

Summer 2019

Time: Tue/Thu 1:15pm-3:45pm

Classroom: MF1

Instructor: Paolo Pellizzari, Ca' Foscari University

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TA: TBA

An Introduction to Complexity in Economics and Social Sciences

Course description

This course provides an introduction to complexity with emphasis on economic and social systems. In the attempt to find a formal and shared definition of complex phenomena, which still lacks in the literature, we explore ideas, models and examples coming from biology, chaos theory, financial markets, computational science, genetics and societies. We mainly aim at showing that, somewhat paradoxically, complex machinery is not needed to generate complexity, which instead is ubiquitous and can be produced by very simple rules of behaviour. We also run some computational models, using free software, to acquire hands-on experience on complex system simulation and control.

Prerequisites

Most discussions are non technical but knowledge of Calculus I and II is needed to work on the logistic map. Interest in computational methods and programming is welcomed.

Required readings

The main textbook is [Mitchell, 2009], supplemented with the rich list of references in [Newman, 2011] and a series of well-known, inspiring or debated papers on the topic.

Textbook

Mitchell, M. "Complexity: A Guided Tour", Oxford University Press USA, 2011.

Papers

- Arthur, B. (1994). Inductive reasoning and bounded rationality. *American Economic Review*, 84:406–411.
- Arthur, W., Holland, J., LeBaron, B., and Taylor, P. (1997). Asset pricing under endogenous expectations in an artificial stock market. In Arthur, W., Lane, D., and Durlauf, S., editors. "The Economy as an Evolving Complex System II". Addison-Wesley.
- Day, R. and Huang, W. (1990). Bulls, bears and market sheep. *Journal of Economic Behavior and Organization*, 14(3):299–329.
- Kelsey, D. (1988). The economics of chaos or the chaos of economics. *Oxford Economic Papers*, 1:1–31.
- Miller, J. and Page, S. (2004) The standing ovation problem, *Complexity* 9(5):8-16.

- Any reasonable treatment of Schelling segregation model: Schelling, T. (1978). "Micromotives and Macrobehaviour", W. W. Norton & Company or Rauch, J. (2002) Seeing around corners, The Atlantic, <http://www.theatlantic.com/magazine/archive/2002/04/seeing-around-corners/302471/> or Schelling, T. (1969). Models of segregation, American Economic Review 59(2), 488-493, <http://www.jstor.org/stable/1823701>
- Thompson, J. (2000). "Simulation: a Modeler's Approach". Wiley, chapter 8.

Recommended Readings

- Miller, H., Page, S., "Complex Adaptive Systems: An Introduction to Computational Models of Social Life", Princeton University Press, 2007.
- Batten, D., "Discovering Artificial Economics: How Agents Learn and Economies Evolve", Westview Press, 2000. The book is out of print but can be downloaded at the ACE web site <http://www2.econ.iastate.edu/tesfatsi/aintro.htm>

Grading

Participation	20%	<i>Active participation is needed and the material must be read in advance. In the first meeting of weeks 2, 3, 4 and 5 each student presents a set of 5 multiple choice (4 options, only one is true) questions to peers, offering the chance to review and discuss the topics of the previous week.</i>
Short Essay	30%	<i>Within the end of the third week: short essay (5-7 pages) or another written assignment. Students may be asked to read and provide feedback related to works done by peers.</i>
Midterm Examination	20%	<i>Within the end of the fourth week: short essay (5-7 pages) or report detailing some computational experiments. No programming is needed but insightful comments on results obtained by running scripts or applets are required.</i>
Final Examination	30%	<i>The final paper/presentation should critically discuss one of the topics covered along the course or describe some computational experiment.</i>

NB: Master's students (studenti a livello magistrale) and all other students at graduate level will be given extra work for grading purposes.

Policies and procedures

Attendance is required and considered as part of the grading. Any absence must be registered by the CFHSS office (email cafoscari-harvard@unive.it).

All work submitted for this course must be the student's own and must follow proper citation procedures. You are responsible for understanding Harvard Summer School policies on academic integrity (<http://www.summer.harvard.edu/policies/student->

responsibilities) and how to use sources responsibly. Not knowing the rules, misunderstanding the rules, running out of time, submitting the wrong draft, or being overwhelmed with multiple demands are not acceptable excuses. To support your learning about academic citation rules, please visit the Resources to Support Academic Integrity (<http://www.summer.harvard.edu/resources-policies/resources-support-academic-integrity>) where you will find links to the Harvard Guide to Using Sources and two free online 15-minute tutorials to test your knowledge of academic citation policy. The tutorials are anonymous open-learning tools.

The Summer School is committed to providing an accessible academic community. The Accessibility Offices at both Harvard and Ca' Foscari Universities offer a variety of accommodations and services to students with documented disabilities. Please visit <http://www.summer.harvard.edu/resources-policies/accessibility-services> and <https://www.unive.it/pag/28640/> for more information.

Students can usually find me in my office during working hours, however it is also possible to make an appointment by phone or email.

Seminars

Lesson	Title and Description	Date
1 / 2	Introduction	Tue 25 June
Readings	Mchap. 1; the standing ovation problem, [Miller and Page, 2004]; first introductory chapter of [Nicolis and Nicolis, 2007], ants and recruiting, [Kirman, 1993].	Thu 27 June
3 / 4	Dynamics, chaos and prediction	Tue 2 July
Readings	Mchap. 2; bulls, bears and market sheep (with computational experiences in R), [Day and Huang, 1990]; a critical view on chaos, [Thompson, 2000], chap. 8.	Thu 4 July
5 / 6	Genetics	Tue 9 July
Readings	M chap. 5, 6, 7 and 9; El Farol bar problem (with computational experiences), [Arthur, 1994]; Braess paradox and traffic problems; Batten (Chap 6).	Thu 11 July
7 / 8	Dedicated to emergence	Tue 16 July
Readings	Mchap 18-19; Schelling segregation model, [Rauch, 2002], Santa Fe artificial stock market (SFASM), [Arthur et al., 1997]. [Donohue and Levitt, 2001]Impact of legalized abortion on crime; Modeling Rumors [Galam, 2002]; Abortion and Crime [Lott-Whitley, 2007].	Thu 18 July
9 / 10	Scattered complexity, focus on decision making and organizations	Tue 23 July
Readings	Modularity and innovation in complex systems, [Ethiraj and Levinthal, 2004]; possibly, cancer as a complex system, see [Schwab and Pienta, 1996] or Ecological Therapy for Cancer [Pienta, McGregor, R.Axelrod and D.Axelrod, 2008].	Thu 25 July
11	<i>Preparation for the final exam</i>	Tue 30 July
12	<i>FinalExam</i>	Thu 1 August