EECS4414/5414 Fall 2021

Information Networks

Assignment 1 (10%): Network Models & Measurements

Posted: Fri, Oct 1, 2021; **Due**: 11:59 pm on Fri, Oct 22, 2021

Objective

In this assignment, you will be writing programs for generating networks and measuring some of their important properties. You will also prepare a technical document where you briefly report about the data, models, methods, measurements, experiments, results, plots of the assignment.

Important Notes:

- If you are working in a pair, **only one of you should submit**. The first page of your report should clearly include information of all team members (first name, last name, login, student#, email).
- You can write code of your own or use available graph libraries (NetworkX, SNAP, JUNG, etc.).
- Your report should be **no more than 5 pages**. To get full marks, your code must be well-documented, and the report should be well organized, using proper technical language and suitable style (sections, figures, tables).

Formatting and Style

All reports should be formatted according to the ACM SIG conference proceedings template in LaTex and prepared using Overleaf, a free collaborative authoring tool. The template can be accessed here: https://www.overleaf.com/latex/templates/association-for-computing-machinery-acm-sig-proceedingstemplate/bmvfhcdnxfty

Electronic Submission Instructions

You should submit your work electronically using the `submit` command in PRISM lab computers. For this assignment, you will submit two files:

- your *code* (**a1-code.zip**), and
- your *report* (**a1-report.pdf**)

When you have completed the assignment, move these two files in a directory (e.g., assignment1/), and use the following command within that directory to electronically submit your files:

```
% submit 4414 a1 a1-code.zip a1-report.pdf
```

You may submit your files as many times as you wish prior to the submission deadline. Make sure you name your files exactly as stated (including lower/upper case letters). You may check the status of your submission using the command:

```
% submit -l 4414 a1
```

Make sure you have submitted the correct version; new or missing files will not be accepted after the due date.

A. Graph Model Generators (20%)

Generate the following list of undirected unweighted graphs:

i. Three (3) graphs based on the Erdős-Rényi random graph model (`er1, …, er3`).
ii. Three (3) graphs based on the Watts–Strogatz small-world graph model (`ws1, …, ws3`).
iii. Three (3) graphs based on the Barabási–Albert preferential attachment model (`ba1, …, ba3`).

Each graph `G(N, E)` should be about the same size, including `N=~1,000` nodes and `E=~10,000` edges. Remember to **report** the parameter values of the graph generator you used to create the graph. In addition, for each graph `G(N, E)`, obtain its giant connected component CC_G and **report** its size (#nodes, #edges) in a Table.

B. Graph Measurements (70%)

For each of the graphs above (i.e., focus only on the associated giant connected component CC_G) report:

i. the node degree distribution of the graph (as a plot)
ii. the distribution of the local clustering coefficient of the nodes of the graph (as a plot)
iii. the global clustering coefficient of the graph (a number)
iv. the distribution of the shortest path lengths of the graph (as a plot)
v. the average shortest path length of the graph (a number)
vi. the diameter of the graph (a number)

Whenever a plot is required, report the most informative/appropriate type of plot, or present more than one plots (using your best judgement).

C. Discussion (10%)

Briefly (~2 paragraphs) comment on:

i. how the properties of the graphs coming from the same graph model compare to each other?
ii. how the properties of the graphs coming from different graph models compare to each other?