Intrinsic noise and deviations from criticality in Boolean gene-regulatory networks

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Gene regulatory networks can be successfully modeled as Boolean networks. A much discussed hypothesis says that such model networks reproduce empirical findings the best if they are tuned to operate at criticality, i.e. at the borderline between their ordered and disordered phases. We study the effect of noise within the context of Boolean networks trained to learn complex tasks under supervision. We verify that quasi-critical networks are the ones learning in the fastest possible way. On the other hand, when additional sources of intrinsic noise in the network are introduced, the optimally performing networks become clearly subcritical. These results suggest that in order to compensate for inherent stochasticity, regulatory and other type of biological networks might become subcritical rather than being critical.

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