CSCI 357: Algorithmic Game Theory (Spring 2025)

Instructor:	Shikha Singh	**Time:**	TF 1:10-2:25 pm
Email:	ss32@williams.edu	**Place:**	Wach 116

Textbooks: Readings will from several different textbooks, and appropriate chapters will be provided.

- Twenty Lectures in Algorithmic Game Theory by Roughgarden
- Algorithmic Economics: A Design Approach by Parkes and Sueken
- A Course in Game Theory by Osborne and Rubinstein
- Mechanism Design and Approximation by Jason D. Hartline

Objectives: This course focuses on topics in game theory and mechanism design from a computational perspective, with the primary goal of understanding and analyzing selfish behavior and whether it can or should influence system design. At the end of the course, students should be able to:

- model strategic interactions in games and reason about them using appropriate solution concepts
- design tractable, yet effective, agent strategies for participants in a mechanism
- analyze properties of a mechanisms such as strategyproofness and pareto efficiency
- understand the design behind various online markets such as sponsored search, dating markets, etc.

Prerequisites: CS 256. Familiarity with basic probability theory is needed. The course may have programming assignments, for which familiarity with Python is assumed.

Grading Policy: The final grade will be calculated based on the following breakdown:

- Homework (10%)
- Paper evaluations (10%)
- Attendance and Class Participation (5%)
- Exams (15 + 15%)
- Assignments (20%)
- Final Project (25%)

Attendance and Class Participation: Attendance is required in the course. Students are encouraged to contact the instructor if they need to miss lecture due to any reason. Each student gets an allowance to skip two lectures without any penalty or explanation.

Learning is a collaborative endeavor and class participation is encouraged and rewarded in this course. The students are expected to contribute to the classroom experience by coming to class prepared, engaging with their peers in-class exercises and questions, answering and asking questions, etc.

Homework: There will be weekly pen-and-paper homework that must be handed in class. Homework questions are typically short-answer and meant to provide practice with the models and definitions covered in class. **No late homework** will be accepted. Two of the lowest-scoring HW grades will be dropped.

Paper Evaluations: Students must turn in a written evaluation of four research papers in the field during the semester. Students must also present their findings in small groups in lecture.

Assignments: There will longer problem sets roughly every two weeks (which may include an occasional programming component). These must be completed in pairs. Release and due dates along with links to actual assignments will be posted on course website.

- All assignments must be submitted through https://www.gradescope.com/ (course code: ZYDB5E)
- Assignments must be typeset using LaTeX, using the template provided.

Exams: We will have two in-class examinations roughly in the 4th-week and 8th-week of the semester. No collaboration is allowed on the exams. Exam-specific details will be discussed in class.

Final Project: There will be a final project, the goal of which is to allow you to explore a topic related to the course that you find fun and challenging. The additional learning goals are to practice reading research papers on the topic, technical writing, and presentation.

Projects must be done in pairs and may involve a theoretical or empirical study of an advanced topic related to the course. Example topics and further guidelines will be provided.

The project will have several checkpoints and deliverables:

- A project proposal followed by a check in with the instructor
- Short presentation during last week of class
- A final report due during the finals period

Course Schedule: The following calendar is a tentative schedule of topics that we will cover in class.

Week 1	Course Overview
Week 2	Game Theory Basics
Week 3	Markets with Money
Week 4	Case-study: Sponsored Search Auctions
Week 5	Markets without Money
Week 6	Case-study: NRMP
	Spring Break
Week 7	Social Choice & Voting
Week 8	Decentralized Markets
Week 9	Case Study: P2P Systems
Week 10	Network Routing
Week 11	Advanced Topics
Week 12	Project Meetings & Presentations

Academic Honesty: For a full description of the Computer Science Honor Code, please see: https://csci.williams.edu/the-cs-honor-code-and-computer-usage-policy/. If you have any doubt about what is appropriate, please email me at ss32@williams.edu. Specific rules are outlined below.

- You must not search the internet and external resources using problem-specific keywords. This includes the use of ChatGPT or similar generative tools.
- You must always **cite external resources** used for background reading.
- You should never turn in a solution that you do not understand. If an honor-code violation is suspected, you will be asked to explain your solution orally to determine if you came up with it on your own.

Homework questions are meant to be individual and assignments and projects are parnter work.
Individual homework: Your work must be entirely your own. While you can exchange high-level ideas with other students, you must not engage in any joint writing or step-by-step problem solving.
Partner assignments: You and your partner must design and implement the solutions together. You may discuss with other groups but should not share any written work or source code with them.

Health and Accessibility Resources: Students with disabilities or disabling conditions who experience barriers in this course are encouraged to contact me to discuss options for access and full course participation. The Office of Accessible Education is also available to facilitate the removal of barriers and to ensure access and reasonable accommodations. Students with documented disabilities or disabling conditions of any kind who may need accommodations for this course or who have questions about appropriate resources are encouraged to contact the Office of Accessible Education at oaestaff@williams.edu.

Inclusion and Classroom Culture: The Williams community embraces diversity of age, background, beliefs, ethnicity, gender, gender identity, gender expression, national origin, religious affiliation, sexual orientation, and other visible and non visible categories. I welcome all students in this course and expect that all students contribute to a respectful, welcoming and inclusive environment. This includes using the name and gender pronouns that individuals ask us to use as a sign of mutual respect. If you have any concerns about classroom climate, please come to me to share your concern.