

CSCI 357: ALGORITHMIC GAME THEORY (SPRING 2022)

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| Instructor: | Shikha Singh | Time: | MR 2:35-3:50 |
| Email: | shikha@cs.williams.edu | Place: | Schow 30A |

Course Links:

- Course webpage: <https://williams-cs.github.io/cs357-s22-www/>
- GLOW page: <https://glow.williams.edu/courses/3378903>
- Office hours: Tues 3-5 pm, Wed 2-4 pm, Thur 4-5 pm

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 Suetken
- 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 a few programming assignments, for which some familiarity with Python is assumed.

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

- Weekly Assignments (35%)
- Attendance and Class Participation (5%)
- Midterms (20 + 20%)
- Final Project (20%).

Course Slack: We will be using Slack for informal classroom discussions, announcements, and questions.

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.

Learning is a collaborative endeavor and class participation is encouraged and rewarded in this class. Participation can take various forms such as coming to class prepared, being active on Slack, answering and asking questions, coming to office hours, etc.

Assignments: There will be weekly problem sets (which may include occasional programming assignments) to test understanding of materials and prepare students for the exams. 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: KYERN3)
- Assignments must be typeset using L^AT_EX, using the template provided.

Late Work: Each student may use a total of two late days during the semester, with at most one late day towards any particular problem set. A single late day enables you to hand in the problem set up to 24 hours after the original due date. After late days have been used, late work will incur a 20% penalty per day.

Midterms: We will have two midterm examinations, tentatively on March 12 and April 23. No collaboration is allowed on the exams. Details regarding the specific format of the exam 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 will be done in groups of 2 or 3, may be theoretical or programming based, and can include an exposition 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 meeting with instructor
- Short presentation during last week of class
- A final paper summarizing your work will be due during finals period

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

| Week | Monday | Thursday |
|------|--|---------------------------------|
| 2/2 | — | 1. Welcome |
| 7/2 | 2. Game Theory I | 3. Game Theory II |
| 14/2 | 4. Auctions I | 5. Auctions II |
| 21/2 | 6. Sponsored Search Auctions | 7. Algorithmic Mechanism Design |
| 28/2 | 8. Incomplete Information Games | 9. BNE in Auctions |
| 7/3 | 10. Revenue Maximization | 11. Matching Markets |
| 14/3 | 12. Stable Matchings 1 | 13. Stable Matchings 2 |
| | Spring Break | Spring Break |
| 4/4 | 14. Top Trading Cycles & Kidney Exchange | 15. Voting 1 |
| 11/4 | 16. Voting 2 | 17. Sequential Games |
| 18/4 | 18. Repeated Games & BitTorrent | 19. BGP Routing 1 |
| 25/4 | — | 20. Spectrum Auctions |
| 2/5 | 21. Incentives in Blockchains | 22. Complexity of Equilibrium |
| 9/5 | 23. Project Presentations | 24. Project 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 shikha@cs.williams.edu. Specific rules are outlined below.

- You must not search the internet or external resources using problem-specific keywords.
- You must always cite external resources used for background reading, and cite the names of students you worked with on any problem in the assignment
- You should never turn in a solution that you do not understand.

Weekly assignments will be specified as single-person or partner assignments.

Solo assignments: 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 of any kind who may need accommodations for this course are encouraged to contact Dr. GL Wallace (Director of Accessible Education) at 597-4672. Also, students experiencing mental or physical health challenges that are significantly affecting their academic work or well-being are encouraged to contact me and to speak with a dean so we can help you find the right resources. The deans can be reached at 597-4171.

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. As a group, I expect that us to contribute to a respectful, welcoming and inclusive environment. If you have any concerns about classroom climate, please reach out to me to share your concern.