

EE672 Applied Game Theory and Evolutionary Algorithms

ECE/SES

Fall 2021

Instructor: Cristina Comaniciu

Classroom: Babbio 220

Course Schedule: Thursday 3.30 - 6.00 pm

Contact Info: Cristina.Comaniciu@stevens.edu

Office Hours: Wednesday 2-3.00 pm; Thursday 12.00pm-1.30pm, B207

COURSE DESCRIPTION

Part I: Introduction to game theory and evolutionary algorithms: games in strategic form and Nash equilibrium, existence and properties of Nash equilibrium, Pareto efficiency, extensive form games, repeated games, Bayesian games and Bayesian equilibrium, types of games and equilibrium properties, learning in games, evolutionary algorithms. Part II: Engineering applications of game theory and evolutionary algorithms. Examples may include: network optimization, cognitive radio networks, internet of things, smart health, smart grids, security applications.

STUDENT LEARNING OUTCOMES

Understand the basic principles of game theory and mechanism design

- Analyze a game for existence and uniqueness of Nash equilibrium
- Select appropriate game theoretic models for engineering problems

- Choose appropriate pricing mechanisms to obtain desired Nash equilibrium for the game
- Apply evolutionary algorithms for engineering applications

COURSE FORMAT AND STRUCTURE

Course is held on campus - room B220

Course Logistics

- Assignments have 1 day grace period to be turned in without penalty. No assignment will be accepted after solutions are posted.

Instructor's Online Hours

I will be available via email and will respond as soon as possible (generally within 24-48) hours. When emailing me, please place in the subject line the course number/section and the topic of the email (e.g. EE672 Homework 2 Question). This will help me tremendously in locating your emails quicker when I scan the hundreds of emails that seem to make it into my box each day.

TENTATIVE COURSE SCHEDULE

Week or Module	Topic(s)	Assignment
Week1	Introduction to game theory. Nash equilibrium. Discussion on application domains.	Homework on Nash Equilibrium
Week2	Pareto efficiency. Cournot games. Theorems for existence of Nash Equilibria.	Paper reading and preparation for in class presentation and discussions

	Application for wireless communications: power control.	
Week3	Stackelberg games. Extensive form games	Homework on Extensive Form Games
Week4	Repeated games. Games with incomplete information. Bayesian games	Paper reading and preparation for in class presentation and discussions
Week5	Dynamic games with incomplete information. Bayesian signaling games. Learning in games: fictitious play	Homework on Bayesian signaling games.
Week6	No-regret learning. Correlated Nash Equilibrium. Types of games. Potential games	Paper reading and preparation for in class presentation and discussions
Week7	Congestion games. Applications of game theory for Cognitive Radio Networks.	Homework on congestion games.

Week8	MIDTERM EXAM - in class	
Week9	Population Games and Evolutionary Dynamics. Replicator Dynamics	Paper reading and preparation for in class presentation and discussions
Week10	Introduction to genetic algorithms	Paper reading and preparation for in class presentation and discussions
Week11	Swarm Intelligence Algorithms	
Week 12	Introduction to Reinforcement learning	
Week13	Project related topics	
Week14	Project presentations	
Finals week	Final Exam – final reports due	

COURSE MATERIALS

Textbook(s): Game Theory, D. Fudenberg and J. Tirole, MIT press, 1991

Other Readings: IEEE research papers, handouts

COURSE REQUIREMENTS

Classwork: independent assignments work in class under professor guidance and supervision- will be uploaded on canvas

Homework: will be uploaded on canvas by the due date.

Reading assignments: papers will be assigned to read and discussed/analyzed in class

Midterm Exam: in class

Project: Final project report

TECHNOLOGY REQUIREMENTS

Required Software

- Current or first previous major release of Chrome, Firefox, Edge, or Safari browser
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint
- Python - recommended

GRADING PROCEDURES

Grades will be based on:

Classwork	20 %
Homework	20 %
Reading Assignments	20 %
Midterm Exam	20 %
Final Project	20 %

Late Policy

One day grace period for late assignments without penalty. No assignments accepted after solutions posted.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to

understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

LEARNING ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

For more information about Disability Services and the process to receive accommodations, visit <https://www.stevens.edu/office-disability-services>. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). CAPS is open daily from 9:00 am – 5:00 pm M-F. Evening hours are available by appointment in the Fall / Spring semesters and up-to-date information regarding the availability of evening appointments can be found by visiting www.stevens.edu/CAPS. To schedule an appointment, call 201-216-5177.

Due to the pandemic, in-person appointments may be limited until further notice. Up-to-date information about the availability of in-person services can be found at www.stevens.edu/CAPS. Teletherapy (therapy via secure video platform) is available to registered students physically located in the states of New York or New Jersey. Students located outside of NY / NJ are encouraged to pursue local treatment through their personal health insurance. To learn more about the process of finding a therapist please visit the CAPS webpage on [Seeking Help Off-Campus](#).

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention

Lifeline (1-800-273-8255) and the Crisis Text Line (text “Home” to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.