CMPLXSYS 270 Agent-Based Modeling
Lab 0
(50 points)

Part 1: Boids (12 points)

Go to https://eater.net/boids

Watch the YouTube video linked there.
(SmarterEveryDay "How Birds Do The Thing")

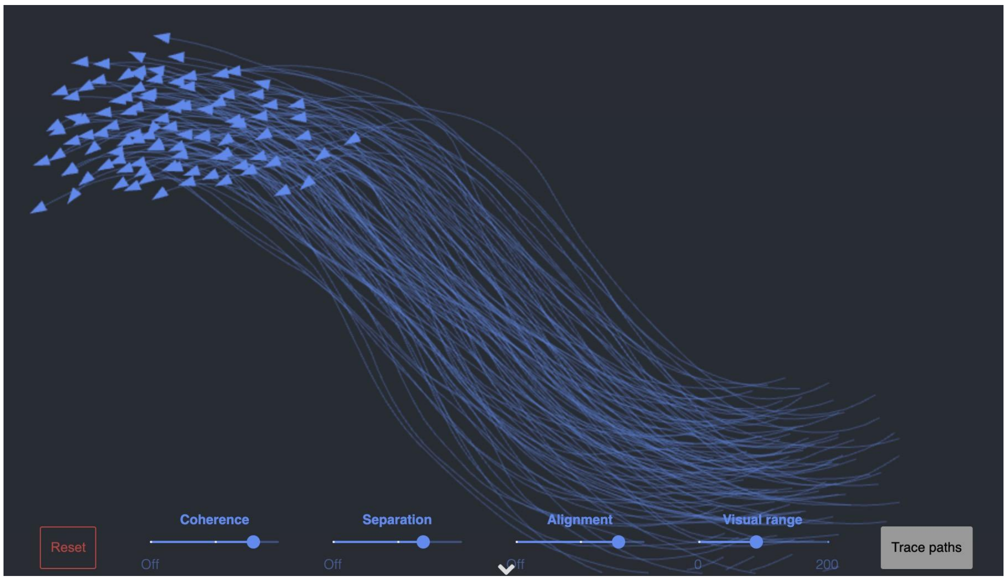
1) Give your (brief) thoughts on the video. (2 points)

The stimulated flocking behavior algorithm in birds shows that birds fly towards the center of the flock and avoid other birds at the same time. Each bird trys to maintain the velocity of the other bird which mirrors the simplicity and the elegance often seen in nature. This flocking algorithm is not limited to simulating only birds but to various other scenarios, such as modeling fish, or even herds of animals.

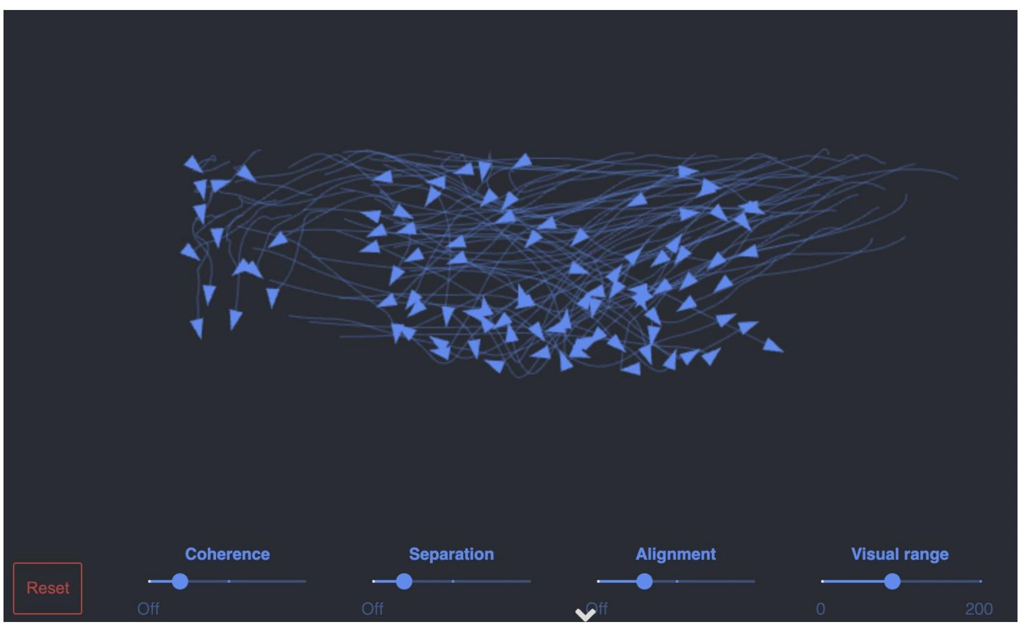
2) Mess around with the sliders on eater.net, find parameters which make behavior look like 2 of the following: small birds, large birds, gnats, fish, other (you

tell me!). Give your slider locations estimated on a scale of 0 to 10 each—or attach a (cropped) screenshot. One caveat: be sure to leave visual range above zero, or else none of the others matter! (4 points)

Birds behavior:



Fish behavior:



3) What are three significant differences between real bird flocking and the simulation as implemented here? (6 points)

The three differences are coherence, separation and alignment. In the simulation implemented in boids algorithm, the "coherence" slider controls how quickly they steer in the direction of one another. The "separation" slider lets you regulate the steering's speed. We can also regulate boids attempt to match the vectors of speed and direction by adjusting “coherence” slider. These three guidelines were developed from observation of the environment. Real bird flocking, on the other hand, is influenced by a variety of different factors, such as habitat, preys and predators, and the behavior of each individual bird. Therefore, the decision-making processes seen in real birds might be different from the simulation as implemented in Boids Algorithm.

Note: many Boids simulations were Java applets, and are no longer supported. This simulation has no speed slider, and may run annoyingly fast on some computers. The size of the simulated environment also depends on your resolution.

If you’re interested, here’s a more precise definition of what this simulation’s rules actually are, in pseudocode:
https://vergenet.net/~conrad/boids/pseudocode.html

If you’re *extra* interested and more comfortable with coding, check out this video with visualized descriptions, extensions, and really cool results:

https://www.youtube.com/watch?v=bqtqltqcQhw&ab_channel=SebastianLague
(featuring a cameo by the Fibonacci sequence!)

Part 2: Emoji Simulator (**ncase.me/sim**) (38 points)

Play a bit with each of the 7 default models.

1) Which one is your favorite, and why? (4 pts)
   The forest fires is my favorite because it offers a general concept of modelling forest fires and shows how the fire spreads over the forest.
2) Pick **one** of the default models, and do the following:
   a) Describe the core phenomenon that this model attempts to capture. (4 pts)
      The core phenomenon that this model attempts to capture is the spread of fires in a forest under various conditions. The trees will regrow after the forest fires gone. The model shows the cycle of forest fires destroying the trees and trees regrowing after fires.
   b) What are your impressions—does it succeed? Is any emergent behavior surprising? (5 points)
      The model successfully simulates how fire spread overtime but it does not show the factors that affect the forest fires, such as weather

conditions and human interactions. The emergent behavior describes patterns or events that develop from interactions between different parts of a system. In the context of forest fire models, the emergent behavior is surprising since it includes unanticipated fire spread patterns and the change of fires or trees depending on the status of its neighbors.

c) Give at least one quantity about the state of the system that would be interesting to keep track of over time as the simulation plays out. Why? (5 pts)

One quantity about the state of the system that would be interesting to keep track of over time is the rate of spread of the forest fire. Since the rate can inform us of how quickly the fire is spreading and helps us understand the dynamics and impact of simulated fires. It also enables us to forecast the fire's future behavior in the real world.

d) i) and ii) Describe (at least) two ways the model could be tweaked. Describe what this change might correspond to in the "real world" phenomenon. (10 pts)

1. We can set and adjust the terrain and topography in simulated environment. For example, we can add valleys in this model

which cause more and intensify the spreading of forest fire. This factor further demonstrates how fires can change the level of fires, which affecting the damage of treetops in real world. This change might also impact the speed of the regrow of trees and let us better understand how terrain can impact fire dynamics.

2. We can introduce some strategies to control the forest fire such as “firefighter” agents in this model. In real world, firefighting teams seek to create barriers to stop the fire from spreading further. With this adjustment, it would be possible for us to investigate how different firefighter methods affect the simulated forest fire. People can gain a better knowledge about the efficacy of various fire control strategies.

(Example: make an “always” activity probabilistic)

e) i) and ii) Make those changes to the model’s logic, and describe the resulting behavior. Does it match what you expected/intended?

(Feel free to fiddle with numbers to try and get what you want. But if you can’t get it to work how you want, just describe your process and what you saw.)

Save your tweaked models (on the right, near the bottom of the page), put the auto-generated url into tinyurl (https://tinyurl.com/app/), and include those abbreviated links. (10 pts)

http://tinyurl.com/yb47w72e

I have added emoji “valley” and “firefighting” into this model. For the new valley emoji, I adjust it with 0.3% chance turning into fire. This chance is larger than the normal tree with 0.1% probability turning into fire, showing that valley can actually cause more forest fire.

For the change of the firefighting control, I turn fire into firefighting and turn firefighting into empty spot. This is suggesting that once there is forest fire, we can use firefighting agent to control the fire.

These changes match what I expected for the most parts. However, I am unable to keep the valley over the same area, which would be slightly different than the terrain and topography in the real world.

f) (optional) Make as many changes as you’d like to the predator-prey simulation to make it more realistic, and include a tinyurl link. (up to 5 extra credit pts) http://tinyurl.com/4x6j75r3

1. We can add the reproduction factors of both the predators and preys since in the real world fox and rabbit will reproduce and their offsprings will survive. Under the empty spot, with a 0.2% chance, it will turn into fox or rabbit.
2. We should also consider the environmental factors such as seasonal and weather changes. Factors such as temperature, daylight hours, rain or snow can affect the hunting and foraging success as well as the survival of both predators and preys in reality. The daylight hours and temperature cannot be shown in this model, so I only added rain and snow here. Under both of the fox and rabbit, if at least 1 neighbor is snow, it will trun into an empty spot. Similarly, if at least 1 neighbor is rain, it will has a probability of 0.4% turning into an empty spot.
   ★ I'll feature a few of the best ones next class for bragging rights!