# Computational Neurodynamics

Exercise Sheet 3 (Unassessed)
Small-world networks

All the files for these exercises can be found online at

https://github.com/pmediano/ComputationalNeurodynamics

*Question 1*

a) Start up Python and build a `NetworkWattsStrogatz` with 12 nodes, a neighbourhood size of 4 and a rewiring probability of 0.1. You can visualise the network you have built with `PlotConnectivity`. Inspect the code for `NetworkWattsStrogatz` and make sure you understand how it works. Verify that the Watts-Strogatz procedure produces a ring lattice for rewiring probability $p$=0 and a random network for $p$=1.

b) Write a function that calculates the small-world index of a binary undirected network. Sample a reasonable number (e.g. 100) of networks with $p$ uniformly distributed in log-space between $10^{-3}$ and $10^{0}$ and plot their small-world index. You can experiment with different network and neighbourhood sizes. What happens to the small-world index as the density of the network increases?

*Hint*: you can use the pip-installable BCTPY package.

*Question 2*

Calculate and plot the local and global efficiency of Watts-Strogatz networks for different values of $p$. Plot also their average shortest path length and clustering coefficient. What are the differences and similarities between these four measures, both theoretically and in practice?