

Fundamentals of Complex Adaptive System Science

CAS/ASM/BIO/SOS 570

Fall 2022 - Mondays 3:00-5:45 PM

Michael Barton, Enrico Borriello, Bryan Daniels, 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.

Because ASU has numerous faculty who are actively involved in studying principles of CAS and applying them in a wide variety of research settings, it created the new School of Complex Adaptive Systems. This course is designed to introduce you to the fundamentals of CAS Science along with many of these faculty to give you the basis to begin 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. The first part of the course will involve an introduction to fundamental concepts and methods used in CAS science. The second part of the course will feature guest presentations by ASU faculty who are applying CAS science in diverse research programs.

Student Learning Outcomes

Upon completion of this course, students will have acquired:

- an introduction to fundamental concepts and methods used in complex adaptive systems science, and particularly useful to studying the dynamics of complex social and biological systems.
- 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;

Readings

Readings are current journal and book chapters that represent up-to-date accounts of ongoing complexity related research across multiple disciplines. Readings will be posted on Canvas in advance of weekly meetings.

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.

READ THE IMPORTANT COURSE AND UNIVERSITY POLICIES LISTED AFTER THE COURSE OUTLINE BELOW

Course Schedule

Week 1 (8/22):	Introduction to complexity: background, history and basic concept of complexity science
Week 2 (8/29):	Evolution and complexity: Manfred Laubichler
Week 3 (9/05):	Labor Day, No Class
Week 4 (9/12):	Collective behavior: scaling and coarse-graining:: Bryan Daniels
Week 5 (9/19):	Collective behavior: emergence and function: Bryan Daniels
Week 6 (9/26):	Computational thinking: Michael Barton
Week 7 (10/03):	Information in complex systems: Enrico Borriello
Week 8 (10/10):	Fall Break
Week 9 (10/17):	Evolution II: Manfred Laubichler
Week 10 (10/24):	Modeling dynamics of complex systems: Michael Barton & Enrico Borriello
Week 11 (10/31):	Networks in complex systems: Enrico Borriello
Week 12 (11/07):	Complexity in urban systems: Shade Shatters
Week 13 (11/14):	Complexity in information systems: Michael Simeone
Week 14 (11/21):	Complexity in economic systems: Joffa Applegate
Week 15 (11/28):	Complexity in socioecological systems: Sean Bergin
Finals week:	Proposal presentations (Dec. 5 at normal time as suggested date)

COURSE AND UNIVERSITY POLICIES AND STANDARDS

Absences

- Inform your instructor ahead of time for expected absences and be prepared to make up missed work.
- Information on excused absences related to religious observances/practices that are in accordance with [ACD 304-04](#) “Accommodations for Religious Practices.”
- Information on excused absences related to university sanctioned events activities that are in accord with [ACD 304-02](#) “Missed Classes Due to University-Sanctioned Activities.”

Student Standards

Students are required to read and act in accordance with university and Arizona Board of Regents policies, including the ABOR Code of Conduct: Arizona Board of Regents Policies 5-301 through 5-308: <https://students.asu.edu/srr>

Expected classroom behavior

Be sure to arrive on time for class and be respectful of your fellow students in class discussions and interactions.

Policy against threatening behavior

All incidents and allegations of violent or threatening conduct by an ASU student (whether on-or off campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students. If either office determines that the behavior poses or has posed a serious threat to personal safety or to the welfare of the campus, the student will not be permitted to return to campus or reside in any ASU residence hall until an appropriate threat assessment has been completed and, if necessary, conditions for return are imposed. ASU PD, the Office of the Dean of Students, and other appropriate offices will coordinate the assessment in light of the relevant circumstances.

If you have any questions, please refer to [ACD-304-10 Course Syllabus](#) or contact P.F. Lengel or Jenny Smith in the CLAS Dean’s Office at (480) 965-6506.

Sexual Harassment and Discrimination

Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been harassed on the basis of sex or sexually assaulted, you can find information and resources at <https://sexualviolenceprevention.asu.edu/faqs>.

As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, <https://eoss.asu.edu/> counseling is available if you wish to discuss any concerns

confidentially and privately. ASU online students may access 360 Life Services, <https://goto.asuonline.asu.edu/success/online-resources.html>.

Academic Integrity

Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions and records. The possible sanctions include, but are not limited to, appropriate grade penalties, course failure (indicated on the transcript as a grade of E), course failure due to academic dishonesty (indicated on the transcript as a grade of XE), loss of registration privileges, disqualification and dismissal. For more information, see <http://provost.asu.edu/academicintegrity>.

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. Please be aware that 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. 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. Please be aware that the work of all students submitted electronically can 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 (including yourself if submitted for a previous class).

Note: Turning in an assignment (all or in part) that you completed for a previous class is considered self-plagiarism and falls under these guidelines. Any infractions of self-plagiarism are subject to the same penalties as copying someone else's work without proper citations. Students who have taken this class previously and would like to use the work from previous assignments should contact the instructor for permission to do so.

Prohibition of Commercial Note Taking Services

In accordance with [ACD 304-06 Commercial Note Taking Services](#), written permission must be secured from the official instructor of the class in order to sell the instructor's oral communication in the form of notes. Notes must have the note taker's name as well as the instructor's name, the course number, date.

Student Support and Disability Accommodations

In compliance with the Rehabilitation Act of 1973, Section 504, and the Americans with Disabilities Act of 1990, professional disability specialists and support staff at the Disability Resource Center (DRC) facilitate a comprehensive range of academic support services and accommodations for qualified students with disabilities.

[Qualified students with disabilities may be eligible to receive academic support services and accommodations](#). Eligibility is based on qualifying disability documentation and assessment of individual need. Students who believe they have a current and essential need for disability accommodations are [responsible for requesting accommodations and providing qualifying](#)

[documentation](#) to the DRC. Every effort is made to provide reasonable accommodations for qualified students with disabilities.

Qualified students who wish to request an accommodation for a disability should contact their campus DRC at: <http://www.asu.edu/studentaffairs/ed/drc/>. If you are a student in need of special arrangements for we will do all we can to help, based on the recommendations of these services. For the sake of equity for all students, we cannot make any accommodations without formal guidance from these services.

Drop and Add Dates/Withdrawals

Please refer to the [academic calendar](#) on the deadlines to drop/withdraw from this course. Consult with your advisor and notify your instructor if you are going to drop/withdraw this course. If you are considering a withdrawal, review the following ASU policies: [Withdrawal from Classes](#), [Medical/Compassionate Withdrawal](#) and [Drop/Add and Withdraw](#).

Email Communications

All email communication for this class will be done through your ASU email account. Your email communications should be [professional](#) and succinct. You should be in the habit of checking your ASU email regularly as you will not only receive important information about your class(es), but other important university updates and information. You are solely responsible for reading and responding if necessary to any information communicated via email. For help with your email contact the [help desk](#). Your email communications should be professional and succinct. General guidelines for email include:

- Expect faculty to respond to emails between 9am and 5pm on Monday through Friday with a forty-eight hour lag time.
- For any concerns about grades, meet with your professor or TA face-to-face.
- Before sending questions via email, make sure that your question is not answered on the course syllabus or website.
- Be specific about the subject of the email in the mail subject heading and use proper salutation (e.g. Dear Professor XXXX) and check spelling, grammar, and punctuation.

Campus Resources

As an ASU student you have access to many resources on campus. This includes tutoring, academic success coaching, counseling services, financial aid, disability resources, career and internship help and many opportunities to get involved in student clubs and organizations.

- Tutoring: <http://studentsuccess.asu.edu/frontpage>
- Counseling Services: <http://students.asu.edu/counseling>
- Financial Aid: <http://students.asu.edu/financialaid>
- Disability Resource Center: <http://www.asu.edu/studentaffairs/ed/drc/>
- Major/Career Exploration: <http://uc.asu.edu/majorexploration/assessment>
- Career Services: <http://students.asu.edu/career>

- Student Organizations: <http://www.asu.edu/studentaffairs/mu/clubs/>

For more information about the School of Human Evolution and Social Change, including our degree programs, research opportunities and advising information, please go to:

<http://shesc.asu.edu/undergraduate/undergraduate-studies>. Our advisors are always willing to discuss career and guidance options with you.

Note: this syllabus is not a contract. It is subject to further change or revision, to best realize the educational goals of the course. Revisions will be announced in class or in course materials on-line with appropriate prior notice.