

Complex Networks: computer exercises

Lab day – 2

Tuesday, 17th of July, 2007

1. GENERATION OF RANDOM NETWORKS: Write an algorithm to generate random networks with N nodes and L links. Make sure that the generated network has L links as desired. *Warning! we do not want to introduce self-loops (a link connecting one node to itself) nor multiple links (more than one link between a pair of nodes).* For a random network with $N = 53$ and $L = 1046$, calculate:
 - (a) its degree distribution, and
 - (b) its clustering coefficient.

Compare to the properties of the cat cortex.

2. RANDOMIZATION OF REAL NETWORKS: Using the cat cortical network as source, write an algorithm to rewire networks that conserve the original input and output degrees of individual nodes. Make sure that the final network conserves the input and output degrees. Once the cat cortical network is rewired, measure the following properties and compare them to original values:
 - (a) reciprocity
 - (b) clustering coefficient C .
 - (c) Additional exercise: compute the local clustering coefficient for each of the nodes in the rewired network. Plot again $\langle c_i \rangle$ vs k_i . What is the difference with the similar plot of the cat cortex?
3. ADDITIONAL EXERCISE. STABILITY OF REWIRING PROCEDURE: For different rewiring parameters ($m_{rew} \in [0, 5L]$) generate a set of 20 rewired networks, calculate the reciprocity of each realization. To show that the rewiring procedure reaches a region of stability (generates maximally random networks with the given degree sequences), plot the ensemble average reciprocities vs m_{rew} .

Report Return a brief report that summarizes both methods used. How do you avoid introduction of self-loops and multiple links? How can you randomly choose a link so that all links are picked with the same probability? Summarize all the obtained results. Compare the real values for the cat cortical network to those of the random networks. Are real values significant? Under which conditions? Commented code of each exercise will be attached in separate pages.