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Spin-glass-like transition in the majority vote model with contrarians

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Majority vote model on random graphs and scale-free networks is investigated, in which a fraction p of agents (called contrarians or anticonformists) follows an antiferromagnetic update rule, i.e., they assume, with probability governed by a parameter q (0 < q < 1/2), the opinion opposite to that of the majority of their neighbors, while the remaining 1-p fraction of agents follows the usual ferromagnetic update rule assuming, with probability governed by the same parameter q, the opinion in accordance with that of the majority of their neighbors. For p=1 it is shown by Monte Carlo simulations and using the Binder cumulants method that for decreasing q the model undergoes second-order phase transition from a disordered (paramagnetic) state to a spin-glass-like state, characterized by a non-zero value of the spin-glass order parameter measuring the overlap of agents' opinions in two replicas of the system, and simultaneously by the magnetization close to zero. Besides, in this state the correlation of the agents' opinions exhibits exponentially decaying oscillations, as expected in the spin-glass phase.
In the case of the model on scale-free networks the critical value of the parameter q weakly depends on the details of the degree distribution. As p is decreased, the critical value of q falls quickly to zero and only the disordered phase is observed. On the other hand, for p close to zero for decreasing q the usual ferromagnetic transition is observed.

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