BT5240 - Assignment 2

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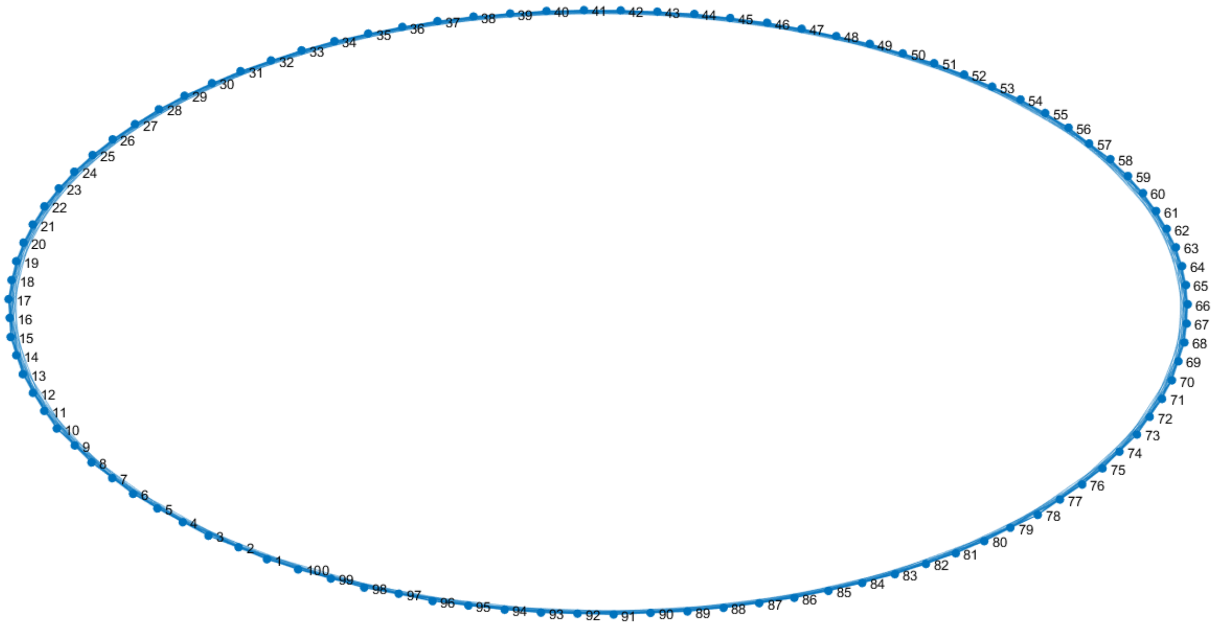
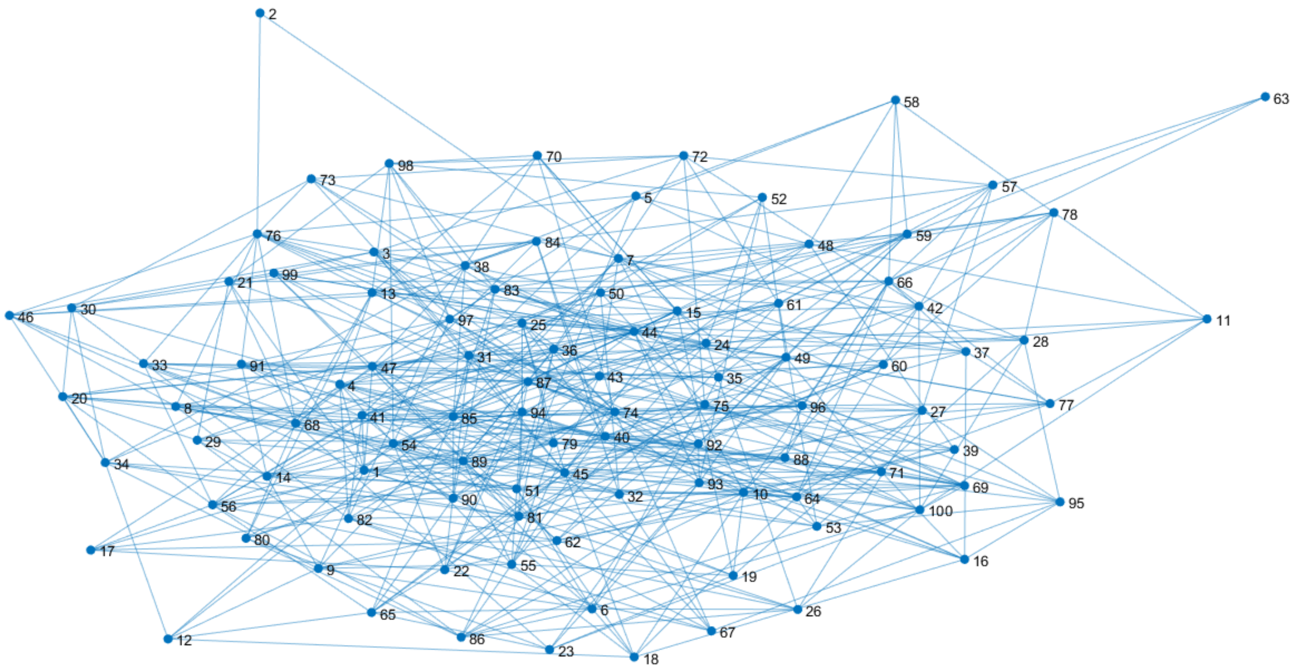
1)

WS network with p=0 (regular lattice)



WS network with p=0.7 (rewired network)

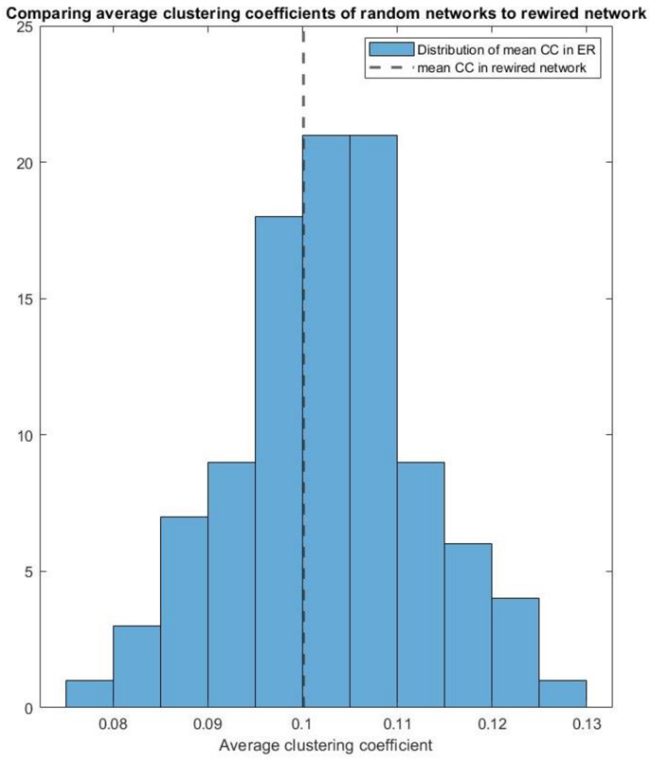


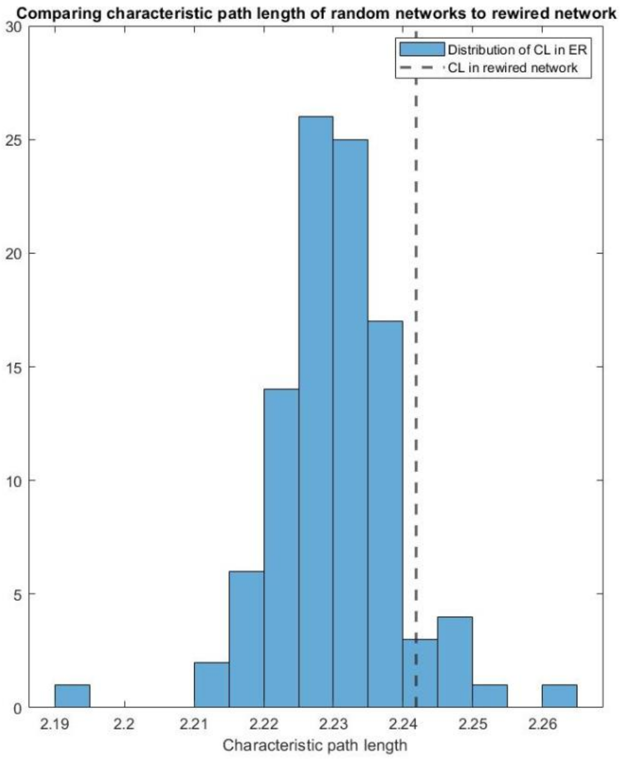
By fixing the random seed to 0, the average clustering coefficient and characteristic path length of the network is

$$average\ clustering\ coefficient = 0.1001$$

$$characteristic\ path\ length = 2.2418$$

To check if these parameters can be obtained from a random network, we generate 100 random networks (WS network with p=1 and everything else the same) and compare it with the parameters of rewired network.



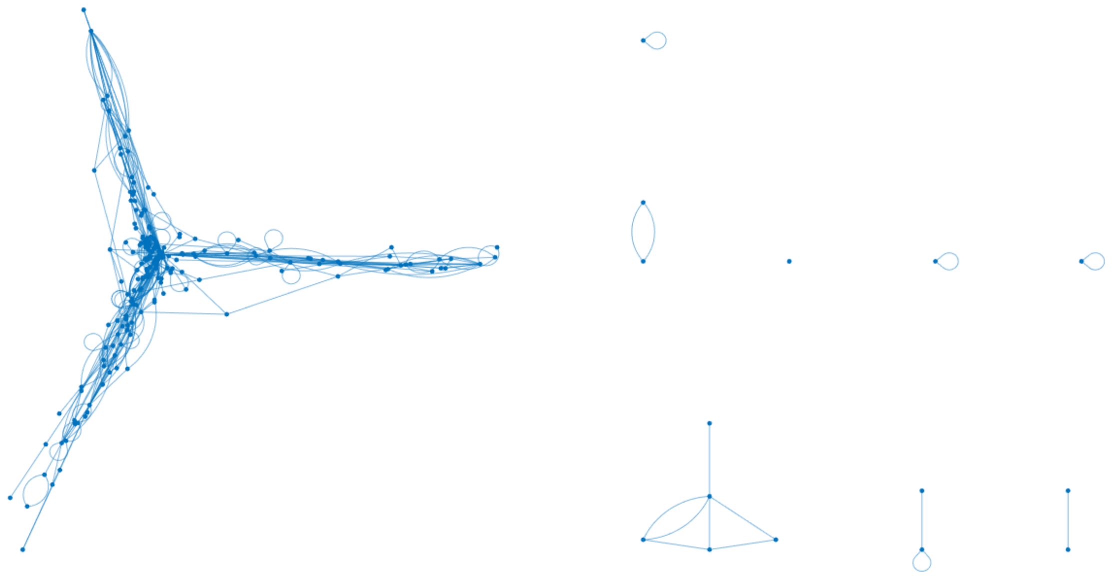


The above figures compare the histogram of average clustering coefficient and characteristic path lengths of 100 ER network to that of rewired network. By visual analysis of the plots, we can see the average clustering coefficient of rewired network can be generated from the random network as it lies in the region of high bin counts of the histogram i.e, high probability that average clustering coefficient of the rewired network can be generated from a ER network. If we look at the plot for characteristic path length, we find that although the characteristic path length of rewired network does not lie in the region of high bin count, there still exits some random networks (around 4 in this case out of the 100) that seems to generate a characteristic path length that is close to the rewired network.

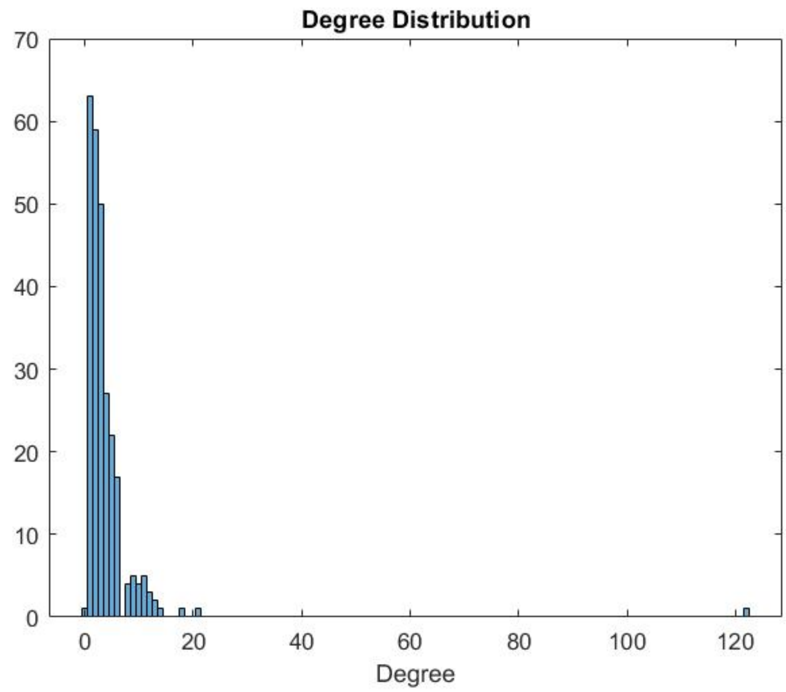
Therefore, these parameters can be obtained from a random network with same number of nodes and edges.

2.a)

From the list of repositories, we chose social networks. The visualization of the network is below

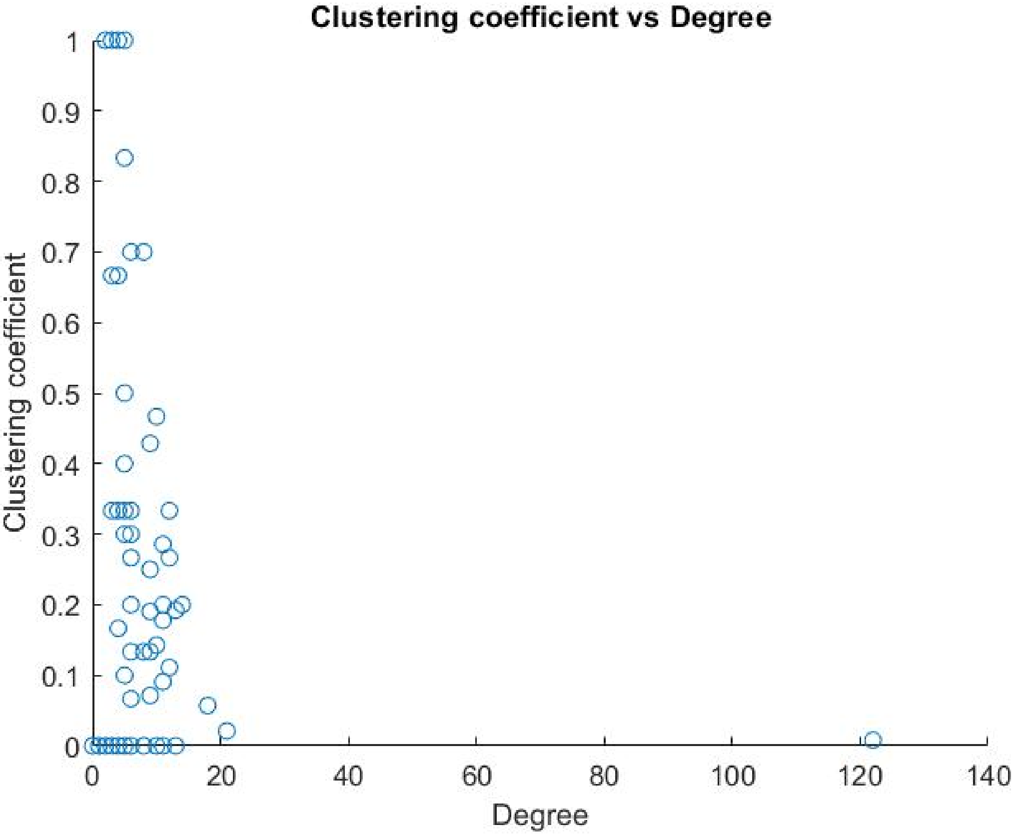


From visually inspection, the network seems to follow a power-law network. Let us compute the degree distribution to corroborate this.



The degree distribution also suggests that there are small number of nodes with very high degree and larger number of nodes with very small degree. This is a property of a power-law network. Therefore, we can confirm that the network is a power-law network.

2.b)



The scatter plot of clustering coefficient vs degree shows that clustering coefficient is high for small degrees and drastically reduces as the degree of the node increases. Going by the formula of clustering coefficient, we can interpret this result as the following statement: low degree nodes have very less triples (sub-graphs with 2 edges and 3 vertices where the node under investigation is vertex common to two edges) thereby resulting high clustering coefficient (number of triples comes in the denominator of clustering coefficient formula). Since we confirmed that the network is a power-law network in 2.a), we know that low-degree nodes are connected only to a hub and do not have many triplets around them. On the other hand, network with very high degree (hubs) have large number of triplets present around them, thereby resulting in low clustering coefficient.

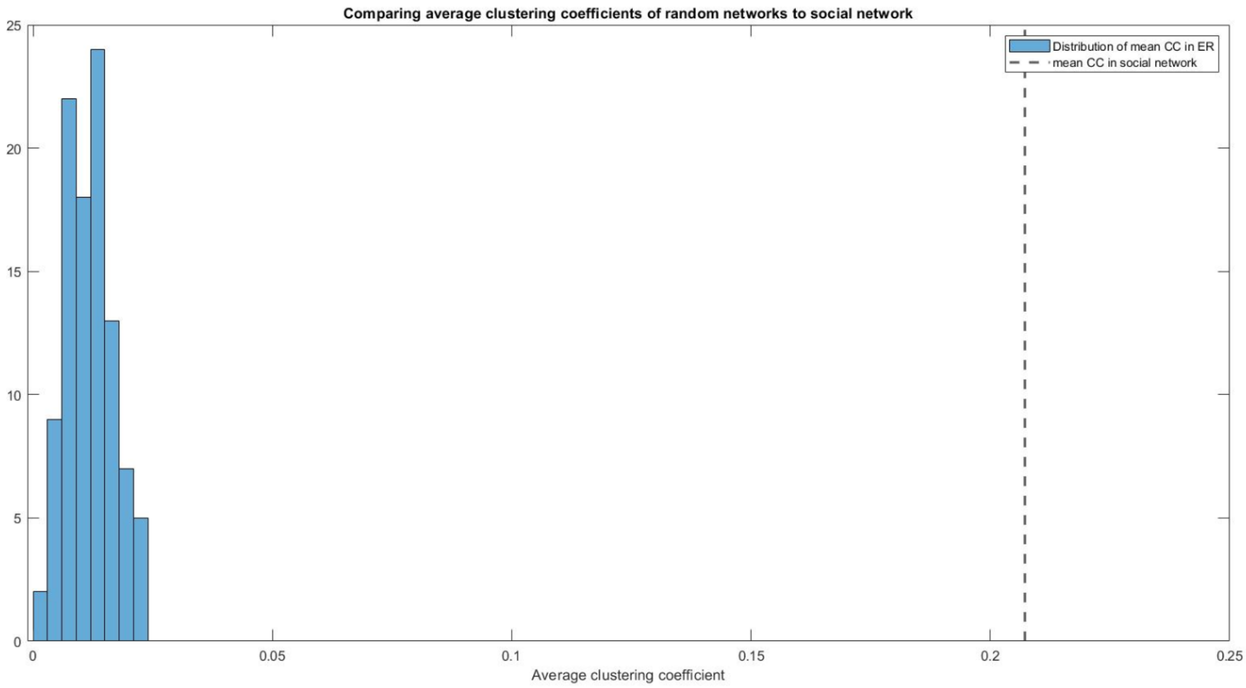
2.c.i)

$$average\ node\ degree = 3.9850$$

2.c.ii)

$$average\ local\ clustering\ coefficient = 0.2072$$

To quantify how small or large the deviation of social network is from a random network of the same degree distribution, we again generate 100 random networks with same number of edges and nodes. We compare the distribution of average local clustering coefficient of these 100 random networks to the average local clustering coefficient of the social network.



From the above figure, we observe that the average local clustering coefficient of social networks is significantly larger than that of random networks. Hence, we can conclude that the average local clustering coefficient of social network is higher than that of random networks with same degree distribution.

2.c.iii)

$$characteristic\ path\ length = 3.125$$