Life in True and False: Design Process

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1 Introduction

The Game of Life by Conway is a well known concept that serves as a simple but effective example of simulations. While it may seem deceptively simple at first, this and many more cellular simulations can be used to represent the behavior of single celled organisms and their gradual evolution. One might initially envision a bunch of random cells but the reality is that, thanks to the simple rules provided, Conway's Game of Life produces complex patterns thanks to the cells interacting with one another.There are many more cellular automations besides Conway's Game of Life, but it's generally agreed upon that this is the most well known of them. Additional reading in regards to cellular automations can be found in the Resources section of this document.

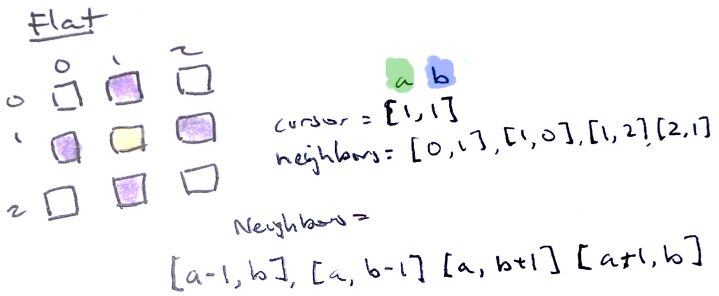
2 Pseudocode

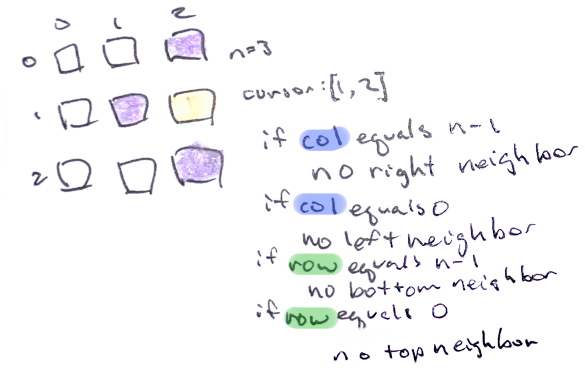
Universe.h has been provided by the CSE13S instructors as a guideline for how to structure the Universe.c file. Life.c: Will require accepting string user input. Admittedly unsure how to do that. I believe I have to do this using getchar, however I don't know the best approach for creating a list of chars for something of unknown length. I will also have to keep in mind exception handling in regards to this. If the user types in a space, this gets viewed differently in the file explorer from the user. The same goes for outputting a file, if the user attempts to input a space, slash, percent character, these will all interfere with creating a output file. Handling the input and output will not be done with a set, but instead with a few variables since there aren't a lot of user input options.
Beyond that, this program will be the driver of this library. It will call the uv_populate function to create the universe, then run uv_census multiple times for the number of generations. It will also handle the ncursor output, which will require some fiddling to get working.
Universe.c:
Constructor: create matrix of indicated width and height of booleans to represent the universe. Bits will be allocated, in the event the allocation fails, I intend on using assert to crash the program.
Destructer: deallocate all boolean values and set pointers to null.

uv_rows: will return rows of universe.
uv_cols: will return number of columns of universe.
uv_live_cell: changes cell to true.
uv_dead_cell: changes cell to false.
uv_get_cell: returns state of cell
uv_populate: parses given file using infile and fscanf. First two items are row and height, can then call constructor to build matrix. Can then call uv_live_on following lines to populate the universe until the end of the file.Returns true if universe is successful. In the event that the population fails, I'm admittedly unsure if the constructor should handle that or if this function should handle it too.
uv_census: This function is the critical aspect for the entire game to work. Firstly the rules indicated by the Conway are the following:

1. Live cells with 2-3 live neighbors survive.
2. Dead cells w/ 3 neighbors becomes live.
3. All other cells die.

This function's role is to return the number of live cells surrounding a cell. First, check that the requested cell is a valid cell. For any cell with coordinates [a, b], its neighbors will follow the following format: top [a, b+1], right [a+1, b], bottom [a, b-1], left [a-1, b].
For a flat universe, if the cell is located at the edge of the universe, then the necessary neighbor will not be taken into account as it does not exist within the universe. The diagram below illustrates this concept:

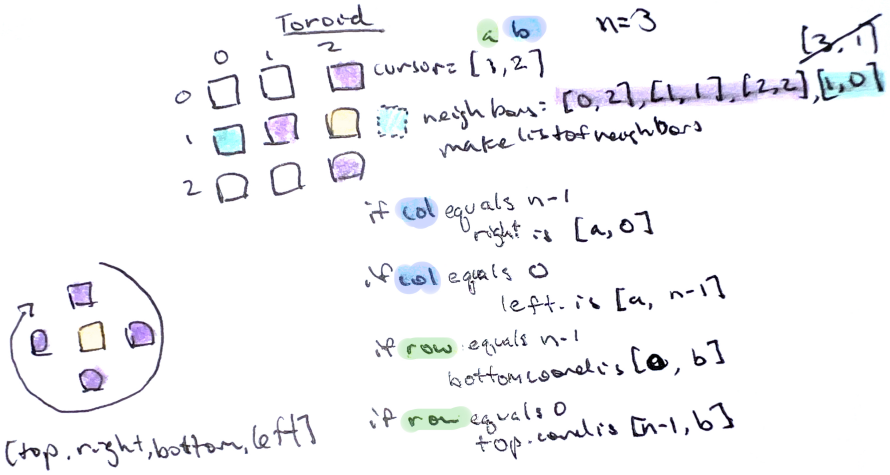




Although a toroid universe may seem intimidating, it isn't too difficult. In the event the cell is located at the edge of the universe, then the corresponding neighbor follows this logic tree, assuming the cell has the coordinates [a, b] and the size of the universe is n by n.

- If column equals n-1 (right edge of universe), right neighbor is [a, 0]
- If column equals 0 (left edge of universe), left neighbor is [a, n-1]
- If row equals n-1 (bottom edge of universe), bottom neighbor is [0, b]
- if row equals 0 (top edge of universe), top neighbor is [n-1, b]

This is illustrated in the following diagram.



There are some edge cases that may or may not have to addressed by this function or the populate function. For example, what do we do if we have an extremely small toroidal function? Can a cell be its own neighbor?
uv_print: parses through universe, uses uv_get to check if cell is dead or alive and prints o for alive, . for dead.

3 Resources

Cellular Automation Wikipedia page
Stable Reflectors
Glider Gun Wikipedia page
Applications of Cellular Automations in Biology