Complex Systems Models in the Social Sciences

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The nonlinear dynamics exhibited by complex social systems pose challenges and create opportunities. In complex social systems, actors adapt to an environment partially constructed by the actions of other adaptive agents. For example, individual and organizations adapt their behavior in light of feedback from other individuals and from aggregate variables produced by the collective actions of individuals. Until the advent of agent-based models, including adaptive behavior in all but the starkest of models had been impossible. Agent-based models (ABM) consist of interacting agents. Each agent's behavior is governed by a small set of simple rules, which often depend on local information and feedbacks. These local rules produce emergent patterns – equilibria, cycles, long transients, and randomness – and emergent functionalities such as robustness. These lectures will give an introduction to recent approaches in computer modeling of complex social systems, comparing them to more traditional mathematical (analytical) approaches and to the previous generation of computer simulations in the social sciences. In addition to describing the methods and techniques of this modeling approach, a number of social science applications will be reviewed and analyzed.

This course includes a lab session in which students also will be able to run implementations of several of the models discussed in the lectures and learn to build their own computational models. Students will gain sufficient knowledge and experience to plan and build models for your own research in Netlogo (a free ABM platform). The lab sessions are being conducted by Aaron Bramson (bramson@umich.edu) and Jon Zelner (jzelner@umich.edu).

There will be regular assignments in the lab, and then two options for final evaluation:

--- updating and running an existing computation model, and writing up the results
or
--- developing an original model and writing a short paper on it
Students may want to purchase the following books:


**Class Schedule**

**July 20: Complex Systems Modeling and Philosophy of Science (Kollman and Page)**


**July 21 Genetic Algorithms, The Evolution of Strategies (Kollman)**

   Princeton University Press. Ch. 10.

**July 22 Aggregation I: The Wisdom of Crowds (Page)**

  Hong. Lu and Scott Page “Interpreted and Generated Signals” *Journal of Economic Theory* forthcoming

**July 23 Aggregation II: Large Events and Emergence (Page)**
184--208.

**July 24 Learning, Adaptation and Multiple Equilibria (Page)**
 Golman, Russell and Scott Page "Basins of Attraction and Equilibrium Selection Under Different Learning Rules" *Evolutionary Economics* forthcoming
Introduction, Chapters. 3, 7.

**July 27: Models of Markets (Kollman)**

**July 28: Models of Participation (Kollman)**

**July 29: Models of Domestic Political Competition (Kollman)**
July 30: Annealing, Sorting, and Institutional Mechanisms (Kollman)


July 31: Path Dependence and Multiple Equilibria (Page)


August 3: Networks (Lamberson)


August 4: Networks and Diffusion (Lamberson)


August 5: Networks and Knowledge (Lamberson)


August 6: Networks and Markets (Lamberson)


August 7: Networks and Cooperation (Lamberson)


August 10: Diversity I: Culture (Page)


August 11: Diversity II: Problem Solving (Page)


August 12: Models of International Relations (Kollman)


August 13: Student Presentations