

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 <http://tuvalu.santafe.edu/~aaronc/powerlaws/>

2. LiveJournal (www.livejournal.com) is a blogging site very popular in Russia and Eastern Europe¹. It has a simple API and a generous policy for data mining (see <http://www.livejournal.com/bots/>).

- Write a function that fetches a list of friends of a test user `valerois` and transforms it into a graph.
- Once you have the list of friends, you may use the *snowball sampling* method (also known as *chain sampling* or *respondent-driven sampling*) to map the social network:

```
Start with a central node
Obtain friends of the central node
For every friend:
    Obtain friends of the friend
    For every friend-of-friend
        Obtain friends of friend-of-friend
    Etc...
```

Limit the depth of the search to two or three levels to avoid an explosion of data.

- Save the results into a file. From now on work with the local copy of the network instead of sampling it every time.
- Determine the number of nodes and edges in the network.

¹Example taken from M. Tsvetovat and A. Kouznetsov, *Social Network Analysis for Startups*, O'Reilly 2011

- Find celebrities in the network (hint: degree centrality).
- Plot the degree distribution of the network.
- Find communication bottlenecks (hint: betweenness centrality).

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