A Cellular Automata Approach to Population Modeling

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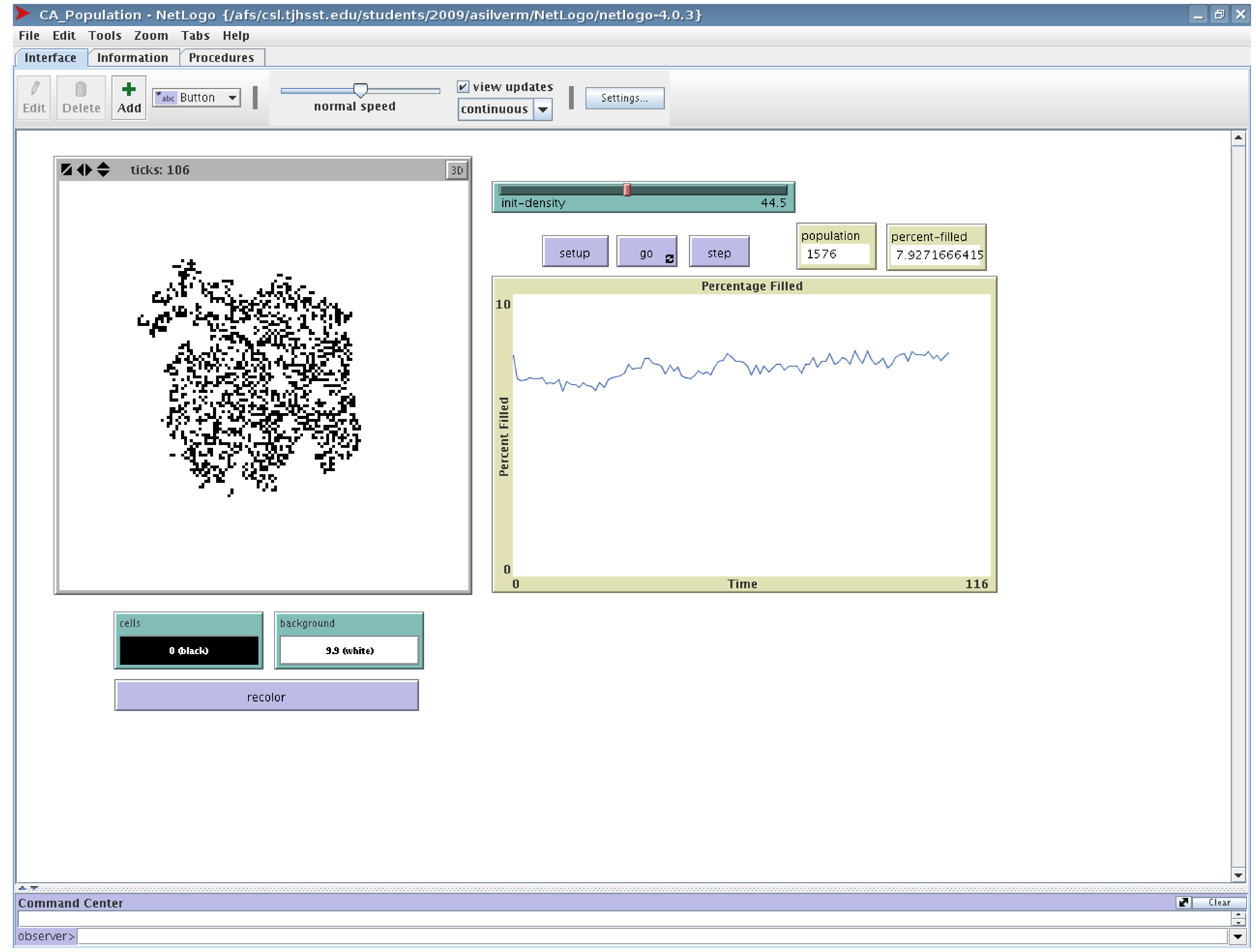
Abstract

This project provides an agent-based model of population growth and change using a 2D cellular automata algorithm to predict behavior. The purpose of this project is to demonstrate how the behavior of a group is dependent on the interactions between individual group members, and to show that a cellular automata approach is valid in modling ecosystem behavior. It will model the effect of various influential factors on populations in an ecosystem and use graphs to show the results of changes in these factors.

Background

Cellular automata exist as ‘cells’ on a grid, wherein the behavior of each cell is determined by the states of its eight neighboring cells. The "Life" collection of automata rules is based on the idea that survival of individuals in a population requires an adequate number of neighbors; that an individual can die due either to loneliness or overcrowding, and that an individual is only born when a "family" of individuals is already present.

The rule used in this project to predict behavior is 14/3; in the terminology of Life rules, this means that a live cell with one or four live neighbors will survive a generation, and a dead cell with exactly three live neighbors will be replaced with a new live cell. This inherently suggests that two types of individuals exist: one which is less social (prefers one neighbor) and one which is more social (prefers four neighbors).



View of the program in the NetLogo interface

Results

The program correctly runs the cellular automata rule 14/3 (live cells with 1 or 4 neighbors survive the turn, dead cells with exactly 3 neighbors are born in the next turn) and allows the user to select the initial population density. It also graphs the percentage of live versus dead cells and provides population counts. Initial densities which are too low or too high result in small, isolated groups of individuals; the ideal initial density (shown above), in which the population grows more or less steadily outward, is about 44.5%.