Abstract

We consider a model for gene regulatory networks that is a modification of Kauffmann's [J Theor Biol 22 (1969), 437–467] random Boolean networks. There are three parameters: n = number of nodes, r = number of inputs to each node, and p = expected fraction of 1's in the Boolean functions at each node. Following a standard practice in the physics literature, we use a threshold contact process on a random graph on n nodes, in which each node has in-degree r, to approximate its dynamics. We show that if $r \geq 3$ and $2p(1-p)r>1$, then the threshold contact process persists for a long time, which correspond to chaotic behavior of the Boolean network. Unfortunately, we are only able to prove the persistence time is $\geq \exp(cn^{b(p)})$ with $b(p)>0$ when $2p(1-p)r>1$, and $b(p)=1$ when $2p(1-p)(r-1)>1$.