Assignment #2

(This is a mini-project <u>individual</u> assignment.)

<u>Brain Networks</u>

Instructions:

a) Please read the paper "Scale-Free Brain Functional Networks" in this folder.

b) Please download the data file containing a dataset and code from the paper. (The data can be download from the dropbox link on moodle.)

c) Unzip and compile the code as instructed in reader.f. (Note: you will need to install Fortran compiler if not already installed in your system).

d) Run the program as instructed, and it will produce the full correlation matrix for all voxel pairs in the brain (see the paper).

e) Form a network from this correlation matrix as follows: let voxels $v_!$ and $v_"$ be connected if the correlation coefficient $r(v_!, v_")$ between them exceeds a threshold $r_#$, that is, if $r(v_!, v_") > r_# > 0$.

f) Write a program and use it to find (approximately) the value of $r_#$ for which the resulting network has a Giant Connected Component (GCC) that consists of 70% of network nodes.

g) Compute the basic network properties (see below) for the network you constructed in the previous step.

h) Provide a vizualization of the network you formed using Gephi (https://gephi.org/), python's plotly (https://plotly.com/python/networkgraphs/) or any other network visualization tool you like.

Completed Assignment:

- The estimated value of the correlation coefficient threshold $r_\#$.

- A short description of how this value was estimated.

- The size (number of nodes), average degree, and average clustering in the Giant Connected Component (GCC) you found in step (f).

- The raw data for the degree distribution $P(k)$, average degree of neighbors $k^*\_nn(k)$ of nodes of degree k, average clustering $c(\ k)$, of nodes of degree k , average betweenness centrality $B^*(k)$, of nodes of degree k, for the GCC of step (f).

- The log-log plots of the above statistics.

- The raw data for the distance distribution in the GCC of step (f)

- The plot of the distance (distribution), in normal.

- The vizualization of the network.

- What is the value of the average and maximum node degrees in the GCC? Does the network have a homogeneous or heterogeneous degree distribution? Please explain (answers without explanations get 0).

- What is the value of the average clustering coefficient in the network? Does the network have strong or weak clustering? Please explain (answers without explanations get 0).

- Is the network assortative or disassortative? Please explain (answers without explanations get 0).

- What is the average distance in the GCC? What is the diameter of the GCC? Can the GCC be considered a small-world network? Please explain (answers without explanations get 0).