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Conway's Game of Life Report

INTRODUCTION

The goal of this project was to study the Game of Life as described by Mathematician John Horton Conway. Conway's Game of Life is less of a game and more of an algorithm. The game is "played" on a grid which is only determined by the initial state of the grid.

CONWAY'S GAME OF LIFE

There are only a couple rules in this game. One rule is that a live cell, a specific point on a grid, 'survives' if it has two or three neighbors. Another rule is that any dead cell that has three live neighbors, 'revives'. Finally, All other living cells die in the next generation. Similarly, all other dead cells stay dead.

IMPLEMENTATION

The simulation that we designed was put together in Python. The map is represented by a 50x50 matrix. Then we can create the initial state by adding some live cells to the empty map. Then we can create a function that kind of acts as a transition function. This function takes the current state, the nxn matrix, and returns the new state. This is achieved by going cell by cell in the input map and adding up all its alive neighbors. It is important to know that the simulation employs a periodic boundary condition, it's easy to think about it like a game of pacman, where when you travel through a tunnel you end up on the opposite side of the screen. Each cell's live neighbors in its Moore model neighborhood is added to find the total number of live neighbors, which is the only thing that really influences the future state of a cell. We then have two cases, the current cell is alive or it is dead, if it’s alive, and the total number of live neighbors is not two or three it dies. If it's two or three it keeps living. The other case is if the current cell is dead. If its dead, the only way it can change states (revive) is by its alive neighbor count is exactly three, so that is the only condition we check for. Then we return the new matrix/state. This process is then animated and displayed with the matplotlib python library.

FINDINGS

When trying out the program there were three interesting shapes that kept appearing, and that are especially important. One is the 2x2 set of live cells, which is referred to as a block. This block object is referred to as a still life because it does not change and will never change unless there is interference from some other cells. Another one is three neighboring live cells in a straight line which is referred to as a blinker. A blinker is a shape that seems to rotate (counterclockwise or clockwise it depends on how you look at it) 90 degrees every iteration. A blinker is an example of a shape that is referred to as an oscillator, this a kind of shape that goes back to its original shape after a number of iterations, given that it is not interrupted by any extraneous live cells. Finally, the most interesting of the shapes was a shape that could travel across the map indefinitely, the shape called the glider. This glider is a part of the spaceship category which can move themselves across the map. This is a shape that could introduce a fair amount of randomness to the state of the map. If we insert a glider into a map as simple as a map of one blinker, and they make contact, we see an impressive amount of activity in the resulting states.

IMPROVEMENTS

There are a few ways that we would have changed our project if we were to have done it all over. The biggest thing that we would change would be testing out other rules. All of the interesting shapes that we found were because of the original rules of the game. Maybe if we change some or all of the rules we can find some different shapes that result from the change in rules.

CONCLUSION

In conclusion, this report has explored the Game of Life as described by Mathematician John Horton Conway, and its implementation in Python by Carlos Mercado, Jordan Nicholls, Edgar Renteria, and Maria Guimaraes. The report has provided a detailed explanation of the rules of the game, the implementation of the simulation using a periodic boundary condition, and the findings from the experimentation with the program. The report highlights the interesting shapes that emerged during the experimentation, such as the still life block, the oscillator blinker, and the spaceship glider, which demonstrate the complexity and unpredictability of the Game of Life. Overall, this project has provided valuable insight into the Game of Life and its potential applications in various fields, such as biology and artificial intelligence.