Cellular Automata on Networks (CAN)

About this document

This documents lists some initial ideas for the simulation/evaluation of Cellular Automata on Networks.

Concept

Cellular automata are simple, discrete processes that were conceived in the context ot artificial intelligence / computer intelligence. One of the major ideas is that for given initial conditions and some simple algorithms, complex patterns results (see http://en.wikipedia.org/wiki/Cellular_automaton)

Historically, cellular automata were defined on 2-dimensional lattices and each 'node' in the lattice had two possible state values (black/whie, on/off). Extensions have been made to n-dimensional lattices and to algorithms that give rise to more than 2 possible state values ("coloured" automata).

All lattices belong to a special class of networks but not vice versa. Within the context of network analysis it may thus be fruitful to analyze how complexity can arise from simple algorithms in general networks. Some specific topologies that are not lattices may be considered (trees, hub-and-spokes, …) for initial purposes.

Literature

Some work has been done within the frame of the Wolfram NKS (New Kind of Science) summer schools, Stephen Wolfram being among the originators of cellular automata. See: http://demonstrations.wolfram.com/PathRewritingCellularAutomata/

This work focuses on re-configurative algorithms, i.e. where nodes actively changes their links as a result of simple algorithms.

Goals

Some specific questions of interest may be:

1. Can results from lattices be generalized to networks in general? In other words, it the 'regularity' of a lattice required for or promoting (certain) emergent behaviour?
2. Are certain topologies less prone to the emergence of complex behaviour?
3. Do topological characteristics give rise to different emergent behaviour? Is there a link?

Strategy

It is likely beneficial to evaluate the simple automaton rules similar to the original works first on different types of particular networks. Some topologies may include:

1. trees
2. hub-and-spoke topologies
3. random networks
4. "circular" topologies (only loops, no "dead ends")