

Computational Modeling & Simulation I (Interdisciplinary Science)
CS 346, Spring 2020
Final Project

Due in part by Friday, April 24, and
in part by Monday, April 27, and
in part by Thursday, April 30, and
in part by Monday, May 11, and
with a code demo by Friday, May 15.

(Please see the notes and descriptions of exercises below!)

Cellular Automata Simulation—Modeler's Choice!

Some introductory notes from your Prof.:

- As noted in email, the Final Project is due by 11:59pm (Maine time) on May 11. Code demos for all CS346 assignments must be completed by the end of the day (Maine time) on Friday, May 15—and please do not expect me to be available after 5pm on May 15! You are strongly encouraged to submit work and set up code demos well before the deadlines.

PLEASE do not wait until the last minute for code demos! I may be busy at the end of the semester, and if there isn't enough time available for your demo to enable me to fully appreciate your code, it may negatively affect your grade on the HW. (See the course syllabus / policies document.)

- For HW3 and the Final Project, you may work in teams of two, or you may work individually. If you work in a team of two, you may choose your team; you are permitted to have the same team for both assignments (i.e., both HW3 and the Final Project).
- In consultation with me, you will choose a topic for this Final Project assignment; together, we will determine the project's component exercises. (See below for more details.) As part of your submitted work for this project, you will submit the relevant code for each programming exercise as well as an accompanying write-up document.
- For presenting a model you developed, your write-up should include not only the model itself—e.g., the differential equations (or finite difference equations), constants, and initial conditions that may comprise the model—but also an explanation of how the model was developed, including what each variable / parameter in the model stands for, what simplifying assumptions were made, and what the reasons were for your decisions. Include all pertinent information; incomplete write-ups may not merit full credit. (Please see the HW Notes & Guidelines document for additional guidelines about write-ups.)
- For simulations, as usual, your write-up should include the values of constants / parameters employed for each run of the simulation and a very brief explanation of why you chose to run those particular values for simulations. Descriptions of results should be

concise and information-heavy; feel free to include figures (e.g., Matlab plots) in write-ups to illustrate your observations. (Please see the HW Notes & Guidelines document for additional guidelines about write-ups.)

- Please use the string `FinalProject` as part of (not *all of!*) the folder name (along with names / userids / etc., as required) for submitting this assignment. See documents on the course website for general HW guidelines and submission instructions. (Not following guidelines may result in small deductions on this assignment—please see your Prof. with any questions!)

Exercises

1. **Find A Topic!** The first thing to do is identify a project topic—one that you will be excited about working on!

As previously mentioned, project proposals must be approved by me—we need to make sure the scope and focus are reasonable for a Final Project assignment for our CS346. You will be required to use Cellular Automaton (*CA*) modeling for this project; moreover, please note that CS346 is about modeling and simulating dynamical systems, with applications for the sciences (typically natural sciences), so projects should be within that broad scope. There are some deadlines associated with this:

- By 11:59 (Maine time) on Friday, April 24, please let me know if you'll be working in a team or as an individual on this project. (Under normal circumstances, this would be a team project, so I hope it will work out for you to be in a team for it, but I understand that these are not normal circumstances, and it's absolutely fine to work individually on this project.)
- A pre-proposal for your project must be presented by Monday, April 27. Email me with the pre-proposal; it needn't be more than a paragraph or two. **If at all possible, please submit this part of the assignment before the deadline!**
- A final proposal for your project must be **approved** (not merely presented) by Thursday, April 30.

For the final proposal, we must agree on exactly what will be modeled and what the component exercises will be for the project. This may require a Zoom meeting and some time spent talking, so **please begin work on your proposal early!**

2. **Modeling & Simulation!** You must then, of course, actually design and implement the model and the relevant simulations. But that's not all there is to this Final Project assignment!
3. **Code Validation!** It is important for all programming projects—and especially for work in interdisciplinary computational science—to be sure your code is well validated. As part of the write-up for this Final Project, be sure to explain the criteria you use to determine if your code functions properly, and the tests you ran on your code to do that validation. (This does not need to be more than you would normally do, if you normally thoroughly validate your code! It just needs to be fully documented.) If

you have any questions about how to test or validate code, or what to include in your write-up, please let me know!

(Note: If you wanted a “practice run,” you might consider writing up your code validation criteria and tests for your exercises from HW3. Although that is not an assigned part of HW3, I will be happy to go over it with you as preparation for this exercise!)

4. **Evaluation—Hypothesis Testing!** In this course, we have encountered various ways to evaluate a model. For examples:

- A model could be evaluated by coming up with hypotheses and seeing how useful the model is for hypothesis testing.
- A model could be evaluated by collecting empirical data and seeing how well the model fits the data.
- Perhaps more generally, a model could be evaluated by analyzing it using the dimensions and overall framework presented in Webb’s article *Can robots make good models of biological behavior?*, from our reading earlier this semester.

(There are also other ways, I’m sure, but let’s stay with these for now.)

In your write-up for this Final Project, evaluate your model in the first of the above ways: **use it for hypothesis testing**. (See our HW2 for additional discussion of what’s involved in hypothesis testing.) In the process of coming up with hypotheses and testing them, it is **highly recommended** that you consult with me to make sure they are sufficient for this exercise!

We will talk more about this project briefly in class, but please feel free to ask me any clarifying questions about it, in or out of class!