COGS 102A LAB 1: The Distributed System of Ant Foraging

Goal: Examine the difference between the properties of the elements of a system and the emergent, system-level properties.

Instructions: Go to the **Ants** (NOT "Ants Line") model at:

ccl.northwestern.edu/netlogo/models/Ants

Before you download, read the paragraphs that describe what the model is, how it works, how you should use it, and what you should notice.It is possible, although *not* recommended, to run this simulation in your browser (click on the "Run Ants in your browser" link). However, the model tends to work better if you download NetLogo (which only takes 2 minutes) directly onto your laptop. Once downloaded, go to Models >> Sample Models >> Biology >> Ants.nlogo . To begin, hit SETUP, then GO. To pause, hit GO again.

Note that the NetLogo description says that individual "ants" are programmed to check left, right, and forward and, in the absence of food or chemical, then move randomly (i.e. shift to 40^{o} one side or the other of their last trajectory). If, as a result of their checking, they find food, their next move will be "uphill" (along an increasing gradient of "nest scent" that emanates from the nest – not shown in the simulation) carrying that food home. Plus, while they carry food back to the nest, they release a chemical at each step (this *is* visible – green to white - in the simulation) Other ants that detect this chemical during their checks will move toward the highest concentration of chemical they detect. It is important to recognize that the ants are NOT programmed to follow others or form trails; these are "system-level" features that emerge when conditions are right.

Experiment with changing the parameters (Population, Diffusion-Rate & Evaporation-Rate). Observe the behavior of the colony to figure out what the parameters do. It is a good idea to change just one parameter at a time, while holding the others constant. It will be useful to slow down or speed up the simulation; use the slider at the top. One person on your team should **keep a written record** (see NOTES page of report) of your actions and their consequences. Although these notes *will* be turned in with the rest of your report, do not worry about this sheet being neat or precise. It should just include the observations, ideas, questions, etc. that arise as you grapple with the lab.

Consequences can be described quantitatively and qualitatively. **Quantitative outcomes** include things like the amount of time until an interesting condition is reached. (Hint: "ticks" are cycles of the model.) For example, when the parameters are set at X, Y & Z, how many ticks until the first food source is exhausted? How many ticks until all of the food has been exhausted? How does this vary as the parameters vary? Etc. You can also turn on the "plot?" switch to see a graph of the amount of food in each source at each tick of the model. **Qualitative outcomes** include things like whether or not the ants form a "stable trail", which food source they tend to target, etc.

After taking notes on your experimentation, you need to answer the specific questions provided on the Lab Report Sheet. You should work out your responses together, thinking and talking through your answers before you commit them to paper. Note that the more carefully you READ the questions, and the more directly you answer them as asked, the better you will do. Please write legibly!

The lab questions you will need to answer for LAB 1 are below.

Please write your answers on the **Lab Report** form, provided in the lab,

after consulting with your Team.

One **Lab Report** per Team should be submitted by the end of the YOUR section.

A) Sensitivity to simple constraints

Describe, qualitatively and quantitatively, how each parameter (population, diffusion-rate, evaporation-rate) affects behavior. That is, what happens when the parameters are set at the extreme values (both high and low)? What combination of values leads to the most successful foraging? Consider ways to simply & clearly graphically represent this information, and show one..

B) From individuals to interaction

The NetLogo Ants page says that "the colony as a whole acts in a sophisticated way." In what ways does the behavior of the colony differ from the behavior of the individual ants? What properties of the colony emerge from the simple, dynamic interactions of the ants? Why might the particular configuration of parameters that you found above, be the one most likely to produce such system-level organization?

C) Patterns in space & time: What is a "stable trail"?

Like the cars in a traffic jam, the ant membership of a stable trail changes continuously with new ants joining and old members leaving. If a stable trail is not defined by a particular collection of ants, what does a stable trail consist of? Think in terms of dynamic relations among elements rather than in terms of the elements alone (elements = ants, food, nest, chemical, range of next possible moves). What dynamic relations (in space and time) compose the stable trail?