TO: The Faculty of the College of Engineering

FROM: Elmore Family School of Electrical and Computer Engineering

RE: New Graduate Course, ECE 50270 Introduction to Game Theory

The faculty of the School of Electrical and Computer Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ECE 50270 Introduction to Game Theory
Sem. 1, Lecture 3, Cr. 3.
Prerequisite: Probability (at the level of expectations) and Linear Algebra (at the level of matrix products); OR graduate student standing

Description:
This course introduces the basics and framework of game theory. The students will understand the application of game theory to model problems in decision making when multiple decision makers are present. An emphasis will be laid on the strong relevance of game theory to engineered systems through examples. Although the course will strive to be rigorous, the emphasis will be on breadth and intuition.

Reason:
Game theory is an important tool in decision theory when multiple decision makers are present. Although it has been used pre-dominantly in economics, it has equally strong relevance to many engineered systems. Currently, there is no class that introduces engineering students to the models and tools of game theory in a comprehensive manner. This class will serve as an introduction to game theory from an engineering perspective, relying on examples from engineering systems to illustrate various aspects of game theory.

Course History: Fall 2023 – 35, Fall 2024 – 62

Mithuna Thottethodi,
Associate Head for Teaching and Learning
Elmore Family School of Electrical and Computer Engineering

Course Information

- **Course number and title:** ECE50270 (-EPE, -059, WN1) Introduction to Game Theory
- **CRN:** 28691, 22676, 28690
- **Meeting day(s) and time(s)**. MWF 1:30 – 2:20 PM, Seng-Liang Wang Hall 2555, (Asynchronous Online Learning for ECE59500-EPE and ECE59500-059)
- **Instructional Modality** Face-to-Face for ECE59500, Asynchronous Online Learning for ECE59500-EPE and ECE59500-059
- **Course credit hours:** 3.0
- **Prerequisites (if any**): Probability (at the level of being comfortable with expectations and independence), linear algebra (at the level of being comfortable with matrix notation and operations such as matrix products), Access to MATLAB (student version is sufficient).

Instructor(s) Contact Information

- **Name of the instructor(s):** Vijay Gupta. Please contact me via email (preferred). Please put "ECE50270" at the start of the subject line.
- **Office Location:** MSEE 252
- **Office Phone Number:** 765 494 0728
- **Purdue Email Address:** gupta869@purdue.edu
- **Student consultation hours, times, and location:** Mondays and Wednesdays 2:30 – 3:30pm in Prof Gupta's office. Zoom available for remote students: https://purdue-edu.zoom.us/j/93317439825?pwd=OwYZ4Zp2DXxeak4cf8Siq5VBOwQvOM.1&from=addon

Grader(s) Contact Information

- **Name of the TA:** Utsav Negi. Please contact him via email (preferred). Please put "ECE50270" at the start of the subject line.
- **Purdue Email Address:** unegi@purdue.edu
- **TA Office Hours:** Tuesdays 2:30 – 4:00 and Wednesdays 4:30 – 6:00 in BHEE 208 Table 3. Zoom available at
  Tuesday Meeting Link: https://purdue-edu.zoom.us/j/99464104617
  Wednesday Meeting Link: https://purdue-edu.zoom.us/j/96933374715

Course Description

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Learning Resources, Technology & Texts

1. **Informed Learning resources:** Strictly speaking, no textbook is mandatory. However, having access to a good text will help your learning by providing, e.g., detailed explanations of covered topics, additional exercise problems, etc. With this in mind, here are a few suggestions
    a. Quite simple to read lecture notes with many examples: "An Introduction to Game Theory," by L. Kockesen and E. A. Ok, http://www.xixilogic.org/events/wp-content/uploads/2019/05/lecture_note_1_LG.pdf
    b. Many examples and well written; intended to be accessible to an undergraduate: "An Introduction to Game Theory," by M. J. Osborne, Oxford University Press
    c. Solid book, may require going through the mathematical appendix first: "Games and Information: An Introduction to Game Theory," by E. Rasmusen, Basil Blackwell Oxford.
    d. A good comprehensive book with many proofs and suitable for a graduate course: "Game Theory, Alive" by A. R. Karlin and Y. Peres, https://homes.cs.washington.edu/~karlin/GameTheoryBook.pdf
    e. Written for engineers and computer scientists: "Non-Cooperative Game Theory: An Introduction for Engineers and Computer Scientists," by Joao P. Hespanha, Princeton University Press, 2017.

- **Software/web resources** MATLAB: https://www.mathworks.com/academia/tah-portal/purdue-university-31484706.html Zoom if required for office hours
- **Hardware requirements (e.g., webcam for exam proctoring):** Please make sure you can run Matlab and access the brightspace resources on your computer. For the ECE59500-EPE and ECE59500-047 courses, we will be using Respondus (Lockdown browser and monitor) for exams and you can utilize zoom for office hours. Please make sure that you can run the software.
- **Brightspace learning management system**: https://purdue.brightspace.com/d2l/home/866475
    - It is strongly suggested that you explore and become familiar not only with the site navigation, but with content and resources available for this course. See the Help tab for resources.
- **Use of artificial intelligence (AI) or Large Language Models (LLM) in this course:** I will not be using any AI or LLM at my end. I do not think solving homework or exam problems through AI / LLM will aid in your understanding or provide fun, both of which are the main aims in this class. However, if you find that generating more examples or alternative explanations is aided by such tools, please use them.
- **Piazza: https://piazza.com/class/lxomxo7h6e15z2**
    - I or the grader will not be regularly monitoring this. This is a tool for you to learn from peers. Remember explaining something to others is the best way to understand it. Also, the way a peer can explain things may be different and complementary to how I explain it. Therefore, utilize this to the maximum.

Learning Outcomes

A student who successfully fulfills the course requirements will have demonstrated:

1. An ability to formulate multi-objective problems with multiple decision makers
2. An ability to identify various solution concepts for such problems
3. An ability to understand properties of various solutions for such problems
4. An ability to apply this framework to engineering problems These outcomes will be measured via assessments including homework, (possible) quizzes, and exams.

Assignments

Your learning will be assessed through a combination of quizzes, midterm exams, and a final examt. The due dates below may shift in case of campus disruptions.

Assignments	Due	Percent of Overall Grade
Homework	Approximately weekly, aim to have it due on Wednesdays (the exact handing out and due dates may shift since the topics in the HWs will be synchronized with the lectures)	40%
Midterm	**Tentatively** set for October 11. In class for residential students and via online proctoring for online students (details of the precise tool used and a practice exercise will be set up before the first exam)	30%
Final Exam	ECE 59500GT – 28690 is scheduled for Thu 12/12 @ 1:00-3:00pm in LWSN B155; For the online students, examity will be used.	30%
		Total: 100%

- Some problems in the homework and exams may be marked specifically for ECE59500 students.
- Homework problems are meant to give you practice to learn the concepts we are studying in class. All homework assignments and solutions will be posted on Brightspace. You are allowed to and encouraged to work collaboratively on the homeworks. However, the final solutions should be your work.
- I do not encourage the use of AI tools such as LLMs for homeworks. However, I will not be using any AI tool to detect issues about whether the homeworks reflect your own effort.
- The date for midterm is tentative. The final date and logistics for the midterm will be announced in class.
- The date for the final exam will be set by the registrar. The logistics will be announced in class.

Grading Scale

In this class, grades reflect the sum of your achievement throughout the semester. At the end of the semester, final grades will be calculated by adding the total points earned in the assessments and converting those into a final score (out of 100) based on the breakdown described above. The final score will be converted to a letter grade. Academic dishonesty will result in the student being reported to the Dean of Students, and a grade of F.

Attendance Policy (only for ECE59500-059)

Subject to the Protect Purdue guidelines (including mask wearing, vaccination/testing), you are strongly encouraged to attend lectures and participate in the discussions. However, we will not be assigning any course

credit to physically attending lectures, and we encourage you to stay home, e.g., if you are feeling ill (and expect you to stay home if you are instructed to quarantine or isolate). If you must miss class at any point in time during the semester (e.g., due to quarantine / isolation), please reach out to me via email. If you find yourself too sick to progress in the course, notify your adviser and notify me via email.

Course Schedule

The tentative course schedule is as follows. This schedule is subject to change.

Number of Lectures (approximate)	Topic
2	*Introduction*
2	*Dominant Strategies and Iterated Dominance*
3	*Pure Strategy Nash Equilibrium*
3	*Mixed Strategy Nash Equilibrium*
2	*Efficiency and Fairness*
3	*Dynamic Games of Perfect and Complete Information*
2	*Stackelberg Games*
3	*Dynamic Games of Imperfect and Complete Information*
2	*Bargaining*
3	*Repeated Games*
2	*Static Games of Incomplete Information*
2	*Auctions*
3	*The Principal Agent Problem*
3	*Network Routing*
2	*Network Externalities*
3	*Learning in Games*
3	*Cooperative Games*

The Purdue Academic Calendar and key University dates for the Fall 2024:

- Aug 19: Classes Begin
- Sep 2: Labor Day (no classes)
- October 7-8: Fall Break
- November 27-30: Thanksgiving vacation
- December 7: Classes End
- December 9-14: Final Exams

Academic Integrity

Purdue's Honor Pledge

"As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."

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]

Please refer to Purdue's student guide for academic integrity:
http://www.purdue.edu/odos/aboutodos/academicintegrity.php

The ECE faculty expect every member of the Purdue community to practice honorable and ethical behavior both inside and outside the classroom. Any actions that might unfairly improve a student's score on homework, quizzes, or examinations will be considered cheating and will not be tolerated.
Examples of cheating include (but are not limited to):

- Sharing results or other information during an examination
- Bringing forbidden material or devices to an examination.
- Working on an exam before or after the official time allowed.
- Requesting a regrade of answers or work that has been altered.
- Submitting homework that is not your own work or engaging in forbidden homework collaborations.

At the instructor's discretion, cheating on an assignment or examination will result in a reduced score, a zero score, or a failing grade for the course. All occurrences of academic dishonesty will be reported to the Assistant Dean of Students and copied to the ECE Associate Head for Education. If there is any question as to whether a given action might be construed as cheating, please see the instructor or the teaching assistant before you engage in any such action.

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Nondiscrimination Statement

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.

More details are available on our course Brightspace, under University Policies.

Accessibility

Purdue University will respond to the needs of 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 is committed to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please make an appointment to speak with the instructor within the first two (2) weeks of the semester in order to discuss any adjustments. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. The website is http://www.purdue.edu/drc.

More details are available on our course Brightspace under Accessibility Information.

Mental Health/Wellness Statement

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 of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

TaskHuman offers private, real-time, on-demand, 1-on-1 video calls with wellness coaches covering over 800+ topics such as anxiety, mindfulness, reducing stress, clean eating, time management, in-home workouts, relationship tensions, financial issues, spiritual guidance and many more. You can access these wellness coaches from around the world 24/7. The College of Engineering has an exclusive agreement with TaskHuman which gives you FREE and UNLIMITED access to these resources. Over 3,200 calls have been made by College of Engineering students, staff, and faculty so far with an average satisfaction rating of 4.89/5. Learn more here: https://engineering.purdue.edu/ECE/TaskHuman.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the Critical Needs Fund

Emergency Preparation

Purdue University is a very safe campus and there is a low probability that a serious incident will occur here at Purdue. However, just as we receive a "safety briefing" each time we get on an aircraft, we want to emphasize our emergency procedures for evacuation and shelter in place incidents. Our preparedness will be critical IF an unexpected event occurs!

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 Brightspace or can be obtained by contacting the instructors or TAs via email. You are expected to read your @purdue.edu email on a frequent basis.

1. Evacuation route and assembly area, as well as the shelter in place locations can be found in Building Evacuation Plans (BEPs): Emergency Preparedness website.
2. While COVID-19 is currently a major focus of our campus health and safety preparations, we must also take time to be prepared for other possible emergencies as we would in any semester. Purdue University is a very safe campus and there is a low probability that a serious incident will occur here at Purdue. However, just as we receive a "safety briefing" each time we get on an aircraft, we want to emphasize our emergency procedures for evacuation and shelter-in-place incidents. Our preparedness will be critical IF an unexpected event occurs!
3. Emergency preparedness is your personal responsibility. Purdue University is actively preparing for natural disasters or human-caused incidents with the ultimate goal of maintaining a safe and secure campus. Let's review the following procedure
    - For any emergency text or call 911.
    - There are more than 300 Emergency Telephones (aka blue lights) throughout campus that connect directly to the Purdue Police Department (PUPD). If you feel threatened or need help, push the button and you will be connected right away.
    - If we hear a fire alarm, we will immediately evacuate the building and proceed to the South side of the EE Building near the loading dock. Do not use the elevator.
    - If we are notified of a Shelter in Place requirement for a tornado warning we will stop classroom or research activities and shelter in our room.
    - If we are notified of a Shelter in Place requirement for a hazardous materials release, we will shelter in our classroom shutting any open doors and windows.
    - If we are notified of a Shelter in Place requirement for an active threat such as a shooting, we will shelter in a room that is securable preferably without windows.
4. "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 the link on the Emergency Preparedness website.

Please review the Emergency Preparedness website for additional emergency preparedness information.