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Frequency of Relevant Nodes with Different Function Classes in Critical Boolean Networks[1] SHABNAM HOSSEIN, MATTHEW REICHL, KEVIN E. BASSLER, University of Houston — Boolean networks have two phases of dynamical behavior, fixed and chaotic, depending on the update functions of the nodes. Boolean functions can be categorized by their symmetry properties, which are related to their canalization properties. Canalization is a type of network robustness, which was first introduced to explain the stability of phenotype expression of biological systems. For networks with 3 inputs per node, the 256 possible Boolean functions can be divided into 14 classes that correspond to the group orbits of rotation plus parity. For critical networks at the boundary of the fixed and chaotic phases, we analytically derive the frequency of the different types of Boolean functions among the relevant nodes that control the dynamics. By setting up a set of differential equations that determines the relevant nodes through a pruning process, we can find the average number of nodes in each of the classes. Then, considering the effects of fluctuations, the probability distribution of the number of relevant nodes is accurately derived. We find that in critical networks the frequency of relevant nodes is inversely correlated with canalization.

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