Fundamentals of CAS Science

Fall 2017 - M 3:00 to 5:45, ISTB 1 Room 401

Michael Barton and Manfred Laubichler

Course Description

Many phenomena of critical relevance to human society are dynamic systems that change over individual and evolutionary time scales, and are highly interactive, both within and between systems. That is, they are complex adaptive systems (CAS). As a consequence, many social and natural systems share isomorphic properties like near-decomposability, hierarchical organization, scale-free networks, self-organized criticality, and emergence that are inherent to the structure, operation, and dynamics of CAS. The spread of epidemics, society-biology interactions of obesity, impacts of agriculture on land degradation, ecological impacts of urban growth, and social responses to natural disasters all involve CAS.

ASU has an exceptional number of faculty who are actively involved in studying principles of CAS and applying them in a wide variety of research settings. Fundamentals of CAS Science bring many of these faculty together to explore the diverse, interdisciplinary applications of a complex adaptive systems across the social, behavioral, and life sciences.

This is a seminar-style course that will combine lecture and discussion of readings and lecture presentations.

Student Learning Outcomes

Upon completion of this course, students will have acquired:

- a broad appreciation of the potential for applying concepts and methods for complex adaptive systems across a wide array of scientific fields;
- an understanding of how research informed by complex systems concepts can lead to new insights about diverse real-world phenomena;
- knowledge of the kinds of methods most useful to studying the dynamics of complex social and biological systems.

Academic Integrity

All students are required to read and act in accordance with university and Arizona Board of Regents policies, including:

- the Arizona Board of Regents Code of Conduct (ABOR Policies 5-301 through 5-308*):* *https://azregents.asu.edu/rrc/Policy%20Manual/5-303-Prohibited%20Conduct.pdf*,
- ASU's policies on academic integrity*:* *http://provost.asu.edu/academicintegrity*, and
- ASU's Computer, Internet and Electronic Communications Policy: *http://www.asu.edu/aad/manuals/acd/acd125.html*

If you fail to meet the standards of academic integrity in any of the criteria listed on the university policy website, sanctions will be imposed by the instructor, school, and/or dean. Academic dishonesty includes borrowing ideas without proper citation, copying others' work (including information posted on the internet), and failing to turn in your own work for group projects. If you follow an argument closely, even if it is not directly quoted, you must provide a citation to the publication, including the author, date and page number. If you directly quote a source, you must use quotation marks and provide the same sort of citation for each quoted sentence or phrase.

You may work with other students on assignments. However, all writing that you turn in must be done independently by you. If you have any doubt about whether the form of cooperation you contemplate is acceptable, ask the TA or the instructor in advance of turning in an assignment. Any work submitted for credit in this class may be scanned using SafeAssignment, which compares them against everything posted on the Internet, online article/paper databases, newspapers and magazines, and papers submitted by other students.

Disability Policy

Disability Accommodations: Qualified students with disabilities who will require disability accommodations in this class are encouraged to make their requests to me at the beginning of the semester either during office hours or by appointment. **Note:** Prior to receiving disability accommodations, verification of eligibility from the Disability Resource Center (DRC) is required. Disability information is confidential.

Establishing Eligibility for Disability Accommodations: Students who feel they will need disability accommodations in this class but have not registered with the Disability Resource Center (DRC) should contact DRC immediately. Their office is located on the first floor of the Matthews Center Building. DRC staff can also be reached at: 480-965-1234 (V), 480-965-9000 (TTY). For additional information, visit: www.asu.edu/studentaffairs/ed/drc. Their hours are 8:00 AM to 5:00 PM, Monday through Friday.

Readings

Readings are current journal and book chapters that represent up-to-date accounts of ongoing complexity related research across multiple disciplines. In the first four weeks of the course we will be reading and discussing John Miller and Scott Paige's *Complex Adaptive Systems* (available at Amazon and other locales, abbreviated by **M&P** below). This is one of the most comprehensive conceptual introductions into complexity science by leading scholars in the field. For the rest of semester we will be discussing research papers in conjunction with faculty presentations. These will be posted on Blackboard.

Assignments and Grading

In this seminar-style course, grades will be based on student participation (50%), and a written paper (50%). The paper will be a grant proposal for a project that employs complexity theory and modeling. It requires (1) a clear question, (2) background research, (3) a preliminary hypothesis and (4) a modeling strategy.

Course Schedule

Week 1 (8/21):	Intro to class: Complexity: Background, History and Basic Concept of Complexity Science (M&P Parts I and II)
Week 2 (8/28):	Information and computation (M&P Part III)
Week 3 (9/04):	**Labor Day, No Class**
Week 4 (9/11):	Michael Barton (School of Human Evolution and Social Change & Center for Social Dynamics & Complexity): Modeling in complex systems (M&P Part IV)
Week 5 (9/18):	Manfred Laubichler (School of Life Sciences & ASU/Santa Fe Institute Center): Gene regulatory networks in development and evolution
Week 5 (9/25):	Deborah Strumsky (ASU/Santa Fe Institute Center): Technology and innovation
Week 6 (10/02):	Xin Wei Sha (School of Arts, Media & Engineering, & Syntheisis @ ASU). Alternative perspectives on emergence and ontogenesis.
Week 7 (10/09):	**Fall Break, No Class**
Week 8 (10/16):	Erik Johnston (School for the Future of Innovation in Society). Complexity in public policy
Week 9 (10/23):	Yun Kang (Simon A. Levin Mathematical, Computational, and Modeling Sciences Center, & Sciences and Mathematics Faculty). Mathematical modeling of social insect colonies as complex adaptive systems.
Week 10 (10/30):	Shauna BurnSilver (School of Human Evolution and Social Change). Social networks and well-being
Week 11 (11/06):	Sara Walker (School of Earth and Space Exploration): Origins of Life
Week 12 (11/13):	Ted Pavlic (School of Computing, Informatics, and Decision Systems Engineering): Bioengineering
Week 13 (11/20):	Michelle Jordan (Mary Lou Fulton Teachers College): Complexity in Education
Week 14 (11/27):	Ken Buetow (School of Life Sciences & Computational Science and Informatics Core Program): Bioinformatics
Finals week:	Proposal presentations