

UNIVERSITY OF PENNSYLVANIA

Politics, Agent-Based Modeling, and Computer Simulation

Department of Political Science
Political Science 498

Professor Ian Lustick
Spring 2005

Among the candidates for the most important scientific theory of the last two hundred years is Charles Darwin's theory of evolution. The theory of evolution explains immense amounts of variation and the production of complex systems based on unguided interactions and simple mechanisms of variation, selection, and replication. Few serious scientists have doubted its power when applied to the life sciences, but earlier attempts to apply evolutionary principles to human behavior have ranged from scandalous to ignorant. In this course we shall explore how recent developments in evolutionary theory relate to larger questions raised by students of complexity and complex adaptive systems. We shall study how they together provide a basis for important critiques of standard approaches in political science and enable fascinating and powerful understandings of politics and political phenomena--including national identity and identity change, state formation, revolution, globalization, and leadership. An important vehicle for the application of these insights for understanding politics is computer simulations featuring agent-based modeling. Students will use "PS-I," an agent based computer simulation platform, to develop their own models, conduct experiments, test hypotheses, or produce existence proofs in relation to popular theoretical positions in contemporary political science. No knowledge of computer programming is required.

The course will be conducted in seminar format. Approximately 50% of the classes will meet in a computer lab for hands on tutorial training with PS-I, the application of concepts discussed in readings, and development of ideas and templates for research projects involving computer based experimentation. Our meetings will focus primarily on collective study of assigned readings, consideration of techniques of computer simulation and in class exercises. It will be important for each student to have or have access to an IBM compatible PC operating in a Windows environment.

Students will submit Lab reports as will be assigned from time to and at least three 2-4 page comments on readings. Each student will also prepare a research project involving the design and execution of a simulation experiment related to politics using the PS-I or another comparable agent-based modeling platform. Topics and techniques will be developed in close consultation with the instructor. Grades will be calculated as follows:

Class participation:	40%
Research paper/project:	30%
Comments on readings and Lab reports	30%

Required texts are available for purchase at House of Our Own Books, on Spruce Street. Additional assigned readings will be distributed in class, are available on the web, or will be posted on Blackboard. These latter readings are labeled with **BB***. All URLs listed in this syllabus are also posted on the course's Blackboard site, under "external links."

Books required for purchase:

Daniel C. Dennett, Darwin's Dangerous Idea (New York: Simon and Schuster, 1995)

Lars-Erik Cederman, Emergent Actors in World Politics: How States and Nations Develop and Dissolve (Princeton: Princeton University Press, 1997)

Robert Axelrod, The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration (Princeton: Princeton University Press, 1997)

John H. Holland, Emergence: From Chaos to Order, Helix Books, Reading Mass. 1998

Class Schedule

I. Evolution Is Not About Monkeys: Evolutionary Thinking, Complexity, and Politics (January 11)

In class display. “Game of Life”

In class readings: W. Brian Arthur, “Why do Things Become More Complex?” Scientific American (May 1993) p. 144

Paul A. David, “Clio and the Economics of Qwerty,” Economic History, Vol. 75, no.2, pp. 332-37
http://www.utdallas.edu/~liebowit/knowledge_goods/david1985aer.htm

II. Evolution and Complexity: An Introduction (January 18)

Required Reading:

Dennett, Chapters 1-7

Murray Gell-Man, “What is Complexity?” Complexity, Vol. 1, no. 1, 1995.
BB* <http://www.santafe.edu/sfi/People/mgm/complexity.doc>

Recommended Reading:

BB*John H. Holland, “Complex Adaptive Systems, Daedalus, Winter 1992, pp. 17-30

BB*Stephen Jay Gould, “Darwinian Fundamentalism,” New York Review of Books, Vol. 44, no. 10 (June 12, 1997)-- <http://www.nybooks.com/articles/1151> (An attack on Dennett’s book, Darwin’s Dangerous Idea by an evolutionary theorist)

III. Exploiting Evolution and Complexity Theory for Political Science: Agent-Based Modeling (January 25, computer lab session)

Required Reading:

Cederman, pp. 3-71

BB*Thomas C. Schelling, Micromotives and Macrobehavior, pp. 137-162

Axelrod, pp. xi-xiv, 3-9.

BB*Ian S. Lustick, "Agent-Based Modeling of Collective Identity: Testing Constructivist Theory," Journal of Artificial Societies and Social Simulations, Vol. 3, no. 1 (January 2000).
<http://jasss.soc.surrey.ac.uk/3/1/1.html>.

In class exercise with ABIR

Recommended Reading:

Joshua M. Epstein, "Agent-Based Computational Models and Generative Social Science," Complexity, Vol. 4, no. 5 (May-June 1999) pp. 41-60.

BB*Robert Axtell and Joshua Epstein, "Coordination in Transient Social Networks: An Agent-Based Computational Model of the Timing of Retirement," CSED Working Paper No. 1, May 1999. <http://www.brook.edu/dybdocroot/es/dynamics/papers/retirement/retirement.htm>

To run and experiment with this model go to:

<http://www.brook.edu/dybdocroot/es/dynamics/models/retirement/>

IV. Operating PS- I as an Agent-Based Modeling Tool (February 1—Computer Lab)

Required Reading:

BB*Scott Page, "Computational Models from A to Z," Complexity, Vol. 5, no. 1 (September/October 1999) pp.35-41.

BB*Ian S. Lustick, "PS-I: A User-Friendly Agent-Based Modeling Platform for Testing Theories of Political Identity and Political Stability," Journal of Artificial Societies and Social Simulation vol. 5, no. 3.

<http://jasss.soc.surrey.ac.uk/5/3/7.html>

BB* Joshua M. Epstein, "Modeling civil violence: An agent-based computational approach," Paper, Proceedings of the National Academy of Sciences

Ian S. Lustick, User Manual for PS-I 4.0.4, pp. 1-24

http://www.psych.upenn.edu/sacsec/abir/_private/publications/PS-I4.0.4.pdf

V. Evolutionary Psychology, Sociobiology, and Group Selection (February 8)

Required Reading:

BB* David M. Buss, Haselton, Shackelford, Bleske, and Wakefield, "Adaptations, Exaptations, and Spandrels," American Psychologist 1998 Vol. 53, No. 5, 533-548.
<http://www.sscnet.ucla.edu/comm/haselton/webdocs/spandrels.html>

BB*Roger D. Masters, "Individual and Cultural Differences in Responses to Leaders' Nonverbal Displays," Journal of Social Issues, Vol. 47, no. 3 (1991) pp. 151-65.

BB*Gary Johnson, "The Architecture of Ethnic Identity," Politics and the Life Sciences (September 1997) pp. 257-261.

BB* David Sloan Wilson, “The New Fable of the Bees: Multilevel selection, adaptive societies, and the concept of self interest”

BB* Stephen R. Palumbi, “Humans as the World's Greatest Evolutionary Force,” Science v.293, n.5536 7sep01.
<http://www.stanford.edu/group/Palumbi/manuscripts/evolution.pdf>

Recommended Reading:

BB*Leda Cosmides and John Tooby, “An Evolutionary Psychology Primer,”
<http://www.psych.ucsb.edu/research/cep/primer.html>

David Sloan Wilson, Darwin’s Cathedral

Richard Morris, The Evolutionists: The Struggle for Darwin’s Soul (2001)

Melanie Mitchell, “Can Evolution Explain How the Mind Works? A Review of the Evolutionary Psychology Debates,” Complexity, (1999) Vol. 4, no. 3, pp. 17-24.

VI. Experimenting with Agent-Based Modeling: Thinking with Distributions of Counterfactuals (February 15—computer lab)

Required Reading:

BB* Lars-Erik Cederman, “Rerunning History: Counterfactual Simulation in World Politics,” in Counterfactual Thought Experiments in World Politics, Philip E. Tetlock and Aaron Belkin, eds. (Princeton: Princeton University Press, 1996) 247-267.

BB* Ian S. Lustick, “Locating the History We Have Within the Distribution of Counterfactuals: Laws, Stories, and Computer Simulation” (draft)

Robert Axelrod, “A Model for the Emergence of New Political Actors,” The Complexity of Cooperation, pp. 124-147

Or

Robert Axelrod, “The Dissemination of Culture: A Model with Local Convergence and Global Polarization,” The Complexity of Cooperation, pp. 148-147.

Recommended Reading:

James D. Fearon, “Causes and Counterfactuals in Social Science: Exploring an Analogy between Cellular Automata and Historical Processes,” in Counterfactual Thought Experiments in World Politics, Philip E. Tetlock and Aaron Belkin, eds. (Princeton: Princeton University Press, 1996) 39-68.

VII. Complex Adaptive Systems and the Principle of Emergence: (February 22)

Required Reading:

John H. Holland, Emergence: From Chaos to Order, Chapters 1-3, 6-7, 11

VIII and IX: Research Design with PS-I—Good Tricks (March 1 and March 15: Computer Lab)

Required Reading:

Two of the following:

BB* Lustick and Miodownik, “Everyone I Know Is Doing It: Tipping, Political Cascades, and Individual Zones of Knowledge,” draft

BB* Benjamin M. Eidelson and Ian Lustick, “VIR-POX: An Agent-Based Analysis of Smallpox (2004) Preparedness and Response Policy, Journal of Artificial Societies and Social Simulation vol. 7, no. 3 <http://jasss.soc.surrey.ac.uk/7/3/6.html>

BB* Ian S. Lustick, “Simulating the Effects of Israeli-Palestinian Violence, Fundamentalist Mobilization, and Regional Disruption on Regime Stability and USA-Friendly Outcomes in Middle East Polity,” January 2004, Presented at the Santa Fe Institute Workshop on “Origins and Patterns of Political Violence 1: Violence in Civil Wars” January 16-18, 2004.
http://www.psych.upenn.edu/sacsec/abir/_private/publications/Lusticksantafe.pdf

BB* Ian S. Lustick, Dan Miodownik, and Roy J. Eidelson, "Secessionism in Multicultural States: Does Sharing Power Prevent or Encourage It?." American Political Science Review, Vol. 98, no. 2 (May 2004) 209-230.
http://www.psych.upenn.edu/sacsec/abir/_private/publications/LusMioEid.pdf

Recommended Reading:

BB* Ian S. Lustick, “Agent-Based Modeling and the Real World: The PS-I Simulation Modeling Platform--Objectives, Accomplishments, Challenges,” Prepared for Modeling and Simulation Workshop, Old Dominion University, January 4-5, 2005.

X. Self-Organized Criticality, Positive Feedback, Genetic Algorithms, and Chaos Effects: (March 22)

Required Reading:

BB* James P. Crutchfield, J. Doyne Farmer, Norman H. Packard and Robert S. Shaw, “Chaos,” Scientific American (December 1986) pp. 46-57)

BB* Per Bak and Kan Chen, “Self-Organized Criticality,” Scientific American (January 1991) pp. 46-53.

BB* W. Brian Arthur, “Positive Feedbacks in the Economy,” Scientific American (February 1990) pp. 92-99

Robert Axelrod, "The Evolution of Strategies in Iterated Prisoner's Dilemma," The Complexity of Cooperation, pp. 14-29.

Recommended Reading:

BB* John H. Holland, "Genetic Algorithms," Scientific American (July 1992) pp. 66-72.

<http://www.econ.iastate.edu/tesfatsi/sylalife.htm>

<http://www.econ.iastate.edu/tesfatsi/allist.htm#Complex>

Leigh Tesfatsion, Complexity Science Websites

XI. Complexity and Evolution: Applications of Agent-Based Modeling in Political Science and Related Fields (March 29)

Required Reading:

Cederman, 72-108, 150-177

BB* J. Stephen Lansing, "Complex Adaptive Systems," Annual Review of Anthropology (2003) Vol. 32, pp. 183-204.

BB* Paul E. Johnson, "Rational Actors Versus Adaptive Agents: Social Science Implications" (1998)

<http://lark.cc.ukans.edu/~pauljohn/ResearchPapers/APSA98-MTHDS/APSA98-Methods.html>

BB* Students should browse through back issues of the on-line journal JASSS (Journal of Artificial Societies and Social Simulations) at <http://jasss.soc.surrey.ac.uk/>. Each student should come to class prepared to report briefly on ideas for an experiment based research project using PS-I.

Recommended Reading:

Paul E. Johnson, "Simulation Modeling in Political Science," American Behavioral Scientist, Vol. 42, no. 10 (August 1999) pp. 1509-1530.

Kenneth Benoit, "Simulation Modeling for Political Scientists," The Political Methodologist, Vol. 10, no. 1 pp. 13-22.

Mailath, George J. "Do People Play Nash Equilibrium? Lessons from Evolutionary Game Theory," Journal of Economic Literature, Vol. XXXVI (September 1998) pp. 1347-74.

BB* Tesfatsion, Leigh. 2002. "Agent-Based Computational Economics: Growing Economies from the Bottom Up." Economics Working Paper No. 1, Iowa State University, January 2002. <http://www.econ.iastate.edu/tesfatsi/acealife.pdf>

XII. Culture, Politics, and Evolution: A Memetics Approach (April 4)

Required Reading:

Dennett, pp. 335-369

BB*Susan Blackmore, The Meme Machine, pp. 1-66.

XIII. Consultations on Research Projects: No Regular Class Meeting (April 4)

XIV. Discussion of Research Projects (April 18)

Reading: Circulated memos

XV. Discussion of Research Projects (April 25)