Course Syllabus
UPP 555 – Complexity-based modeling for planning and policy
Spring 2009

Instructor: Moira Zellner, Ph.D., Assistant Professor, Urban Planning and Policy Program.

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Office hours: By appointment.

Meeting time and location: Tuesdays and Thursdays 4:00-5:30pm, Rooms ADH 2232 (Tuesday Lectures) and SEL 2249F (Thursday Labs).

Course description:

This class is an introduction to complexity-based models (e.g. cellular automata, agent-based models, network models, genetic algorithms) and their possible applications to a range of planning and public policy issues. Students are not required to have experience in object-oriented programming, although it would be very helpful. The course will use Netlogo (http://ccl.northwestern.edu/netlogo/) to learn the basics of complexity-based modeling. We will focus on how the modeling effort fits within the research and policy design. This includes defining a research/policy question for which complexity-based modeling is an appropriate analytical tool, designing the components and mechanisms of the model, building and documenting the model, combining the model with other methods, testing the model, conducting simulation experiments and data analysis, and communicating the modeling process and results. The emphasis of this course is in exploratory, rather than predictive or forecasting, modeling.

This is an interdisciplinary course, and you will be exposed to theories and tools from different social and computational sciences, as well as planning and policy literature. The main themes that will be discussed include:

- Introduction to complexity theory
  - interactions, adaptation and evolution
  - cellular automata, agents, networks and genetic algorithms
  - epistemology: the meaning and applications of models
- Introduction to modeling and software
  - building on previous models
  - designing your own model
  - running experiments and analyzing results

    - testing, verification and validation issues
- Applications (these will vary according to interests)
    - land use and land cover
    - transportation
    - housing
    - resource sustainability and pollution
    - generation of social norms and institutions

Readings:

Required texts:

- Holland, J. (1995) Hidden Order: How Adaptation Builds Complexity. Addison Wesley.
- Miller, J. H., & Page, S. E. (2007). Complex Adaptive Systems: An Introduction to Computational Models of Social Life. Princeton, NJ: Princeton University Press.
- Other required readings will be posted on Blackboard throughout the semester.

Recommended texts:

- Epstein, J. M. (2007). Generative Social Science: Studies in Agent-Based Computational Modeling. Princeton, NJ: Princeton University Press.
- Gilbert, N. and K. Troitzsch (2005) Simulation for the Social Scientist. Philadelphia, PA: Open University Press.

Course requirements and grading:

The requirements of the course include:

- Class discussion (based on quantity and quality): 25%
- Group project (based on my and your team-mates evaluation): 25%
- Final project proposal: 5%
- Presentation of paper: 10%
- Term paper: 35%

Grading scheme: A (88%-100%), B (75%-87%), C (55%-74%), D (40%-54%).

Class discussion:

In each lecture we will cover the theory and modeling applications. ***Discussion and interaction is essential***, both on the readings and your assignments. Please note that you will be graded every day for class participation. You are welcome to propose readings and/or exercises for class.

Weekly labs:

During the first part of the semester (until Spring Break) you will get weekly programming assignments to practice with Netlogo. You will be asked to modify and run experiments with existing models, and document your modifications, problems encountered and findings. The later part of the term will be dedicated to working on your own projects. You will not need to submit reports on these exercises, but you are expected to practice on your own and/or in groups.

Group project:

A group project will be assigned for which you will have to submit a report on the model, the problem it is supposed to address, tests and data analysis, providing appropriate documentation. The report should be a maximum of 10 pages long, 12 pt. font size, double space. The grade for this assignment will be based on both my and your team-mates assessment.

Deadline: February 26, 2009.

Term paper (individual):

The second half of the semester will be dedicated to the design, implementation, simulations, and writing up of the results from your own model. You will need to choose a problem for which complexity-based modeling is an appropriate approach. You will submit and present your proposal in class (approximately a 5-minutes presentation) around mid-term. The proposal should give a brief description of the problem, your hypotheses about complex system behavior, questions to explore, and the analysis you will conduct on the output measures.

For your final paper, you are required to explain the problem and modeling approach, hypotheses, structure of the model (including the existing models you may be building on), testing and documentation, experiment design and analysis of results. Although the projects are individual, I recommend that you interact with your classmates to solve modeling problems and discuss mechanism implementation. Students will present their paper in class. The final paper presentation is expected to be a professional presentation, with adequate preparation and auxiliary materials (e.g. visuals, handouts).

Deadlines: March 12, 2009 (proposal); May 5, 2009 (final paper).

Length: maximum 4 pages (proposal), maximum 20 pages (final paper), 12 pt. font size, double space.

All assignments will be evaluated based on clarity and organization and appropriate substantiation of research and modeling. ***Late written assignments will <u>not</u> be accepted.***

Academic integrity:

I expect academic integrity. Any case of academic dishonesty will be reported and handled according to university policies. If you have any questions regarding this issue, do not hesitate to talk to me.