[P24] Boolean cascade model for metabolic networks: a branching process approach

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The branching process (BP) approach has been successful in explaining the avalanche dynamics in complex networks. However, its applications are mainly focused on unipartite networks, in which all nodes are of the same type. Here, motivated by a need to understand avalanche dynamics in metabolic networks, we extend the BP approach to a particular bipartite network composed of Boolean AND and OR logic gates. We reduce the bipartite network into a unipartite network by integrating out OR gates, and obtain the effective branching ratio for the remaining AND gates. Then the standard BP approach is applied to the reduced network, and the avalanche size distribution is obtained. We test the BP results with simulations on the model networks and two microbial metabolic networks, demonstrating the usefulness of the BP approach.