

# Complex Adaptive Systems

DSBA 6500, HCIP 6500, ITCS 6500/8500, ITIS 6500/8500 Combined  
Spring 2017

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## Contact Information:

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## Course Description:

Complex systems consist of a network of parts whose interactions give rise to interesting properties including self-organization, non-linearity, and emergence. Self-organization is a process where the organization of a system spontaneously increases. New, emergent properties appear. Ant colonies, networks of neurons, the immune system, the Internet, and the global economy are a few examples where the behavior of the whole is much more complex than the behavior of the parts (non-linearity). This course will cover these and similar topics in an instructor led, self-exploratory manner.

## Schedule of Topics, Exams & Presentations:

Date	Topic	Canvas Reading Assignment
January 12	Complex Adaptive Systems Introduction and Definitions Project Assignments	Week 1
January 19	Self-Organization Emergence	Week 2
January 26	NetLogo Tutorial Project Demo	Week 3
February 2	Agent-Based Simulation Designing a CAS  Cellular Automata Information & Energy	Week 4

February 9	Adaptation Learning CAS Verification & Validation	Week 5
February 16	Chaos Theory & Fractals	Week 6
February 23	Preliminary Project Presentations	Week 7
March 2	Midterm	Week 8
March 9	Spring Break	Week 9
March 16	Dynamical Systems Network Science	Week 10
March 23	Evolution Genetic Algorithms Creativity & Innovation	Week 11
March 30	The Economy as a CAS Measuring Complexity	Week 12
April 6	TBD	Week 13
April 13	Class Cancelled	Week 14
April 20	TBD	Week 15
April 27	Final Project Presentations	Week 16
May 11, 8-10:30pm	Final Exam	

**Textbook - Required:**

- **Complexity: A Guided Tour**  
Melanie Mitchell, Oxford University Press - September 2011

**Recommended Reading:**

- **The Social Atom: Why the Rich Get Richer, Cheaters Get Caught, and Your Neighbor Usually Looks Like You**  
Mark Buchanan, Bloomsbury USA – June 2007
- **Complexity: The Emerging Science at the Edge of Order and Chaos**  
M. Mitchell Waldrop, Simon & Schuster - January 1992
- **Complex Adaptive Systems: An Introduction to Computational Models of Social Life**  
John Miller & Scott Page, Princeton University Press - March 2007
- **The Computational Beauty of Nature**  
Gary Flake, Bradford Books - January 2000
- **Growing Artificial Societies: Social Science From the Bottom Up**  
Joshua M. Epstein & Robert L. Axtell, Brookings Institution Press & MIT Press – October 1996
- **Generative Social Science: Studies in Agent-Based Computational Modeling**  
Joshua M. Epstein, Princeton University Press – 2006
- **Agent\_Zero: Toward Neurocognitive Foundations for Generative Social Science**  
Joshua M. Epstein, Princeton University Press – 2014
- **The Age of the Unthinkable: Why the New World Disorder Constantly Surprises Us And What We Can Do About It**

Joshua Cooper Ramo, Back Bay Books – June 2010

- **How Nature Works: The Science of Self-Organized Criticality**  
Per Bak, Copernicus - 1999

### Recommended References:

- **An Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo**  
Uri Wilensky & William Rand, The MIT Press - April 2015
- **Agent Based & Individual Based Modeling: A Practical Introduction**  
Steven Railsback & Volker Grimm, Princeton University Press - November 2011
- **Introduction to the Modeling and Analysis of Complex Systems**  
Hiroki Sayama, Open SUNY Textbooks – August 2015

### Course Requirements and Grading Policy:

Project:	40%
<b>In-Class Quizzes:</b>	<b>20%</b>
Midterm Exam:	20%
Final Exam (not cumulative):	20%

### Note on in-class quizzes:

- **In-class quizzes will be held in the first 10 minutes of class, and will be based on the reading material assigned for that week.**
- Students are expected to read all materials assigned for a class **prior** to the class meeting.
- Students who are late or absent will receive a grade of 0 for that day's quiz.
- The three lowest quiz grades will be dropped.

### Project Grading Breakdown:

- **10%:** 1st written submission - basic concept
- **30%:** 2nd written submission - detailed concept, and preliminary project presentation
- **60%:** 3rd written submission - analysis of model results, model code submission, and final project presentation
- **Late submissions will not be accepted.**

### Additional Policies:

#### Attendance:

Students are expected to attend all class meetings and to arrive before the class starts. Class topics are integrated, with each week building on prior weeks. Failure to attend or to arrive on time can adversely affect both individual performance, ability to contribute to the group project, and the earned letter grade. If a student

misses a class due to work or other reasons, it is their responsibility to get notes from peers; instructors do not hold extra repeat class sessions.

Students will be allowed to miss no more than 3 classes without affecting their final grade. For every 3 absences the final grade will be lowered by one letter grade.

### **Grade Discussions:**

The instructor and TA will discuss grades only in person (and not via telephone or e-mail) and only with the student (not with parents, spouses, etc). Office hours are listed in the syllabus.

### **Electronic Devices:**

Students are not allowed to use any electronic devices during the class, unless otherwise instructed by the instructor.

### **Academic Integrity:**

All students are expected to adhere to the [UNC Charlotte Code of Student Academic Integrity](http://legal.uncc.edu/policies/ps-105.html) (<http://legal.uncc.edu/policies/ps-105.html>) as specified in the current [Catalog](http://catalog.uncc.edu/) (<http://catalog.uncc.edu/>). Among other things, this code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty.

### **Inclement Weather:**

University Policy Statement #13 states the University is open unless the Chancellor announces that the University is closed. The inclement weather hotline number to call is 704-786-2877. **In the event of inclement weather, check your email the morning of class.** The instructors will use their best judgment as to whether class should be held understanding that some of you commute from far away and the instructors will notify you by email if class is cancelled.