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Boolean modeling of collective effects in complex networks[1] JOHANNES NORRELL, JOSHUA SOCOLAR, Duke University Physics Department — Complex systems are often modeled as Boolean networks in attempts to capture their logical structure and reveal its dynamical consequences. Approximating the dynamics of continuous variables by discrete values and Boolean logic gates may, however, introduce dynamical possibilities that are not accessible to the original system. We show that large random networks of variables coupled through continuous transfer functions often fail to exhibit the complex dynamics of corresponding Boolean models in the disordered (chaotic) regime, even when each individual function appears to be a good candidate for Boolean idealization. A simple criterion identifies continuous systems that exhibit the full dynamical range of their Boolean counterparts. Transfer functions inferred from the literature on transcriptional regulation of genes do not satisfy the criterion.

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