Assignment 6: Network models

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Task 1 Using the social network shown in Figure 1, calculate the following:

1. The average degree
2. The clustering coefficient
3. The average path length

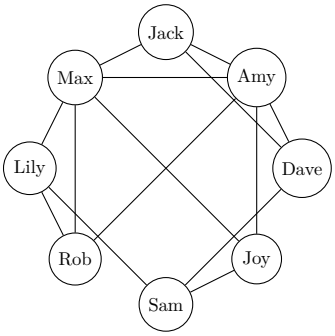

Figure 1

Task 2 Implement a Python script using NetworkX and Matplotlib libraries, and perform the following tasks for the network in Task1:

1. Generate a *Small World* graph, with degree 4 and probability $\beta = 0.5$.
2. Generate a *Random Graph* using networkx library, with probability 0.4.
3. Visualize the simulated random and small world graphs using Matplotlib.

Task 3 Implement a Python script using Snap and Matplotlib libraries, and perform the following tasks:

1. Download and load the social network *email-Eu-core.txt.gz* from `http://snap.stanford.edu/data/email-Eu-core.html` into your script.
2. Compute the clustering coefficient and the average path length using Snap library.
3. Plot the degree distribution. That is, for every vertex find its degree and plot the distribution.

Task 4

1. Implement the *Random Graph* model. The algorithm should use two parameters:

   - n: Number of vertices
   - p: Edge probability

   Hint: You can use either *numpy.random.random* or *numpy.random.uniform* to generate random numbers. You can also use SNAP library: $TUNGraph$ and add nodes and edges using $AddNode$ and $AddEdge$.

2. Using the implemented model, do the following:

   (a) Generate 3 graphs such that the number of vertices is $10^3 \leq n \leq 10^5$ and the probability is $0.05 \leq p \leq 0.2$. Compute the clustering coefficient of each of the generated graphs. Show empirically that the clustering coefficient is equal to p?

   (b) Plot the degree distribution of the 3 random graphs you generated.

   (c) Download the Facebook dataset: *facebook_combined.txt.gz* from `https://snap.stanford.edu/data/egonets-Facebook.html`. Generate a random graph with the same number of vertices as the Facebook network, and $p = 0.1$. Compare the resulting graph with the Facebook graph by the number of edges and the clustering coefficient. Explain the reason of such a difference between them.