenvalues are [2. , 1.5, 0. , 0.5] and the corresponding eigenvectors are:

[[-0.5 , -0.63245553, 0.5 , -0.63245553],
[0.5 , 0.31622777, 0.5 , -0.31622777],
[-0.5 , 0.31622777, 0.5 , 0.31622777],
[0.5 , -0.63245553, 0.5 , 0.63245553]]

Then the eigenvector corresponding to 0 eigenvalue is [0.5, 0.5, 0.5, 0.5].