Game of Life Report

I. Motivation

To be able to create a simulation of repopulation, overpopulation, and self-sustaining systems.

II. Problem Statement

- We already play the Game of Life, there is the process of repopulation, without that, we tend to notice the trend of the population going in a downl.
- On the other hand, we have the overpopulation issue, which some could say is happening at this moment, where there are not enough resources to sustain such a population
- The last part is of a self sustaining system - based on the name is where the objects of a simulation are able to sustain themselves with their resources that are in their surroundings.

III. Background Material

- Rules:
  - Any live cell with fewer than two live neighbors dies, as if by underpopulation
  - Any live cell with two or three neighbors lives on to the next generation
  - Any live cell with more than three live neighbors dies, as if by overpopulation
  - Any dead cell with exactly three live neighbors becomes a live cell, as if by reproduction
- Objects:
  - R-Pentomino- stable =1103 generations
  - Shoots off gliders- like migration
  - Glider guns - infinite expansion
  - Puffer Train - leaves a trail behind

IV. Approach and experiment set-up

- We first need to look over the different aspects of the simulation, especially with the amount of different variables that are illustrated

throughout the simulation. One of the major factors comes from the R-Pentomino pattern, which is unstable and is only able to become stable after it goes through 1103 generations. Since the R-Pentomino pattern has five cells in the beginning, the overall end of it is the constellation, where it inhabits twenty-five objects. These objects are, eight blocks, six gliders, four beehives, four blinkers, one boat, one loaf and one ship, where this starts to occur on the 821st generation.

- Once there is the stabilization of the pattern, it will illustrate that it is not finite, but will end up shooting the gliders throughout the simulation.
- The next pattern that we have for the simulation comes in the form of the glider gun, which is used for the infinite expansion of the simulation. It was developed by MIT professor Bill Gosper in proving that there can be an object in the Life universe that can keep growing infinitely. This is how we are able to include in our simulation how new objects are created and brought to life through the process of being hit by the glider gun. The other object that was created by Gosper, comes in the form of the Puffer Train, which from the name is exactly similar to that of the smoke trail of a real train. This is another part of the Life universe, where there is just a trail of debris that is left behind in the constant movement of the train

V. Results and Discussion

For the simulation, we look at repopulation, overpopulation and self-sustaining systems, with the rules that are in place for this simulation. Now the rules are completely different from our everyday lives, based on what is needed to test this out. First rule is based on reproduction, for the simulation to achieve this, there needs to be a dead cell with three live neighbors in its vicinity, turning it back into a living cell. For this cell to keep on living, the second rule is given if it is near two or three live neighbors, it will continue to live into the next generation of the population. The next rule applies to the overpopulation based on the living cell having more than three neighbors in its vicinity, who will die from the overpopulation rule. The final rule ties into the previous rule, but in this case it is where if

the cell has less than two neighbors, it will die as a result of underpopulation.

VI. Contributions and Conclusions

- When using the simulation, it will come to a complete stop after a while, because of the deterministic rules. From having preset rules for the input that we have for the simulation, we will attain the desired results from the specific rules and inputs. We are able to view the whole process by creating a window, allowing us to view the Life universe, illustrating how the process of life works. The whole process of the Life universe comes from the creator, John Conway, who illustrates how different objects are living throughout the Life universe. Our results illustrated the findings of both Conway and Gosper, where we can simulate the way life is created and ends, while also viewing the way that there can be an infinite possibility of constant generations.
- Our experiment was made with randomized on and off blocks that allowed us to see natural behavior. It exhibited similarities to the puffer train's exhaust.
- Code was done by Travis and reviewed by other team members. Report was written by Carlos and revised by other team members

VII. Reference

The Game of Life. Game of Life :: Walks of life :: Interesting patterns. (n.d.). Retrieved May 12, 2022, from https://cs.stanford.edu/people/eroberts/courses/soco/projects/2001-02/cellular-automata/walks%20of%20life/patterns2.html#:~:text=The%20R-pentomino%27s%20final%20constellation%20consists%20of%2025%20objects,an%20object%20that%20begins%20with%20only%205%20cells.