CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36722

Project Title

Spaceship Soup: Predicting the Emergence of Moving Objects from Random Configurations of Cells in Cellular Automata

Abstract

Objectives/Goals

I wanted to find what conditions were necessary for moving objects, known as #spaceships#, to be produced in cellular automata with varying birth rules (how many of an empty cell#s eight neighboring cells are required to be on to turn it on) and survival rules (how many of an already-on cell#s eight neighboring cells are required to be on for it to stay on). I hypothesized that rules in which cells are born with three neighbors (Conway#s Game of Life and DryLife) would produce more spaceships than rules in which cells are born with two or four neighbors (Move, 2x2, and Seeds).

Methods/Materials

I used the open-source computer program Golly to run tests of five cellular automata: Conway#s Game of Life, Seeds, Move, 2x2 and DryLife. Using Golly#s #random fill percentage# feature, I created three random initial starting configurations, called #soups#, which are 16x16 grids of cells in which 25%, 50% or 75% of the cells are already #on#, with the #on# cells distributed randomly. I watched these soups evolve for 1,000 generations in each of the five cellular automata, and then counted the number of spaceships that had appeared.

Results

Seeds (which requires two neighboring #on# cells to turn an #off# cell on) produced by far the most spaceships of any rule, with about 500 ships produced. Conway#s Game of Life and DryLife (whose birth rules are three neighboring #on# cells and three or seven neighboring #on# cells, respectively) also produced spaceships. Move (which requires three, six, or eight neighboring #on# cells to turn an #off# cell on) and 2x2 (which requires three or six neighboring #on# cells to turn an #off# cell on) produced no spaceships.

Conclusions/Discussion

My hypothesis was partially correct. I hypothesized that rules in which cells are born with three neighbors would produce more spaceships than rules in which cells are born with two or four neighbors. My hypothesis was correct in that rules in which cells are born with three neighboring #on# cells did produce many spaceships, but incorrect in that the rule in which cells are born with two neighboring #on# cells would produce the most spaceships. I did predict that Move and 2x2 would produce fewer spaceships.

Summary Statement

I tested five different cellular automata to see which ones would produce the most moving objects after 1000 generations, starting with random configurations of cells on a 16x16 grid.

Help Received

I designed and performed the experiment myself. My parents proofread the final project report and display board.