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EECS 472 Project Proposal, take 2
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Teaching Middle School Students Collaborative Diffusion

Intro: I plan to design a lesson plan for middle school students about collaborative diffusion. This is a great way to teach them about artificial intelligence and game design, path planning, and emergent behavior. Collaborative diffusion works similar to basic diffusion, but with two important distinctions. Obstacles are not given a diffusion value, and if an agent is taking one path it dampens the diffusion value for that path, thus leading to more of a 'divide and conquer' approach. In path finding applications with obstacles in a multi-agent environment, this leads to emergent 'collaborative' behavior.

I will do this by building three or four models as teaching tools to illustrate the emergent behavior from collaborative diffusion. One will be a simple maze model that will compare diffusion approaches with and without collaboration to illustrate how simple rules result in effective 'divide-and-conquer' multi-agent method. I will also modify the Pac-Man model in the models library to have ghosts search for Pac-Man via collaborative diffusion- this will serve as a fun application for the students to see collaborative diffusion in action once they understand the principles behind it. For the 472 portion, I will implement a Hub Net activity- I have two ideas for that and they will be discussed in the implementation section. Lastly, if I have time, I will also add a 'Make Your Own Maze' activity where students will get to create their own obstacle course in a NetLogo model and see how a team of agents/turtles search for the goal via collaborative diffusion.

What can be learned: My reasons for choosing this approach are that I want to get young students excited about computer science, and this is a good way to show them many facets of the field, including game design, modeling and simulation, artificial intelligence, and path planning.
Collaborative diffusion is a very simple concept that results in behavior that can be understood visually, which for students in this age bracket is really important. The comparisons between diffusion with and without collaboration (which are clear by simply running the simulation in different configurations). Because it's dealing with game AI and is so interactive it should be an effective tool for middle schoolers.

Implementation: I plan to implement 3-4 models as teaching tools.

1. Simple model to demonstrate collaborative diffusion: Multiple agents seek to reach a static goal. I've already implemented a very basic/bare-bones version of this (attached).

The two types of agents are ghosts (similar to Pac-Man) and the goal agent. In this case the goal agent is static, and the ghosts must find the goal agent only by the scent the goal agent

leaves. You can toggle collaboration on and off, there will be different maze configurations, and you will be able to adjust the diffusion rate. Each patch has a diffusion/scent value calculated, and each time the agent moves, it queries the surrounding patches and goes in the direction of the greatest value (so basic hill climbing following the scent). Walls have diffusion values of zero, and if a ghost is on a given patch, the diffusion value for that patch is set to zero (dampening effect that encourages collaboration).

2. “Make Your Own Maze”: I only anticipate implementing this on if I have the time. The user would specify the number of ghosts, the goal(s), and would draw their own maze in the model interface. From there it would run like the model above.

3. Modify the Pac-Man model in models library to have ghosts search for pac-man via collaborative diffusion. Again, I would simply be incorporating the collaborative diffusion mechanism.

4. Hub Net activity: This will be one of two options (haven’t decided which yet):

a. Have students sign into the maze game and act as ghosts who have find the goal. The catch is that from their vantage point they can only see the valid ‘moves’ you would be able to make at that moment via collaborative diffusion. So at any given time everything except their neighboring patches would be blacked out in their view onscreen. This game would illustrate how collaborative diffusion works on a single-agent level. The first person to get to the goal wins. For this one I like the idea of them understanding the mechanism of collaborative diffusion by having to ‘be the ghost,’ but I’m not sure how effective it would be, given that the collaboration aspect is absent since it is now a race to the finish where you only have the scent to follow.

b. The other option is a foraging game where the students go head to head with the bots. There would be two teams, the students signed in via Hub Net and the ‘ghost’ agents. There would be pockets of food in the middle of the board, and it would be a contest to see who can gather the most food. The bot mechanism would be implemented via collaborative diffusion, and difficulty could be adjusted by adjusting the bot speed and diffusion rate. This could be a fun game for them to see this simple AI implemented, as well as for them to be able to interact with it and come up with strategies to gather the most food.

In addition to the 3-4 models, there will be a detailed lesson plan pdf for instructors, a user guide for students, and powerpoint slides to present collaborative diffusion and the associated models as a lesson.

Rationale:

In my experience with middle school engineering outreach, I’ve found that interactive and visual means of teaching them about engineering work best. Collaborative diffusion is a good method to use in teaching them about various aspects of computer science for this very reason- it

results in nice emergent behavior from an algorithm that can be understood by that age bracket and the emergent behavior is easy to see simply by watching the simulation. For my goals then, the models I am selecting are good choices because of their interactive nature.