Optimized node numbering in evaluating topological proximity of complex networks

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The node numbering in complex network is arbitrary and has on influence on the network topology. However, it can influence the way the network is represented, either by the way nodes and links are drawn or by the form of the adjacency matrix (AM). In the first case, numerical softwares like PAJEK [1] provide optimized representations, in which the nodes with largest degrees are placed in the center of the figure, while nodes with low degree occupy the areas close to the border of the figure. This way, the node numbering becomes irrelevant for the final representation. In the second case, we propose here a procedure to optimize the AM representation, which is based on the knowledge of generalized AM's that indicate the different higher order neighborhoods of the nodes in a network. Such matrices can be conveniently defined with the help of Boolean products of matrices [2], and can be summed up to constitute a matrix Mc the entries of which count the minimal number of steps linking any two nodes. The renumbering procedures is based on Monte-Carlo process, in which a function E that measures the sum of the differences between the corresponding matrix elements of two matrices: Mc, which is generated from the original numbering; and a matrix L, a priori chosen, which represents que ideal situations, as that one in which a matrix is completely ordered and periodic. The time evolution of the numbering is indicated by Mc(t). Its asymptotic form characterizes how well the network has properties that are similar to that one displayed by the network represented by L. Finally, the optimized numbering allows us to graphically identify, through the asymptotic form of the matrix Mc, whether the net work shares similarities with some archetypical networks (ordered, small world, Erdos-Renyi or scale free).

[1] http://vlado.fmf.uni-lj.si/pub/networks/pajek/
[2] http://arxiv.org/PS_cache/physics/pdf/0508/0508068.pdf