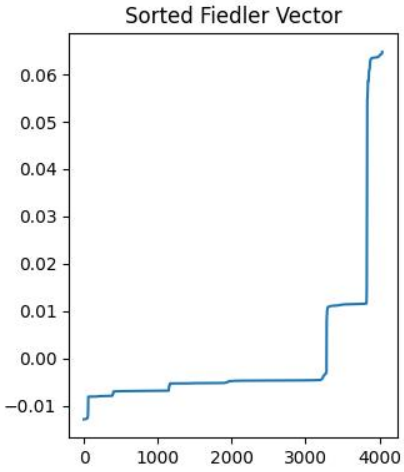
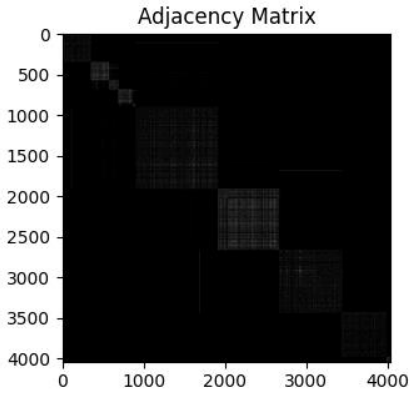
Assignment 2

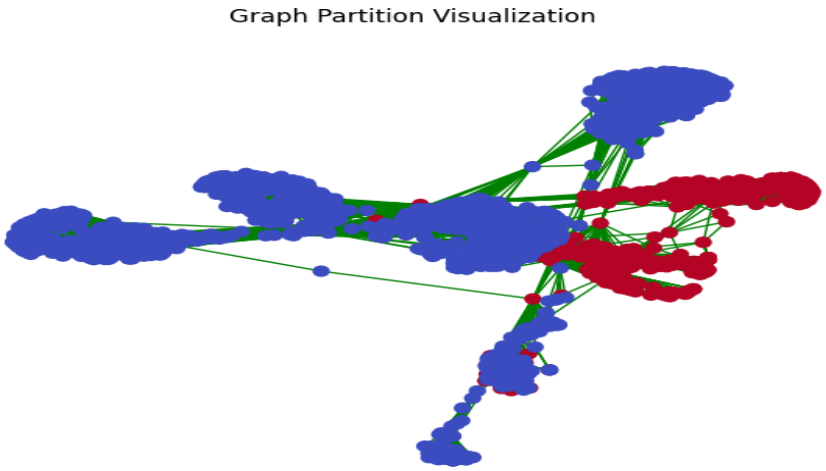
1. **Run one iteration of the Spectral decomposition technique. Plot the sorted Fiedler vector, the associated adjacency matrix, and the graph partition.**

   Run one iteration of Spectral decomposition, computed the Fiedler vector (eigenvector corresponding to the second smallest eigenvalue) of the adjacency matrix, sort it, and visualize it. The adjacency matrix represents the connections between nodes in graph.

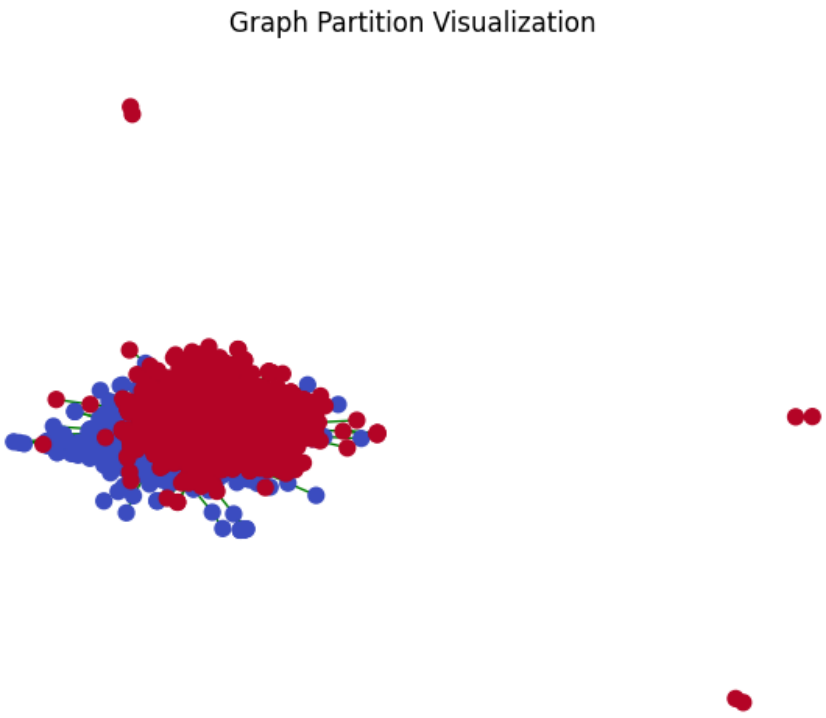
Facebook Dataset







BTC Dataset

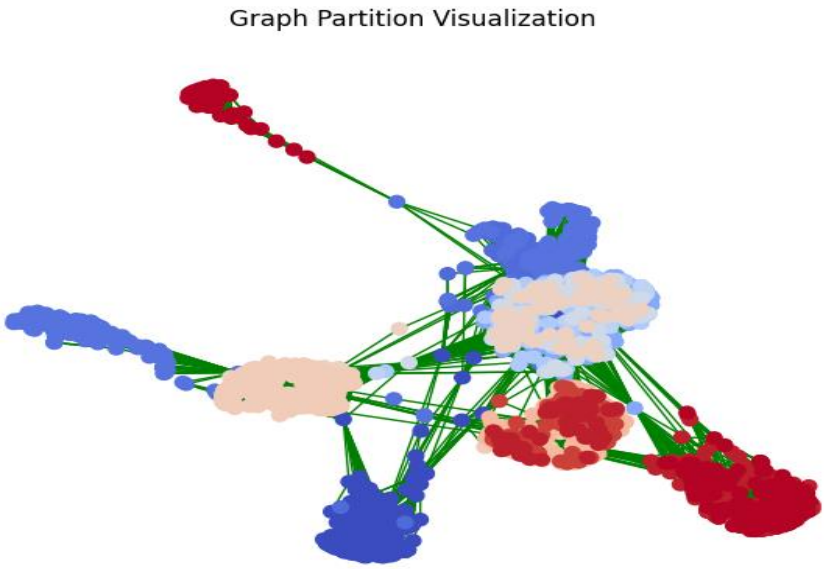


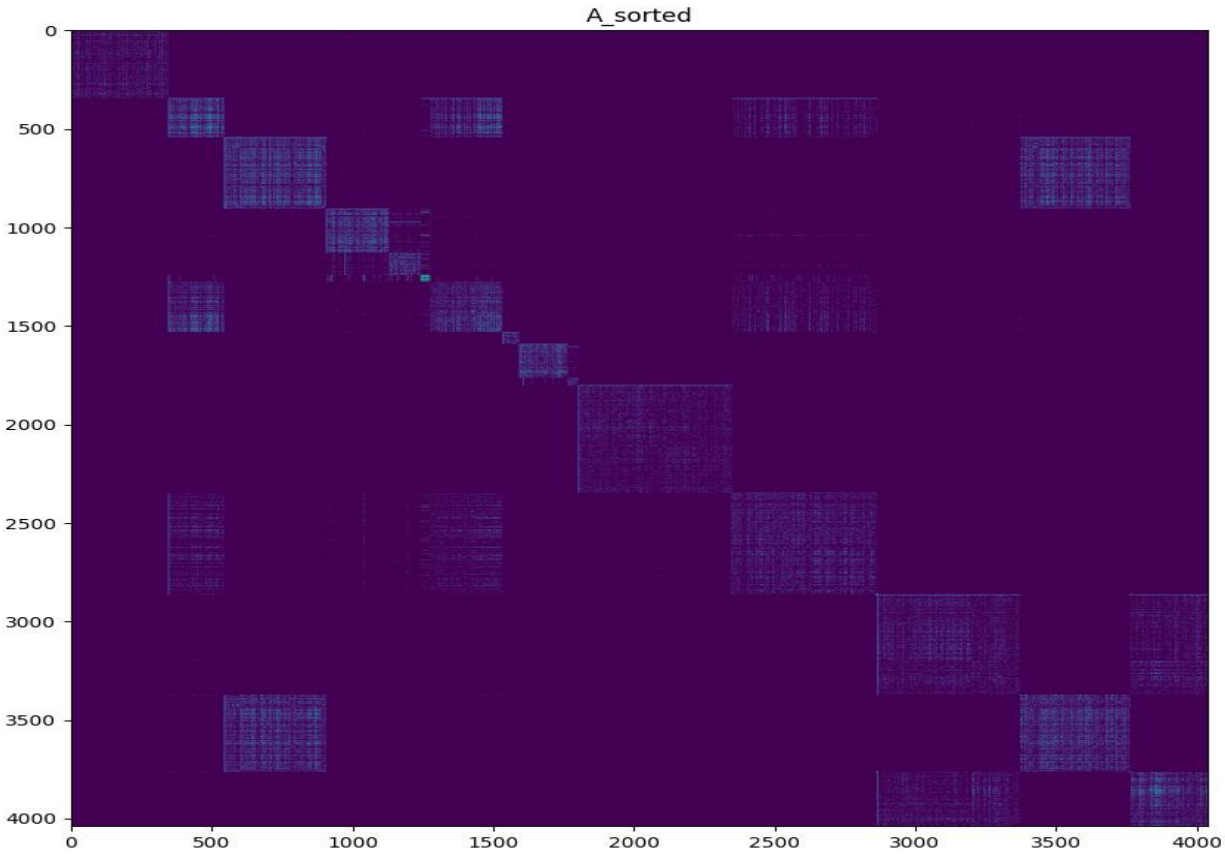
2. **Come up with an automated algorithm to determine the right set of communities using the spectral decomposition method. What would be your stopping criterion. Plot the associated adjacency matrix sorted by associated sorted sub graph Fiedler vectors. Visualize and show the graph that you obtained.**

I am partitioning the nodes based on the Fiedler vector. A common stopping criterion is to continue until the communities no longer change significantly between iterations. I tried to use eigen gap (difference between 2 and 3 eigen values) as a stopping criterion but failed to do so. Later I used no. of nodes divided by 10 as my stopping criterion.

Facebook Dataset

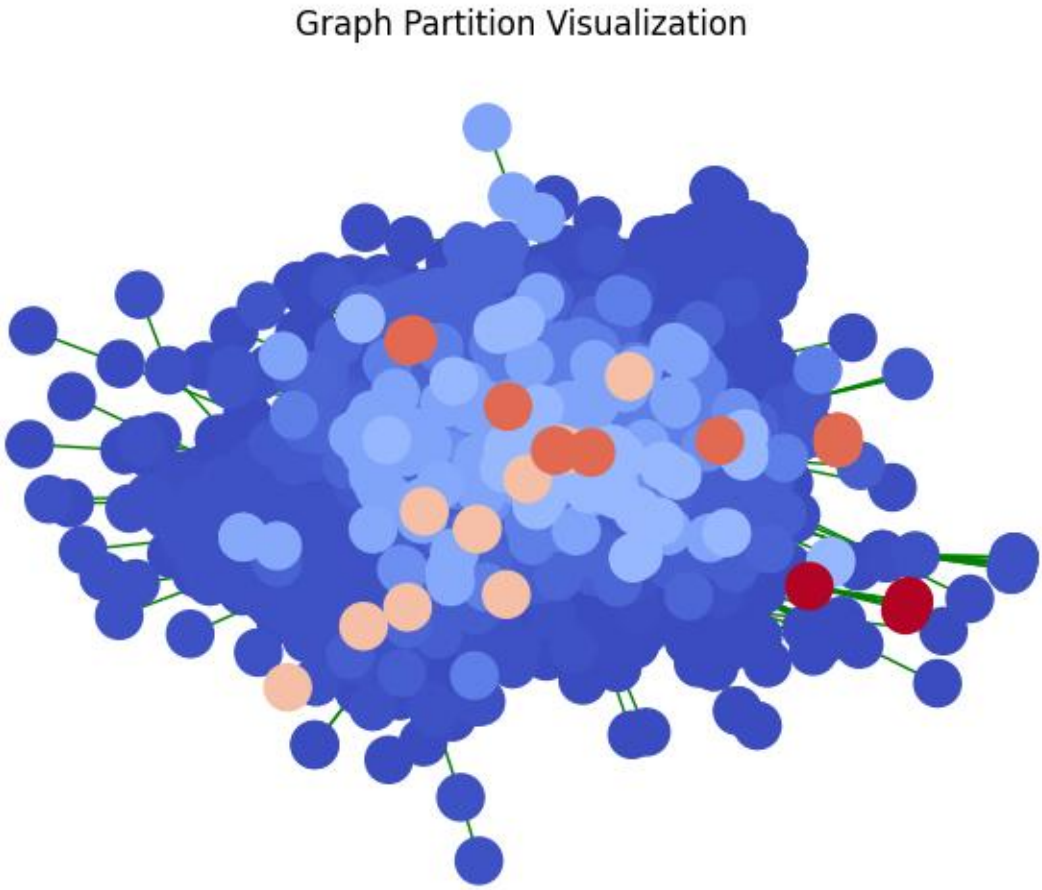
Total communities I am getting 15.





BTC Dataset

Total communities I am getting 28.



3. **Do the same for the Louvain algorithm. Show the communities you get after one iteration.**

   I am not able to visualize the communities I am getting after one iteration but in the code, I have printed it as a list of partitions.

4. **What was the running time of the Spectral decomposition algorithm versus the Louvain algorithm on the data sets you were given?**

   Facebook dataset

   spectral decomposition in 7 min

   Louvain algorithm 4 min

   BTC dataset

   spectral decomposition in 25 min

   Louvain algorithm 10 min

5. In your opinion which algorithm gave rise to better communities, why?

For Facebook dataset spectral decomposition performs better because there are clear spectral gaps in data while for the BTC dataset Louvain performs better there is no clear spectral gaps and Louvain can handle wide range of graph structures.