Individual Capstone Assessment

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In short, this project is interactive application focused on exploring different configurations for cellular automata in 2D. The goal is to provide configurable options for the rulesets, and for configuring number of neighborhoods, neighborhoods shapes, and neighborhood sizes. The end Idea would be to add the option to add competing rulesets to simulate ecological competition between species. After the user has created the configurations they would be able to start the simulation and watch the cellular automata proceed in 'real-time', although the timesteps have no real world equivalent. The plan is to have this as a web application, that way anyone can run this on their browser, with the end goal of hosting this on a server for people to connect and configure their own cellular automata. With it being a web app that is hosting a 'real-time' simulation, having good performance a large number of system will be important, with multi-threaded programming or leveraging the GPU for computations important. The original idea to make this a web app using JavaScript instead of using more performant languages, was so I could quickly create a very robust user interface for all the configurations which would take a lot more time working in a language like C++, outside of building this in a game engine like Unity or Godot, which I don't have much experience with.

For my self in my UC curriculum, I have had the standard UC CS curriculum, with no real specialization in any direction, trying to get the broadest CS experience possible during university so I understand my preferences and strengths in the field before I narrow myself down too much after college during my first jobs. Although, unique to most CS students I did participate in a study abroad program during fall 2024, at the Zurich University of Applied Sciences (ZHAW) in Switzerland, during this one of the classes I took that really interested me was Scientific Computing. Scientific Computing was a class about applying computing to real world problems that would be impossible to solve otherwise, and one of the big topics was simulation, so I will be able to use my experience from that class when designing my project which itself is a simulation. For classes at UC that are applicable, currently I am taking Operating Systems (EECE4029), which will cover multi-threaded programming which I will most likely be implementing in some degree during this project. Other classes such as Data Structures (CS2028), and Algorithms (CS4071) will provide useful as these are important topics when it comes to optimizing for simulations.

For my Coop experiences, my first couple Coops where spent with EEP through UC's coop team. During that time I got to create projects and really explore what interested me. During that time I made several 2D simulations which gives me some background into this project; I made a 2D fluid simulation in C++, as well as a flow field visualizer in vanilla JavaScript. During that time I was also working part-time as an IT intern at A Shade Better, where I got my first experience in web development, but it was very basic, and most of my time was spent elsewhere. But more recently,

I Cooped at Medpace for 2 semesters as a Software Development Intern. My first rotation there I worked in the modernization team, working on a full stack web application, working very closely with the Angular frontend and some of the more advanced features that it offers, as well as some work in the backend, setting up endpoints. That experience using Angular is what is convincing me to using Angular during this project, although I may branch out to try and gain experience using React to be more varied. My second rotation was more backend and infrastructure focused, centered around Azure and SQL databases which isn't as applicable to this project.

For this project personally, I am excited to work on it, as I like creating simulations, especially ones that are visually pleasing, as when I can play around with something and create a beautiful result, with nothing but coding and math behind it is kind of crazy to me. For cellular automata in particular, I think the concept is fairly interesting, really starting from Conway's Game of Life, but as you increase the complexity of the rules, you can get some really amazing results. For choice of technologies, I think creating it as a webapp makes it more available for people to interact with it, instead of having to compile their one C++ application with libraries, as I have done in the past. A lot of work in the CS field is also done with web applications so the experience there really helps. For the computation, I really want to get in to parallelization, as in the past I have only had single threaded applications which limits the performance and what is possible to compute for a satisfying real-time simulation.

For designing my final solution, I am planning on implementing a basic webapp for cellular automata with basic configurable rules, before building and expanding on that base in a more 'agile' fashion. Once I have my proof of concept ready, I can test different methods for computing, such as using JavaScript GPU frameworks to use resources client side, or have containers with parallel computing for a server backend that way computation speed would be independent of user computer resources, but that is yet to be decided. For my self I won't be done with this project until I am happy enough about it to showcase it to the world really, even if I eventually have to cut out features by the end of this course I still want to have a final product that I have a satisfying time playing around with and that I am confident in showcasing to other people as well who are interested. For evaluating myself, it's really about keeping track of my weekly contributions, making sure I am not slacking, and if I take time off from the project there is a good reason, not just procrastination. Working on a team by myself that will be more of a challenge than having team mates who can keep me on track, but I have experience working on projects on my own before that I feel confident that I can put in good work during this course.