Diffusion Processes on Complex Networks - Lab

Assignment 3

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1. Implement the following models in the language of your preference:

   - Random graph.
   - Watts-Strogatz model.
   - Barabasi-Albert model.

   Set the number of nodes to $N = 2000$, simulate the models for various settings of the parameters and save the graphs. You may use graph data structures provided by the existing network libraries or your own class to store the graphs. For each graph:

   - Report the number of vertices and edges.
   - Compute the average degree and the variance of the degree distribution.
   - Generate the frequency plot for the degrees of the nodes.
   - Fit a model distribution to the obtained data. In case of the Barabasi-Albert graph, you may have a look at `https://aaronclauset.github.io/powerlaws/data.htm`

2. Go to a social media platform of your choice (e.g. Twitter, Facebook, Youtube). Use either the API of the platform or web scrapping techniques to map a part of your social network. Depending on the platform, you may define edges in the network as:

   - friendships on Facebook[1],
   - retweets, mentions or just followers on Twitter,
   - users commenting the same video on Youtube.

   Limit the depth of the search to a few levels to avoid an explosion of the data.

   (a) Save the results into a file. From know on work with the local copy of the network instead of sampling it every time.
   (b) Determine the number of nodes and edges in the network.
   (c) Find celebrities in the network (hint: degree centrality).
   (d) Check the data for friend paradox.
   (e) Plot the degree distribution of the network.
   (f) Find communication bottlenecks (hint: betweenness centrality).
   (g) Visualize the network.

   You are allowed to use network libraries to analyze and visualize the network.

[1] See https://towardsdatascience.com/observe-the-friend-paradox-in-facebook-data-using-python-314c23fd49e4 for an example of how to use Selenium for Facebook scrapping.