CMSC/BIOL 361: Emergence

More NetLogo Explorations

Today we are just going to spend some more time playing around with the various NetLogo models of self-organization and (potentially) emergent systems. In particular, we are going to focus on three types of systems, all mentioned in your reading: Flocking Behaviors, Stigmergistic Feedback, and Dissipative Mechanisms.

The three models we will be exploring are Flocking, Termites, and Fur. The "exercises" are meant to provide a basic guideline for your exploration; please feel free to also experiment with particular variations of settings that catch your interest.

Exercise 1: Flocking

Before you begin to play, read the information tab to make sure that you understand how the model works.

Summarize the "rules" of interaction that govern the behavior of the model. Do you think that these are realistic biological rules, i.e., is this how real-world birds flock?

Start out by playing with the parameter sliders. How does changing each parameter affect the behavior of the system?

How do you think this system self-organizes (i.e., what type of feedback mechanism do the turtles use)?

Turn off a rule by setting a parameter slider to zero (i.e., if the parameter = 0 then the rule relating to that parameter has no impact on the system). Does flocking still occur? What is missing from the behavior of the system? Try turning off a different one. How does the behavior of the system change? What if you turn off more than one rule?

If you allow the model to run for a long time, will the birds settle into an unchanging formation? Are the combinations of parameter settings that result in an ever-changing formation; i.e. chaos? Is this system emergent? Are their combinations of parameter settings for which there is no emergent behavior?

Extend the model: Create an obstacle in the middle of the world around which the birds must fly.

Exercise 2: Termites

Before you begin to play, read the information tab to make sure that you understand how the model works.

Summarize the "rules" of interaction that govern the behavior of the model. Do you think that these are realistic biological rules, i.e., is this really how termites excavate material?

Start out by playing with the parameter sliders. How does changing each parameter affect the behavior of the system? Is there a particular threshold of either density or population size that must be reached before the system will begin to self-organize? Are there particular combinations of parameters for which the termites are unable to generate stable sets of woodchip piles?

How do you think this system self-organizes (i.e., what type of feedback mechanism do the turtles use)?

What is the difference between decentralized and centralized organization?

Exercise 3: Fur

Before you begin to play, read the information tab to make sure that you understand how the model works.

Summarize the "rules" of interaction that govern the behavior of the model. Do you think that these are realistic biological rules, i.e., is this really how color patterns are generated?

Start out by playing with the parameter sliders. How does changing each parameter affect the behavior of the system?

How do you think this system self-organizes (i.e., what type of feedback mechanism do the turtles use)?

Let's do some "parameter tuning". Parameter tuning is the process of figuring out what parameter range of parameter values result in a specific outcome. Try and generate the following types of colorations:

1. zebra stripes
2. giraffe spots
3. dots

How sensitive are each of these patterns to initial starting conditions (i.e., what is the range of parameter values over which each is generated)?

Extend the model: create a button that automatically sets the parameters to generate your favorite pattern.