Introduction to Complexity

Unit 7 Homework

(optional)

You can choose whether you want to do the Beginner, Intermediate, or Advanced level. You are free to discuss this part of the homework with anyone, or to ask questions about it on the course forum.   You can also use any resources you like, including our course NetLogo models. Note that homework in this course is not turned in or graded.

Note to all: *We'll publish a solutions video for the Beginner level that demonstrates how to use the NetLogo Behavior Space tool. The other assignments are open-ended, so we won't be publishing solutions for them. However, if you run into questions or get stuck, we encourage you to post questions to the course forum.*

Beginner Level:

Modify Fireflies.nlogo (from the Models library) to stop when all the fireflies have synchronized. To do this, add the following line of code at the beginning of the "go" procedure:

```
if all? turtles [color = yellow] [stop]
```

Now you can see how different parameter values affect the time it takes for all the fireflies to synchronize. Use the Behavior Space tool to investigate how this time-to-synchronize is affected by varying the `number` of fireflies, the `flash-length`, and the `cycle-length`. Can you form hypotheses to explain the results you see?

Intermediate /Advanced Level:

The best way to learn about models of self-organization is to write them yourself! Try writing, from scratch, simplified NetLogo models of flocking and of firefly synchronization using the descriptions given in class.   If you get stuck on any part of the implementation, take a look at how it was implemented in the original models in the NetLogo Models Library, but as much as you can, implement your models without referring to those original models.

<u>Very Advanced Level:</u>

The following is a very advanced exercise, whose results could be published! We leave it deliberately open-ended.   Don't take this on unless you have a lot of time and interest in this phenomenon!   [This is in response to course participants who have asked for interesting unsolved problems.]

Read the paper The Regulation of Ant Colony Foraging Activity without Spatial Information
(**http://www.ploscompbiol.org/article/info:doi/10.1371/journal.pcbi.1002670**), which discusses a very different algorithm for ant foraging than the one discussed in our lectures. Build an agent-based model of this system, and see if your model reproduced the qualitative behavior of the authors' mathematical model.