

# COLL60V Ants, Brains, Cities, and Software

Mills College Fall 2009

Lectures: Tu-Th 4:00-5:15 pm Lab We 3:00-5:00 pm

Last Modified 26 August 2009

## OVERVIEW, Etc

### Course Description

Introduction to intelligent agent modeling (IAM) across many disciplines. Participants will use software to build simulations of phenomena ranging from pedestrian traffic to ant colonies, from slime mold to cities, and will become familiar with concepts such as: chaos, emergence, self-organization, complexity, dynamical systems, and the butterfly effect. Examples drawn from economics, art, biology, chemistry, physics, sociology, anthropology, public policy, city planning, entomology, and mycology. Course assumes no computer background beyond keyboard and mouse skills. This course combines exposure to a wide range of ideas in readings with lots of hands-on use of computer applications, writing computer programs, and writing about and presenting results of same. In addition to a broad range of reading materials, the main work of the course consists of series of progressive programming, research, writing, and presentation exercises leading toward selection, preparation, execution, and presentation of individual project. Feedback along the way. Small component of grade based on degree to which student "sticks with the program" and keeps on schedule but major component based on competence gain demonstrated in execution of final project.

### PREREQUISITES

This course has two prerequisites: you must be prepared to be really interested in many things and you must be willing to invest time in a relationship with computer.

### HOW

**What We Will Do.** Learn to program and explore computer models and simulations using the NetLogo programming language--a simple and intuitive but powerful language designed for multi-agent simulation and designed to be easy to learn for those with little or no background in computer programming.

Topical Focus. Idea-wise, the course will focus on decentralized, self-organizing systems and emergence. Substantive examples will be drawn from biology, ecology, economics, sociology, mathematics and computer science.

**What to Expect.** A considerable amount of the semester will be devoted to learning this language. It is simple and easy to learn but "big" and so takes a certain number of hours in the

pilot's seat to master. The work for much of the course will consist of a series of hands-on tutorials and increasing sophisticated problem sets through which you will develop skills necessary to design, code, run, and debug simulations. You will spend a lot of time working on the computer and thinking hard about it.

**Then What?** From about the middle of the semester we will turn our attention more to applications and what makes a good simulation. Having a background at this point in general area of emergence and self-organizing systems as well as NetLogo, we may read and discuss some research papers based on multi-agent simulations. You will select a project (ideally related to another class or your major) to work on for the second half of the semester.

**Along the Way.** You will learn about some of the disciplines from which substantive examples come and you will learn about some important ideas from the discipline of computer science.

## Labs

This is very much a "doing" course. There will be in-class labs every week and attendance at all labs is required. There will also be "take-home" lab exercises/problemsets -- that is, you should not expect to do all of your hands-on work in the weekly lab sessions. In fact, you should expect to spend several hours outside of class each week working on the computer. Two secrets of success in this endeavor are total time invested and frequency of time on task. Toward the end of the semester when you are working on your semester project the time at the keyboard may be quite considerable.

## Instructor Contact Information

Phone contact is all but futile. Email (danryan@mills.edu) generally answered promptly. ALL email connected to this class MUST have the word COLL60V at the start of the subject line!!! Office hours [by appointment made electronically](#).

## Submitting Work, etc.

Any file you ever submit electronically must have a standard file name that includes your surname, the course identifier, a short name of the problem or assignment and the date in YYYYMMDD format AND an extension (especially important for mac users). For example, if I were to send you something regarding the first lab, the file name would be

```
ryan-coll60v-lab01-instructions-20090827.docx
```

It seems long but has many advantages (on my machine it won't overwrite another file, it will sort easily by student, by assignment, and by version date, for example). Any file sent without these items in the file name is subject to the perils of sloppy bookkeeping, professorial impatience, snarky sarcasm, or worse.

## **Requirements, etc.**

Successful completion of this course earns you your "upper division interdisciplinary" badge and your "human institutions and behavior" badge. Here's how:

### **Human Institutions & Behavior**

Learning Goal: Recognize the difference between empirical, theoretical, and ethical questions regarding human behavior

How We Measure: Be able to define and provide examples of each. Be able to take one type of human behavior and give example of each kind of question. In particular, you will be expected, in presenting your final project, to indicate what the important theoretical, empirical, and ethical questions relevant to the topic are and where your work fits in with these.

Learning Goal: Understand a model of human behavior, how it departs from the models of related disciplines, and what phenomena it is useful for explaining

How We Measure: Ability to coherently contrast centralized and decentralized models of organized behavior and offer examples of pros and cons of each. You will be expected to demonstrate how the modeling approach taken in your project differs from other possible approaches to the same topic.

Learning Goal: Recognize that human behavior is affected by factors ranging from the psychological to the global

How We Measure: Successful expression in final project of appreciation that phenomenon being analyzed is subject to multiple levels of causes.

### **Interdisciplinary Perspectives**

Learning Goal: Identify the areas of study, specific methods, and representative viewpoints or theories in at least two disciplines

How We Measure: Be able, by semester end, to identify basic ideas in at least two disciplines encountered during course. You should be able to identify two that are relevant to your project topic by midterm. Assessment will be based on degree to which your final project provided evidence of your knowledge of these two disciplines.

Learning Goal: Explore the benefits of interdisciplinary study within these disciplines

How We Measure: Ability to describe a concrete example of interdisciplinarity leading to a solution or explanation that one discipline alone could not reach. This will be assessed by looking at the degree to which your final project writeup and presentation

Learning Goal: Communicate critical thinking, both orally and in writing

How We Measure: Ability to take an idea, translate it into a model, program the model, generate data, make sense of data, present results orally and in writing.

## **Readings and Other Course Materials**

There are two books to buy...

And you are required to have a hard copy bound/bindered of the [NetLogo User Manual](#) and [NetLogo Dictionary](#)

## Requirements & Grading

The numerically graded work for this course which will be used to calculate semester grades is as follows

Problem Sets	24%
Midterm Oral Exam	10%
Midterm Presentation	20%
Book Review	12%
Final Project	33%

Grading falls into three broad categories: Excellent/impressive (A!); satisfactory A/B); do over (C/F). More on this as the course proceeds.

## Other Policies

**Attendance:** Students are expected to attend all class sessions and labs. Each missed lab costs 1% of total course grade. Make-up work for classes missed for legitimate reasons is the student's responsibility and should be arranged in advance when possible. Academic work proceeds up to the date and hour of the beginning of holidays and semester breaks and resumes promptly at the end of such breaks at the time specified in the academic calendar; make travel plans accordingly and do not request permission to miss class just before Thanksgiving or to take an exam early because of winter break (see [http://www.mills.edu/academics/undergraduate/catalog/academic\\_regulations.php](http://www.mills.edu/academics/undergraduate/catalog/academic_regulations.php) for Mills policies).

**Late Work:** Work can be submitted up to the start of the first class after a due date for a maximum grade of B. There is no guarantee of detailed evaluation or feedback on late work. Except by prior arrangement, nothing accepted later than that.

**Intellectual Integrity:** If you attach your name to a document or other work, the presumption is that it is the product of your mind and effort. If this is not the case, sources must be documented using standard academic format and following whatever licensing instructions the author designates. Failure to do so will be understood as an attempt to pass off another's work as your own. The Mills Honor Code is implicitly assumed to have been observed in connection with any work submitted for evaluation; it must be explicitly written and signed on final projects and exams.

**Incompletes:** An incomplete grade can be given only if you have completed 2/3 of the total coursework and the request for an incomplete is due to unforeseen/unforeseeable circumstances. In this class, this translates to the fact that to be considered for an incomplete students must (1) have taken the midterm, (2) be 70% current with term time work and (3) be able to submit a 50% "down payment" (subjectively determined by instructor) on final project before requesting an incomplete. Students who have not completed substantial coursework should not assume that an incomplete grade will be an option; consult with instructor prior to due date for final project if you anticipate being in this situation.

## Accommodations

Students who anticipate issues related to the format or requirements of the course due to disabilities of any kind should contact instructor no later than two weeks into the course to discuss ways to ensure full participation in the course. If you think that formal disability related accommodations are necessary (exam modifications, notetakers, readers, recorders, amplification, etc.), you should register as soon as possible with [Office of Services for Students with Disabilities](#) so that accommodations can be arranged. To schedule an appointment, students can go to the Cowell Building in person or call 510.430.2130. To leave a message for the director of Services for Students with Disabilities, call 510.430.2264 or email [disability@mills.edu](mailto:disability@mills.edu)

## Schedule

Jump to week [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [11](#) [12](#) [13](#) [14](#) [15](#)

<b>Week 1</b>	<b>Getting Started</b> Hands-on means hands-on and so we will start by doing. After a quick quiz on background (anonymous and ungraded -- just to give me a sense of where folks are coming from) you will learn how to download and install the software we will be using, NetLogo, and how to fire up and explore a NetLogo model. Your homework for the week will be to install the software on another machine and to work through the first tutorial in the NetLogo user manual. There will be a quiz about this material that you should be able to complete with flying colors before the second week of class.
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W 26 Aug

Lab - [Beginning at the Beginning](#)

NOTE: MEET IN STERN 14!

Read

["What is NetLogo?"](#)

[Sample Model: Party](#)

Today we learn how to download and install NetLogo, run a simple simulation, locate and access the user manual, and follow a tutorial.

```
NETLOGO:Installation; Interface(buttons, sliders,  
tabs, monitors, speed); How to load and run a model
```

Th 27 Aug

## Formal Course Introduction and Tutorial #1

Introduction to course; how we'll proceed; the software; why you are here; multi-media. We'll repeat tutorial #1 in class. Lessons from Party example : macro patterns from micro behaviors. Theory of predatory-prey. How it illustrates micro/macro. System level vs. individual level.

### To ABSORB

Read "[Agent-based model](#)" in Wikipedia

Read through and play with Tutorial #1 (pages 29 to 38 in the NetLogo Manual ([html](#) | [PDF](#))).

Watch the slide show, not worrying about understanding everything, but with an eye to getting a sense of what's up.

Cosma Shalizi. 2009. "[Lecture 22: Agents and Agent-Based Models](#)"

Short slide show introducing ABM by "fixing" an aggregate predator-prey model (Lottka-Volterra). Uses a bit of math (basic calculus) but thoroughly understandable.

Two short videos to provide some context.

Oswald Schmitz, "[The Predator, Prey, Plant Connection](#)" [4:52]

Predators have considerably more influence than plants over how an ecosystem functions, than previously thought. Ecosystem ecologists have long held that plants and their interaction with the soil determine the type and abundance of herbivores and carnivores in an ecosystem. Schmitz paper, "[Effects of Predator Hunting Mode on Grassland Ecosystem Function](#)," shows that the opposite is true.

Garrett Hardin on [Overpopulation and Carrying Capacity](#) [9:27]

Take a look around this website for atmospheric and inspiration. Fred Jopp & Hauke Reuter "[Agent-Based Models in Ecology](#)" (website)

Skim to get a sense of how ABM is used in research.

Janssen, M. A., and E. Ostrom. 2006. "Empirically based, agent-based models."

[Ecology and Society 11\(2\): 37](#). (6pp)

Part of Special Feature on [Empirical based agent-based modeling](#). Other articles in this issue useful in course.

Robert L. Axtell, Clinton J. Andrews, Mitchell J. "[Small Agent-Based Models of Industrial Ecosystems](#)" (3pp)

Policy guys use ABM to look at polluting firms for EPA applications.

```
NETLOGO: models library; button; forever button;
sliders and switches; model speed; info tab; plots;
monitors; view; world size; go; setup
```

**SU 30 AUG** [PROBLEM SET #1](#) DUE MIDNIGHT

**Week 2**

**Programming for Beginners**

NetLogo is an ideal platform for an introduction to computer programming. The language is simple, but powerful, and the work environment is very user friendly. By the end of this week you should have a basic sense of the NetLogo and the user interface. Perhaps the most important lesson of the week, though, will be Thursday's "Finding What You Need" -- how to develop an "I can figure that out" reflex.

**Tu 1 Sept** **NetLogo Commands and Procedures**

We learn some lingo: commands and procedures and variables. Naming things (conventions for procedures and variables and commands). Comments.

**Sign up today for midterm [presentation topics](#)**

**Read etc**

Tutorial #2 in NetLogo Manual ([html](#) | [PDF](#))

Tutorial #3 in NetLogo Manual ([html](#) | [PDF](#))

**[Problem Set #2 Due 9.6](#)**

Answer questions from Tutorial #2, Do Tutorial #3.

```
NETLOGO: Command center; ask; set; pcolor; color;  
world = turtles; patches, observer; perspective;  
agent monitors; agent commander; who numbers; shape
```

**W 2 Sept**

**[Programing 101: NetLogo Procedures](#)**

Tutorial #3 walks us through the production of a full blown simulation model. It's a model of a population of turtles that lives on a field of grass. The turtles move around, eat grass, reproduce, get old, and die. The grass grows. The model lets us see how the turtles and grass "populations" interact. This is a simple, but classic, model of interactions between interdependent species in an ecosystem. We'll do the tutorial in the lab and then you'll be expected to repeat it at home with some modifications.

**Read**

[Lab #2](#) (Repeats tutorials 2 and 3 and extends)

```
NETLOGO: Clear; create; setxy; random reporters;  
procedures; world topology; right/left/forward; agent  
owned variables; count reporter; with; if-else;  
hatch; expressions; die; plot commands; referencing  
slider globals in procedures;
```

Th 3 Sept

## [You Can Look It Up](#)

NetLogo is easy to learn and most of its commands are straightforward. Some are subtle and take some real head scratching to understand. Easy or hard, though, there are a lot of them and the only way to learn them is by spending time with the documentation and trying things out. You need not memorize anything -- rather, you want to develop an intuition for the kinds of things there are commands for and what they are likely to be called. There are also a small group of "meta concepts" that you need to get your head around to make use of the documentation. That's what we'll be talking about this week.

**NOTE: Bring hard copy of manual in a binder to this class session.**

### Skim

Interface Guide pp. 77-88  
Programming Guide pp 89-136  
Dictionary pp. 277-390  
"Index" by Category pp. 277-279

NETLOGO: [manual](#)

Su 6 Sept

[Problem Set #2](#) Due MIDNIGHT

Week 3

"You don't need something more to explain something more!"

The main "big idea" of the course -- and, in fact, the idea that makes it interdisciplinary by showing up in fields ranging from biology to linguistics to sociology to art, is "emergence." It's a broad concept with lots of definitional variation but the basic idea is this: simplicity can give rise to complexity. This week and next will be spent exploring a very simple instance of emergence: cellular automata.

Tu Sept 8

## Emergence

What is? Examples. Related concepts. Slime mold. Why is this a big deal? What sorts of things does it apply to? Prove this is interdisciplinary!

### Readetc

1. Murray Gell-Mann [On Emergence](#) [1:30]
2. Johnson, Chapter 1
3. Resnick, Chapter 1
4. [Slime mold video 1](#) [2:12]
5. [Slime mold video 2](#) [0:16]
6. [Slime mold video 3](#) [0:27]
7. "Emergence," from [PBS's July 2007 NOVA](#) [11:54]  
Be sure to check out the "Everyday Examples," "Ask the Expert," and "Video Extra" features.
8. [Engels: Industrial Manchester, 1844 in the Modern History Sourcebook](#)

9. [Jane Jacobs in Wikipedia](#)

### Models

NetLogo: [Slime](#)

### Optional

1. ["Emergence" -- Radio Lab](#) February 18, 2005 [59:00]  
Foreshadows topics to be covered later in the course.
2. Studio 360 2002 ["Emergence"](#) [57:00]  
Includes interview with Steven Johnson and piece about Jane Jacobs  
[Also on iTunes](#) (\$0.95).

### [Problem Set #3](#) Due 9.13

NETLOGO: `Diffuse; scale-color; setxy; patch-ahead`

We Sept 9

### [Lab : Cellular Automata and "Life"](#)

#### Readetc

1. Martin Gardner, 1970. ["The fantastic combinations of John Conway's new solitaire game 'life'."](#) *Scientific American* 223 (October 1970): 120-123.
2. ["Conway's Game of Life"](#) in Wikipedia
3. ["Cellular automaton"](#) in Wikipedia

### Models

1. NetLogo: [Life Turtle-Based](#)
2. NetLogo: [Life](#)

### Optional

1. [Conway's Game of Life Java program](#) that runs on Windows, Mac and Linux
2. Very cool [3D version of Game of Life](#)
3. [Standalone Java program](#)
4. [Lecture slides](#) Univ of Zurich

### Lab Assignment

NETLOGO :

Th Sept 10

### Cellular Automata -- Way More than Meets the Eye

Dimensions, states, rules, determinism, cycles

#### Readetc

1. NetLogo: [CA 1D Elementary](#)

2. Wolfram TBA

NETLOGO:

F Sept 11 Midterm Project Meetings  
09:00  
10:00  
11:00  
01:00  
02:00  
03:00  
04:00

M Sept 14 Midterm Project Meetings  
09:00  
10:00  
11:00  
01:00  
02:00  
03:00

Su Sept 13 [Problem Set #3](#) Due Midnight

**Week 4** **Decentralized Order**

**Tu Sept 15** **Ants**

Ant colonies are paradigmatic case of decentralized order. They exhibit an amazing division of labor and coordination without any central source of control. We'll readetc a bit about ants and play with and dissect a few simple models that try to capture a little bit of ant hill behavior.

**READETC.**

1. Dr. Deborah Gordon "[How Ant Colonies Get Things Done](#)," Google Tech Talks April, 30 2008 [1:05:09]
  1. How do colonies get ants to show up at a picnic, and what determines which ants go? Experiments with harvester ants show that task allocation arises from a dynamical network of brief interactions. Which task an ant performs, and whether it performs it actively at that moment, depends on its recent rate of encounter with other ants.  
[Deborah Gordon's Ant Lab](#)
2. Johnson ch. 1 "The Myth of the Ant Queen"
3. Flannery, Tim. 2009. "[The Superior Civilization](#)," a review of *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies* by Bert Hölldobler and Edward O. Wilson. New York Review of Books, Volume 56, Number 3 · February 26.

**Models**

[Ant Lines](#)

[Ants](#)

Ants Perspective Demo

```
NETLOGO:diffuse; breeds; sprout; patch-at;  
distancexy; one-of; reporter; smelling
```

[Problem Set #4](#) Due 9.20

**We Sept 16**

**Lab: Documentation, Slides, Screenshots, Webpages, etc.**

The goal for today's lab is to review techniques for embedding material you generate with a NetLogo model in a PowerPoint presentation. There will be a number of "here's how you do this, now give it a try" exercises to complete during the lab.

**Readetc**

- COLLEGE005. [Powerpoint Basics](#).
- Edward Tufte. 2003. "[PowerPoint Is Evil: Power Corrupts. PowerPoint Corrupts Absolutely](#)." *Wired Magazine* Issue 11.09 | September 2003.
- Cliff Atkinson. "[Five Experts Dispute Edward Tufte on PowerPoint](#)."
- David Byrne. 2003. "[Learning to Love PowerPoint](#)." *Wired Magazine*
  - See also his [Envisioning Emotional Epistemological Information](#)
  - and NPR: "[David Byrne's PowerPoint Art: Musician Uses Business Program for Ironic Avant-Garde Art](#)"
- "[The 10/20/30 Rule of PowerPoint](#)"
- [Make a great PowerPoint presentation video - CNET TV](#)
- "[How to make effective PowerPoint Presentations](#)" (a bit tedious -- no sound, 50 slides -- but good material)

NETLOGO:

**Th Sept 17**

**More on Ants**

**Su Sept 20**

[Problem Set #4](#) Due Midnight

**Week 5**

**Things that Spread -- Diffusion and Disease**

**Tu Sept 22**

**Viruses and Epidemics**

Hopefully, this topic will not be TOO topical this fall, but given what may come to pass, its relevance cannot be overstated. Lecture introduces basic concepts of epidemiology and diffusion.

**Readetc**

1. Interview with Joshua Epstein "[Agent-Based Modeling and the Smallpox Example](#)" [6:02]
2. Nathan Wolfe "[Why we have virus outbreaks & how we can prevent them](#)" @ TED February 2009 [13:05]  
*"SARS, avian flu, swine flu ... each virus outbreak raises the question: What can be done? A compelling answer from virus hunter Nathan Wolfe, who's outwitting the next"*

*pandemic by staying two steps ahead: discovering new, deadly viruses where they first emerge -- passing from animals to humans among poor subsistence hunters in Africa -- and stopping them before they claim millions of lives."*

3. Laurie Garrett "[What can we learn from the 1918 flu?](#)" @ TED 2007 [21:05]  
*In 2007, as the world worried about a possible avian flu epidemic, Laurie Garrett, author of "The Coming Plague," gave this powerful talk to a small TED University audience. Her insights from past pandemics are suddenly more relevant than ever.*
4. Hans Rosling on HIV: [New facts and stunning data visuals](#) @ TED 2009 [9:57]  
*Hans Rosling unveils new data visuals that untangle the complex risk factors of one of the world's deadliest (and most misunderstood) diseases: HIV. He argues that preventing transmissions -- not drug treatments -- is the key to ending the epidemic. See [Gapminder](#).*
5. Philippa Marrack "[The Immunological Self](#)" (itunes)

### Models

1. [Disease Solo](#)
2. NetLogo [AIDS](#)
3. Malaria Control by Erin Flanagan on [Community Models Page](#)
4. Disease\_in\_groups by Talaya White on [Community Models Page](#)
5. Epidemic\_Typhoid\_Fever\_on\_Disaster\_Area by Agung Budi Sutiono, MD on [Community Models Page](#)

### We Sept 23 [Experimental Design and Simulation](#)

What is a simulation experiment? Role of chance. Multiplying out the options. Repeating runs. Collecting data. Converting to Excel. Charting. Looking for critical points and phase transitions. Putting charts into Powerpoint.

Read about "[BehaviorSpace](#)" in NetLogo Usermanual

NETLOGO:

### Th Sept 24 Flu Continued (it's that important!)

We will build a simple model to investigate how immunization rates are likely to effect the spread of the flu this season.

Su Sept 27 [Problem Set #5](#) Submit Presentation PPT by Midnight

### Week 6 Review and Presentations

Tu Sept 29 Midterm Presentations  
(ten minute windows)

- 1.
- 2.
- 3.
- 4.

5.

[Problem Set #6](#) Due 10.4

We Sept 30

Midterm Presentations

6.

7.

8.

9.

Break

10.

11.

12.

13.

Th Oct 1

Midterm Presentations

14.

15.

16.

17.

18.

Su Oct 4

[Problem Set #6](#) Due Midnight

**Week 7**

**Flocking and Schooling**

Tu Oct 6

Turtles That Can SEE!

In previous models the turtles wandered randomly around the world quite oblivious of other turtles. This week we learn how elegant group movement can emerge from individuals following only simple rules of consideration for the behavior of only nearby neighbors.

**Readetc**

- [Boids \[1:44\]](#)
- [Flocks, Herds, and Schools: A Distributed Behavioral Model](#), C. Reynolds, SIGGRAPH, 1987.
- Adrien Treuille, Seth Cooper and Zoran Popović "[Continuum Crowds](#)"
  - A real-time crowd model based on continuum dynamics that naturally exhibits emergent phenomena that have been observed in real crowds.
- [Simple flocking behaviour, funky camera.](#)
  - Made with [processing](#) a free animation software system
- [7935 Boids simulation in a GeForce8800GT](#)
- [Blender\\* predator prey simulation with boids particle system \[1:20\]](#)
  - *\*Blender* is an open source suite of tools for 3D content creation.

- [Usage of Boids for a prey-predator simulation \[:15\]](#)

### COOL Stuff

- Boids with obstacles and predators
  - Made with [processing](#)
- <http://web.arch.usyd.edu.au/~ykol3681/Predray/applet/applet.html>
  - Made with [processing](#); may only work with certain graphics cards

### Extras

- Open University "[Soaring By Design](#)" (online video lecture series on the physics of gliders if you are interested in learning about flight more generally)

### [Problem Set #7](#) (FINAL PROJECT PROPOSALS) Due 10.11

NETLOGO:

**We oct 7**      **Flocking and Schooling**

In preparation for today's lab you should look over the flocking code.

NETLOGO:

**Th Oct 8**      **Flocking and Schooling**

NETLOGO:

**Su Oct 11**      [Problem Set #7](#) Due Midnight

**Week 8**      **Stealing This Code!**

Programming as [bricolage](#). Never re-invent the wheel. Open-source. Creative commons. Respecting creativity of others while being creative as a member of a community.

**Tu Oct 13**      **Making Sense of Code Examples**

[Problem Set #8](#) Due 10.18

NETLOGO:

**We Oct 14**      [Building Models Out of "Found" Code](#)

NETLOGO:

**Th Oct 15**      **Creativity and Integrity**

1. Larry Lessig: "[How creativity is being strangled by the law](#)" @ TED 2007 [ 19:08]

- Larry Lessig, the Nets most celebrated lawyer, cites John Philip Sousa, celestial copyrights and the "ASCAP cartel" in his argument for reviving our creative culture.
- 2. [How do I cite NetLogo in an academic publication?](#)
- 3. [What license is NetLogo released under? Are there are any legal restrictions on use, redistribution, etc.?](#)
- 4. December 2008 [Creative Commons Seminar at Berkman Center](#)  
Panelists included James Boyle, The Public Domain; Lawrence Lessig, Remix; Joi Ito, Free Souls; and Molly S. Van Houweling, Creative Commons' first Executive Director. Jonathan Zittrain, of the Berkman Center for Internet & Society, moderated
- 5. [Sheryl Seibert](#)'s video about [found art and remix culture](#) or [here](#)
- 6. Justin Cone ["Building on the Past"](#)

NETLOGO :

Su Oct 18 [Problem Set #8](#) Due Midnight

**Week 9**

## Simulating Agents on Networks

Networks is a "next big thing" (not really "next" any more, but new to many of us). The more you learn about networks the farther you will go in almost any discipline. This week we'll learn the very basics of network science and how to program "link turtles" that allow us to build simulations of networks. Warning: it's very cool.

Tu Oct 20 Networked Turtles

Read [Links](#) in NetLogo User Manual

Models

[Team Assembly](#)  
[Diffusion on a Directed Network](#)  
[Giant Component](#)  
[Preferential Attachment](#)  
[Small Worlds](#)  
[Team Assembly](#)  
[Virus on a Network](#)

[Problem Set #9](#) Due 10.25

NETLOGO :

We Oct 21 Network Lab

**Read TBA**

NETLOGO :

Th Oct 22 More on Networks

Read TBA

NETLOGO :

Su Oct 25 [Problem Set #9](#) Due Midnight

**Week 10**

### Teaching Turtles to Play Games

An important research/teaching use of agent models is in the analysis of strategic behavior using game theory. Game theory is the study of strategic interaction -- situations in which the outcome for a given actor depends on both what she chooses to do and on what others choose to do. In this section of the course we'll learn some basic game theory and how to make our turtles play games.

Tu Oct 27 **An Introduction to Games for Turtles**

Introduction to game theory and how to make turtles play games.

**Readetc**

1. "[Game Theory](#)" in Wikipedia. Read introduction and sections on "normal form" and "Application and challenges"
2. Play with [this online prisoner's dilemma game](#) until you "get it" -- be sure to try different strategies and running the simulation.
3. Jonathan Cave. 1987. "[Introduction to Game Theory](#)" @ RAND. Nice semi-technical intro from the days of typed manuscripts.
4. [Scene from A Beautiful Mind](#) [2:34] (content warning: some may find the scene sexist)

**Assignment**

[Problem Set #10](#) Due 11.1 Game theory exercises

NETLOGO :

We Oct 28 **Turtles Playing Games Lab**

**Readetc**

NETLOGO :

Th Oct 29 **Applications: Theory of Cooperation and Conflict**

**Readetc**

[Exploring cooperation and competition using agent-based modeling ...](#)

[The Emergence of Cooperation](#) [0:55]

[NEXUS: AN INTELLIGENT AGENT MODEL OF SUPPORT BETWEEN SOCIAL GROUPS](#)

Nexus is an intelligent agent model focused on the support of social groups and organizations

for each other and blame for departure from a social contract as evidenced by actions. Results are presented on a study of an insurgency using data collected from subject matter experts. It was found that, given historical events, a direct action by the US government only cause one group to like the insurgency a little more than they would have had the US government chosen an indirect approach to disaster relief.

NETLOGO :

Su Nov 1 [Problem Set #10](#) Due Midnight

**Week 11** **Evolution**

**Tu Nov 3** **Giving Turtles DNA and Allowing Them to Have Sex**

Readetc

1. Zann Gill "Designing Innovation Networks Modeled on Life's Origins & Evolution" Google Tech Talks (<http://www.youtube.com/watch?v=bCukhYknLh8>) [48:01]
  - o Highly innovative organizations face a constant challenge to process a flood of good ideas, both generated by employees and submitted from outside. In the wake of Google's Tenth Birthday Competition, this talk describes how innovation networks apply principles found in life's origins and evolution to "processing innovation." Debates about how novelty emerged in the origin of life and its evolution toward complexity demand revising assumptions that we've taken for granted.
2. [Natural Security \(A Darwinian Approach to a Dangerous World\)](#) Google Tech Talks May, 29 2008
3. [Darwin College Lectures 2009](#) at Cambridge University
4. [Paul Seabright "Darwin and Human Society"](#)
5. Martin Tompa "[Computational Biology: Comparing Vertebrate Genomes](#)" [v50:32]
6. Three pages on "Topics Amenable to Simulation" in Axelrod 1997. Pp. 26-28

Models

1. [Altruism](#)
2. [Bug Hunt Camouflage](#)
3. [Bug Hunt Speeds](#)
4. [Cooperation](#)
5. [Echo](#)
6. [GenDrift P global](#)
7. [GenDrift P local](#)
8. [GenDrift T interact](#)
9. [GenDrift T reproduce](#)
10. [Mimicry](#)
11. [Peppered Moths](#)
12. [Sunflower Biomorphs](#)

[Problem Set #11](#) Due 11.8

NETLOGO :

**We Nov 4            Evolution and Genetic Algorithms**

**Readetc**

[NetLogo Lab 5](#) @ Evergreen

NETLOGO:

**Th Nov 5            Evolution and Genetic Algorithms**

**Readetc**

NETLOGO:

Su Nov 8            [Problem Set #11](#) Due Midnight

**Week 12            HubNet: Using NetLogo to Build Participatory Simulations**

**Tu Nov 10**        Lecture: What is participatory simulation and who is using it for what? How does NetLogo implement PS? What sort of models will we be looking at this week?

**Readetc**

1. Review the online material at Northwestern's [Center for Connected Learning and Computer-Based Modeling](#) on [Participatory Simulation](#).
2. Read about [Hubnet in the NetLogo user manual](#)NetLogo

**Models**

1. NetLogo [Disease Doctors](#) (Hubnet)
2. NetLogo [Disease](#) (Hubnet)

**Other Resources**

- Castella, J. C., Tran Ngoc Trung, and S. Boissau. 2005. "Participatory simulation of land-use changes in the northern mountains of Vietnam: the combined use of an agent-based model, a role-playing game, and a geographic information system." [Ecology and Society 10\(1\): 27](#).
- [Participatory Simulation @ ISHIDA & HATTORI Lab](#)
- [PDA Participatory Simulation Games at MIT](#)

[Problem Set #12](#) Due 11.15

NETLOGO: Final project draft zero due

**We Nov 11        Hubnet Lab**

**Readetc TBA**

NETLOGO:

**Th Nov 12** **Playing Well With Others**

NETLOGO:

Su Nov 15 [Problem Set #12](#) Due Midnight

**Week 13** **Extensions**

**Tu Nov 17** **Sound**

**Read**

NetLogo [Sound Extension](#)

[Midi Background 1](#)

[Midi Background 2](#)

NETLOGO: Final project draft one due

**We Nov 18** **Saving Your Model as an Applet**

In this lab we'll learn how to take a model and post it on a web page.

**Th Nov 19** **GIS and MIAMs**

**Read**

NetLogo [GIS Extension](#)

NETLOGO:

**Week 14** **Thanksgiving Week**

**Tu Nov 24** **EXTRA**

Final project draft two due

**No Class Thanksgiving Break**

**Th** **No Class Thanksgiving Break**

**Week 15** **Presentations**

**Tu Dec 1** **Presentations (4@ 20)**

Note: please be prepared to stay a 15-30 late for this class session.

**We Dec 2** **Presentations (6@20)**

Note: please be prepared to stay a 15-30 late for this class session.

**Th Dec 3**      **Presentations (4 @ 20)**

Note: please be prepared to stay a 15-30 late for this class session