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Mutual information in random Boolean models of regulatory networks[1] JOSHUA SOCOLAR, Physics Dept. and Center for Systems Biology, Duke Univsersity, ANDRE RIBEIRO, Tampere University of Technology, BJÖRN SAMUELSSON, Lund University, JASON LLOYD-PRICE, STUART KAUFFMAN, University of Calgary — In a large, complex network of interacting elements, such as a genetic regulatory network within a cell, the average of the mutual information over all pairs of elements is a global measure of how well the system can coordinate its internal dynamics. We study the average pairwise mutual information $\mathcal{I}$ in random Boolean networks (RBNs) as a function of the distribution of Boolean rules implemented at each element, assuming that the links in the network are randomly placed. As the number N of network nodes approaches infinity, $N\mathcal{I}$ exhibits a discontinuity at parameter values corresponding to critical RBNs. For finite systems, $N\mathcal{I}$ peaks near the critical value, but slightly in the disordered regime for typical parameter variations. The source of high values of $N\mathcal{I}$ is the indirect correlations between pairs of elements from different long chains with a common starting point. The contribution from pairs that are directly linked approaches zero for critical networks and peaks deep in the disordered regime.

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