Ecological and Social Agent-based Modeling  
NR 554 / ANTH 554  
Spring 2017

Instructor:  
Randall Boone, Professor, ESS and Research Scientist, NREL  
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Office hours:  4-5 pm, WF or appointment

Lecture:  
TR 9:30-10:20, NESB B224

Lab:  
R 10:30-12:20, GTL Lab, NR 232

Course Website:  Canvas

Course Description: Students will learn the theory and practice of agent-based modeling through lectures and by using and constructing computer simulations. Frequent use of case studies in ecology and social modeling will emphasize points. An agent-based modeling platform will be used in laboratories that is straightforward, so that each student will be able to create models with complexities on-par with their interests and abilities.

Course Objectives: When the course is complete you should be able to demonstrate:
- Your understanding of the purpose of agent-based modeling, its utility, and its history;
- The distinctions between top-down and bottom-up approaches, and emergence;
- A familiarity with the tools used in agent-based modeling;
- An ability to create agent-based models using NetLogo;
- In depth familiarity of how agent-based modeling may be applied to a topic of interest;
- Your understanding of the assessment of agent-based models.


Additional journal articles will be provided to you as PDFs on Canvas. Most of these readings will be optional.

For required readings, we will often discuss how points they make may apply to your research, work, or interests.  We may discuss items in the readings that are confusing or with which we disagree.  Students should consider these questions (e.g., three ways in which a paper related to a topic of interest, three things that were confusing about a paper) when reading the papers.  

*Student readiness will be reflected in the participation portion of the course grading.*
Class schedule (subject to change):

Week 1

**Tuesday (Jan 17)** – Introduction, Overview, Agent-based models, and Why We Model
No readings

**Thursday (Jan 19)** – Comparing modeling approaches
Readings
Railsback and Grimm. 2011. Part I.1 (pages 3-12)
Optional Readings

*(Lab) (Jan 19)* Comparing modeling approaches

Week 2

**Tuesday (Jan 24)** – Individual-based modeling
Readings
Optional Readings

**Thursday (Jan 26)** – Top-down, bottom-up, and emergence
Readings
Railsback and Grimm. 2011. Part II.8 (pages 101-114)
Optional Readings

*(Lab) (Jan 26)* NetLogo introduction
Readings
Railsback and Grimm. 2011. Part I.6 (pages 75-94)
Week 3

**Tuesday (Jan 31) – Agent-based modeling theory and practice**

**Readings**
- Railsback and Grimm. 2011. Part II.9-10 (pages 115-141)

**Thursday (Feb 2) – The many forms of agent-based modeling**

**Optional Readings**

**Lab (Feb 2) Ecological agent-based modeling case studies**

**Optional Readings**

Week 4

**Tuesday (Feb 7) – Game theory and agent-based modeling**

**Readings**

**Optional Readings**
Thursday (Feb 9) – Tools for agent-based modeling
Readings
Optional Readings

(Lab) (Feb 9) Social agent-based modeling case studies
Optional Readings

Week 5
Tuesday (Feb 14) – Creating agent-based models
Readings
Optional Readings

Thursday (Feb 16) – Creating agent-based models
Readings

(Lab) (Feb 16) NetLogo Programming

Week 6
Tuesday (Feb 21) – Models of ecological interaction
Readings
Railsback and Grimm. 2011. Part II.16 (pages 209-224)
Optional Readings
Thursday (Feb 23) – Models of social interaction
Readings

Optional Readings

(Lab) (Feb 23) NetLogo Programming

Week 7
Tuesday (Feb 28) – Class project introduction
No readings

Thursday (Mar 2) – Judging appropriate levels of complexity in modeling
Readings
Optional Readings

(Lab) (Mar 2) NetLogo Programming

Week 8
Tuesday (Mar 7) – Nature inspired simulation
Readings
Railsback and Grimm. 2011. Part II.11 (pages 143-156)
Optional Readings
Thursday (Mar 9) – *Environments, spatial data, and agent-based modeling*

**Optional Readings**

*(Lab) (Mar 9) NetLogo Programming*

(Spring Break)

**Week 9**

Tuesday (Mar 21) – *Propose individual case studies (one-on-one)*
No readings

Thursday (Mar 23) – *Propose individual case studies (one-on-one)*
No readings

*(Lab) (Mar 23) Environments and geospatial agent-based modeling, plus Nature inspired modeling*

**Week 10**

Tuesday (Mar 28) – *Propose individual case studies (in class)*
Student suggested readings

Thursday (Mar 30) – *Propose individual case studies (in class)*
Student suggested readings

*(Lab) (Mar 30) Model Development*

**Week 11**

Tuesday (Apr 4) – *A group case study – Group polarization*

**Readings**

**Optional Readings**

Thursday (Apr 6) – *Merged with lab*

*(Lab) (Apr 6) Model development*
Week 12

Tuesday (Apr 11) – Evaluation and Critique of agent-based models
Readings
Railsback and Grimm. 2011. Part IV.23 (pages 291-308)
Optional Readings

Thursday (Apr 13) – Merged with lab

(Lab) (Apr 13) Model development

Week 13

Tuesday (Apr 18) – From simulation to theory in and across disciplines
Readings
Optional Readings

Thursday (Apr 20) – Merged with lab

(Lab) (Apr 20) Model development

Week 14

Tuesday (Apr 25) – Scenario analysis and Communicating Results
Readings
Railsback and Grimm. 2011. Part IV.22 (pages 277-290)
Optional Readings
Thursday (Apr 27) – *Merged with lab*
No readings

*(Lab) (Apr 27) Model analysis*

**Week 15**

Tuesday (May 2) – *Present individual case studies*
No readings

Thursday (May 4) – *Present individual case studies*
No readings

*(Lab) (May 4) Present individual case studies*

**Week 16**

Wednesday (May 10, 5 pm) – *Final project report and model due*

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**Attendance Policy and Participation:** Students are encouraged to attend lectures regularly. Discussions and demonstrations in lectures will be critical for you to develop a deeper understanding of the utility and practice of agent-based modeling. If you are forced to miss a lecture, the visuals used will be posted afterward informing you of what you have missed. However, those visuals will not include the animations, simulations made, or discussions that were had during lecture.

**Special Needs:** Any student who needs special accommodations or has special needs are encouraged to speak with me about those needs within the first two weeks of the course.

**Academic Responsibility:** All work in this course must be completed in accordance with the CSU academic honesty policy (http://catalog.colostate.edu/front/policies.aspx). Plagiarism or failing to meet the academic honesty policy in other ways may result in dismissal from class and will be reported. By participating in this course, you agree to abide by the following honor pledge, “I will not give, receive, or use any unauthorized assistance in this course.”

**Expectations of Me:** I will bring my enthusiasm and experience with agent-based modeling to our meetings, and strive to create an atmosphere of collaborative learning. I will have up-to-date lecture materials, and will use engaging examples in our class. Students have their own experiences and background. I will build off those, encouraging and appreciating an interdisciplinary approach to our work. I will strive to keep all students up-to-date on their class standing. I will be readily available to students, with my office door commonly open, and by appointment if helpful.

**Expectations from You:** In addition to promptness, participation, attention to CSU student expectations, etc., I expect students to embrace the interdisciplinary nature of the course. People of different backgrounds and experience gain from this course – some are anthropologists, some are ecologists, some are graduate students, some undergraduates, some have programming
experience, and some do not. We are colleagues, sharing in a learning experience and learning from each other.

At the core of this course is a project. We will be making incremental progress toward the completion of your project during this course, and so in general, I will be familiar with its status. However, later in the semester there will be opportunities for you to work in a laboratory setting on your project, and to ask questions of me and your classmates. Your attendance at such sessions is optional. However, if you do not attend these sessions, I will assume that your modeling efforts are going well. If you have any difficulties in the class, speak with me or find some other way to let me know, otherwise your difficulties may go unrecognized.

**Methods of evaluation:**

*Class participation:* 20%
Students are expected to raise questions and join in discussions in class and laboratories. Evaluation of students’ class participation will be provided at intervals through the course.

*Occasional modeling exercises:* 20%
Students will be constructing some models or doing other tasks associated with agent-based modeling. These assignments will be evaluated, and feedback provided so that future modeling efforts may be modified if needed.

*Individual project updates:* 20%
An individual project will be central to this course. Students will receive assignments that allow them to make incremental progress toward completion of that project. Comments and evaluation of these updates will allow students to modify plans or procedures as needed.

*Final project report and model:* 30%
Students will submit a final report describing their individual project and its results, plus the application used in the research.

*Final exam:* 10%
A final exam will assess students’ understandings of core concepts and techniques.

Final grades will be assigned using the following CSU grading scheme:

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