CS6161 Algorithm Term Project

Conway's Game of Life

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1. The Introduction of Conway's Game of Life

At the University of Cambridge, Professor John Horton Conway designed a computer program called "game of life" in 1970. Then, interest mathematician, Martin Gardner introduced Conway's game of life all over the world, by Scientific American magazine. At that moment, Conway's game of life has attracted the interest of a large number of lovers and followers.

1)Concept

The game of life is a zero-player game. It consists of a two-dimensional rectangular world in which each square is inhabited by a living or dead cell. The next time a cell lives or dies depends on the number of cells alive or dead in the next eight squares. If there are too many cells alive in the adjacent square, the cell will die at the next moment (or next-generation) due to lack of resources; Conversely, if there are too few living cells around, the cell will die because it is too lonely. In practice, the player can set the number of living cells in the environment to be suitable for that cell's survival. If the number is set too many, most of the world's cells will die because they can't find enough living neighbors until the world is dead; If this number is set too low, the world will be filled with life and nothing will change dramatically.

In practice, this number is usually set to two or three; So that the whole world of life is not too desolate or crowded, but a dynamic balance. In this case, the rule of the game is: when there are two or three living cells around a square, the living cells in the square continue to live at the next moment; Even if there are no living cells in the box at this moment, at the next moment living cells will be born.

Actually, you can also set some more complex rules in this game, such as the status of the current grid is not only determined by the parent generation, but also consider grandfather generation. Players also can serve as the "god" of this world, random set the lives of a grid cell, to observe the influence of the world.

2) Rules

In the game of life, for any cell, the rules are as follows:

Each cell has two statuses - live or dead, and each cell interacts with the surrounding eight cells centered on itself. (for example, black for survival, white for death)

1. Any live cell with fewer than two live neighbors dies as if caused by under-population.
2. Any live cell with two or three live neighbors lives on to the next generation.
3. Any live cell with more than three live neighbors dies, as if by overpopulation.
4. Any dead cell with exactly three live neighbors becomes a live cell, as if by reproduction.

The original cell structure can be defined as the seed, and the first cell map can be obtained when all the cells in the seed are simultaneously processed by the above rules. Follow the rules to continue with the current cell map, you can get the next generation of cell map, repeat.

2. Realization

Our group uses two computer languages to realize Conway's game of life individually. Since the algorithm of the game of life is BSF, it's not hard to achieve them, so the key point of our project is focused on how to get different representative types of survival in different languages. We choose two of the most representative process-oriented languages – C and Python to get the graphic interface to represent the revolution of community in this two-dimensional rectangular world.

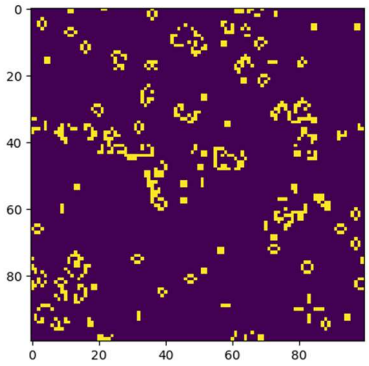
For the patterns we created, we created random mode, glider mode and launcher mode in python and random mode and diamond mode in C, which represent a special growth pattern like the distribution of cells from disorder to order, the number of cells decreases and become stabilized or the number of cells increases indefinitely.

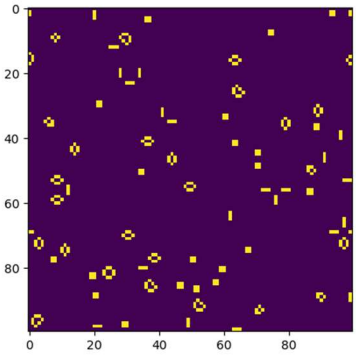
3. Visualization

Here are three typical modes in python:

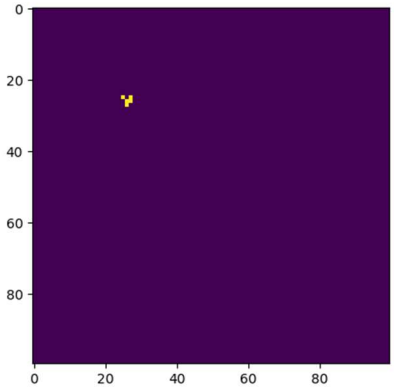
1) Random mode: It's a random mode with cells generated randomly. After many generations of reproduction, it becomes stable with many midsize clusters.

   First generation: After many generations (stable):

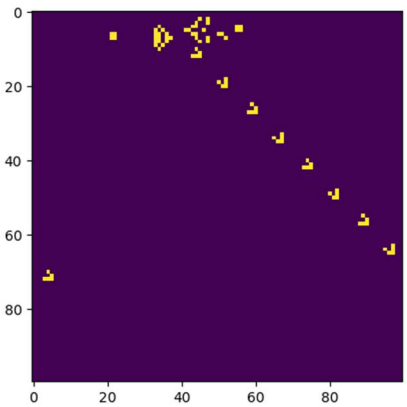




2) Glider mode: It's a mode with a little cluster glider from left top to the right bottom.

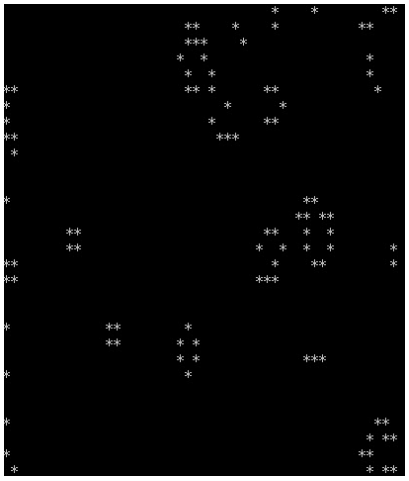


3) Launcher mode: It's a typical mode, represents a type of infinite reproducing, we call the setup which is at the top of the picture the launcher, and it can shoot a series of bullets to the right bottom.

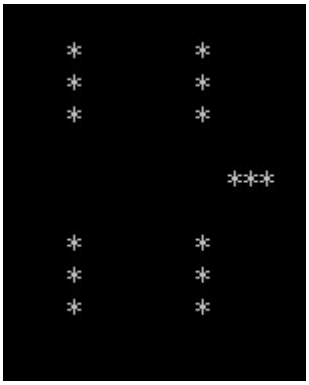


And here are two typical modes in C:

1) Random mode: The cell will become less, then keep stable.



2) Diamond mode: The cluster will be organized like this. (much like the village along the road.)



4. Conclusion and enlightenment

In the process of the game, disordered cells will gradually evolve into a variety of delicate and tangible structures; These structures tend to have good symmetry and change shape with each generation. Some shapes are locked and do not change from generation to generation. Sometimes, some already formed structures are destroyed by the "invasion" of disordered cells, but shape and order often emerge from clutter.

The world we live in is the same as the game of the world designed by Conway. Like we usually talked in real life, overpopulation can't be neglected as time goes by. But as game of life told to use, overpopulation means fast die like the tide. And the development of things has its inevitable law, like many modes in the game, are finally stable and become triangles and diamonds, which are not too crowded nor too desolate.