An Investigation of Cellular Automata Dynamics

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Introduction

John Conway's Game of Life consists of a field of square cells, each of which can be alive or dead and has eight cells around it. Under his rules, every living cell that had exactly two or three living neighbors would survive into the next generation. Every dead cell with exactly three living neighbors would be alive in the next generation. This project enables different cells to have different rulesets; every cell that is born inherits its rules from the cells around it, but can also mutate, based on a probability partially inherited from its neighbors.

Abstract

John Conway's Game of Life showed that simple rules can generate amazingly complex patterns. Using variations of the rules he devised, one can learn about the advantages of different sets of rules and the implications for simple evolution and chaos theory.

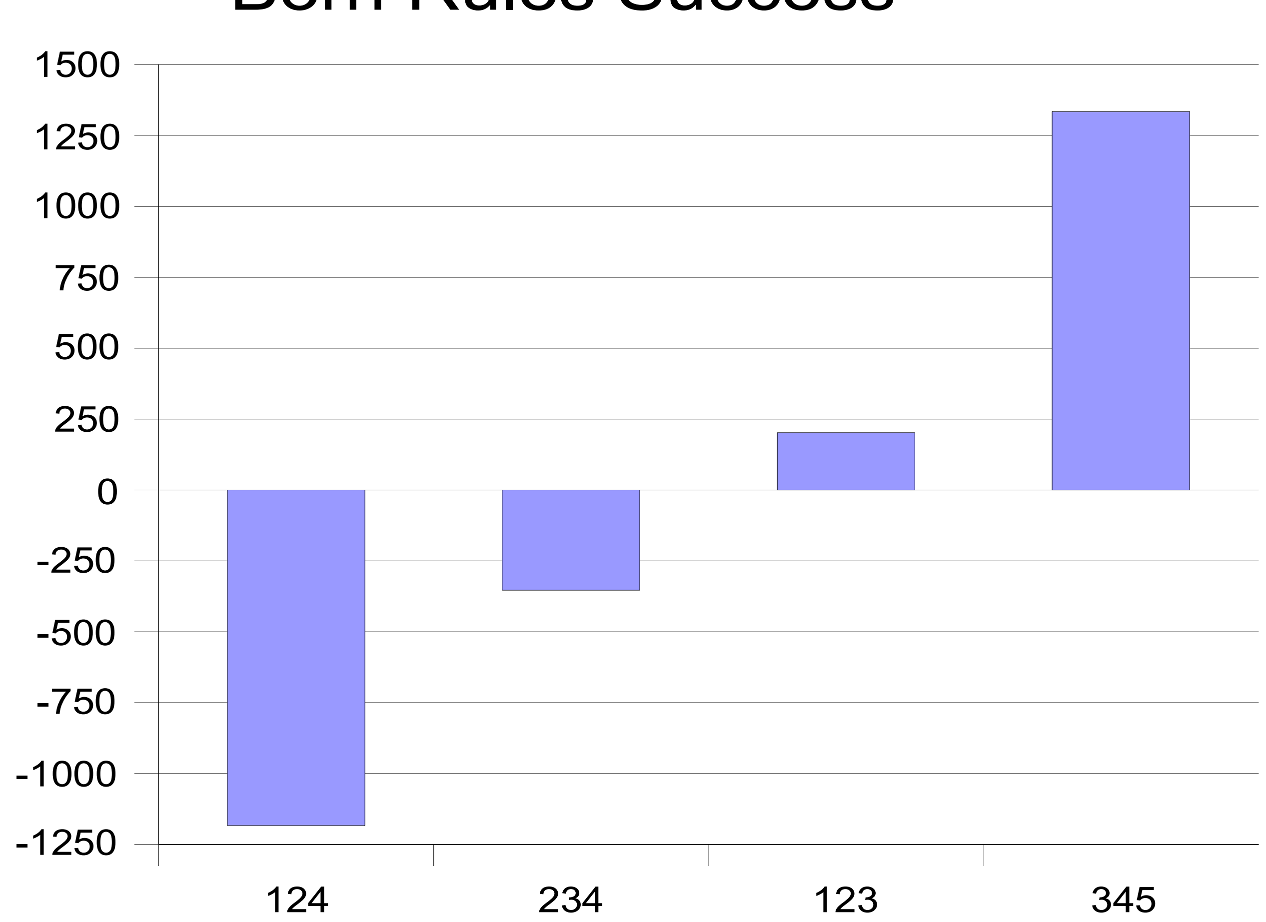
Procedures

The field is initially set with two or more rulesets active; each cell is randomly set to be alive or dead, and its neighbors share its rules. After one set dominates the board, it and its opponents are recorded. When twenty of these trials have been run, the rulesets occurring at the end of trials are recorded and ordered by the number of trials in which they were present. These rulesets are then matched against each other in the second round of testing to determine relative strengths.

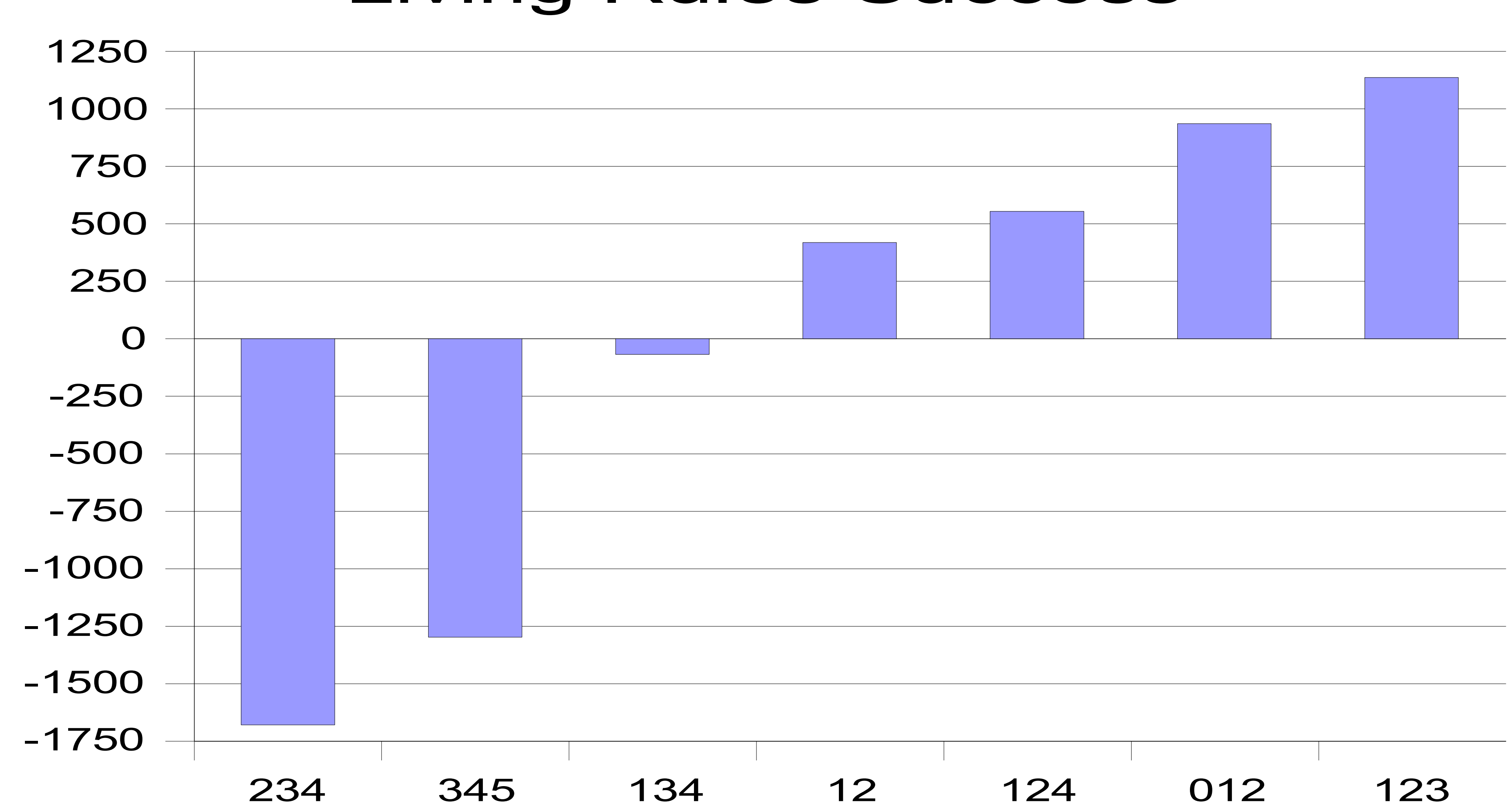
Conclusions

The strongest ruleset in general was 345/234, but though that was the focus of the project, that result is not the most important conclusion. From looking at the graphs of how well the born rules did, and how well the living rules did, one would think that we could calculate how well the combination would do, but that is not in fact the case. The two parts of a ruleset are intimately connected, and one cannot consider them in isolation and use that data to generalize to larger results.

Born Rules Success



Living Rules Success



Overall Percentage in Testing