**CS – 590.21 Analysis and Modeling of Brain Networks**[**Department of Computer Science**](http://www.csd.uoc.gr/)**University of Crete**

**Graph theoretical analysis– ReadMe file**

This graph theoretical analysis introduces the script main\_small\_world that takes as input the following datasets:

1. the biological data of an animal that contains information about the number of neurons, the type (e.g., interneuron, astrocyte or pyramidal) and the coordinates of each neuron
2. the representation of a network which is an m x 2 array (m: the number of edges in this network). Each row represents a connection between the neuron with the id of the first column and the neuron with id of the second column.

This script estimates the small-worldness and the small-world propensity coefficient of the network. It uses three different approaches for these estimations:

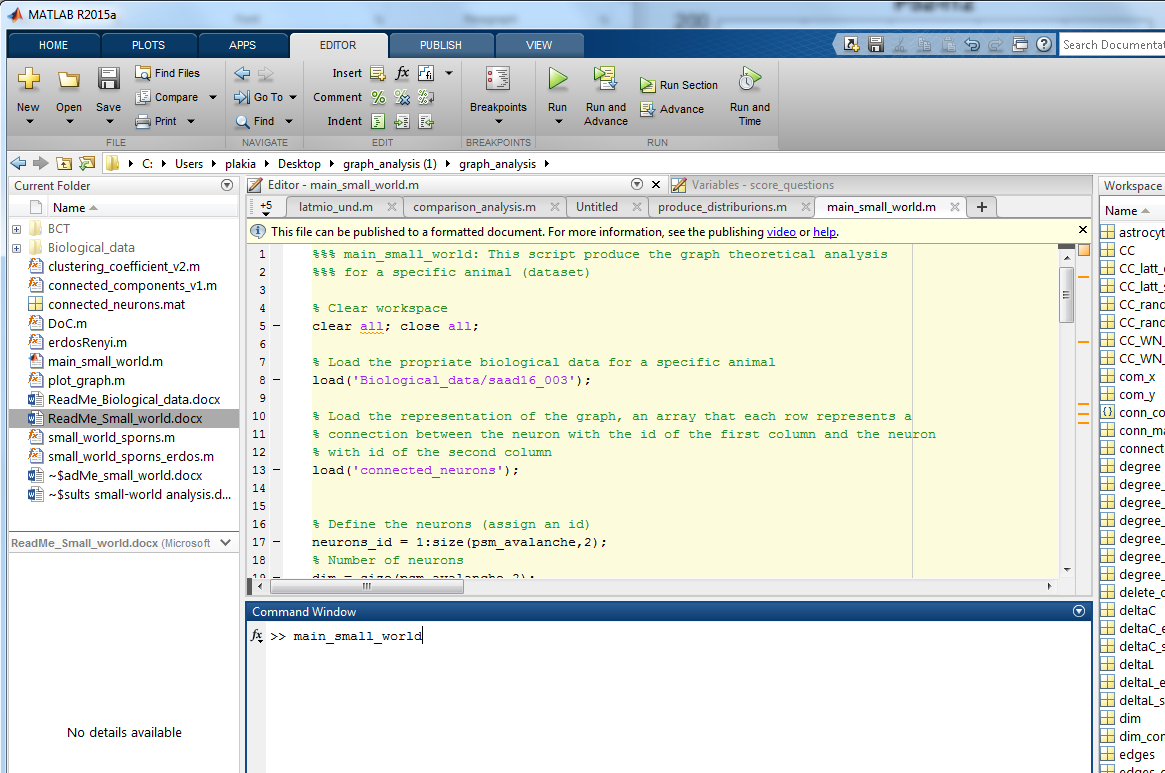
1. Sporns real-based method (function: small\_world\_sporns)
2. Sporns Erdos like (function: small\_world\_sporns\_erdos)
3. Erdos-Renyi (function: erdosRenyi)

For each one of the approaches there are estimated two types of graphs the lattice and the random. Moreover for each one of the graphs there are computed the following metrics:

* clustering coefficient (function: clustering\_coefficient)
* shortest path length (build-in function: graphallshortestpaths)
* degree of connectivity (function: DoC)

After downloading the folder graph\_analysis, start form the main\_small\_world script.

First you will need to define the biological dataset of a specific animal (line 5) and the corresponding network represantation (line 13). When the datasets are specified then on the command window of the Matlab run the following command: *main\_small\_world*



In lines 33- 35 the connected components of the network, with more than three neurons, are estimated.

Then we apply the small-world analysis for each one of the connected components (lines 38-52), considering three approaches:

1. Sporns real-based method
2. Sporns Erdos like
3. Erdos-Rιnyi

Based on the produced metrics the small-worldness coefficient and the small-world propensity coefficient are computed.

In the following lines of the script several plots about the degree of connectivity are produced.