Network Models

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Introduction

The aim of this assignment was to compute average shortest-path as a function of the parameter p of the WS model and plot the average shortest-path length as a function of the network size of the ER model. We chose to use `networkx library` for our analysis.

Implementation

We followed all the instructions as per the pdf document. The first choice we had to take was to figure out the right value for the constant `z` (Average degree) and `p` in such a way that do not get isolated vertex.

Using the folmula below, we could obtain the best value of `z = 13` for graphs with nodes upto `100,000` where all nodes that give us connected graph.

$$z = (n - 1) * p$$

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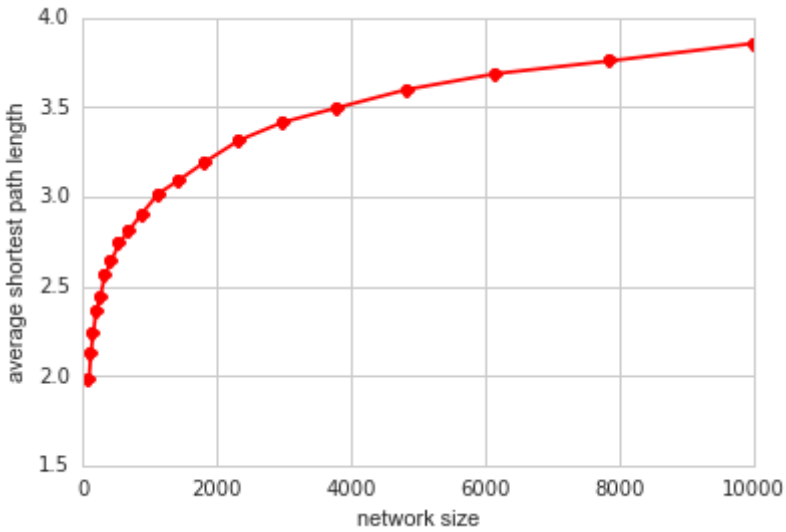
Erdos-Renyi Model

Instead of using the `erdos_renyi_graph` api from from networkx which has $O(n^2)$ runtime complexity, we chose `fast_gnp_random_graph` api as it has $O(n + m)$ run time complexity, `n` is the number of nodes and `m` is the expected of edges. Once we obtained the values of network size between `100` and `100000` and average shortest-path length we obtain the scatter plot below.

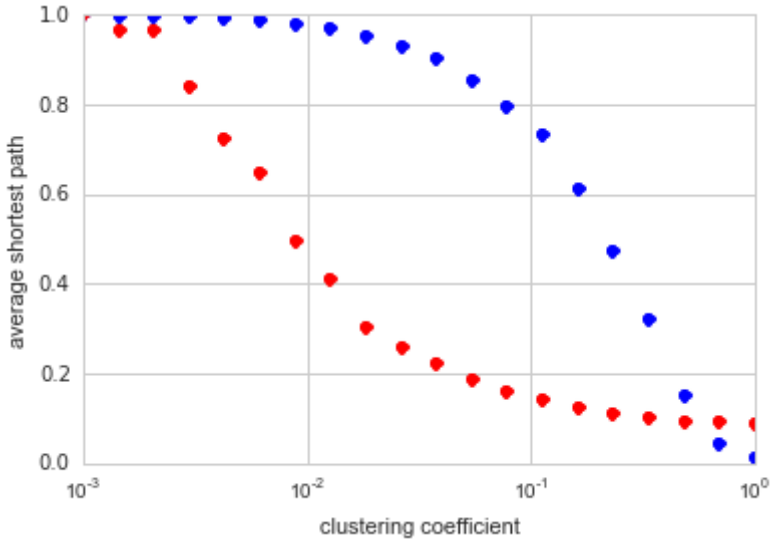


Erdos-Renyi Model

Watts-Strogatz Model

We needed to compute clustering coefficient and average shortest-path as a function of parameter `p`. The constants we used were, `k = 4` (Nearest neighbors in ring topology), Size of graph `n = 500` (Since computaionally it did not take too much time). After obtaining these values over function of parameter `p` we

normalized it to be within range `[0, 1]`. By Averaging the the cluster coefficient and shortest path over 10 different random seeds we obtained smoothed scatted plot below.The averaging was perfored using a function which for every p generated k values and returned their mean value.



Watts-Strogatz Model

Results

We did not have any problem simulating the results. Using python comprehensions we were optimized our code and improved readibility. The plots obtained for Watts-Strogatz model gave us better results when averaged over multiple graphs with different random seeds.