Math 140 Getting the sheep-herding project rolling

Today we want to start modeling the sheep and sheepdog in earnest in NetLogo. For this purpose, you may want to start forming a group with others who have similar modeling ideas for this project. For the final project report, you should ideally work in a group of 3, although groups of 2 or 4 will also be accepted (since the class size is not a multiple of 3).

I strongly recommend starting simple to test the effect of each proposed rule for sheep and sheepdog. Interactions between sheep and dog will quickly get complicated enough with just a few simple rules, so gradually build up the sophistication of your model, making sure that you fully understand what behavior each new rule is generating.

A good place to get started is your fish-predator model, so that you have the basic code for how the sheep can form a herd and for computing measures like nearest neighbor distance and polarization to compare to the values you get from the data. (Note that the NetLogo file we developed in lab to visualize the data is separate from the NetLogo file you will develop for the model. You will have a NetLogo file for running your model and generating simulation data, while the data-based NetLogo file will help you determine whether or not your model is reproducing the patterns observed in the data by computing the outcome measures for the real data.)

We have lots of possible rules to try. You could have sheep always try to move toward the center of the herd as a simplistic implementation of the Selfish Herd Theory, or you could add a domain of danger and/or anxiety as suggested in class. You can play with having sheep all able to run the same max speed or have a range of speeds (so that the fastest ones tend to be at the front). If your fish-shark model exhibited some herding-like dynamics, you may want to start with that. For example, "fountain" dynamics or moving perpendicularly to the heading of the dog could yield interesting results.

<u>Goals in this modeling effort</u> (extending over the next couple of weeks):

1. Develop rules for the sheep and the dog such that the dog is able to herd a group of 50 sheep to the lower left corner. The sheep should start in a configuration like that seen in the real data.

2. Measure outcomes from your sheep-herding model to compare to the real data. Based on this comparison, do you think your rule is a possible explanation of sheep behavior? It's equally fine to answer yes or no here (so long as you have good analysis to back up your answer). The central objective here is to *test different hypothetical sets of rules* that the sheep might be following.

3. Test a range of parameter values in your rules to explore what range of behaviors results. Is there a set of parameter values that most closely reproduces the patterns in the real data? Or does your set of rules lead to patterns qualitatively different from those in the data?