

POL486H (S); Spring 2007
Complex Social Systems: War and Peace

University College, Room 248
Tuesdays, 12-2 p.m.

Instructor: Thomas Homer-Dixon
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Office Hours: Thursday, 3:30-5:00 p.m., plus additional hours each week on a varying schedule. All meetings by appointment only. Contact Ashlie Claassen at 416-978-2485 or admin@trudeaucentre.ca.

Note: Whenever possible, if you want to discuss matters related to the course, please try to see me in person. If a meeting is not possible, you can contact me by e-mail. However, e-mail should not be seen as an alternative to a meeting, nor should it be used as a means to receive private tutorials or explanations of material covered in lectures you missed.

Description of the Course

This is a seminar course that reviews theory and research in ecology, evolutionary biology, physics, economics, and political science on complex adaptive systems, with specific attention to recent applications of complexity theory to political conflict and international state behavior. The seminar incorporates some simple mathematics and computer modeling.

Format and Requirements

The seminar will meet for two hours per week. It is essential that students complete all the required reading assignments for each week, and it is strongly advised that they also read the recommended readings. Each student will be responsible for leading the discussion of an item on the required reading list every two or three weeks. The fourth week will take place in the Gerstein computer laboratory, where Dr. Brad Bass will lead a demonstration of his COBWEB agent-based model.

In three written assignments, students will investigate the implications of recent research in complexity theory for the study of international relations and war and peace. The first assignment is a paper (of 1500 words) probing the results of experimentation with COBWEB; the second is an outline (of 500 words) of the research paper; and the third is the research paper itself, which should be no more than 3000 words (not including references). In each of these written assignments, students should strive for clarity of analysis and efficiency of expression.

Participation will be graded on the basis of attendance and active participation in seminar discussions. In assessing participation, quality of contributions will matter as much as quantity.

All students should ensure that they have an e-mail account, as important course announcements will be sent by email. It is highly recommended that you obtain an e-mail address from the University of Toronto if you have not already done so, even if you have other e-mail accounts.

COBWEB analysis	25 percent	February 13, 2007
Research paper outline	10 percent	March 13, 2007
Research paper	40 percent	April 10, 2007
Presentation of readings	10 percent	
Seminar participation	15 percent	

Rules and Regulations

PLEASE NOTE THE FOLLOWING CAREFULLY.

Registration in the course constitutes your agreement to the following rules.

- All written assignments are to be handed in at the beginning of class on the date that they are due. To be fair to students who hand in their assignments on time, if you hand in yours once class has begun, I consider it to have been handed in late. Where no extensions have been granted, late papers and assignments will be penalized. There is no grace period, and no allowance for computer problems, printer problems, late buses or trains, etc.
- There is a 1 percent penalty for papers and assignments received after class has started but before 5 pm on the day they are due. After that, the late submission penalty is 2 percent per each late day, weekends and holidays included. The cut-off time for the determination of late days is 5 pm. Ideally, late assignments should be turned in at the University College administrative office at UC173. Students should make sure that late assignments are signed and dated by UC staff.
- You may submit your assignment early or late, but if you put it in my mailbox or slide it under my door, I will consider it to have been submitted on the day I discover it. So you should do your best to hand your assignment into UC173 or to me directly.
- Assignments submitted by fax or e-mail will not be accepted, unless prior arrangements have been made with me.
- In general, I do not grant extensions, unless you have an acceptable reason that is adequately supported, such as a medical emergency that is documented by an official U of T medical certificate. Because of a significant incidence of fraud with regards to doctors' notes, we may contact a note's author to confirm its authenticity. Appropriate documentation must be submitted within one week of the assignment due date.
- Multiple assignments coming due at the same time, or midterms in other courses, do NOT constitute "acceptable reasons" for an extension. If you have several assignments due at the same time, you should plan ahead so that you finish some of them early.
- You must properly acknowledge the words or ideas of the published works of another individual. If you do not, you are committing plagiarism—a serious academic offense. If you are at all uncertain about what constitutes plagiarism, or what are acceptable forms of citation and referencing, please consult me.

Readings

The following materials should be purchased for the course:

- Lars-Erik Cederman, *Emergent Actors in World Politics: How States and Nations Develop and Dissolve* (Princeton, NJ: Princeton University Press, 1997).
- Robert Axelrod, *The Complexity of Cooperation* (Princeton: Princeton University Press, 1997).

These books are available for purchase at the [Toronto Women's Bookstore](#), located at 73 Harbord Street. Other reading materials are available on short-term loan at [Laidlaw Library](#).

Lecture Topics and Readings by Week

Week 1 (January 9): Introduction

- No Readings.

Week 2 (January 16): Fundamental Concepts I

Required:

- Vicsek, Tamas, "The Bigger Picture," *Nature* 418 (11 July 2002): 131.
- Homer-Dixon, Thomas, excerpts from "Tectonic Stresses," chapter 1 of *The Upside of Down: Catastrophe, Creativity, and the Renewal of Civilization* (Toronto: Knopf: 2006), pp. 21-9, plus endnotes.
- _____, "Complexities," chapter 4 of *The Ingenuity Gap: Can We Solve the Problems of the Future?* (Toronto: Knopf, 2000), pp. 101-20, plus endnotes.
- Gell-Mann, Murray, "The Simple and the Complex," chapter 1 in *Complexity, Global Politics, and National Security*, eds. David Alberts and Thomas Czerwinski (Washington, D.C.: National Defense University, 1997), pp. 3-28.

Recommended:

- Weaver, Warren, "Science and Complexity," *American Scientist* (October, 1948): 536-44.
- Arthur, Brian, "On the Evolution of Complexity," in *Complexity: Metaphors, Models, and Reality*, G. Cowan, D. Pines, and D. Meltzer, eds. Santa Fe Institute Studies in the Sciences of Complexity, Proceedings Vol. 19 (Reading, Massachusetts, 1994), pp. 65-78.

Week 3 (January 23): Fundamental Concepts II

Required:

- Gell-Mann, Murray, "What is Complexity?" *Complexity* (John Wiley, 1995), pp. 16-9.
- Jervis, Robert, "Complex Systems: The Role of Interactions," chapter 3 in *Complexity, Global Politics, and National Security*, pp. 45-72.
- Bertalanffy, Ludwig von, "An Outline of General System Theory," *British Journal for the Philosophy of Science* 1, No. 2 (August 1950): 134-165.
- Crutchfield, James, J. Doyne Farmer, and Norman Packard, "Chaos," *Scientific American* 255, No. 6 (December 1986): 46-57.

Recommended:

- Ishii, Page and Wang, "A Day at the Beach: Human Agents Self-Organizing on the Sand Pile," *Advances in Complex Systems* 2, No. 1 (1999): 37-63.

Week 4 (January 30): Complex Adaptive Systems; Agent-Based Modeling

Required:

- Schelling, Thomas, "Simple Models of Segregation," *Micromotives and Macrobehavior* (New York: Norton, 1978), pp. 147-165.
- Holland, John, "Complex Adaptive Systems," *Daedalus* 121 (1992): 17-30.
- _____, "Genetic Algorithms," *Scientific American* (July 1992): 66-72.
- Sawyer, Keith, "Social Explanation and Computational Simulation," *Philosophical Explorations* 7, No. 3 (2004): 219-31.

Recommended:

- Nowak, Martin and May R.M, "Evolutionary Games and Spatial Chaos," *Nature* 359 (29 October 1992): 826-829.
- Sawyer, Keith, "Emergence in Sociology: Contemporary Philosophy of Mind and Some Implications for Sociological Theory," *American Journal of Sociology* 107, No. 3 (November 2001): 551-85.

Week 5 (February 6): Axelrod, Cooperation

Required:

- Axelrod, Robert, "Evolving New Strategies," chapter 1 in *The Complexity of Cooperation* (Princeton: Princeton University Press, 1997), pp. 10-29.
- _____, "Promoting Norms," chapter 3 in *The Complexity of Cooperation*, pp. 40-68.
- _____, "Choosing Sides," chapter 4 in *The Complexity of Cooperation*, pp. 69-94.
- _____, "Building New Political Actors," chapter 6 in *The Complexity of Cooperation*, pp. 121-44.

Recommended:

- Riolo, Rick, Michael Cohen, and Robert Axelrod, "Evolution of Cooperation without Reciprocity," *Nature* 414 (22 November 2001): 441-43.

Week 6 (February 13): Cederman, Emergent Actors

Required:

- Cederman, Lars-Erik, "Modeling Actors in World Politics," chapter 2 in *Emergent Actors in World Politics: How States and Nations Develop and Dissolve* (Princeton, NJ: Princeton University Press, 1997), pp. 14-36.
- _____, "Towards Richer Models," chapter 3 in *Emergent Actors*, pp. 37-71.
- _____, "Emergent Polarity," chapter 4 in *Emergent Actors*, pp. 72-108.
- _____, "Modeling Nationalism," chapter 6 in *Emergent Actors*, pp. 136-150.
- _____, "Nationalist Mobilization," chapter 7 in *Emergent Actors*, pp. 151-83.

Week 7 (February 27): Endogeneity and Power Laws

Required:

- Cederman, Lars-Erik, "Modeling the Size of Wars: From Billiard Balls to Sandpiles," *American Political Science Review* 97,1 (2003): 135-150.
- _____, "Endogenizing Geopolitical Boundaries with Agent-Based Modeling," *Proceedings of the National Academy of Sciences* 99 (14 May 2002): 7296-303.
- _____, "Endogenizing Corporate Identities: The Next Step in Constructivist IR Theory," *European Journal of International Relations* 9, No. 1 (2003): 5-35.
- Epstein, Joshua, "Modeling Civil Violence: An Agent-Based Computational Approach," *Proceedings of the National Academy of Sciences* 99 (14 May 2002): 7243-50.
- Clauset, Aaron, and Maxwell Young, "Scale Invariance in Global Terrorism," unpublished draft (30 April 2005).

Week 8 (March 6): Energy, Thermodynamics, and Complexity

Required:

- Hall, Charles, et al., "Hydrocarbons and the Evolution of Human Culture," *Nature* 426, No. 6964 (November 20, 2003): 318-22.
- Homer-Dixon, Thomas, "So Long, Cheap Slaves," chapter 4 of *The Upside of Down*, pp. 77-100, plus endnotes.
- _____, "A Keystone in Time," chapter 2 of *The Upside of Down*, pp. 31-56, plus endnotes.
- Tainter, Joseph, et al., "Resource Transitions and Energy Gain: Contexts of Organization," *Conservation Ecology* 7, No. 3 (2003), available at <http://www.ecologyandsociety.org/vol7/iss3/art4/print.pdf>

Recommended:

- White, Leslie, "Energy and the Evolution of Culture," chapter 13 in *The Science of Culture: A Study of Man and Civilization* (New York: Farrar, Straus and Giroux, 1949 [1969]), pp. 363-93.
- Schrödinger, Erwin, "Order, Disorder and Entropy," chapter 6 in *What Is Life?* (Cambridge: Cambridge University Press, 1944), pp. 672-80.

Threads on thermodynamics on the Forum of www.homerdixon.com.

Week 9 (March 13): Societal Collapse

Required:

- Homer-Dixon, Thomas, "Disintegration," chapter 10 of *The Upside of Down*, pp. 235-264, plus endnotes.
- Tainter, Joseph, "The Study of Collapse," chapter 3 in *The Collapse of Complex Societies* (Cambridge: Cambridge University Press, 1988), pp. 39-90.
- _____, "Understanding Collapse: The Marginal Productivity of Sociopolitical Change," chapter 4 in *The Collapse of Complex Societies*, pp. 91-126.
- Holling, C.S., "Understanding the Complexity of Economic, Ecological, and Social Systems," *Ecosystems* 4 (2001): 390-405.

Recommended:

- Gill, Richardson, "Summary and Discussion," chapter 13 in *The Great Maya Droughts: Water, Life, and Death* (Mexico City: University of New Mexico Press, 2000), pp. 363-80.

Week 10 (March 20): Fitness Landscapes and Solution Search

Required:

- Homer-Dixon, Thomas, "White-Hot Landscapes," chapter 11 of *The Ingenuity Gap*, pp. 279-312, plus endnotes.
- Kauffman, Stuart, "High-Country Adventures," chapter 8 in *At Home in the Universe: The Search for Laws of Self-Organization and Complexity* (Oxford: Oxford University Press, 1995), pp. 149-89.
- Kollman, Ken, John Miller, and Scott Page, "Decentralization and the Search for Policy Solutions," *Journal of Law Economics and Organization* 16 (2000): 102-28.
- Koza, John, Martin Keane, and Pieter Johnson, "Evolving Inventions," *Scientific American* 288, No. 2 (February 2003): 52-59.

Recommended:

- Wright, Sewall, "The Roles of Mutation, Inbreeding, Crossbreeding and Selection in Evolution," *Proceedings of the Sixth International Congress on Genetics* 1 (1932): 356-66.
- Kollman, Ken, "The Rotating Presidency of the European Council as a Search for Good Policies," *European Union Politics* 4, No. 1 (March 2003): 51-71.

Week 11 (March 27): Implications for Research Design and Methodology

Required:

- Hayek, F.A., "The Theory of Complex Phenomena," chapter 2 in *Studies in Philosophy, Politics, and Economics* (London: Routledge & Kegan Paul, 1967), pp. 22-42.
- Bernstein, Steven, Richard Ned Lebow, Janice Gross Stein, and Steve Weber. 2000. "God Gave Physics the Easy Problems: Adapting Social Science to an Unpredictable World." *European Journal of International Relations* 6, No. 1 (March 2000): 43-76.
- Schwartz, Daniel, Tom Deligiannis, and Thomas Homer-Dixon, "The Environment and Violent Conflict," chapter 13 in Diehl and Gleditsch, eds., *Environmental Conflict* (Boulder, Colorado: Westview Press, 2001), 273-294.
- Thompson, William, "A Streetcar Named Sarajevo: Catalysts, Multiple Causation Chains, and Rivalry Structures," *International Studies Quarterly* 47, No. 3 (September 2003): 452-74; and Lebow, Richard, "A Data Set Names Desire: A Reply to William Thompson," 475-8.

Week 12 (April 3): Implications for Military Strategy and Tactics

Required:

- Saperstein, Alvin, "Complexity, Chaos, and National Security," chapter 5 in *Complexity, Global Politics, and National Security*, pp. 101-34.
- Beyerchen, Alan, "Clausewitz, Nonlinearity, and the Importance of Imagery," chapter 7 in *Complexity, Global Politics, and National Security*, pp. 153-70.
- Schmitt, John, "Command and (out of) Control: The Military Implications of Complexity Theory," chapter 9 in *Complexity, Global Politics, and National Security*, pp. 219-46.
- Mazarr, Michael, "Chaos Theory and U.S. Military Strategy: A 'Leapfrog' Strategy for U.S. Defense Policy," chapter 11 in *Complexity, Global Politics, and National Security*, pp. 303-26.

Week 13 (April 10): Reflections of the Future of Humanity

Required:

- Yaneer Bar-Yam, "Human Civilization II: A Complex(ity) Transition," chapter 9 in *Dynamics of Complex Systems* (Reading, MA: Addison-Wesley, 1992), pp. 782-825.