Network Science

Assignment 1

Code for following tasks. Barring Question 5 & Question 1(b) (involving Cytoscape), ***do not*** *use 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 as well as the PDF of the final Jupyter Notebook for the ease of assessment.***

Delayed submissions will be flatly penalized with 3 points (out of total 10 scaled points).

1. Using data of any network of your choice ($N > 200$), **write a Python script** to: (a) Represent the network in terms of its 'adjacency matrix' as well as 'edge list'. (b) Visualize the network. (c) Comment on the 'sparseness' of the network. (d) Compute its average degree $< k >$. (e) Plot its 'scaled degree distribution', $p_k \times k$. (f) Compute its Average Path Length (*Implement Breadth First Search Algorithm*), Diameter and Average Clustering Coefficient. **[15]**

2. **Write Python script** for computing in/out-degree for directed graphs. For a real world directed network **compute and plot** its in- and out- degree distribution. **[2]**

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 graph, plot (a) 'weighted degree distribution' and (b) 'Clustering Coefficient' versus 'Degree'. **[5]**

4. **Write a Python script** to create a Gilbert random graph corresponding to an undirected and unweighted real-world network. **Plot and compare** their 'degree distributions'. Compute the degree distribution of the random graph over 100 instances. **[5]**

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