CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

Drew L. Bent

Project Number

J1603

Project Title

Exploring Rule Variations in Conway's Game of Life: Programming for the Computer and iPhone Platforms

Abstract

Objectives/Goals

Conway's Game of Life is a cellular automaton, which is a mathematical simulation that demonstrates the phenomenon of how complex patterns can be formed by a few simple rules. The purpose of the project is to investigate how changing the rules will affect the population of cells as a function of generation in the Game of Life. It is hypothesized that there is a rule set different from Conway's that has a larger variety of evolution patterns formed from simple starting arrangements. Such a rule set would be an improved version of Conway's according to his standards, in which he tried to find a set that created unpredictable population behavior.

Methods/Materials

The Game of Life was programmed on the iPhone platform using the iPhone Software Development Kit and for the computer platform using Adobe's Flash software. In one experiment, rule variations were tested against the original rules using each of 12 pentominoes as starting arrangements. Population was recorded at each generation and the population evolution was categorized into four different population outcomes (rapidly increasing, dying off, steady, and oscillating) for each pentomino under each set of rules. In the second experiment, a new parameter was used with the original rules that caused each cell to die after staying alive for a specific number of consecutive generations (called a death parameter).

Results

In the first experiment, the results show that different sets of rules lead to different distributions of population outcomes. Two of the tested rule variations have a more even distribution of population outcomes (standard deviations of ~2.12 and ~1.58) than Conway's original rules do (~2.55). In the second experiment, the generation numbers at which the average populations of the pentominoes for each rule set start to noticeably decrease (G') are correlated with the values for the death parameter (D). The bigger the D value, the longer it takes for the average population to decrease, with G' becoming more similar as the death rates get larger.

Conclusions/Discussion

The results from both experiments support the idea that the rules play an important role in creating different patterns in the Game of Life. The biggest contribution this work will give to the field of Conway's Game of Life is finding two rule variations that create more interesting and unpredictable patterns than Conway's when using simple starting arrangements.

Summary Statement

This project involves programming Conway's Game of Life for two platforms and exploring the effects of altering the rules to try to find a more desirable set of rules than the original ones.

Help Received

Parent helped with discussions about experimental design.