CS-E5740 Complex Networks,
Answers to exercise set 7

Xing An, Student number: 801966

November 11, 2019

Problem 1

a) Please see the plot using loglog scale. From the distribution, since log-log of a power law distribution appears as a straight line, so it is not power law distribution. And the log-log plot is more similar to the log-log of Gaussian distribution. So it is more like Gaussian distribution
For estimating 90% of the degree, strength and weight distribution, we could see the data at 1-CDF = 1-0.9=0.1. So Weight approx. 10. Degree approx. 40. Strength approx. 200.

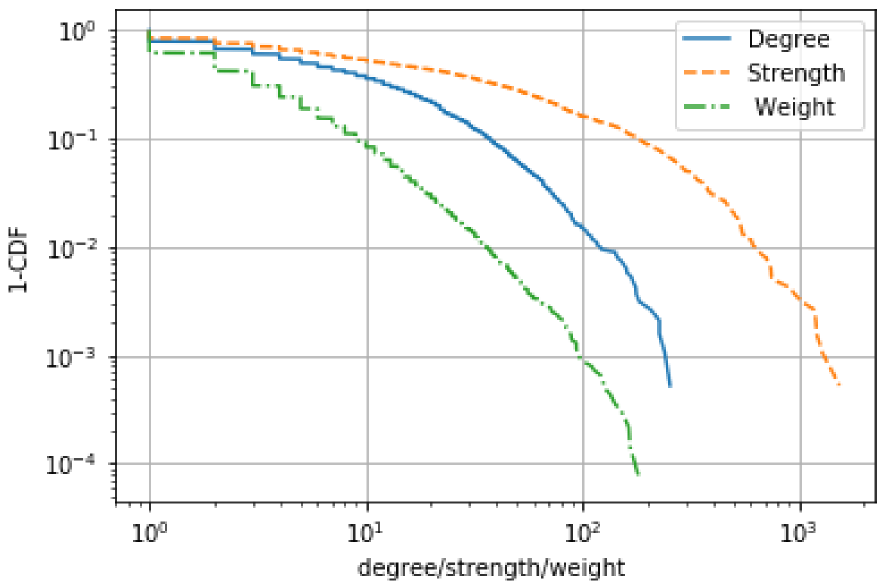

Figure 1: 1-cdf for node gree, node strength and link weight

b,c) Please see the plots.

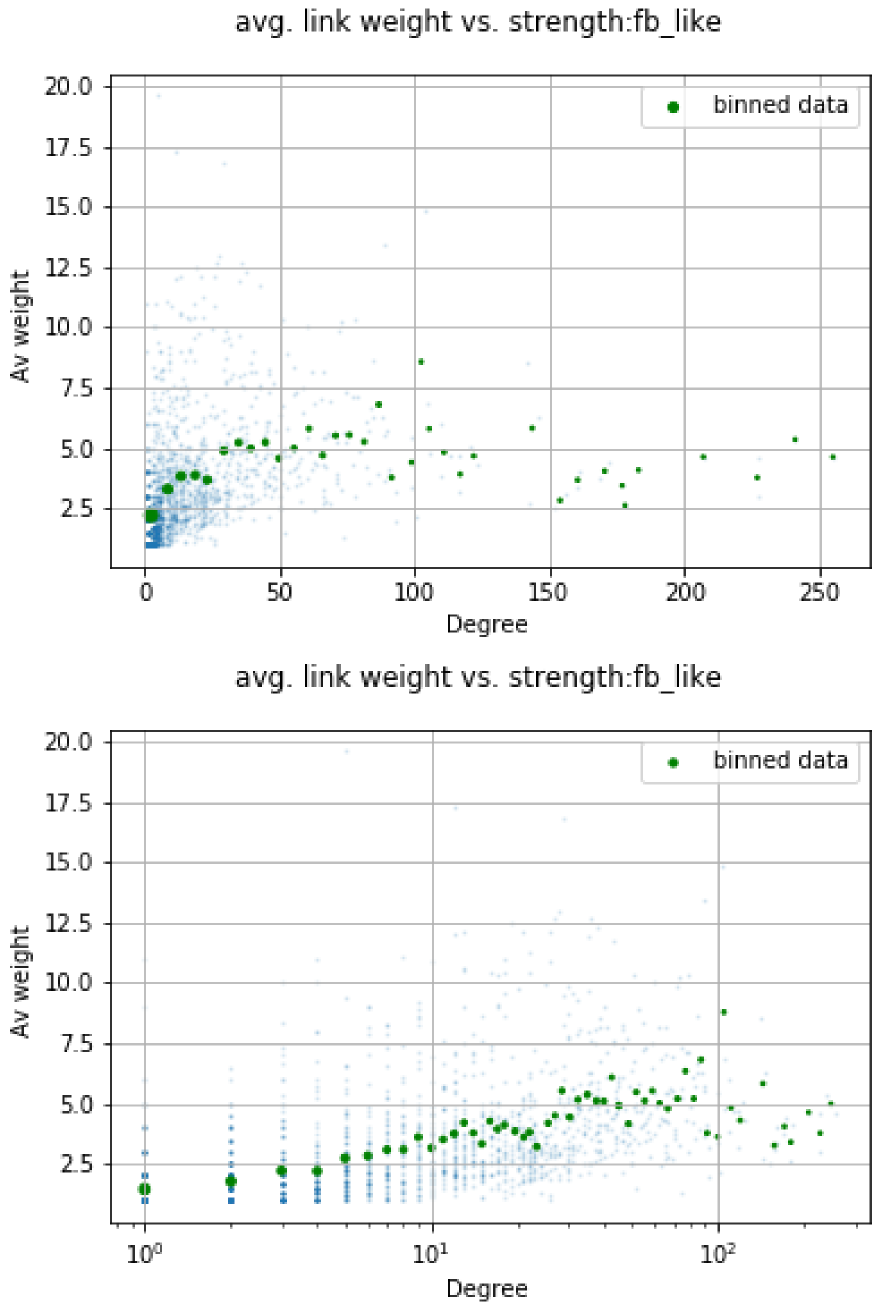

Figure 2: average link weight for node degree

d) Logarithmic suits better. Because it presents clearly the average link weight increased to the degree.
My result is not with this obeservation, when degree increases from 10 to 100, the average weight is still increasing. Because in social networks, people need a time to

maintain the relationship so it typically decreases. And what we are dealing with is a private message system, which might because the active people who has more friends(degree) easily to message a lot to their friends which cause still high average weight. so it doesn't typically decrease, but looks like a fluctuation and a little bit increase. This might because the noise.

e) The plot is shown as below.
Observing from the trend in the plot, overlap is increasing of the link weight. So the trend is in accordance with the Granovetter hypothesis.

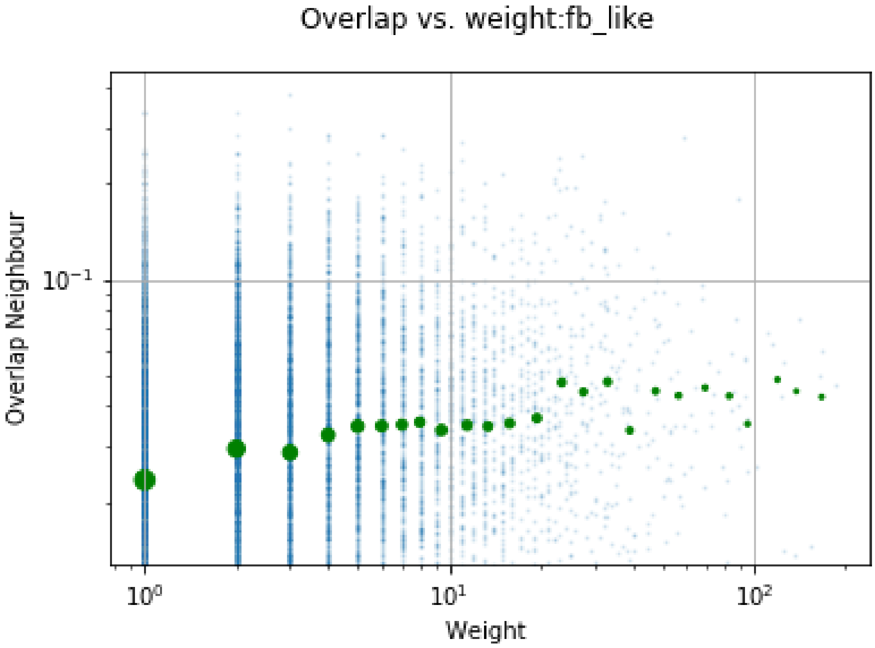

Figure 3: 1-cdf for node gree, node strength and link weight

Problem 2

a) number of node: 279
number of link: 2088
density: 0.05384079832907867
diameter: 4
average clustering coefficient: 0.6465167472774311

b) Visualize the full network shown as below.

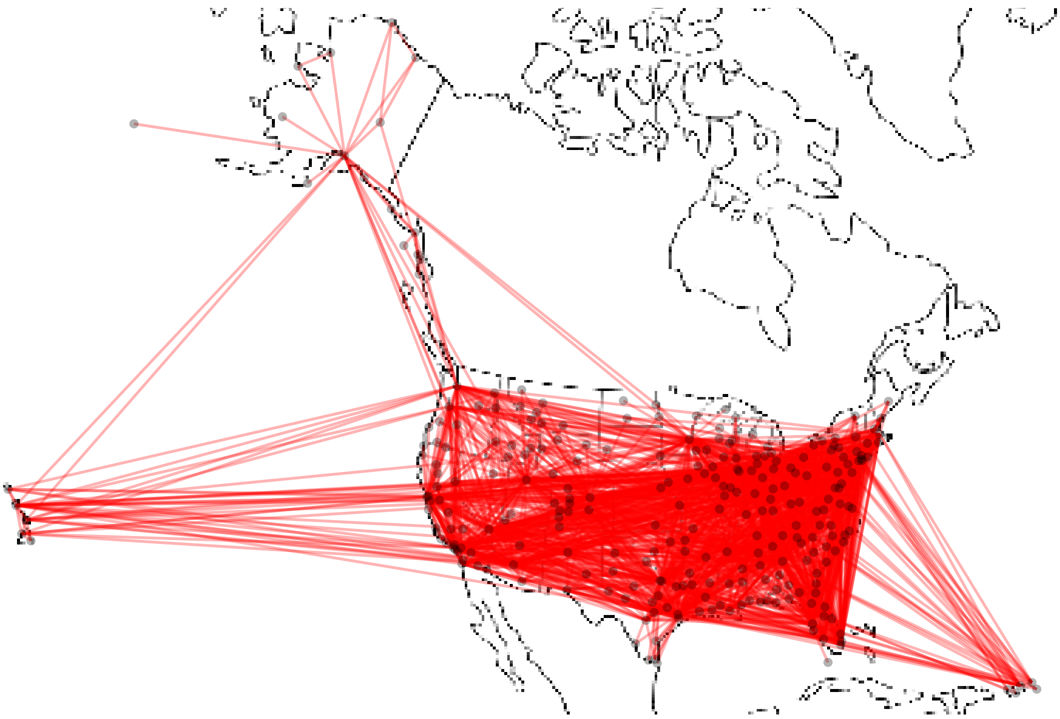

Figure 4: Full network.

c) For the node Hawaii, the maximal spanning tree has only one flight connected from LA to Hawaii is chosen because it has to link to every node, but the weight for other flights between Hawaii and other node in the American other cities is not that high so not be chosen. As for the minimal spanning tree, we could tell the weight between Hawaii and other nodes like in Alaska is low so they are chosen to generate the minimal spanning tree to minimum the weight as well as connected every node. So in a word, the minimal spanning tree and maximal spanning tree all contains all the nodes of the original network, but the sum of link weights is maximized and minimized relatively.

Maximal and minimal spanning tree visualization show below. I will chhose maximal spanning tree, because it is generated by the links of the maximum weights, which means more frequent and main flights.

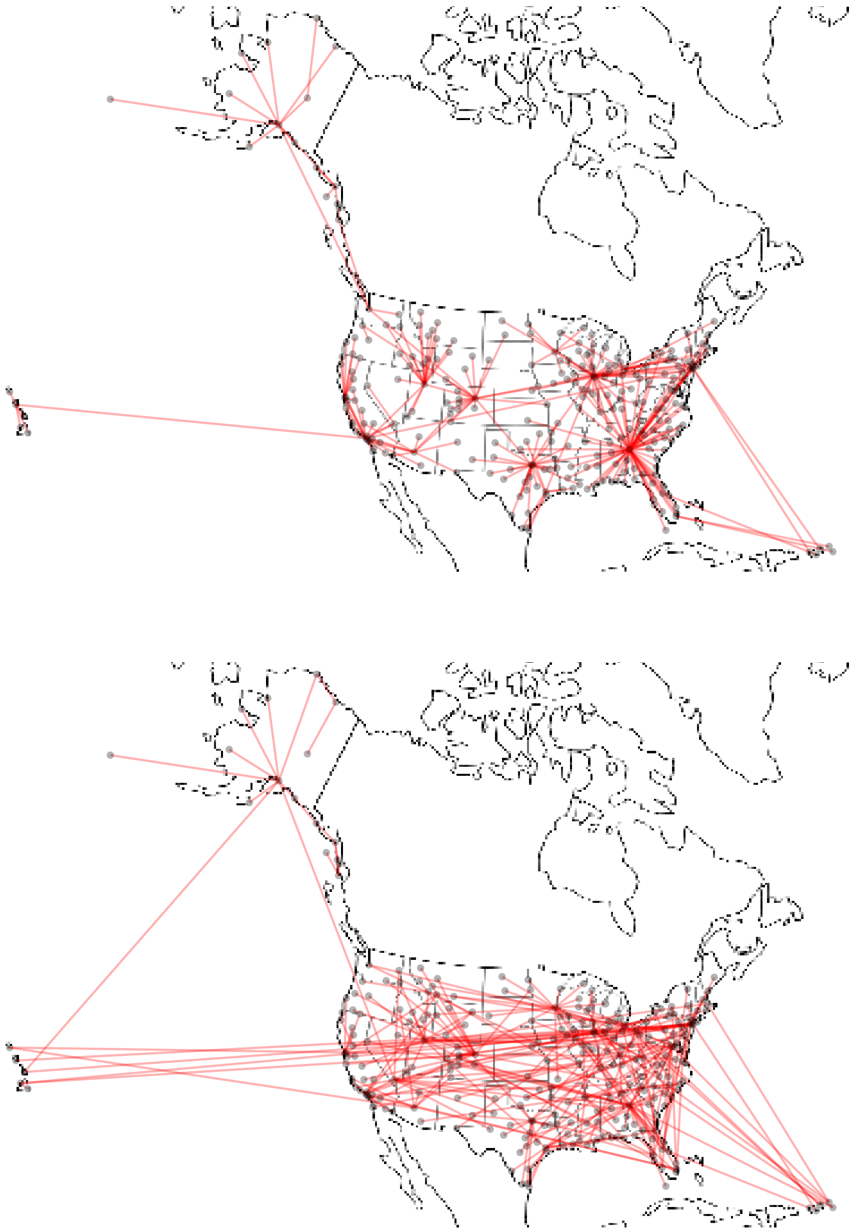

Figure 5: Maximal(up) and minimal(down) spanning tree

d) Visualization is shown below.

Number of the shared link: 97.
From the observation of the thresholding graph and the maximal spanning tree, it doesn't look very similar. As for the numbers they shared is about 35% of the maximal links, so the simple thresholding doesn't yield a similar network as the maximum spanning tree.

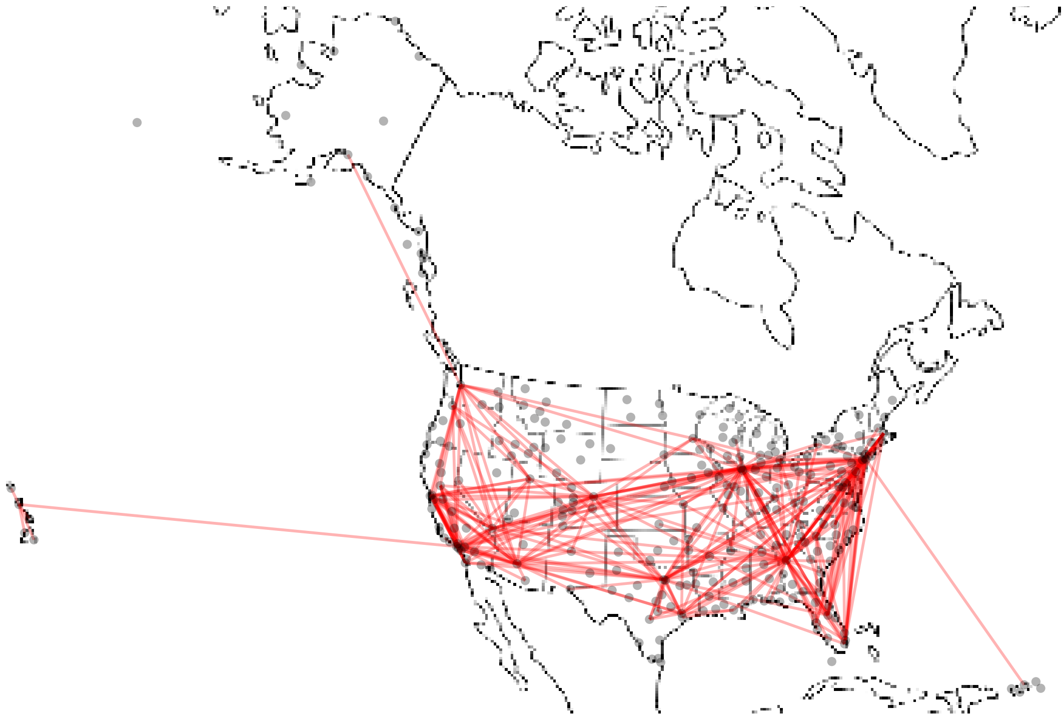

Figure 6: With M strongest link