CMP 5371/6371
COMPLEXITY AND SYSTEMS THINKING
Spring 2020
Prof. Sarah Hinners  sarah.hinners@utah.edu
Mondays 9:00-12:00 MLIB 1008 (Mac Lab)
Office Hours: after class and by appointment

COURSE DESCRIPTION
Today, numerous disciplines are struggling with the challenges of understanding the interconnections between human behaviors, environmental change, and decision-making, management and policies. These connections are often too complex to be studied within a single discipline, or using traditional reductive approaches. They involve numerous emergent, indirect and unanticipated consequences, surprise variations and counter-intuitive results. Comprehending these connections requires thinking in terms of dynamic systems, system structures, and the scales at which system processes operate. Computer-aided exploration through modeling is the predominant methodology for studying complex adaptive systems.

This course consists of two primary activities and modes of learning: 1) Through reading and discussion, we will explore theory, case studies and frameworks for understanding complexity and complex adaptive systems, drawing from natural and social sciences, 2) In parallel, we will use an easy-to-use software tool – STELLA® – to explore and build dynamic system models. STELLA® offers a visual programming environment with a graphical user interface to better explore environmental systems design and simulation without requiring proficiency in the underlying mathematics.

COURSE OBJECTIVES
1. Learn to identify complex systems at work in the world at multiple scales, and achieve enhanced conceptual understanding of such systems.
2. Learn thinking patterns and software tools used to define problems, develop hypotheses, experiment with policy options, probe the robustness of analysis and convey results to others.
3. Explore the potential for complexity and systems thinking to bridge disciplinary boundaries.
4. Design a system dynamics model and prepare a report on its structure and behavior.

COURSE GRADING
Attendance/Participation/Discussion: 15%
Periodic Exercises: 25%
Class Topical Presentations: 10%
Project Preliminary Oral Presentation 10%
Project Final Oral Presentation 10%
Final Technical Report 30%

TEXTBOOKS AND MATERIALS (DRAFT LIST OF POSSIBILITIES)

REQUIRED:


Additional Readings on Canvas

STELLA software is available on the classroom computers, with remote access capability. After the class has started, students will be eligible to download a temporary (starting at about $59) or perpetual license from [www.iseesystems.com](http://www.iseesystems.com)

**SCHEDULE OF ACTIVITIES**

The class is scheduled to meet once a week for three hours. We will use this class time in a combination of lecture, discussion of readings, computer-based modeling activities, student presentations and project development. The first part of the semester will focus more heavily on lecture and readings/discussion, with a shift toward modeling and projects toward the end of the semester. Students will be expected to find examples of relevant work in their own field to share in class.

Students will develop a systems modeling project based in their own field or area of interest. We will devote some class time to group “workshopping” of student projects and computer modeling exercises. We will work our way through Ford’s *Modeling the Environment* to learn to model dynamic systems in Stella. Students have found that the experience of developing systems dynamics models transforms their thinking about their work far beyond the scope of what they do in this class.

**DRAFT SEMESTER SCHEDULE (SEE CANVAS FOR UP-TO-DATE VERSION)**

January 6 – Introduction to class, Complexity, Stella
January 13 – Seeing Complexity, Intro to System Dynamics, Stella exercises
January 20 MLK Day – no class
January 27 – System Dynamics, Stella exercises
February 3 – Agents in Complex Systems
February 10 – Agents and Agent-based models
February 17 Presidents Day – no class
February 24 - Resilience and Adaptive Cycles
March 2 - Panarchy
March 9 Spring Break
March 16 - Networks
March 23 – Project work-in-progress presentations
March 30 - TBD
April 6 - TBD
April 13 - TBD
April 20 – final project presentations
April 27 – final project due

**NOTES AND POLICIES**

**Attendance**: "The University expects regular attendance at all class meetings. Instructors must communicate any particular attendance requirements of the course to students in writing on or before the first class meeting. Students are responsible for acquainting themselves with and satisfying the entire range of academic objectives and requirements as defined by the instructor." PPM, Policy 6-100III-O)
**Americans with Disabilities Act (ADA) Statement:** The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, including sexual orientation or gender identity/expression, you are encouraged to report it to the University’s Title IX Coordinator; Director, Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or to the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to police, contact the Department of Public Safety, 801-585-2677 (COPS). Additional information regarding reporting and victim supportive resources are available at the offices listed above.

**Academic Misconduct:** Academic misconduct includes cheating, plagiarizing, research misconduct, misrepresenting one’s work, and inappropriately collaborating. Definitions of these and other terms can be found in the Student Code at http://www.regulations.utah.edu/academics/6-400.html. The Student Code (at section 6-400(V)) also specifies the required procedures that must be followed when disciplinary actions are taken in response to instances of academic misconduct. For students enrolled in degree programs in the College of Architecture + Planning, a second occurrence of academic misconduct will result in the student’s dismissal from their academic program.