Boolean Modelling

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Boolean modelling results the "boolean" properties of the network. However other types of modelling can result in different sets of hidden properties network possesses with respect to that modelling formalism.

Boolean modelling is somewhat interesting since it eliminates the need for requirement of dynamic parameters since in the case of gene regulatory networks, the combination of dynamic parameters results in pretty much two kinds of beaviours approximately, there is some sort of canalization just in terms of the kinetic parameters as well.

There are several ways to discretize and model what we have or rather different boolean formalisms.

- Synchronus
- Asynchronus
- Threshold Boolean networks
- Petri nets
- P systems
- Reaction diffusion systems

Gene regulating networks are canalizing but since the output space is limited then the network must either sit steady on an attractor or form a cycle. Thefore you can charaterize a function on the basis of how fast it leads to an attractor if it does and how many attractors are there, how many loops are there.

Boolean formalism helps us to understand several centrality measures. What would date hubs mean here?

In order to have feedback loops you need outward nodes.

Now when it comes to defining the boolean function, two transcription factors could be simultaneously needed for a node to become active, or rather be joined vi a an and function. When there's independent activation then OR operator could capture the boolean function.

Asynchronous and stochastic update leads to non deterministic functions while synchronys leads to a deterministic trijectory.

Apparently updating schemes have a considerable effect on the dynamics of the system.

For some reaso whe nthere is no information to inform the choice of update scheme, updaing one node at a time is the most effective choice.

Basin of attractors. Ideally one might want to map the basin and would expect nearby states to have the same attractor.

One might think of the map from state space repertoire to attractors and think about the dimensionality, basis etc if they mean anything in this biological context.

attractors of a synchronus model has disjoing basins of attraction. The basin of attraction od ifferent attrators in stochastic aynchronus models may overlap.

An interesting question is how does the formalism restrict the possible solutions? And what restrictions does just the update function and asynchronus update function imposes on the possible steady states/solutions or does it allow all sorts of solutions to exist.

synchronus models may exhibit limit cycles which are not present in the corresponding asynchronus models

The steady states are solutions of a certain equation??

One could use network reduction techniques and get rid of edges which don't add much meaning.

Iteratively absorbing nodes without a self loop was proven to preserve the fixed points of a system.

State transition graph: Nodes are the states of the system and the edges denote the allowed transitions among the states according to the chosen ypdating scheme.

We could also look into initial nodes which could give rise to both terminal phenotypes. The lack of such intersections might indicate robustness in some way.

Network reduction

1 Concepts in Boolean Network Modeling: What do they all mean?

After considering different variants of asynchronyus updating, it was found that synchronus update was more suitable for checking robustness. Something called temporal BN exteinsion allows modling on different interactions and timescales while maintaining the deteministic nature of synchronus BNs.

A variety of different update strategies for asynchronus BNs ami to limit the burst of different dynamics emerging from the asynchronus paradigm.

probabilistic BNs allow for alternative boolean functions for each component. The update mechanism is synchronus and the boolean function fo each component is drawn according to its probability before each state transition.

Biological networks exhibit modularity. A large number of biological networks also exhibit scale free property. This topology has significant effects on robustness.

Regulatory functions in biological networks are monotone? What does this mean?

Probabilistic boolean networks allow complex attractors as synchronus ones?

Characterising initial states which lead to different basins and then characterising such basins might be a metric which might indicate hybridness