Assignment 1, step one out of three

This assignment is done in *three parts. For this part, you will work alone*. The only persons you can ask for help are the instructor, lab assistant, and library tutor. Anyone else is a non-authorized collaboration, that is, an act of academic dishonesty. If you have any doubt or question about what qualifies as academic dishonesty, please contact the instructor to make an informed decision.

Objective: Casting problems as either cellular automata (CA) or agent-based models (ABM).
Due date: Thursday Sept 27th at 9pm. Assignments do not receive a grade after the due date.
How to submit: On the course website only (no emails or hardcopies accepted).
Send a single PDF document named "Firstname_Lastname_Assignment1.pdf"
Do *not* include any identifying information (e.g., your name/ID) in the PDF itself.
(For any issue saving your files as PDFs, please refer to:
https://www.digitaltrends.com/computing/print-pdf-windows/2/)
Submissions in other file formats or with identifying information will be returned.

I. Overview

On the next page, you will be given a list of problems. For each one of them, you'll have to:

- argue whether you would prefer to model it as CA or ABM (detail why you are making this choice)
- explain how your CA or ABM would work (needs to be sufficiently detailed so that, if anyone was to read your explanation and they know NetLogo very well, they could go ahead and write code)
- include a figure (with legend) showing the initial state of your model. If you use a CA, you don't need to show more than 5 by 5 cells. If you use an ABM, a handful of agents would suffice.

As a brief guidance to "explain how your CA or ABM would work", start with the slide deck "3-Approaches to building virtual worlds" and then consider the following. **If you use a cellular automaton**, you need to tell us about:

- the set of states. At any time step, in which state could a cell be? What do these states mean?
- the initial configuration. When you set-up the model, how do you decide of the cells' states?
- the rules. From one time step to the next, how could the state of a cell be changed? Remember on slider 35 that rules can "involve probabilities", "involve a timer", and be based on neighboring cells.
- when we should stop running the model. That may either be after a given number of time steps, or when some criteria have been met such that it's unnecessary to run the model any longer.

If you use an **agent-based model**, you would need to tell us about:

- the types of agents. For instance, on slide 51, the "wolves eating sheeps" had two types of agents (wolf, sheep). The "birds" had a single type of agent (bird), and so did the ants (ant).
- for each type of agent, what characterizes them. For instance, wolves were characterized by their reproduction rate, and how much they gain from food.
- the environment. It is composed of cells in different states (in "wolves eating sheeps" a cell was either 'grass' or 'empty'), so similarly to a CA list the states and their meaning.
- the initial configuration. When you set-up the model, what's the environment like? How many agents of each type do you have? For each type of agent, how are their characteristics set-up (e.g., what is the *value/number* for the reproduction rate and gain from food of each wolf).
- the rules. For each type of agent, what can they do at each time step, and how do they make these decisions?
- when we should stop running the model.

There is no word/page count. Write what it takes for your arguments and explanations to be complete. While there is a lazy incentive to use CA everywhere (because it takes less explaining than an ABM), your grade upon completion of all steps of this assignment will depend on: completeness (any explanation/argument missing?), appropriate model choice (if you use one that doesn't fit well then your explanations will be very awkward), and professional style (no typos or draft-like figures).

II. The problems

Each of the following describes one problem. Since it's a "problem", it's not a particularly joyful phenomenon (e.g., getting sick or having landslides). All problems do occur in the real-world, but the problem settings (e.g., classroom, Furman campus, Carolinas) are imaginary. The footnotes are just there if you are personally curious, but should not affect how you model each problem.

1) Spreading the flu in a classroom

A handful of hard-working students may make the selfish choice of coming to class when they know they have the flu, thus infecting others and causing problems throughout the community. This model seeks to capture how flu spreads in the classroom. We consider that students are either infectious, or not (e.g., susceptible, infected but not yet infectious, recovered). A student may cough/sneeze/talk, which (to really simplify) produces a cloud of infectious droplets invisible to the human eye. If a person walks through this cloud, the droplets can land in the mouth/nose or be inhaled into the lungs, and this person can get sick. Droplets survive in the air for a few hours.

2) Spreading HIV on campus

The Centers for Disease Control and Prevention (CDC) announced last August that sexually transmissible diseases (STDs) in US reached record high[1]. The Human Immunodeficiency Virus (HIV) is an STD[2]. We are interested in creating a model that simulates how residential Furman students may be getting HIV via unprotected sex over the course of an academic year. Once a person is infected, this person is extremely infectious (via unprotected sex) during the next few weeks. After treatment has occurred, the virus may drop to the point where it becomes undetectable in the body[3], and the consensus is that the risk of transmitting HIV then becomes statistically negligible.

3) Landslides

Because of flooding in North Carolina, the stability of some surfaces has been affected and they're now more prone to landslides. For a given land, we're interested in creating a model that can simulate how the land moves when the landslide takes place (i.e., assuming a landslide is triggered we want to know where the land goes). As vegetative structures may affect the dynamics of the landslide, note that the lands in the area of interest all have some shrubs and trees.

4) Landslides... revisited

Assume the setting and goals are identical to problem (3) above. *In addition*, assume that landowners with peculiar hobbies also have bongos, oryxes, kudus, and lechwe[4] grazing on the land. As they graze, they damage shrubs (but not trees) and thus remove some of the vegetative structures that hold the land together.

5) Up to you

Describe a real-world problem that you personally care about (you don't need to say *why* you care about it). Include this description in your PDF, and solve the problem just like the other four above.

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[1] https://www.cnn.com/2018/08/28/health/std-rates-united-states-2018-bn/index.html

[2] It can also be acquired by sharing needles for injection drug users, by being transfused with contaminated blood, or from mother to child during pregnancy/labor/delivery/breastfeeding. These are *out of topics* here.

[3] Be careful about the fine prints. People who strictly adhere to taking their medications *daily* may achieve and *maintain* an undetectable viral load. But if you don't take the medications daily, the viral load can go back up. And even if you adhere, HIV is a virus that mutates a lot, so it may change enough to evade the effect of drugs.

[4] In case you wonder, I'm not making them up. These animals do exist. In the US, they mostly exist in zoos.