

16:198:598 AI Methods for Market Design (Spring 2024)

Time: Fridays, 10:20 AM - 1:20 PM

Location: Science & Engineering Resource Center (SEC), Room 205

Instructor: Xintong Wang

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- Office hours: Fridays, 2 PM – 3PM

Course description: Marketplaces use algorithms and sets of rules to allocate resources among self-interested participants, who hold necessary information and act to pursue their own goals. Market failure – the designed algorithms or rules fail to achieve certain objectives – can occur when the designer fails to elicit agent preferences or accurately model how agents respond to rules and influence each other to produce outcomes. The course introduces how to integrate modern AI and machine learning techniques and economic thinking (e.g., game theory) to (i) model strategic agent behavior, (ii) identify relation between rules in the marketplace and market failures, and (iii) redesign them to achieve broader, system-wide objectives.

Cases of today's marketplaces will be discussed, such as online platforms, ride-sharing systems, financial exchanges (centralized & decentralized). Some applied questions include: How should an economic platform (e.g., Amazon) design its membership structure and matching to promote efficiency and seller diversity? How to elicit and fairly reward agent information to achieve the "wisdom of the crowd"? How to disincentivize manipulation in markets where agents learn from others' action to trade? What incentives and frictions arise in blockchains?

Prerequisites: This course will assume basic knowledge of AI and machine learning (e.g., 01:198:440/461/462, 16:198:520/530/536, or equivalent) and mathematical maturity (comfortable with linear algebra, probability, and algorithm analysis). Familiarity with economic/game theory will be helpful but not required; students without economics background would benefit from a course that provides exposure to the basic ideas of utility maximization and rational behavior (e.g., from an AI course).

Course material and resources: Part of the lecture content will be based on

- A draft of *Algorithmic Economics: A Design Approach*, by David Parkes (Harvard) and Sven Seuken (U. Zurich). Relevant chapters of the book will be distributed on Canvas during the course.
- *Twenty Lectures on Algorithmic Game Theory* by Tim Roughgarden (Columbia). The book is not available online, but it is based on [lecture notes](#) for the course on *Incentives in Computer Science*.

Links to papers and reading materials will be posted before each lecture, and slides will be posted after lectures.

Course topics (tentative): The course will explore the interplay between computational and economic thinking for designing multi-agent, economic systems. We will try to cover the following topics:

- Week 1: Introduction
- Week 2-3: Basics of game theory, equilibrium computation
- Week 4-5: Auction design, online advertising market
- Week 6: Mechanism design
- Week 7-8: Matching
- Week 9-10: Information elicitation, prediction markets
- Week 11-12: Cryptoeconomics
- Week 13-14 (buffer): Incentives and game-theoretic aspects in learning settings

Coursework requirements:

- Readings: Students are expected to read posted materials/papers before each class. The goal is to familiarize with new definitions and be ready to ask questions and participate in discussions. Based on initial understanding, students should complete simple comprehension questions / commentaries on papers before each class.
Drop policy: at most two CQ / commentaries can be skipped.
- Problem sets: There will be 2-3 problem sets, covering topics and concepts discussed in lectures. You can work in pairs, if you wish.
- Paper presentation: To complement lecture content, we will read and discuss a selected list of papers on recent advances. Each student (typically in a pair) should present and lead discussion on one paper. More information on paper bidding and presentation guidelines to follow.
- Class project: The goal of the project is to allow you to explore independent interests, learn more about a particular area, and practice teamwork and presentation skills. Projects should be done in a group of 2 or 3, and may be analyzing an existing model or proposing new ideas, and primarily theoretical or empirical. More instructions to follow.

Grading:

- Class participation: 20%
 - In-class participation: 10%
 - Survey / comprehension questions / commentaries before class: 10%
- 2-3 problem sets: 20%
- A paper presentation: 15%
- A class project: 45%
 - Proposal (tentative due date, March 8): 10%
 - Presentation (last week of class, April 26): 15%
 - Final report (tentative due date, May 6): 20%

Attendance and Participation:

You are encouraged to attend classes if you can and you are comfortable to.

The University policy on attendance and cancellation of classes: <https://sasundergrad.rutgers.edu/degree-requirements/policies/attendance-and-cancellation-of-classes>

You are encouraged to report absences using the University self-reporting absence system: <https://sims.rutgers.edu/ssra/>.

Disability Accommodations:

If a student is in need of disability accommodations, please register for accommodations and consult the policies and procedures of the Office of Disability Services website: <https://Ods.rutgers.edu>.

In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation.

Academic Integrity Policy:

University website on Academic Integrity: <http://nbacademicintegrity.rutgers.edu/>

Rutgers University takes academic dishonesty very seriously. By enrolling in this course, you assume responsibility for familiarizing yourself with the Academic Integrity Policy and the possible penalties (including suspension and expulsion) for violating the policy. As per the policy, all suspected violations will be reported to the Office of Student Conduct. Academic dishonesty

includes (but is not limited to):

- Cheating
- Plagiarism
- Aiding others in committing a violation or allowing others to use your work
- Failure to cite sources correctly
- Fabrication
- Using another person's ideas or words without attribution, including re-using a previous assignment
- Unauthorized collaboration
- Sabotaging another student's work

If you are ever in doubt, please consult your instructor.

Student Support and Mental Wellness:

Here are a list of Rutgers resources:

- Student Success Essentials: <https://success.rutgers.edu>
- Student Support Services: <https://www.rutgers.edu/academics/student-support>
- The Learning Centers: <https://rlc.rutgers.edu/>
- The Writing Centers (including Tutoring and Writing Coaching): <https://writingctr.rutgers.edu>
- Rutgers Libraries: <https://www.libraries.rutgers.edu/>
- Office of Veteran and Military Programs and Services: <https://veterans.rutgers.edu>

- Student Health Services: <http://health.rutgers.edu/>
- Counseling, Alcohol and Other Drug Assistance Program & Psychiatric Services (CAPS): <http://health.rutgers.edu/medical-counseling-services/counseling/>
- Office for Violence Prevention and Victim Assistance: www.vpva.rutgers.edu/

Statement of the Moment:

In the last few years, we have all been going through a lot, individually and together. It is important to acknowledge that events and circumstances outside of the classroom can impact our ability to be present and engaged at any given moment. At Rutgers, we are focused on the whole student. If, at any point, you experience anything impacting your performance or ability to participate in this class, please reach out to me. Please also see the academic, health, and mental wellness resources on the syllabus as well as others searchable at <https://success.rutgers.edu/> for further support.