Nestedness in complex networks

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Understanding the causes and effects of network structural features is a key task in deciphering complex systems. In this context, the property of network nestedness has aroused a fair amount of interest as regards ecological networks. In order to make progress, systematic analyses of nestedness and nestedness indices are necessary. Indeed, Bastolla et al. introduced a simple measure of network nestedness[1] which opened the door to analytical understanding, allowing them to conclude that biodiversity is strongly enhanced in highly nested mutualistic networks.

In this work[2] we suggest a slightly refined version of such a measure of nestedness that exhibits a number of additional advantages: (i) it allows us to identify the amount of nestedness associated with each single node in a network, making it possible to define a "local nestedness"; (ii) the new index is properly normalized and provides an output equal to unity in uncorrelated random networks, allowing us in this way to discriminate contributions to nestedness beyond network heterogeneity. Having removed the direct effects of the degree distribution - which has a dominant contribution to other measures of nestedness - it is possible to move one step forward and ask how degree-degree correlations (as quantified by Pearson's coefficient) influence nestedness measurements. We aim to understand to what extent nestedness is a property inherited from imposing a given degree distribution or a certain type of degree-degree correlations on a network.

We find that most of the empirically found nestedness stems from heterogeneity in the degree distribution. Once such an influence has been discounted - as a second factor - we find that nestedness is strongly correlated with disassortativity and hence - as random networks have been recently found to be naturally disassortative - they also tend to be naturally nested just as the result of chance. In conclusion, degree heterogeneity together with the finite size of real networks suffice to justify most of the empirically observed levels of nestedness in ecological bipartite network.

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[1] Bastolla U, Fortuna M, Pascual-García A., Ferrera A, Luque B, et al. (2009) The architecture of mutualistic networks minimizes competition and increases biodiversity. Nature 458: 1018-21

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