Community detection, the process of identifying groups within a network, is a core problem in network science, graph machine learning, social network analysis, and data analysis using networks [1]–[3]. Among the most common approaches for detecting communities are the modularity-maximization algorithms [4]–[6], which are designed to maximize a utility function, *modularity* [7], across all possible ways that the nodes of a network can be partitioned into communities.

Seven heuristic methods for community detection using modularity maximization are as follows:

1. the Clauset-Newman-Moore (CNM) algorithm [8],
2. the Louvain algorithm [9],
3. the Leiden algorithm [10],
4. the Combo algorithm [11],
5. the Leicht-Newman (rb_pots) algorithm [12],
6. the Paris algorithm [13], and
7. the EdMot algorithm [14].

Generate random Barabasi-Albert graphs of different sizes and use them as experimentation data for comparing the scalability (running time) and performance (modularity) of the seven aforementioned algorithms. You can use a range of Barabasi-Albert networks to obtain results and plot the running time and the modularity of their output communities based on the size of input graphs.

Email me the following for this assignment (by the deadline in the email you have received):

1) Link to a public GitHub repository which stores a Jupyter notebook file documenting all your computational experiments
2) A summary in pdf format (600 words excluding references) with one table (optional) and one illustrative figure (optional) explaining your experiments and findings. Include your GitHub repository link also in the first line of the pdf file. Use this format for your file: Firstname_Lastname_summary.pdf

Hints:

- The Python package 'networkX' is probably useful for you. It has functions for generating Barabasi_Albert graphs.
- The Python package 'cdlib' is probably useful for you. It has functions for all seven heuristic algorithms mentioned above.
- The Python packages 'igraph', 'louvain', and 'leidenalg' will probably be useful as well.
- If you have any questions about this assignment, please consult online resources and references.
- If any part of this assignment is not fully determined in the above instructions, it is an opportunity for you to make your own choices and justify them in your summary.

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