SIMULATION OF CONWAY'S GAME OF LIFE USING CELLULAR AUTOMATA

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Abstract — In biology, automata mobile games and computer simulations are often used as heuristic tools to investigate the impacts and impacts of different perspectives. For this reason, Game of Life was often used. The purpose of the game was to investigate the emergence of natural groups. It is also used in other biological processes, such as symbiopoiesis. We show that the development processes are inseparably linked components of a single biological system, similar to the symbiopoiesis integration processes. We compare and contrast two epigenetic ideas, developed by both Turing and Edelman, as used in Game of Life and its elements. We demonstrate the use of experimental computer simulations and suggest large extensions with new experimental tests. We used the game to investigate the complexity of symbiopoiesis and evo-devo, as well as the abstract hypothesis: that similarities occur at many levels such as cells, animals, the natural community etc. As a result of similar interactions between both as a health-based play.

Keywords — Game of Life, Cellular Automata, Elderman complex etc.

I. INTRODUCTION

Game of Life is a non-competitive Zero-Player mobile-automata game developed by John Conway in the 1970s[9]. The game is played on an endless grid of square cells, the first state that determines the continuity of the game. The game contains squares and other spaces called cells[5]. These squares can be turned on or off and black will be 'on' / or 'live' and white will be 'off' or 'dead'. If the cell does not have a living neighbor, the cell will die. But if a cell has two neighbors, the cells will survive. This is always where the law of 'birth' comes into the play[8]. When 3 cells combine, another cell is born. Because the cells on the left and the right have only one neighbor, the center cell, perishes. Because the middle cell has two neighbors left and right, it survives[6]. Because the top and bottom cells are joined by three neighbors (center, right, and left), they survive. It is important to remember that the cell does not die or live until the replication is complete. In other words, the algorithm determines which cells will die or live and informs them all at once. This eliminates the importance of sequencing in which cells are tested[7][13].

Animal species can be created for example, 'survival', 'periodic', 'glider' and 'spacecraft', etc. All of these are represented by different patterns [12].

II. LITERATURE REVIEW

Prof. Sapin & Bull, L. (2021). The Glider Guns in Cellular Automata found by Evolutionary Algorithms. In this case, the goal is to build an automated system for the acquisition of a mobile automotive computer, geographically. Shiny and mounting gun structures are required for such systems. In this paper, a large number of automatic shotguns are generated using a genetic algorithm. A classification of shotguns has been suggested considering the number of students evacuated.[1]

Dr. Lareno & Hodge, Robert & Hernandez, Sergio. (2016). The Game of Life and Its Epigenetic Goal. The Conway's Game of Life has been widely used for this purpose. The game was designed to explore the emergence of natural communities. We use it in other biological processes, including symbiopoiesis. We look at the similarities and differences between the two epigenetic models, Turing and Edelman, as seen in Game of Life objects. Indicates the number of computer simulations we should check and raises common action scenarios with experimental test novels at different levels (cells, organisms, natural communities) as a result of similar interactions both as the processes that are modeled in the Game about health. [2]

R. Karamani, I. Fyrigos, V. Ntinas, "GOL in Memristor Cellular Automata", a game that is part of Life-like Cellular

I -Automata (CA), impresses researchers from a wide range of scientific disciplines as it used to demonstrate the evolution of various complexity of patterns, and the use of the universal Turing machine, despite of the simple nature it has. space for simple connections, known as the CA cell in it. This function helps to develop a CA cell novel that often utilizes the benefits of memristor equipment, which are the CMOS flexibility and compatibility, to reproduce the GoL behavior at various different circuit levels it occupies. [3]

E. Sapin, O. Bailleux, and P. Collet, Demonstrated the universality of a new cellular automaton discovered a universal CA which is universal because it can simulate the GOL. This was achieved by using two genetic algorithms (Gas). [4]

III. METHODOLOGY

Beginning with the basic configuration, the game contains specific rules and the game board evolves, allowing the game to play itself. The following are the rules:

1. Birth: If exactly three of a cell's eight neighbours were alive at time t, it will be alive at time t + 1.

2. Death: A cell can die as a result of:

   2.1Overcrowding: if a cell is alive at time t + 1 and four or more of its neighbours are alive at time t, the cell will die at this time that is t + 1.

   2.2.Exposure: If a living cell has only one or no live neighbours at time t, it will die at this time that is t+1.

3. Survival: a cell lives from time t to time t + 1 if and only if two or three of its neighbours are still alive at time t.

These processes can be reframed in a more comprehensive way as follows-

1. **Division of cells**: Gol's basic rules include milieu-dependent version of this, in which new cells are created not by duplicating cells but by the setting of the spatial conditions in which new cells (all of which are identical in the GoL) will also develop.

2. **Death of cells**: In terms of biological theory, Edelman's insistence on the relevance of this as a driver of development is ground-breaking. It's represented in Gol's second constitutive rule, which creates death on a regular basis. It corresponds to the role of selection in evolutionary theory, where the fit survives while the others are removed. The process of turning genes off is just as significant as turning them on in epigenetic processes as they are now understood Figure 1 Generations.

3. **Movement of cells**: Although cells move during the development process, a top biological framework is required to recognize the process. Cells go through a variety of mechanical processes as a result of their movement into new locations. Similarly, niche mobility is rarely emphasized in evolutionary theory. However, niches are dynamic systems that require and influence constant change in both species and ecosystems. GoL automatons have movement, which is a rare yet astonishing and lifelike feature. This feature is critical for development, according to Edelman's view Figure 2 Oscillator.

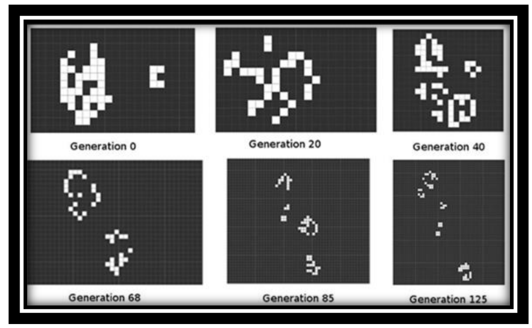

Figure 1 Generations

4. **Cell adhesion**: is the fourth factor to consider. One of Edelman's regulatory process is this even though it is not well-known in the Game of Life, it can be understood in terms of one of its form as shown in Figure 2 Oscillator.

The initial level in this diagram is made up of three squares. In GoL, three squares are a vulnerable form, and this is the only three-square construction that survives. In this scenario, the configuration generates a new cell that connects the three together form a firmly connected structure that keeps all members together during subsequent iterations. This form, which corresponds to Turing's stable form, may appear to be a small GoL output, but it is the simplest form that will survive the epigenetic processes, along with blinkers. Both are widely available as items. This research shows that a few very simple forms that have survived for a long time may be elemental in certain ways.

5. Differentiation and the induction are the 5th and 6th steps. This is a term used by Edelman to describe complex processes that can be understood as several processes. The key difference between this and GoL forms is that these mechanisms work with cell-collectives rather than individual cells. This is an important fact regarding developmental processes that is difficult to convey in GoL words.

The game has also been equipped with a function to show the current generation of the cells. This numeric figure keeps changing as the cells evolve in the visualization. Libraries imported in the game are as follows: -

1. NumPy- NumPy is used to conduct a wide range of array-based mathematical operations.

2. PySimpleGUI- a library that allows programmers of all abilities to design graphical user interfaces.

The following functions have been used in the game –

i. def live neighbours(self, i, j): (to count the number of live neighbours around point(i, j)

ii. def play(self): (to commence the game of life)

iii. def init_graphics(self): (to add and set graphics for the simulation and visualization of the cells and game)

iv. def drawboard(self): (to draw the board and define the parameters)

v. def manual_board_setup(self): (to set-up the manual board for beginning the simulation using go button and exiting the game using exit button)

A. PROPOSED SYSTEM

John Conway found a set of simple rules by which it is possible to build structures within a metaphor that can replicate, move, or collaborate[15]. It was later proved that the game of life with this set of rules "Turing Complete". With a complete Turing machine, you can do any theory any number. So, you can say that a machine or software that is being using the "Game of Life" itself is a type of computer, though another complex one that is always unusually sophisticated at most times[10]. There has been a great deal of interest in unveiling new patterns in Game of Life since its inception[11]. From the immutable 'existing' fundamentals to imitating universal Turing machines, patterns can be categorized according to the complexity of their behavior[14].

1. Still life – A repeating pattern in which no alterations are made to the original configuration which is shown in Figure 4 Still Life.

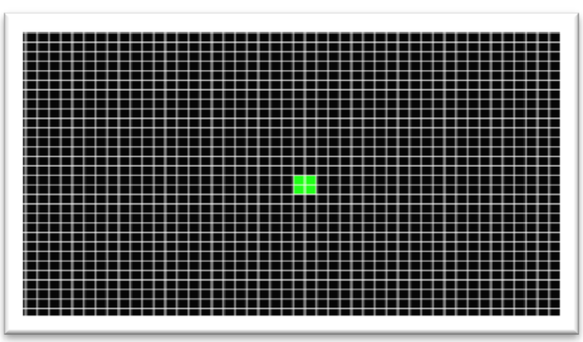

Figure 3 Oscillator

2. Oscillator - Patterns that change over time but repeat after a certain number of renewals (period). A blinker is a period-2 oscillator which is shown in Figure 2 Oscillator

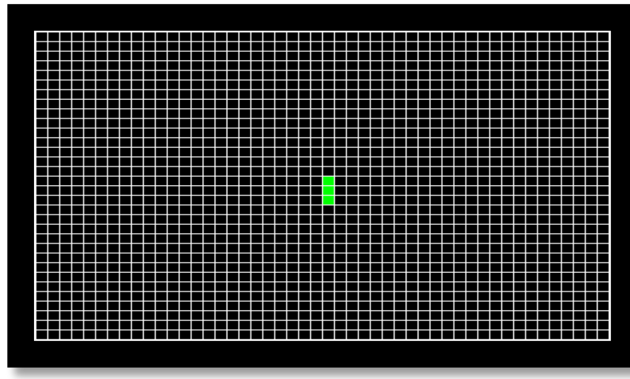

Figure 2 Simulations of Cells

IV. RESULTS AND DISCUSSION

The result of consolidating the entire set of laws is in line with the constitution, where natural selection strategies work. Conway seems to refer to the evolutionary process when he uses the terms "population growth" and "diversity" as well as natural science. However, it mimics a common pattern that can be seen in various biological systems. He suggests a machine that can produce many varieties with a few rules if those laws are organized into two groups: one gene, in which the genes are produced and reproduced, and the other epigenetics, in which those rules and processes are released in the epigenetic space. produces many different stable genres and novels while limiting or eliminating many other possibilities. GoL is a set of laws that combine genetic and genetic and epigenetic functions. They are classified as a combination of two principles, existing laws and conditional laws. This is a vague explanation of what we call the epigenetic system in biological systems. Cell placement: - By clicking will mimic cells: -

1. Placing the cells –

Figure 4 Still Life

2. Clicking on go to simulate the cells –

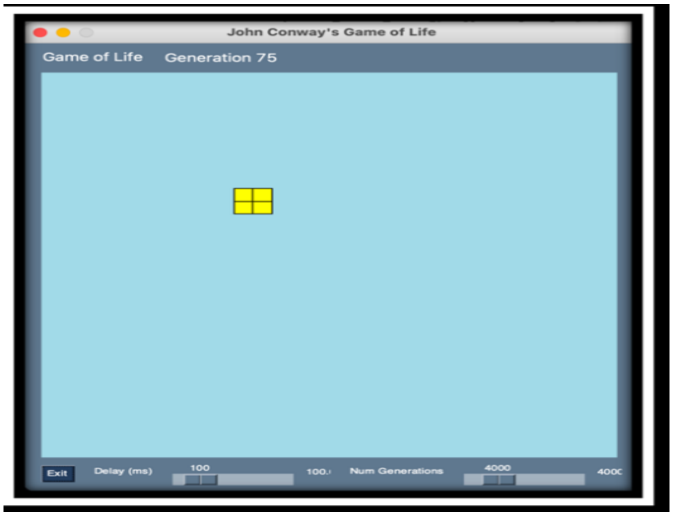

Figure 5 Placing Cells

V. LIMITATION

The game falls short of a better GUI for serene user interaction. The game has not been provided with a reset button for user to start the game again from the beginning instead of exiting the game.

VI. CONCLUSION

We have built Game of Life which is scale invariant and it may be used to model systems at all scales, from the formation of cells and animals to those of evolution of various forms of communities and ecologies. Scale is also incorporated into symbiopoietic theory, with distinct components of like a superorganism having varied evolutionary histories and organisational scales. Only a few genes may have been engaged in the structuring of these morphogenetic processes, working very early in the evolutionary process and actualized by a variety of epigenetic mechanisms, both chemical and mechanical, according to this research. Self-similarity of patterns can be found both inside a species (for example, snake, tiger, and zebra-fish patterns) and between species and families, resulting in a layered fractality that usually links in the development and the evolution of various cells.

VII. FUTURE SCOPE

Instead of simply one hue, a color gradient which can also be used to represent more than two states connected with each cell, such as growth and ageing. Another concept which can be implemented is to model disease and mutation propagation at the cellular level.

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