

Algorithms and Applications in Social Networks

HW #1

Instructions: Implementation should be done using Python and NetworkX library. Please submit your code in .py files (file per question) or .ipynb file (Jupyter Notebooks).

The theoretical part of the question should be submitted in a PDF file.

Do not forget to write IDs of all members in the team (pair). Submit only once per team!

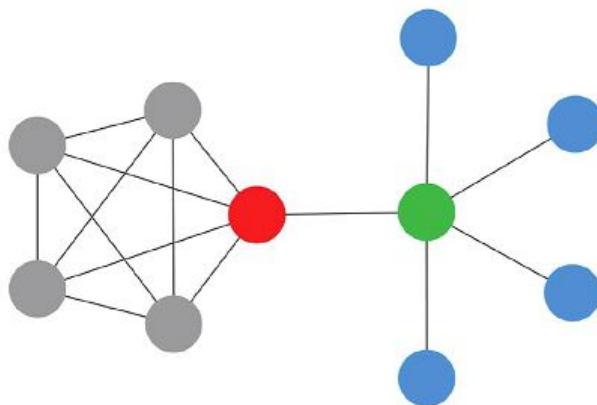
Please ZIP all files together, name the file HW1_<student_id>.zip and upload it to Moodle.

Question #1:

- Implement an Erdős–Rényi model. Write a function that gets n - number of nodes and p - probability of an edge and returns a random graph.
- Implement a function that computes the clustering coefficient of a given graph. Implement a helper function that computes clustering coefficient of each node.
- Run the Erdős–Rényi model with the following parameters: $n=100$, $p=0.2$ and Erdős–Rényi with $n=200$, $p=0.1$ and analyze the results by comparing the degree distribution, the diameter and the clustering coefficient of the graphs

Question #2:

- Implement 3 centrality measures: Degree centrality, Betweenness centrality and Closeness centrality.
- Run these measures on a random Gnp network with $n=25$ and $p=0.4$ and report top-5 nodes according to each of the measures.
- Visualize the network using different centrality measures by changing node sizes based on the centrality measure value of each node.
- Compute (manually) each of the centrality measures for red, green, blue and grey nodes. Rank the nodes by each of the measures and explain the difference between gray and green nodes in terms of different centrality measures.



Question #3:

- a. Implement `check_balance(G)` function that checks balance (according to “Theory of Structural Balance”) of a G . Explain your implementation decision.
- b. Generate a random network using Erdős–Rényi using $n=12$ and $p=0.6$. On each edge, assign random sign (“+” or “-”) with different probabilities:
 - i. $p(+)=0.95, p(-)=0.05$
 - ii. $p(+)=p(-)=0.5$
 - iii. $p(+)=0.05, p(-)=0.95$
- c. Visualize the graph with different colors for positive and negative edges. Run the `check_balance(G)` on each of the graphs and print the reason (i.e. negative cycles of odd length).
- d. Think about a real-world example of a signed social network (up to 10 nodes). Present the network, explain the nodes and the edges. Check (manually) if the network follows the “Theory of Structural Balance” and explain the results.