

Scaling of consensus times in the biased-voter model

R. Toral

IFISC (Institute for cross-disciplinary physics and complex systems), UIB-CSIC, Palma de Mallorca, Spain

The voter model is arguably the simplest and one of the most widely studied out-of-equilibrium models with application to different scenarios of social interest. The rules are very simple: consider a network such that in each node lies an agent capable of holding one of the possible values of a binary variable. Then, a node is randomly selected and the agent in that node copies the value of the variable held by another agent in another randomly selected connected node. Most of the literature assumes that both values of the binary variable are equivalent. In this work we focus in the situation where there is a bias towards of the two values. This situation has been considered previously as, for example, indicating the lack of asymmetry in the social preference for one or another language in a bilingual community. We introduce bias by letting a fraction of the agents to copy with a higher probability one the two options (the preferred option). We first assume that there is no correlation between the connections of the biased agents and revisit some of the results about the dependence of the time to reach consensus as a function of the bias parameter. We then ask the question of how the ratio of the density of connections between biased nodes (B) and unbiased nodes (U) influences the behavior of the system. To this end we use two different strategies to connect nodes and compare the results with the random network. Both strategies keep the same average degree and the total number of links as in a random network of the same size. Case I assumes that we cut links between unbiased nodes and draw additional links between biased nodes (i.e. a UU node becomes BB). The strategy in case II is to rewire links to increase the number of biased-biased connections (BU becomes BB) or to decrease the number of unbiased-unbiased connections (UU becomes UB), keeping the degree of each node constant. It seems that a crucial role for reaching consensus are the degrees of biased and unbiased nodes, rather than the number of links between pairs of biased or unbiased nodes. Even if the majority of the nodes is biased but weakly connected, the probability to reach consensus in cases I and II cannot be larger than in a random network. On the other extreme case, when biased nodes form a well-organized minority, case I gives higher probability to order for the preferred state. In the thermodynamic limit any non-zero value of the bias leads to preferred consensus. In contrary, when the network is finite, there is always a chance to order in the not preferred state. For random network case we find that behavior of the system depends of the effective bias, which is the value of bias parameter multiplied by the number of biased nodes. When the topology is not random that scaling disappears. Our analytical results are supported by numerical simulations.