

DESIGNING AND CONSTRUCTING MODELS WITH MULTI-AGENT LANGUAGES

EECS 372/472

Spring 2009

Tuesday, 10AM – 12:45 PM

Francis Searle 3220

Contact Information

Professor: Uri Wilensky

Address: Annenberg 337, Phone: 847-467-3818

2nd address: Ford 3-211, Phone 847-467-3886

E-mail: uri@northwestern.edu

TA: Josh Unterman

Address: Ford 3.215

Phone: 847-467-6945

E-mail: junterman@ccl.northwestern.edu

TA: Forrest Stonedahl

Address: Ford 3.215

Phone: 847-467-6945

E-mail: forrest@northwestern.edu

Course website: <http://ccl.northwestern.edu/courses/mam/>

Blackboard: log in at <https://courses.northwestern.edu/webapps/login/>

Course mailing list (students and faculty): mam@ccl.northwestern.edu

Course faculty (professor and TAs): mam-fac@ccl.northwestern.edu

Course Description

This is a hands-on projects course. All students will design and implement multi-agent models in the NetLogo language.

This course will begin with an introduction to the multi-agent language NetLogo. Students will design and implement several NetLogo models and analyze their behavioral regimes. Students will also learn to build models of interaction on social networks (or other types of networks). We will cover methodology for verifying, validating and replicating agent-based models and comparisons with systems dynamics and equation-based models. Students will also have an opportunity to explore existing and create their own participatory simulations using the HubNet architecture.

The course is designed for both undergraduates and graduates. (Graduate students will be expected to do additional project work.) Three main classes of students are anticipated:

- Computer Science students who would like to learn about multi-agent languages, artificial life and bottom-up AI
- Natural Science, Engineering and Social Science students who have content expertise and would like to learn how to build multi-agent models of their content domain
- Learning Science graduate students interested in the design of multi-agent learning environments

NetLogo is a programmable modeling environment for simulating natural and social phenomena. It is particularly well suited for modeling complex systems developing over time. Modelers can give instructions to hundreds or thousands of independent "agents" all operating concurrently. This makes it possible to explore the connection between the micro-level behavior of individuals and the macro-level patterns that emerge from the interaction of many individuals. NetLogo lets users run simulations and "play" with them, exploring their behavior under various conditions. It is also an "authoring tool" which enables users (both novices and experts) to create their own models. NetLogo is simple enough that novices can easily run, explore and build their own simulations. NetLogo has extensive documentation and tutorials for all of its features. It also comes with a Models Library, which is a large collection of pre-written simulations that can be used and modified. These simulations address many content areas in the natural and social sciences, including biology and medicine, physics and chemistry, mathematics and computer science, and economics and social psychology. Several model-based inquiry curricula using NetLogo have been in use.

HubNet is an extension of NetLogo that enables multiple users to collaborate and participate in a simulation. In a HubNet activity, each participant controls an agent or set of agents in a larger model. Several HubNet activities are also included in the models library.

The class will place significant emphasis on being a structured environment to support student projects. It is expected that class members will support each other and will make regular use of the class mailing list (mam@ccl.northwestern.edu). Questions about NetLogo syntax, semantics and modeling idioms and efficiency should go to that list and class members are expected to read each others' questions and reply.

Curricular requirements fulfilled by this course

- For CS and CIS undergraduate majors, it counts towards:
 - one credit of the project course requirement
 - the A.I. or Interfaces area breadth and depth requirements
- For Cognitive Science undergraduate majors, it counts as:
 - an advanced elective credit for the Cognitive Science major.
- For Learning Sciences graduate students, it fulfills:
 - a design course requirement
- For graduate students working the Cognitive Science Specialization: it counts as:
 - one course credit toward specialization

Grading

All assignments and projects will be graded as either complete or incomplete. If a project is judged incomplete, you will have an opportunity to complete it or redo it the following week, but with a small penalty. Email mam-fac@ccl.northwestern.edu if you need to request an extension for any assignment or project. You will also be assessed on your class participation both in class and virtually. Graduate students are required to do two projects.

- Class Participation: 20%
- Homework Assignments: 30%
- Final Project: 50%
- There will be no exams for this course.

Requirements

- Read selections from an as-yet-unpublished textbook, and several other selected papers.
- Master the NetLogo language
- Read, post, and reply to NetLogo questions on the course mailing list
- Share, discuss, and revise models using the *Modeling Commons*
 - The *Modeling Commons* is a new web system that allows people to share models, discuss models, find and comment on other users models, tag models, save a history of revisions of models, collaborate with others, etc.
 - (It's like a cross between “YouTube” and Wikipedia, except for agent-based models.)
 - This is beta software, so there may be a few glitches. Don't worry, we'll work them out together as the course progresses.
- Complete assigned homework exercises/explorations, including tasks such as:
 - Revising an existing NetLogo model from the Models Library
 - Participating in a few HubNet collaborative simulations
 - Comparing systems dynamics models with multi-agent models
 - Incorporating social network primitives, measures and utilities into multi-agent models
- Complete the final project
 - Construct at least one polished NetLogo or HubNet model and do an analysis of the model.
 - Submit weekly progress reports on the final project

About the Final Project

The final project is to design and implement a polished NetLogo (or HubNet) model. This includes interface window, commented procedures and a full and detailed info window. The model should be embedded in a web page that describes it to a novice user. It should be possible from that web page to download the model or to run it as an applet.

The first draft of the final project design specification is due by April 21st.

The final project is due by May 29th.

Final projects will be presented on June 2nd.

Depending on progress, some project presentations may take place on June 9th (at our regular class time, but during finals week), so please hold that date for class. (*If this time conflicts with students' other scheduled finals, it will be rescheduled.*)

Readings

- Selections from Wilensky, U. & Rand, W. (2009). Introduction to agent-based modeling. MIT Press.
- Wilensky, U. & Resnick, M. (1999). Thinking in Levels: A Dynamic Systems Perspective to Making Sense of the World. *Journal of Science Education and Technology*. Vol. 8 No. 1. pp. 3 – 18
- Wilensky, U. & Stroup, W. (2004). Embodied Science Learning: Students Enacting Complex Dynamic Phenomena with the HubNet Architecture
- *Selected further readings to be determined*