Simulation of an Ecosystem on a Toroidal Lattice with Three Species

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The Wa-Tor problem (from water torus) is a well-known dynamic cell process, aiming to mimic the predator-prey interaction in Biology. It is introduced by Alexander Dewdney in the 80s for two ”species” on a toroidal lattice, with straightforward procedures for procreation, starvation and death and is observed to have features reasonably similar to both the Lotka-Volterra model and actual predator-prey observation data. Its most important feature is that with suitable initial conditions it stays in balance indefinitely, exhibiting cyclic behavior. Additional reason for interest in this cellular process is the fact, that it have been considered as a benchmark for testing multithreading directives in parallel computing. This is important, as similar, but more computationally intensive processes have been proposed for modelling forest fires, floods and the behavior of invasive species. In the current project, we generalize the classic problem to a food chain with size 3 and we show examples of stable starting conditions which are found via genetic algorithms.We also examine the periodic behavior of the system and provide a new algorithm for finding the boundary for the stable starting conditions of the system both with two and three species when fixing the size of the torus. We also introduce a memoryless equivalent of Wa-Tor, which might be easier to study with the apparatus of the mutually catalytic branching random walks.

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