Network Science

Assignment 1

- *Code for the following tasks.* ***Do not*** *use any existing network analysis libraries (such as NetworkX/igraph). All results must be submitted through a well-documented Jupyter Notebook.* ***Please submit the data, Jupyter Notebook, the PDF of the final Jupyter Notebook.***
- Strictly follow the rubric while providing answers.
- Please start working on the assignment right away, as the tasks may take time to complete.

1. Identify an **undirected network** of your choice such that $N > 1000$. **Write a Python script** to: (a) Represent the network in terms of its 'adjacency matrix' as well as 'edge list'. (b) Visualize the network and export it as an image (PNG/JPG etc.). (c) Computer the 'sparseness' of the network. (d) Compute its average degree $< k >$. (e) Plot its 'scaled/normalized degree distribution', $p_k \times k$. (f) Compute its Average Path Length (*Implement Breadth First Search Algorithm*) and plot average path length distribution, and (g) Average Clustering Coefficient and plot it as $C(k) \times k$. **[1+1+1+1+3+4+4=15]**

2. **Write Python script** for computing in/out-degree for directed graphs. For **a real-world directed network of** $N > 1000$, **compute and plot** its in- and out- degree distribution. **[3]**

3. How would redefine the notion of 'degree' and 'clustering coefficient' for a weighted network to account for the edge weights? **Implement a Python script** to compute these and, for any relevant **real-world, weighted** graph, plot (a) 'weighted degree distribution' and (b) 'Clustering Coefficient' versus 'Degree'. **[6]**

4. **Write a Python script** to create a Gilbert random graph corresponding to an undirected and unweighted real-world network that was used in Question 1. **Plot and compare** their 'scaled/normalized degree distributions'. Compute the degree distribution of the random graph over 100 instances. **[3]**

5. Load the real-world networks studied in the above examples in *Cytoscape* and visualize them using various layouts. Export the images in PNG/JPG or similar format. **[3]**