Complex Network "Project"

Dipartimento di Elettronica e Telecomunicazioni
Politecnico di Torino – 2016
Professor: Ana Paula Couto (DCC-UFMG-Brazil)

This project aims to introduce some network science tools, used for understanding complex systems properties as well as important processes that run over these networks.

I strongly encourage you to try crawling some complex network that you are willing to understand the behavior. However, if you are not used to implement crawlers, data from Stanford Large Network Dataset Collection (https://snap.stanford.edu/data/) can be used.

The tools that we will explore are:

- **Networkx** (https://networkx.github.io/): NetworkX is a Python language software package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.
- **NetLogo** (https://ccl.northwestern.edu/netlogo/): NetLogo is a multi-agent programmable modeling environment. It is used by tens of thousands of students, teachers and researchers worldwide. It also powers HubNet participatory simulations. It is authored by Uri Wilensky and developed at the CCL.
- **Gephi** (https://gephi.org/): Gephi is a visualization and exploration software for all kinds of graphs and networks.

1. Networkx: From the set of data available from Snap website, choose two networks from different types (for instance, ego-Facebook and co-AstroPh). The idea is to compare two different complex systems by means of the main properties we discussed. Calculate (and plot) the following properties:

a) Degree distribution;
b) Clustering coefficient of each node and its distribution;
c) Number of components and their size;
d) Betweenness distribution;
e) Closeness distribution;
f) Provide a snapshot from the network (using Gephi).

Provide a comparison between the two networks you chose in terms of the calculated properties. Do you have any hint about why they are similar or dissimilar?

2. **NetLogo**: From the set of implemented models found in NetLogo:

a) Consider the Small-World model (File → Models Library → Networks → Small World). Consider a network with 40 nodes. Choose a set of rewiring probability values and report the values for its diameter and clustering coefficient properties. Give a description of the results you found.

b) Consider the spreading model for the AIDS (File → Models Library → Social Science → AIDS) disease. Verify how the people behavior can impact the disease diffusion time (in terms of total of people infected). Choose a set of values for the possible overlapped relationships as well as the period of time of the relationships. Give a description of the results you found.

c) Consider the epidemiological model (File → Models Library → Networks →Virus on Network). Run the simulation with different degree node values and give a description of the results you found.