

# Fundamentals of Complex Adaptive System Science

Fall 2021 - 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.

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.

## 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 Canvas.

## 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.

## Special Health and Safety Information for Fall 2021

The **ASU Face Cover Policy** (<https://www.asu.edu/about/fall-2021#face-coverings>) requires the wearing of face covers in the majority of classrooms, teaching laboratories, studios and workshop settings. The space for this class has been designated as a space requiring face covers. Please wear a face covering over your nose and mouth at all times during class for the health and safety of yourself and others.

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

#### **Course Schedule**

Week 1 (8/23):	Intro to class: Complexity: Background, History and Basic Concept of Complexity Science (M&P Parts I and II)
Week 2 (8/30):	Information and computation (M&P Part III)
Week 3 (9/06):	<b>Labor Day, No Class</b>
Week 4 (9/13):	Modeling in complex systems (M&P Part IV): Michael Barton
Week 5 (9/20):	Networks and collective behavior: Bryan Daniels
Week 6 (9/27):	Modeling stochastic dynamics: Enrico Borriello
Week 7 (10/04):	Gene networks and evolution: Manfred Laubichler
Week 8 (10/11):	<b>Fall Break</b>
Week 9 (10/18):	Complexity economics: Joffa Applegate
Week 10 (10/25):	Complex systems and computation: Stephanie Forrest
Week 11 (11/01):	Analyzing text with computers: Michael Simeone
Week 12 (11/08):	Designing complex adaptive systems: templates from nature: Ted Pavlic
Week 13 (11/15):	Life and information: Sara Walker
Week 14 (11/22):	Cities as complex systems: Shade Shutters
Week 15 (11/29):	Complexity in learning and education: Michelle Jordan
Finals week:	Proposal presentations (Dec. 6 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.