

1. Generate a random network with 200 nodes and three communities. Two communities should be substantially larger than the third one. For example, the first community can have 90 nodes, the second 70, and the third one 40 nodes. To generate a strong community structure with more links within the groups and less links between the groups you can use stochastic block model generator, e.g., SBM.

Using your generated network as the ground truth evaluate the following algorithms for community detection:

- Kernighan-Lin
- One greed modularity maximization of your choice
- Spectral methods:
 - Graph Laplacian
 - Modularity matrix
- One additional method of your choice.

Most of the methods can be found in e.g., <https://networkx.org/>. The spectral methods are not directly implemented in networkx but you have methods for computing the matrices and their eigenvectors. For spectral methods, make several experiments by taking different number of eigenvectors for clustering, i.e., start with one eigenvector and then take an increasing number of vectors.

Evaluate the accuracy of the methods with standard metrics, e.g., precision, recall, or F1.

Finally, take an empirical network of your choice without the ground truth and extract communities from this network with two methods of your choice. Discuss the results that you obtain for the empirical network.