Complex Adaptive Systems

UNM CS 423/523 Spring 2020
Tu, Th 2:00 – 3:15
Collaborative Teaching and Learning Building room 210

https://tinyurl.com/CAS2020schedule

Professor: Melanie Moses
Email: melaniem XX cs.unm.edu
Office Hours:
Th 3:15 – 4:15 after class in CTLB
Mon 9:00-10:00am, Farris 3340

TA: Mona Esmaeili
Email: mesmaeili XX unm.edu
Office hours TBD

Textbook: We don't have a textbook for this course, but we'll use as a guide *Complexity, A Guided Tour*, Melanie Mitchell, Oxford University Press. Each week we'll read journal articles to explore concepts from the book in more depth. These articles will include more detailed technical explanations and recent conceptual advances in understanding CAS.

Course Description: A graduate level introduction to selected topics in complex adaptive systems (CAS). The course focuses on computational tools to simulate and measure complexity, and analysis of biological and computational complex adaptive systems. Topics include definitions of complexity, evolution and genetic algorithms, cellular automata, dynamical systems, scaling and fractals, ant colonies & ant colony optimization algorithms, immune systems & immune inspired computer security and swarm robotics.

Course Assignments and Grading: The course requires extensive reading, participation in discussions and in-class exercises, attending lectures, and completing programming assignments, written reports and oral presentations. In addition to the primary textbook, students will read papers from the primary scientific literature or chapters from supplemental textbooks each week.

• 20% of the course grade will be based on class participation, including short pop quizzes to ensure that you have completed the reading, participation in in-class exercises, and participating in discussions of assigned readings. Students enrolled in the graduate section (CS 523) will present a paper to the class. This presentation will be 10% of the grade.

• 20% of the grade will be based on a midterm.

• 60% of the grade will come from three reports based on programming projects. The first project will be relatively simpler (a simple set of programs, data analysis and presentation in a written report). The second and third projects will be more complex. Students may come up with their own independent project for the third project. You must have the project proposal approved by the professor beforehand.

You will work in pairs for all assignments and document the contribution of each team member. For each project, you will turn in your code, a readme file describing how to run your code, and a report describing how your code works, results and analysis and answers to specific questions. Your grades will be based primarily on the quality of your reports which should be clear, concise, free of typos and grammatical errors and contain clear and meaningful figures. Your reports should indicate an understanding of relevant concepts covered in lectures, readings and discussions. You should spend at least as much time writing your report as writing your code.

Projects turned in late will be penalized 10% for each late day, for a maximum of 3 days. Students who have a true emergency must contact the professor before the due date. No exceptions.

Academic dishonesty will not be tolerated. If you cheat, you will fail the class. In collaborative work, the contributions of each student must be documented clearly in an author contributions section of the report. Your report must clearly document all downloaded code and how you have modified or incorporated it into your own code. Failure to document the source of any code that you did not write yourself constitutes cheating. Similarly, you must cite all journal articles, books, web pages and other online sources for your reports in a references section.

Course Topics

Introduction & Foundations: Definitions of complexity; dynamical systems, information theory
Evolution and Genetic Algorithms
Cellular Automata
Swarm Robotics
Natural and Computational Immunology
Midterm Review & Midterm
Brains, Neural Nets & Analogies
Modeling & the Prisoner's Dilemma
Networks, scaling & fractals
Complexity Revisited
Complexity and AI

Readings, Assignments and the schedule of topics are listed at
https://tinyurl.com/CAS2020schedule

Sign up for presentation slots at
https://tinyurl.com/CAS2020signups

UNM Policies:

Attendance Policy: Regular and punctual attendance is required. UNM Pathfinder (the UNM Student Handbook http://pathfinder.unm.edu/) policies apply, which in part means the instructor may drop students based on non-attendance. This policy applies regardless of the grading option you have chosen.

Accommodation Statement: Accessibility Resources Center (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need

alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting the Accessibility Resources Center, see the see the Bachelor and Graduate Programs office.

Academic Integrity: The University of New Mexico believes that academic honesty is a foundational principle for personal and academic development. All University policies regarding academic honesty apply to this course. Academic dishonesty includes, but is not limited to, cheating or copying, plagiarism (claiming credit for the words or works of another from any type of source such as print, Internet or electronic database, or failing to cite the source), fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Note that plagiarism may be either deliberate or unwitting, it is the student's responsibility to know what constitutes plagiarism (link to UNM plagiarism rules: https://grad.unm.edu/aire/airedocs/plagiarism-guidelines.pdf). The University's full statement on academic honesty and the consequences for failure to comply is available in the college catalog and in the Pathfinder.

Specifically, in this course, you may discuss assignments with your classmates, but we will scan assignments for plagiarized code. Assignments completed in collaboration should always identify who contributed what to the assignment. You may never type in another student's program without being cited as a collaborator. If you are unsure about whether something violates the Academic Integrity policy, it is your responsibility to ask an instructor. We will pursue the strongest penalties available for students violating the principles of academic integrity.

Cell Phones and Technology: As a matter of courtesy, please turn off cell phones, pagers, andother communication and entertainment devices prior to the beginning of class. Notify the instructor in advance if you are monitoring an emergency. Computers should be used during class to work on class material, and nothing else.

Chemical sensitivity: The University of New Mexico supports sustaining healthy indoor air quality. In the interest of promoting the health and safety of the University, we are requesting this class to be a perfume-free environment. Some individuals at UNM have been identified as having Multiple Chemical Sensitivity, listed under the American Disabilities Act as a physical disability. Individuals with this diagnosis are sensitive to many products that we wear each day. Please refrain from using perfume-scented personal care, laundry, and cleaning products. Thank you for your consideration of others in providing an environment in which every person on campus can feel safe and comfortable.

Sexual Violence and Sexual Misconduct: As UNM faculty members and instructors, we are required to inform the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu) of any report we receive of gender discrimination which includes sexual harassment, sexual misconduct, and/or sexual violence. To talk with someone anonymously, contact LoboRESPECT (link below). You can read the full campus policy regarding sexual

misconduct at https://policy.unm.edu/university-policies/2000/2740.html. If you have experienced sexual violence or sexual misconduct, please ask a faculty or staff member for help or contact the LoboRESPECT Advocacy Center online: loborespect.unm.edu, by phone: (505) 277-2911, or by email: loborespect@unm.edu.

Work Hard. Be Nice*: UNM has established policies to encourage a respectful and supportive learning environment for all students. There are specific policies in the Pathfinder regarding, for example, student grievances, code of conduct, sexual harassment, and discrimination. All UNM policies apply in this class. Additionally, we expect all students and instructors to be respectful of one another, an attitude captured by the *motto of the KIPP charter schools: **Work Hard. Be Nice.** Within that context we also encourage you to **Be Creative. Have Fun.**