Modularity and Boolean Network Decomposition

Claus Kadelka[1], Reinhard Laubenbacher[2], David Murrugarra[3], Alan Veliz-Cuba[4],
Matthew Wheeler[2,*]

[1]*Department of Mathematics, Iowa State University, Ames, IA 50011*
[2]*Department of Medicine, University of Florida, Gainesville, FL 32610*
[3]*Department of Applied Mathematics, University of Kentucky, Lexington, KY 40508*
[4]*Department of Mathematics, University of Dayton, Dayton, OH 45469*

`mwheeler1@ufl.edu`

The notion of modularity arises in many areas of biology, but almost never as a mathematically well-defined concept. Boolean networks have proven to be effective tools for representing and analyzing complex networks, especially biological networks. We discuss a theory for decomposing Boolean networks. A major prospect of this theory is that the dynamics of the network can also be broken down and computed from the smaller constituents of the decomposition. While mathematically interesting on its own, this decomposition theory also has interesting biological implications. The properties of the decomposition of models can provide hypotheses for the definition and identification of biological models. In the long run, we are interested in learning what this theory might tell us about the modularity of biological networks.