88-374: Agent Based Modeling for the Social Sciences

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Course Time / Location: Sunday and Tuesday 3:00-4:20; Rooms 2147 (Sundays) and 1185 (Tuesdays).

Office Hours: Sunday-Tuesday 4:30-5:30 and by appointment.
If my door is closed, I am not available (out of the office, working, etc). If you'd like to meet with me and can not make the posted office hours, I highly encourage you to set up an appointment to make sure I will be around.

Course Description

This is a research and project-based course that will provide you with a hands-on introduction to the field of agent-based modeling. An agent-based model is a tool used by social scientists to study how large-scale social dynamics result from micro-level individual behavior. In its basic form, a collection of individuals, or agents, are programmed into a computer, along with a simple behavioral algorithm describing how they act. The computer then allows the agents to interact (possibly in both space and time), and ultimately simulates a social dynamic that can then be analyzed in terms of the behavioral rules.

In the social sciences many problems we are interested in involve group phenomena that may seem perplexing when viewed in the aggregate. Examples include fads, norms, segregation, stereotyping, and network formation. The goal of an agent-based model is to look at how these micro-level decisions that people make, such as whether to live close to a friend, slow down to take a look at an accident, or arrive early to the theater to get a good seat, may influence aggregate behavior and have large unintended consequences for society as a whole.

This course will require a fair amount of computer programming but is not a programming course per se. It is my intention that this course provides an applied, hands-on, alternative approach to understanding social science phenomenon. The simulations that you will be programing are simply alternative methods. You don't need to be an expert programmer for this course – I actually assume that you have a fairly minimal background – but you do need to be willing to put in the effort. It's my hope that if you put in the time, constructing and playing with the simulations can actually be a lot of fun. If you are concerned with your computer programming background, please come see me at the beginning of the semester.

Course Logistics

In the first two months our time will be divided into two parts: discussing the weeks readings and working on various projects in the computer lab. The readings are drawn from different fields and genres. I selected them in part familiarize you with how agent-based models are done, but also to give you inspiration for the sorts of problems you may be interested in tackling in your own final projects. I expect everyone to do the readings every week and to be prepared to comment on them.

I have structured each lab project to loosely correspond with the topics we have discussed in class. During our lab time you will work on bits of code and learn how to implement your own models. I will be available to help you one-on-one with any problems you might run into. This time is meant to be fun and exploratory (but may be a fair amount of work!). The individual labs I assign are intended to help you get your feet wet with new concepts. You're welcome to brainstorm and work with your classmates on these problems (I would actually highly encourage it), but also remember that in order to learn how to program you will need to write your own code. You'll be required to type your results and ideas up in one to two page summaries that will be due with your code. I'll be looking for you to explicitly and clearly state your model, to summarize your results, and to suggest potential modifications of the model.

The ultimate goal of the class is for you to produce your own models. You'll spend the part of the course almost exclusively working on your final project. Class time will be set aside for you to present your preliminary ideas and results to your classmates. On the last day of class we will hold a session for you to present your model. A 4000 word term paper will be due at the end of the semester.

Required Texts:

- Micromotives and Macrobehavior, Thomas Schelling, 1978.
- The Tipping Point. Malcom Gladwell, 2000.
- Agent-Based and Individual-Based Modeling, Railsback and Grimm, 2012.

Suggested Texts:

- Complex Adaptive Systems, Miller & Page, 2007.

Grades

I realize that students may enter this course with very different levels of programming experience. When grading your group and individual projects I'll be looking for creativity and thoughtfulness in the discussion of the results as much as execution. Your final grade will be based on the following criteria:

1. Participation (15%)
2. Weekly discussion write-up (25%)
3. Lab projects (30%). Best 5 out of 6.
4. Final project presentation (10%).
5. Final project paper (10%).
6. Final project model (10%).

Again, my intention is to split the class time between discussion (initially once per week) and lab time. In order to make the discussion section fruitful I am going to require that every week you write up a set of discussion points / questions you have for other students. This is not meant to be onerous if you do the readings. The discussion sections are meant for our class to *discuss*, not for me to lecture. The minimum guideline here is that these discussion points should be roughly at least $\frac{3}{4}$'s of a page. Bullet points are fine, but I will be looking at these and you should spell-check/edit them appropriately. This discussion write-ups will be scored on a check / check-minus scale. **No extensions will be granted for a discussion point write-up**; these are intended to help you discuss the assigned readings.

The programming labs account for 30% of your final grade and will vary in difficulty and often be multi-parted. There will be six of these labs throughout the semester and they will be due approximately every two weeks. **I will not grant any extensions for programming labs**, but I do understand that things happen and life events come up. Therefore, **your lowest lab score will be dropped when calculating your final grade**: I will calculate your score based on the best five out of the six labs.

In general, try to figure things out on your own first. Visit Blackboard – I've set up a discussion board for the class. Any question you might ask me, you should ask there first, unless it is of a personal nature. I am happy to help, but youll learn the most by trying to solve problems on your own first. You will also learn a lot by trying to explain things to others. Therefore part of your participation grade will come from your responses to questions asked on the Blackboard discussion board.

Weekly readings and lab projects

Class	Date	Topic	Reading	HW Due
1	2-Sep	Introduction	MM 1; ABM 1	
2	4-Sep	Lab 1: Intro to NetLogo	ABM 2	Intro tutorial
3	9-Sep	Patterns in the social sciences	MM 2	
4	11-Sep	Lab 2:Lost dog	ABM 3	Lab 1
5	16-Sep	Patterns in the social sciences	Tipping Point 1, 2	
6	18-Sep	Lab: Programming fundamentals	ABM 5	
7	23-Sep	Patterns in the social sciences	Tipping Point 3, 4	
8	25-Sep	Lab 3: Herd Behavior & SOP	ABM 6	Lab 2
9	30-Sep	Patterns in the social sciences	TP 5, 6	
10	2-Oct	Lab: Gathering Data		
11	7-Oct	Sorting, moving & mixing	MM 4	
12	9-Oct	Lab 4: Segregation		Lab 3
13	14-Oct	Patterns in the social sciences	TP 7, 8	project proposals
14	16-Oct	Lab: Distributions & File I/O		
15	21-Oct	Group Choice	MM3	
16	23-Oct	Lab 5: Voting Institutions		Lab 4
17	28-Oct	NO CLASS - EID		NO CLASS - EID
18	30-Oct	NO CLASS - EID		NO CLASS - EID
19	4-Nov	Networks	TBA	
20	6-Nov	Lab		Project lit review
21	11-Nov	Diffusion & Cascade models	TBA	
22	13-Nov	Lab 6: Networks		Lab 5
23	18-Nov	Networks & Belief Formation	McAdam handout	Project prototype
24	20-Nov	Lab		
25	25-Nov	Analysis: Sensitivity & Robustness		
26	27-Nov	Lab: Data Analysis		Lab 6
27	2-Dec	final project lab		Project Model & Data
28	4-Dec	final project lab		
29	9-Dec	Presentations		
30	11-Dec	Presentations		
	13-Dec			Project Reports Due at Noon