Project Proposal

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My goal for this course project is to create a 3-D visualization for one of my current research projects. My research project is a 2D agent-based model of honey bee swarm formation, a process in which worker bees search for the queen by forming a pheromone communication network to collectively find her location and swarm around her. I would like to build a program that animates this swarming process, as a cool introduction to the project to show in my various presentations in the future.

The program will contain the honey bee objects that I have been building over the past few homeworks. There will be two types of bees: the queen and the workers. They will be morphologically different, with the queen slightly bigger with a longer body. I will use textures to make the bee bodies look better than just the stripes I currently have.

The queen will be a stationary object and she has a pheromone scent that diffuses out and eventually decays in time and space. The worker bees that detect her pheromone (above some sensitivity threshold) will in turn emit their own pheromone and fan it towards behind themselves to propagate the signals, collectively forming the communication network. So the worker bees' motion will include walking around a world and flapping their wings when they emit pheromones. I will either implement the mathematical foundations for the pheromone diffusion and decay (2D diffusion equation, gradient model) directly in C or grab the numerical data (bee positions/orientations and pheromone concentration maps in forms of 2D arrays over time) already outputted from my agent-based simulations and just focus on the visualization. I'm thinking that the pheromone maps will be visualized on a surface, using shaders.

Stretch goals:
- I want a simple animated scene for my presentations of this research project, but I'm very interested in making a much nicer scene with other objects besides bees. I envision other bee-related objects like a hive, or trees/flowers, grass, etc. Bees can form swarms outside of their hives, so the outside world has many objects to model.

Super stretch goals:
- In real life, pheromones are like smells that are invisible, but here, I want to visualize the pheromones similar to smoke, which at the moment seems like a challenge but worth it.