Assignment 4 WRITEUP.pdf

Julian Chop

February 14, 2023

1 Conway's Game of Life

John Horton Conway's, "The Game of Life", is a zero-player game. This means that it requires no input other than its initial state. The game is played on a 2-D grid of cells that represents a universe. The game progresses through generations and there are three rules that determine the state of the universe after each generation:

1. Any live cell with 2 or 3 live neighbors survives to the next generation
2. Any dead cell with exactly 3 live neighbors becomes a live cell
3. All other cells die, either due to loneliness(not enough neighbors) or overcrowding (too many neighbors)

A neighbor is defined by any cell directly up, down, or diagonal to that cell. Our task was to implement all of this in C!

2 Understanding My Code

For this assignment, we had to make 2 c files: universe.c and life.c. My universe.c file contains the Universe ADT or abstract data type, as well as functions for my ADT. These functions are used to manipulate this ADT; access, construct, manipulate.

The universe is abstracted as a struct called Universe. We also made it a new type with typedef. This means we treat Universe as opaque; you cannot interact with it outside of universe.c. That is why the functions within universe.c is so important. functions such as uv_rows and uc_cols allow us to access data within Universe. Functions like uv_populate and uv_live_cell let us manipulate them.

All these functions are used in life.c. Life.c contains main() and is the file that puts everything together. life.c uses the functions implemented in universe.c to make "The Game of Life". This is where I coded the command-line options, the game's rules, and the animation of the game(using ncurses). Life.c isn't able to directly interact with the universe fields, but it can call the functions on a pointer pointing to the universe to access or manipulate it.

3 ncurses

Displaying the state of the universe after each generation was also something that we were tasked with in this assignment. To accomplish this task, we had to use the ncurses library. ncurses is used to develop text-based user interfaces so we can use this to display our changing universe!

What I ended up doing was printing out the current state of the universe onto the window using a nested for loop. Then I would refresh the window and print the next state of the universe. This process would continue to run until the specified number of generations was finished. The result of this was an animation of the changing universe over generations!

One thing that's different between the ncurses library and libraries we have used before(stdlib,stdio, stdbool) is that it is not part of the standard C library. Because of this, we needed to use a linker flag in our Makefile to link ncrurses. Standard C libraries don't need to do this because they are linked by default when compiling.

4 Errors and Mishaps

Damn this assignment had me going crazy. The amount of segfaulting I had while working was insane. Most of the problems came from accessing cells from the universe. Trying to access cells outside of the grid specifically. This issue ultimately stemmed from doing arithmetic between unsigned and signed variables, which would result in overflow or underflow.

One upside that came out of this was that I got really familiar with Valgrind and how to understand its error messages. So at least we got something out of the suffering!

5 We Learning!

Overall, this assignment got me learning! This was my first time writing an ADT, as well as it being an opaque type. It was also my first time working with a 2-D matrix in C. Through this assignment, I got to work with manipulating, accessing, and constructing the data within matrices.

The ncurses library was probably the best part of the assignment for me. It was so cool to implement an actual display of a changing universe. I think my favorite initial universe was Gosper-Gun. It also got me more familiar with how linking and compiling work when making an executable.

The first part of the process is compiling which takes my source code files and turns them into code that the machine can read, object files or .o files. Then the next step of the process is linking these object files into a single executable program. Linking also includes any libraries that I used in the program. Libraries in the standard C library are linked by deafult but 3rd party libraries such as ncurses requires LDflags or linker flags to link.

6 Citations/Resources used

- I went to Tuesday's section from 7:00-8:30 with the tutor John. He explained what we needed to do in the assignment and how we might implement some of the functions in universe.c.
- I based some of my code off the pseudo-code from resources. The allocating memory for a matrix and the ncrurses pseudo-code specifically.