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Mini Forest Simulator

Topic

Old growth forests are one of the world's most valuable resources. Forests provide habitat for countless species that would go extinct without them. They also provide a source of carbon capture, taking CO_2 from the atmosphere and storing it in trees that later become soil for more plants and trees. Despite the benefits, humans are continually cutting old growth forests all over the world without regard for how to replace the value they provide outside of agriculture and industry. These ecosystems are so complex with so many organisms from the soil to the canopy that science has been unable to fully reconstruct the delicate ecosystems of forests built over millennium. Old growth forest ecology is a fascinating subject worth our time to better understand.

Vision

There is so much complexity to the equilibrium of a forest that has been thriving for longer than humans have existed. And though I have read a few books on the subject, I am not an ecologist. Therefore, I cannot begin to simulate all the organisms, interactions, and events that make up a forest. That said, I would like this project to include a few specific characteristics and behaviors of old growth forests that I have learned about.

1. Mixed age

One of the key characteristics of an old growth forest is mixed age of organisms, which means the forest has a way to support older and younger individuals. Nurse logs are large old trees that have fallen to the forest floor and recycle into the next generation of organisms. These trees will rot, providing food for many animal species but also providing a

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perfect place for saplings to start. This could be represented by many young trees starting up from a long line caused by the death of an older tree.

2. Mixed species

Old growth forests have many states that provide ideal conditions for different species at different times. One example of this characteristic is pioneer species. When a gap in the canopy opens whether from an old tree dying, high winds, or fire, pioneer species will rapidly fill the space. They thrive in this state of abundant sunlight by growing extremely fast relative to the rest of the forest. However, the larger slower growing species will catch up eventually and starve many of the pioneering individuals from light as they fill the upper canopy again. This allows many different species to occupy the same space in the forest. This could be represented by open space being filled very quickly by a particular species but then reducing in numbers as bigger and slower species catch up.

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3. Management

Another undeniable behavior of forests is how humans manage them. There are many approaches taken by various cultures over time. Indigenous peoples in North America would deliberately burn portions of the forest to help produce some of the outcomes above. Research has shown this helped sustain the forest. Colonizing cultures treated forests as a resource to be harvested. That perspective remains in many ways as large portions of formerly old growth forests are essentially single species timber plantations. Contemporary conservation emphasizes more protection of forests, and awareness of how to prevent losing them to human caused forest fires. There is growing concern that the lack of burning has only added fuel to make inevitable fires far more severe and do more damage than the forest has evolved to sustain. Suffice to say, forest management is not a straightforward effort and is vigorously studied and debated. In a simulation, many of these factors could be represented by adjusting the frequency of burning, cutting, planting, or introducing invasive species to the forest.

The program itself should take user input that impacts the above mechanisms. This might be the starting state of the forest in diversity of both age and species. Or it might be how often forest fires occur with and without human intervention. From there, the program should show the behaviors above under the given parameters played out over time.

Concerns

One concern I have is representing the state of the forest in a fun and engaging way. Ideally, this program would have a nice GUI that shows plants represented on the screen pictographically. The screen would update the field as trees fall, new species erupt, fires burn and so on. This all feels a little ambitious, and my concern is that it isn't a very interesting project without a GUI. I've built some GUIs using Windows frameworks like WFP and Blazor web apps, but nothing graphically or visually like what I am envisioning.

I do feel confident in my ability to understand and implement and test the systems I described in this document without graphical display. Without a GUI I will have to come up with a good way to show the state of the simulation.

Github

https://github.com/kaleb2/MiniForestSimulator