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Preliminary Report on Final Project

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# Evolving Interesting Universes Using Supersets of Conway's Game of Life

Introduction

Years after its discovery, Conway's Game of Life endures as one of the most popular, accessible, and commonly known examples of cellular automata. A great deal of writing and programming have gone into exploring it and its variations, and associated cell patterns ranging from logic gates to artwork.

Consider for a moment the possible number of rules in the Game of Life. Since each cell can be surrounded by 0 to 8 cells, there are 9 different possibilities. Since there are one set of rules for birth and one set for survival, the total number of rules is (2 ^ 9)(2 ^ 9) = 2 ^ 18. At the risk of being extremely prejudice about the other rules to this game, one could say that 1 in 2 ^ 18 rules led to a *really* interesting universe.

What if the possibilities were expanded? Consider a variation, the *Weighted* Game of Life, wherein the corners and orthogonal cells are treated with different numerical weights when performing addition. Since a cell is always surrounded by 0 to 4 cells diagonally by 0 to 4 cells orthogonall, 5 x 5 = 25 different configurations are possible. Thus the equation for the total number of possible rules in Weighted Game of Life is (2 ^ 25)(2 ^ 25) = 2 ^ 50.

Experiment Discussion

The large possible number of rules available in the Weighted Game of Life make it an excellent choice for employing evolutionary algorithms to evolve interesting universes. For the first experiment a population of 40 randomly generated rules describing a Weighted Game of Life universe will be evolved. Each rule will be simulated in a 100 x 100 grid, starting with a random population, and be given 100 cycles to operate. The fitness function will be derived from Conway's Game of Life, and its preliminary form will be based 1/3 on the number of static cells, 1/3 on the number of 2-8 period oscillators, and 1/3 on the remaining number of cells displaying complex behavior. The rules will be ranked, the top ranking rule will be saved to disk, and finally an entirely new generation will be created from crossbreeding and mutating the top performing half of the rules (killing off the parent generation). The simulation will be allowed to run until the fitness of the best rule reaches 0.99, then allowed to continue for several more generations to see what ensues.

I expect that the best performing rules will approach the fitness of and share some "lifeforms" with Conway's Game of Life. Though possible, I do not expect the experiment to rediscover the exact rule Conway's Game of Life.

I believe followup experiments involving modification of the geometry or fitness function could lead to a variety of interesting new universes, ones that would not be discoverable without the Weighted birth and survival approach.