Purdue University AAE 560: Systems-of-Systems Modeling & Analysis
Spring 2022 Syllabus

Instruction Team

Dr. Cesare Guariniello,   Office: ARMS 2085
Phone: (765) 496-3465   cguarini@purdue.edu
Office Hours: Tue 12:00-1:30 pm EST, ARMS 2085

Derek Carpenter, Teaching Assistant   Office: N/A
Office Hours: Wed 2:00-3:20 pm EST, ARMS 3118   carpe103@purdue.edu
           Thu 12:00-1:20 pm EST, ARMS 2007
Join virtually: https://purdue-student.webex.com/meet/carpe103

Tom Cunningham, Teaching Assistant   Office: N/A
Office Hours: Tue 1:30-2:30 pm EST, ARMS 2007   tomcat16@purdue.edu
           Thu 1:30-2:30 pm EST, ARMS 2007
Join virtually: https://purdue.webex.com/meet/cunnin85

Liam Durbin, Teaching Assistant   Office: ARMS 3154
Office Hours: Fri 1:30-3:00 pm EST, ARMS 2007   durbinl@purdue.edu
Join virtually: https://purdue-student.webex.com/meet/durbinl

Lecture: T/Th 10:30 – 11:45 am in WANG 2579

Instruction Modality: Face-to-Face, and Async Online

Course websites and communication

Brightspace course website (https://purdue.brightspace.com/d2l/login) will be used to distribute course material (e.g., lecture notes, readings, assignments), receive uploaded assignments from students, and track grades.

Piazza (https://piazza.com/purdue/spring2022/aae56000) will be used for all class discussions and all submission/response to questions about lectures, homework, etc.

NOTE: We will try to eliminate much/most email communication in the course. If you have a need to email the instruction team, such emails MUST start with "AAE560" in the subject line, otherwise they will not be answered. You should only email the TAs about issues specific to you (e.g., need a HW extension, setting an appointment); all other queries should be posted on Piazza so all ma benefit from the answers. For example, if you have a question on a HW problem, use these steps (in order):
1. search appropriate Piazza discussion folder
2. if no answer to your question exists yet, post your question to the folder
3. if no answer is given in discussion, visit TAs in office hours.

Course description:

The goal for this course is to enable students to characterize, abstract, model, simulate, and analyze a special kind of system termed a "System-of-Systems" (SoS). While covering a few topics in detail, the course also exposes students to interesting areas of further study and highlights the broader importance of SoS in society. The course presents recent developments in frameworks for formulating system-of-systems problems, lexicon for their articulation, and analysis methodology for their study. Through individual work and a team project, students gain experience in formulating problems and applying modeling theory and techniques.

Course Learning Objectives:

At the completion of this course, successful students will be able to:
- Recognize distinctive traits of a system-of-systems
- Understand the implications of these traits on modeling and analysis activities
- Formulate system-of-systems analysis and design problems
- Develop/use appropriate modeling & analysis methods for these problems
- Synthesize solution candidates for relevant decision criteria including complexity; explore validity
- Articulate problem formulation, analysis, and solution synthesis in written and verbal formats

Textbook:

There is NO required textbook, however:
- Potions of an "in progress draft" textbook on SoS Modeling and Analysis will be given to students as primary reading to augment lecture notes,
- Numerous technical articles will be assigned as required and/or supplemental reading

Grading

Team Project	20%
Homework Assignments	35%
Midterm Exam	25%
Weekly Online Assessments	15%
Participation (Online discussion threads)	5%

Project

Working in teams of 3 people, the team project allows students to demonstrate knowledge of key concepts through application, culminating in a final report and poster presentation. Each three-person team will identify a paper, article, or report that addressed SoS or a SoS challenge. Teams must successfully apply the DAI approach to critique, redress, and extend their selected work using some novel SoS modeling and analysis. More details will be given in the Project folder on Brightspace.

Homework Assignments and Online Weekly Assessments (quizzes)

~4 Homework assignments will be given during the semester. These assignments will require in-depth work and provide opportunity for the students to demonstrate skill with the course concepts. The weekly online assessments (quizzes) consist of multiple-choice questions meant to ensure that the student is reading assigned materials and following the lectures. The assessments will be administered via Brightspace.

Mid-Term Exam

The one exam will be open book/notes, take-home style; thus, proctors for distance students will NOT be required (unless otherwise specified). **There is no Final Exam**.

Readings

Many! Separated into REQUIRED and SUPPLEMENTARY (some will be loaded on Brightspace before the beginning of class; some will be added as topics arise in class).

Software

Students are expected to be capable (not expert) in MATLAB or equivalent scientific programming environments. Other software may be used that is a) appropriate to the modeling needs of their project, b) available to all Purdue students via ECN or ITAP, or is freeware. The following have been used in the past; others may be selected as needed by teams:
- AnyLogic (https://www.anylogic.com/downloads/) → FREE Personal Learning Edition
- Pajek (http://pajek.imfm.si/doku.php) → FREE Network analysis and visualization
- UCINET (https://sites.google.com/site/ucinetsoftware/home)
- Netlogo (http://ccl.northwestern.edu/netlogo/) → ABM
- Netlogo sys dynamics (https://ccl.northwestern.edu/netlogo/docs/systemdynamics.html) → Sys Dynamics
- SoS Analytic Workbench (access provided in class)

Attendance Policy during COVID-19

"Students are expected to attend all classes in-person (or "virtually" by watching recordings, participating in online discussions) unless they are ill or otherwise unable to attend class. If they feel ill, have any symptoms associated with COVID-19, or suspect they have been exposed to the virus, students should stay home and contact the Protect Purdue Health Center (496-INFO).

In the current context of COVID-19, in-person attendance cannot be a factor in the final grades. However, timely completion of alternative assessments can certainly be part of the final grade. Students need to inform the instructor of any conflict that can be anticipated and will affect the timely submission of an assignment or the ability to take an exam.

Classroom engagement is extremely important and associated with your overall success in the course. The importance and value of course engagement and ways in which you can engage with the course content even if you are in quarantine or isolation, will be discussed at the beginning of the semester. Student survey data from Fall 2020 emphasized students' views of in-person course opportunities as critical to their learning, engagement with faculty/TAs, and ability to interact with peers.

Only the instructor can excuse a student from a course requirement or responsibility. When conflicts 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 conflicts, when advance notification to an instructor is not possible, the student should contact the instructor/instructional team as soon as possible by email, through Brightspace, or by phone. In cases of bereavement, quarantine, or isolation, the student or the student's representative should contact the Office of the Dean of Students via email or phone at 765-494-1747. Our course Brightspace includes a link to the Dean of Students under 'Campus Resources.'"

Academic Guidance in the Event a Student is Quarantined/Isolated

"If you must quarantine or isolate at any point in time during the semester, please reach out to me via email so that we can communicate about how you can continue to learn remotely. Work with the Protect Purdue Health Center (PPHC) to get documentation and support, including access to an Academic Case Manager who can provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Your Academic Case Manager can be reached at acmq@purdue.edu. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation."

Classroom Guidance Regarding Protect Purdue

"The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, properly wearing a mask in classrooms and campus building, at all times (e.g., mask covers nose and mouth, no eating/drinking in the classroom), disinfecting desk/workspace before and after use, maintaining appropriate social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not properly wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the **Office of the Student Rights and Responsibilities.** See also **Purdue University Bill of Student Rights.**"

Academic Dishonesty

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]

Use of Copyrighted Material

Among the materials that may be protected by copyright law are the lectures, notes, and other material presented in class or as part of the course. Always assume the materials presented by an instructor are protected by copyright unless the instructor has stated otherwise. Students enrolled in, and authorized visitors to, Purdue University courses are permitted to take notes, which they may use for individual/group study or for other non-commercial purposes reasonably arising from enrollment in the course or the University generally. Notes taken in class are, however, generally considered to be derivative works of the instructor's presentations and materials, and they are thus subject to the instructor's copyright in such presentations and materials. No individual is permitted to sell or otherwise barter notes, either to other students or to any commercial concern, for a course without the express written permission of the course instructor. To obtain permission to sell or barter notes, the individual wishing to sell or barter the notes must be registered in the course or must be an approved visitor to the class. Course instructors may choose to grant or not grant such permission at their own discretion, and may require a review of the notes prior to their being sold or bartered. If they do grant such permission, they may revoke it at any time, if they so choose.

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 misses assignments or assessments in the event of the death of a member of the student's family.

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. If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first three (3) weeks of the semester in order to discuss any adjustments. It is important that we talk about this at the beginning of the semester. It is the student's responsibility to notify the Disability Resource Center (http://www.purdue.edu/drc) of an impairment/condition that may require accommodations and/or classroom modifications.

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, genetic information, marital status, parental status, sexual orientation, gender identity and expression, 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. Any student who believes they have been discriminated against may visit www.purdue.edu/report-hate to submit a complaint to the Office of Institutional Equity. Information may be reported

anonymously.

Mental Health

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: 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 mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of 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.

Emergency Preparedness

EMERGENCY NOTIFICATION PROCEDURES are based on a simple concept - if you hear a fire alarm inside, proceed outside. If you hear a siren outside, proceed inside. * Indoor Fire Alarms mean to stop class or research and immediately evacuate the building. * Proceed to your Emergency Assembly Area away from building doors. Remain outside until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave. * All Hazards Outdoor Emergency Warning Sirens mean to immediately seek shelter (Shelter in Place) in a safe location within the closest building. * "Shelter in place" means seeking immediate shelter inside a building or University residence. This course of action may need to be taken during a tornado, a civil disturbance including a shooting or release of hazardous materials in the outside air. Once safely inside, find out more details about the emergency*. Remain in place until police, fire, or other emergency response personnel provide additional guidance or tell you it is safe to leave. In both cases, you should seek additional clarifying information by all means possible...Purdue Emergency Status page, text message, email alert, TV, radio, etc...review the Purdue Emergency Warning Notification System multi-communication layers at http://www.purdue.edu/ehps/emergency preparedness/warning-system.html

EMERGENCY RESPONSE PROCEDURES: * Review the Emergency Procedures Guidelines https://www.purdue.edu/emergency preparedness/flipchart/index.html * Review the Building Emergency Plan (available on the Emergency Preparedness website or from the building deputy) for: * evacuation routes, exit points, and emergency assembly area; * when and how to evacuate the building; * shelter in place procedures and locations; * additional building specific procedures and requirements.

EMERGENCY PREPAREDNESS AWARENESS VIDEOS: * "Shots Fired on Campus: When Lightning Strikes," is a 20-minute active shooter awareness video that illustrates what to look for and how to prepare and react to this type of incident. See: http://www.purdue.edu/securePurdue/news/2010/emergency-preparedness-shots-fired-on-campusvideo.cfm (Link is also located on the EP website) MORE INFORMATION Reference the Emergency Preparedness web site for additional information: https://www.purdue.edu/ehps/emergency preparedness/