

# It's a Complex World: Addressing Global Challenges

## 11228 - SYS 30000 - H01

### Course Information

Spring 2020

T, Th 3:00 pm - 4:15 pm

WALC 3121

3 Credit hours

This course uses Blackboard, if you do not have access, contact one of the instructors.

No prerequisites required.

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TA: TBD

### Course Description

The main goal of this course is to use the ideas and tools of complex adaptive systems to address grand challenges that are of global concern—such as environmental sustainability and energy use, natural and human disasters, and political and economic development. The course exploits the broad expertise of the three faculty members by treating these challenges from diverse disciplinary perspectives, from the biological and physical sciences, to the social sciences, to engineering. Through case studies and computer simulation, students will analyze the features of these challenges which make them 'complex,' and seek to explain and find solutions to the problems that arise in each case. Their treatment of the cases will be informed by published research. Students will actively participate in discussions regarding these global challenges, and contribute to the progress of the class using oral and written presentations. The course will culminate with a final project.

### Course Goals

The main goal of this course is to prepare students to use the perspective of "complex adaptive systems" to analyze and solve real world problems.

### Learning Objectives

1. Describe global challenges using engineering, biological, physical, and social scientific perspectives, including attention to the interdependence of the different perspectives.
2. Explain the fundamental concepts of 'complex adaptive systems,' including applications to different global challenges.
3. Develop basic proficiency in applying computer modeling to represent the behavior of complex systems, with applications to the global challenges.
4. Apply the concepts and tools of complexity research to develop a group-based project of comprehensive policies/solutions/strategies in a new and unresolved problem area.

## Course Requirements

Each of the five main units of the course will include one (or more) assignments combined for a total of 60% of the final grade. There will also be a final project worth 40% of the final grade. A tentative schedule for the assignments is as follows:

Assignment	Type	Due Date	Weight	Group or Individual Score
Climate Simulation 1	Regular	23-Jan	5%	Group
Unit 1		13-Feb	7%	Individual
Unit 2		27-Feb	12%	Individual
Unit 3		31-Mar	12%	Individual
Unit 4		14-Apr	12%	Group
Unit 5 - Climate Simulation 2		23-Apr	12%	Group
Final Project Slides		28 or 30-Apr	5%	Group
Final Project Report		1-May	30%	Group
Final Project Peer Review	1-May	5%	Individual	
<b>Total Regular Assignments</b>			100%	
Course Evaluation	Extra Credit	3-May	1%	Individual
<b>Total with Extra Credit</b>			<b>101%</b>	

### Missed or Late Work

Work is due at the start of class on the due date, unless otherwise indicated. Late work will be penalized 20% per day.

### Required Texts

Readings will be made available at the course website on Blackboard before the relevant class session. They are to be completed before class on the due date.

### Required software

- Each student will download NetLogo. It is available free of charge at
  - <https://ccl.northwestern.edu/netlogo/>
- R (statistical computing and programming language) and R Studio (a user interface) are also needed. Both are available for free download at
  - <http://cran.r-project.org/>
  - <http://www.rstudio.com>
  - Several packages on CRAN will need to be installed. Details will be provided in class.
- GeNIe influence diagram software will be available as cloud-based software at
  - <https://goremote.itap.purdue.edu>
    - After logging in with your Career ID, select "Use light version" and search for GeNIe
  - <https://repo.bayesfusion.com/bayesbox.html>
    - This is an interactive repository of GeNIe models

The syllabus is subject to change. All dates are tentative.

**Grading**

Final grades will be assigned as follows:

A = 93-100%	C = 73-76%
A- = 90-92%	C- = 70-72%
B+ = 87-90%	D+ = 67-70%
B = 83-86%	D = 63-66%
B- = 80-82%	D- = 60-62%
C+ = 77-80%	F = 59% and below

**Academic Dishonesty**

"As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue." Here is a link to a web page for [Purdue's Honor Pledge](#)

The University Policy on Academic Dishonest Reads:

Purdue prohibits "dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty." [Part 5, Section III---B---2---a, University Regulations] Furthermore, the University Senate has stipulated that "the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest." [University Senate Document 72---18, December 15, 1972]

The Purdue student guide to academic integrity can be found at:

<https://www.purdue.edu/odos/osrr/academic-integrity/index.html>

We will comply with the procedures and recommendations of the Office of the Dean of Students. Specifically:

- We will be attentive to whether or not your written submissions are your own work and whether, if you use somebody else's work either directly or indirectly, you properly attribute credit to that person.
- We report all conduct violations to the Office of the Dean of Students.
- The existence of evidence consistent with acts of academic dishonesty will result in putative grading, as described at the link above, and per the discretion of the professors.

**Attendance:**

Attendance is required. We will record attendance at each class. More than two absences are a concern, and may influence your grade. Patterns of tardiness will also be a concern. The university policy for attendance is as follows:

"Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible...For unanticipated or emergency absences when advance

notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students".

**Grief Absence Policy for Students:**

Purdue University recognizes that a time of bereavement is very difficult for a student. The University therefore provides the following rights to students facing the loss of a family member through the Grief Absence Policy for Students (GAPS). GAPS Policy: Students will be excused for funeral leave and given the opportunity to earn equivalent credit and to demonstrate evidence of meeting the learning outcomes for missed assignments or assessments in the event of the death of a member of the student's family.

**Email and Communication:**

Email is the best way to reach the instructors and TAs (if the course has a TA). We expect all of you to communicate primarily via university email. You should check your Purdue email account every day. We will also be available to you through email. You should expect a response to your emails within 48 hours. If you have not heard from the instructors or TAs within 48 hours, please check to ensure that we have received your email.

**University Policy Prohibiting Violent Behavior Policy:**

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity.

**Students with Disabilities:**

Purdue University is required to respond to the needs of the students with disabilities as outlined in both the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 through the provision of auxiliary aids and services that allow a student with a disability to fully access and participate in the programs, services, and activities at Purdue University.

Purdue University strives to make learning experiences accessible to all participants. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let us know so that we can discuss options. You are also encouraged to contact the Disability Resource Center (DRC) at: [drc@purdue.edu](mailto:drc@purdue.edu) or by phone: 765-494-1247. For more information visit DRC website: <https://www.purdue.edu/drc/index.php>.

**Mental Health**

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at [\(765\)494-6995](tel:7654946995) and <http://www.purdue.edu/caps/> during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business

hours.

### Emergencies:

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

For additional information, see:

[https://www.purdue.edu/ehps/emergency\\_preparedness/bep/WALC-bep.html](https://www.purdue.edu/ehps/emergency_preparedness/bep/WALC-bep.html)

The Shelter-In-Place location for the WALC is the **basement level corridors, restrooms or classrooms B091, B093, B074, B068, and B058**. When the All-Hazards Emergency Warning Sirens sound or if notified by the Purdue ALERT system, calmly proceed to the basement level of the WALC.

EMERGENCY	SHELTER IN PLACE OPTIONS FOR CONSIDERATION
Weather-Related - Tornado Warning	Basement corridors, basement offices, basement restrooms Or the lowest level of the building (stay away from windows and doors)
Hazardous Materials (HAZMAT) Release	Remain or find an unaffected office or work area and close windows and doors.
Active threat, such as a shooting	Seek a safe location, preferable a room without windows that can be locked or secured by barriers.

### University Policy on Nondiscrimination:

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies.

## Class Schedule

Week	Date	Topic
<b>UNIT 1: Introduction to Systems</b>		
1	Tu 1/14	Introduction to the class and syllabus
1	Th 1/16	Climate Change: A Systems Perspective
2	Tu 1/21	C-ROADS Simulation Set-up
2	Th 1/23	C-ROADS Simulation
3	Tu 1/28	Introduction to Systems
3	Th 1/30	Key Properties of Systems
4	Tu 2/4	Systems Thinking
<b>UNIT 2: Modeling and Simulation</b>		
4	Th 2/6	Introduction to Modeling and Simulation
5	Tu 2/11	Agent-Based Models
5	Th 2/13	System Dynamics
6	Tu 2/18	Agent-Based Models
6	Th 2/20	Sensitivity Analysis
<b>UNIT 3: Networks</b>		
7	Tu 2/25	Networks Intro
7	Th 2/27	Networks
8	Tu 3/3	Networks
8	Th 3/5	Networks Data Analysis
9	Tu 3/10	Networks Data Analysis
9	Th 3/12	Networks and Contagion
Spring Break 3/17 & 3/19 (week 10)		
<b>UNIT 4: Decision Making for Complex Systems</b>		
11	Tu 3/24	Introduction to Decision Making for Complex Systems
11	Th 3/26	Stakeholders and Framing Decision Opportunities
12	Tu 3/31	Multi-attribute Decision Making
12	Th 4/2	Introduction to System Modeling for Decision Making
13	Tu 4/7	Influence Diagrams for Multi-Attribute Decision Making
<b>UNIT 5: Game Theory</b>		
13	Th 4/9	From Single Decision-Maker to Games
14	Tu 4/14	Fundamentals of Game Theory
14	Th 4/16	The Prisoner's Dilemma
15	Tu 4/21	Negotiation and Bargaining
15	Th 4/23	Simulation and Negotiations
<b>Student Project Presentations</b>		
16	4/28, 4/30	

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