# Network Analysis

Jose Pérez Cano & Jordi Puig Rabat

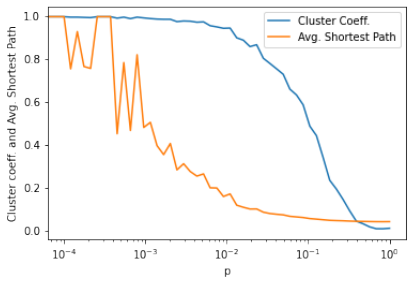
December 2020

## Task 1

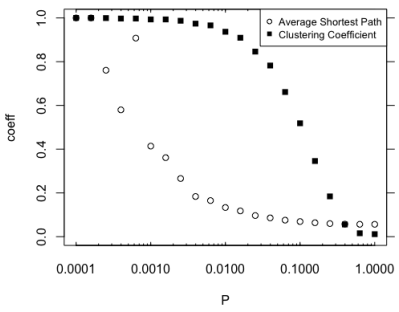
The first task we were given is: *Plot the clustering coefficient and the average shortest-path as a function of the parameter p of the WS model.* An important thing here is to iterate through the values of $p$ in a logarithmic way.

```
import numpy as np
p_vals = np.concatenate([[0], np.logspace(-4, 0)])
```

After that we only needed to iterate through these values, generate a graph with parameter $p$ and compute the measures we were asked. Plotting the Clustering Coefficient and the Average Shortest-path over the values of $p$ in a logarithmic scale gives us these results:

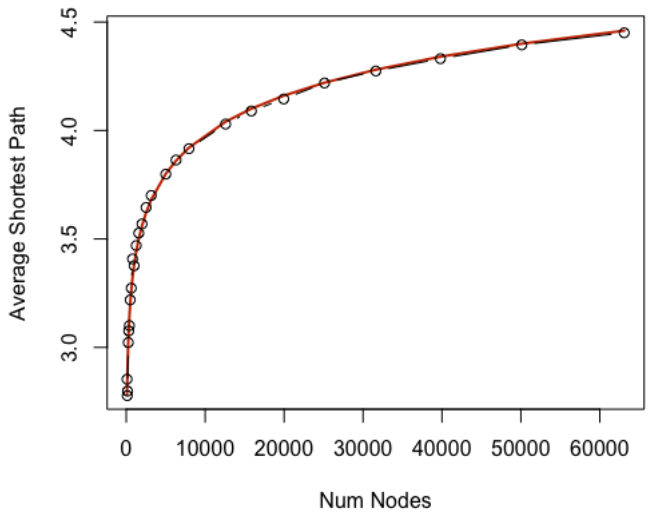



Similarly, we did the same process with R and the resulting plot is as follows:

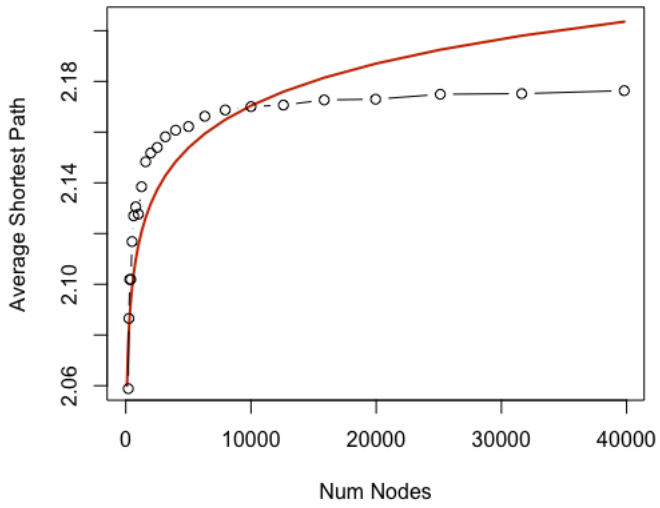


# Task 2

We used the function `count_components` to check that there was only one connected component. Moreover, we chose the values for $n$ in the same way we chose the values for $p$ in the last section, so that we have few big values of $n$. We also used the heuristic given with $\epsilon = 0.3$. To see better if the result followed a logarithm, which is the expected function, we fitted a logarithm to the points. The result is as follows:




Apart from that heuristic for $p$, we tried another one $p = \frac{(1+\epsilon)}{\sqrt{n}}$ to see if the graphic still showed a logarithm. To our surprise, the average shortest path decreased faster than a logarithm function. Implying that the average shortest path depends on the value of $p$, and not only on the value of $n$. In fact, it seems to converge to some value.



# Task 3

The third task given said: *Plot a histogram of the degree distribution of a BA network. What distribution does this follow? Can you describe it?* The simplest approach is to create a BA graph and then get the degree list with `.degree()` and plot a histogram with some plotting library (`matplotlib` in our case). The result after creating a graph with parameters n = 100 and m = 2 is: