Conway's Game of Life

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Motivations

Analyze the rules of the game.

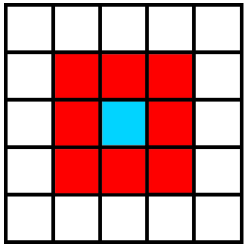
Understand the behavior of certain “shapes” of cells, and how they interact with each other.

The Rules

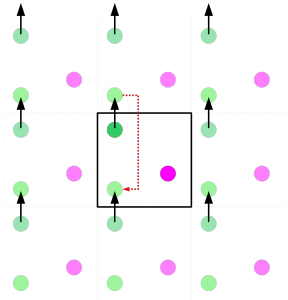
1. If a cell is ALIVE and it has fewer than two live neighbors it dies. (*Underpopulation*)
2. If a cell is ALIVE and it has two or three live neighbors it lives on to the next generation.
3. If a cell is ALIVE and it has more than three live neighbors it dies. (*Overpopulation*)
4. If a cell is DEAD cell has exactly three live neighbors, it becomes an ALIVE cell. (*Reproduction*)

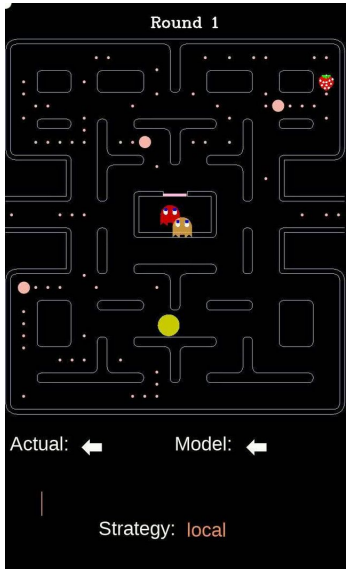
Approach

- Moore Neighborhood



- Periodic Boundary Condition





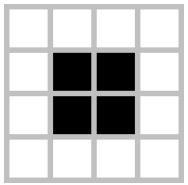
Approach

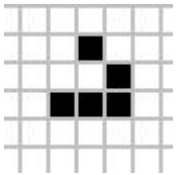
- Initial state:
  - NxN matrix with some cells set to alive, represented as a 1, and the rest set to dead (0).
- Determining the new state of the map (transition function):
  - For each cell, find the total amount of live neighbors and use that information alongside the rules to find the next state of the cell.
  - Do this step until we have an entire new map.

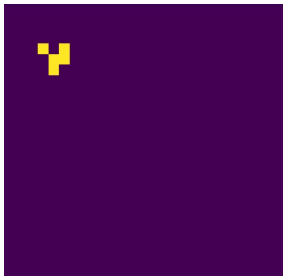
Results and Discussion

There are a few shapes that were common in the testing of this game.

1. Block
   a. 2x2 live cell shape.
   b. It will stay this shape perpetually.
2. Blinker
   a. Three live cells in a row.
   b. It will perpetually “rotate” 90 degrees.
3. Glider
   a. 5 cells in a specific order.
   b. Shape will perpetually fly across
   c. The board

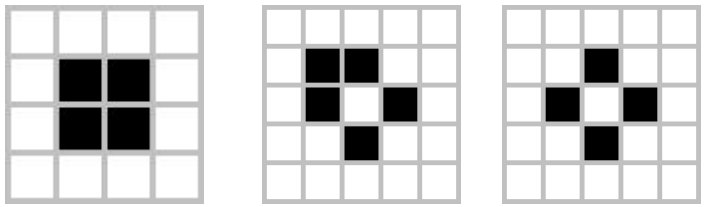




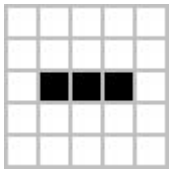
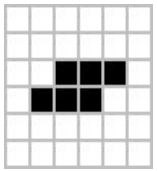
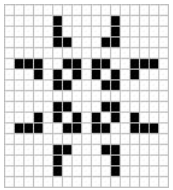


Results and Discussion

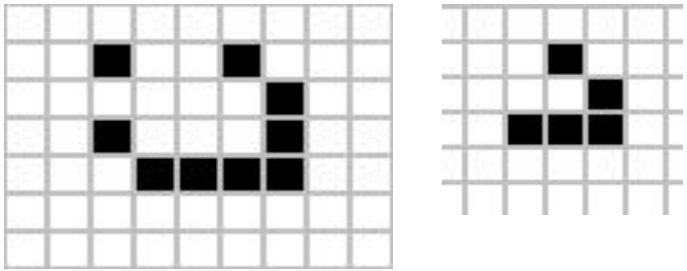
Something interesting about the shapes formed by the simulation is that they can be put into three groups.

1. Still lives
    a. Shapes that do not change shape unless they are interrupted by other live cells
    - 

Results and Discussion

1. Oscillators
    a. Shapes that always return to their original shape after a finite amount of generations
        -   

Results and Discussion

1. Spaceships
   a. Shapes that move themselves across the map.
      - 

Results and Discussion

1. Interesting Properties.
    a. It is very easy for a simulation to become suddenly very chaotic. Just two relatively simple shapes like a glider and a blinker can create an very unpredictable end state.