Simulation in Psychology:
The Computer as a Tool for Theory Building

Psychology 398

Spring 2017 Syllabus

T & Th 11:30-12:45p; Room 253 Sullivan Center

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Overview

Computer simulation has been used for decades as a tool for understanding and predicting the natural world. The use of computer models to generate weather forecasts is a familiar example. Increasingly, scientists are also beginning using computer simulations to address a wide range of questions about complex human behavior. Why are many cities around the world racially segregated? Does generosity encourage or inhibit cooperation in others? And why do well-informed groups sometimes make ill-advised decisions?

Finding answers to questions like these requires that we develop ways to translate traditional, relatively static theories about the behavior of individuals into predictions about what will likely happen when those individuals interact dynamically through time with other people. Computer simulation is one way to accomplish this.

The purpose of this laboratory course is to teach you the "nuts and bolts" of computer simulation as it applies to human social behavior. We will emphasize the use of computer simulations to (a) express psychological theory and (b) derive predictions about social psychological phenomena—obtained by running the simulations—that would be difficult or impossible to derive in any other way.

In this course you will learn how to analyze and validate computer simulations, and to create your own simulations using a freely available simulation environment: NetLogo. No prior programming experience is required, although some experience of this type may be helpful to a limited degree.

The first part of the semester will be devoted to exercises and assignments designed to help you learn the NetLogo programming language and to gain an understanding of how computer simulations operate in general. Then, during the rest of the semester you will develop your own simulation of social behavior in a specific topic area that you will select from among a number of available alternatives. As part of this, you will be asked to give several brief in-class presentations on your simulation (e.g., regarding its structure, implementation of theoretical constructs, and results obtained) and get constructive feedback from the class that will be helpful for further developing the simulation.

By the end of the course you will be able to think critically about simulations designed by others, and you will have developed the skills needed to evaluate the appropriateness of computer simulations as means of understanding and predicting human social behavior.

This course will count as a B-Group laboratory course for those majoring in psychology.

Prerequisites

The only official prerequisite for the course is PSYC 101 (General Psychology). However, it is strongly recommend that you have also successfully completed PSYC 304 (Statistics), and PSYC 306 (Research Methods). Neither PSYC 275 nor PSYC 321 (the social psychology lecture and laboratory courses, respectively) are prerequisites, although both provide useful background information about social psychological theory relevant to the modeling projects students will do in this course. Prior experience with computer programming is also not a prerequisite. Although some programming experience is may be helpful, most students should be able to learn the necessary programming skills without prior programming experience. NetLogo is a low-threshold, high ceiling language, meaning that it is relatively easy to learn (low threshold) yet still very powerful (high ceiling).

Textbook & Software

The following book by Railsback & Grimm (2012) will serve as both textbook and laboratory manual for the course. It is available in the Loyola University Bookstore. Specific reading assignments (for both inside and outside of class) are listed in the table below.

Railsback, S. F., & Grimm, V. (2012). *Agent-based and individual-based modeling: A practical introduction*. Princeton, NJ: Princeton University Press.

In addition, it is necessary that you have regular access to a desktop or laptop computer in order to complete homework assignments and projects. You should install the free NetLogo simulation environment on that computer. The homework assignments and projects cannot be completed without having NetLogo installed. NetLogo is also installed on most or all University lab computers, including those in the Information Commons, but having it available on your own machine will be much more convenient. NetLogo can be downloaded from https://ccl.northwestern.edu/netlogo/.

Attendance

You are expected to attend every class meeting. Some material will be presented in class that is NOT in the textbook, and there will be in-class activities to help you learn NetLogo. The benefits of these activities cannot be gained except by being in class. There will also be periodic quizzes to assess your learning. You must be in attendance to get credit for these.

Modeling Project

You will be expected to work with a lab partner on a major simulation project that is to be completed by the end of the semester. Students will choose from among a set of pre-defined projects, but there is plenty of room within each project for creatively shaping the final simulation. You and your lab partner will be expected to work together as a team, pool your mental resources, and develop the most creative—yet still true to psychological theory—model that you can. You will pass several (graded) milestones as you develop your model, including two preliminary in-class team presentations, a final team presentation, and an independent write-up to accompany each presentation. The in-class presentations will be made and graded as a team (i.e., both members will receive the same grade), but the accompanying write-ups will be written and graded independently.

Grading

Your course grade will be based on your performance on each of the following:

- In-Class Coding Quizzes: 10%
- Two mid-project in-class presentations: 10% each
    - These presentations are made as a team, and both members received the same grade
- Two sets of formative peer evaluations (given, not received): 5% each
- Two individually written mid-project reports: 10% each
    - Each team member turns in an independently written and graded report
- A final team presentation: 20 %
    - This presentation is made as a team, and both members received the same grade
- A final written report: 20%
    - Each team member turns in an independently written and graded report

Date		Assignments
Week 1		
1/17	Homework|	- **Read**[1] R&G, *Ch. 1: Models, Agent-Based Models, & the Modeling Cycle* - Download NetLogo from: https://ccl.northwestern.edu/netlogo - **Work through** the Introduction (both *What is NetLogo?* and *Sample Model: Party*) in the NetLogo User Manual (found by clicking "Help" in NetLogo)
1/19	In Class|	**Work through** Tutorial #1 in the NetLogo User Manual
	Homework|	- **Work through** NetLogo Tutorials #2 and #3 - **Work through** R&G, *Ch. 2: Getting Started with NetLogo*
Week 2		
1/24	In Class|	Catch-Up Day
	Homework|	**Read** R&G, *Ch. 3: Describing and Formulating ABMs: The ODD Protocol*
1/26	Homework|	**Work through** R&G, *Ch. 4: Implementing a First Agent-Based Model*
Week 3		
1/31	In Class|	Catch-Up Day
	Homework|	**Work through** R&G, *Ch. 5: From Animations to Science*
2/2	Homework|	**Read** R&G, *Ch. 6: Testing Your Program*
Week 4		
2/7	In Class|	Catch-Up Day
	Homework|	- **Read** R&G, *Ch. 7: Introduction to Part II* - Review Potential Modeling Projects
2/9	Homework|	**Work through** R&G, *Ch. 8: Emergence*

[1] NB: Some assignments ask you to "Read" a chapter, while others ask you to "Work through" a chapter.

- "**Read**" implies that while there is much to be learned in the chapter, it is mostly conceptual in nature, and there is less work to do directly in NetLogo as you read. These chapters can generally be understood even if you are not sitting in front of your computer with NetLogo running.
- "**Work through**" implies that you should actually try in NetLogo almost everything that is described in the chapter. Thus, you should plan to read these chapters while you are sitting with your computer turned on and NetLogo running, so that you can try to implement what is described in the chapter as you go. This will take extra time and effort, but you will learn and remember the material much better—and will be a more successful modeler—if you actually try these things out for yourself and explore how they work.

Week 5

2/14	In Class|	Catch-Up Day
	Homework|	**Work through** R&G*, Ch. 9: Observation*
2/16	Homework|	**Work through** R&G*, Ch. 10: Sensing*

Week 6

2/21	In Class|	Catch-Up Day
2/23	In Class|	Start Preparing Your March 2 In-Class Presentation
	Homework|	**Work through** R&G, *Ch. 11: Adaptive Behavior and Objectives*

Week 7

2/28	In Class|	Continue Preparing Your March 2 In-Class Presentation
3/2	**In Class|**	**Presentation Describing the Real-World Phenomenon and/or Psychological Theory you will model (Emphasis is on the phenomenon and/or theory, not NetLogo Model**
	Homework|	**Read** R&G, *Ch. 12: Prediction*

Spring Break

Week 8

3/14	In Class|	Catch-Up Day
3/16	**Due|**	**Write-up Covering Material in March 2 Presentation**
	In Class|	Work on Your Model
	Homework|	**Work through** R&G, *Ch. 13: Interaction*

Week 9

3/21	In Class|	Work on Your Model
3/23	In Class|	Work on your Model
	Homework|	**Work through** R&G, *Ch. 14: Scheduling*

Week 10

3/28	In Class|	Work on Your Model
3/30	In Class|	- Work on Your Model - Start Preparing Your April 6 In-Class Presentation
	Homework|	**Read** R&G, *Ch. 15: Stochasticity*

Week 11

4/4	In Class|	- Work on Your Model - Continue Preparing Your April 6 In-Class Presentation
4/6	**In Class|**	**In-Class Presentation Describing the Basics of Your Model (what features of the real world will be modeled, how specific variables will be operationalized, how it will work**
	Homework|	**Read** R&G, *Ch. 16: Collectives*

Week 12

4/11	In Class|	Catch-Up Day, and Work on Your Model
4/13	**Due|**	**Write-up Covering Material in April 6 Presentation**
	In Class|	Work on Your Model
	Homework|	- **Read** R&G, *Ch. 17: Introduction to Part III* - **Read** R&G, *Ch. 18: Patterns for Model Structures*

Week 13

4/18	In Class|	Work on Your Model: Focus on Generating Quantifiable Results
4/20	In Class|	Work on Your Model: Focus on Generating Quantifiable Results
	Homework|	**Read** R&G, *Ch. 19: Theory Development*

Week 14

4/25	In Class|	- Work on Your Model: Focus on Generating Quantifiable Results - Start Preparing Your Final In-Class Presentation
	Homework|	**Read** R&G, *Ch. 20: Parameterization and Calibration*
4/27	In Class|	- Work on Your Model: Focus on Generating Quantifiable Results - Continue Preparing Your Final In-Class Presentation

Finals Week

5/2 (9-11a)	**In Class|**	**Final Present of the Phenomenon, Model, and Final Results that you Obtained**
	Due|	**Final Write-Up Describing the Phenomenon, Model, and Results**