SI 652 / EECS 547: Incentives and Strategic Behavior in Computational Systems
Syllabus

Instructor: Grant Schoenebeck
Lecture: Monday and Wednesday; 8:30am-10:00am Location Mason Hall 1449
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Office Hours: Friday 1-2pm NQ 3341
            Monday 2-3pm (private by appointment) https://umich.zoom.us/j/9215506718

Introduction

As the internet draws together strategic actors, it becomes increasingly important to understand how people interact with computational artifacts. In this course we will study this interaction, focusing on reasoning about incentives and strategy. We will use game theory, which models and reasons about interactions between strategic agents, and mechanism design which studies how to design systems that take agent strategies into account.

On-line auction sites (including search word auctions), cyber currencies, and crowd-sourcing are all obvious applications. However, even more exist such as designing non-monetary award systems (reputation systems, badges, leader-boards, Facebook “likes”), recommendation systems, and data-analysis.

Because of the way these systems interact with people, they must be designed to take into account the fact that agents may act strategically (e.g. report false information), in addition to the traditional focus on computational tractability. Moreover, agent incentives can interact in complicated ways with other goals such as fairness and privacy.

Format: The class periods will be (interactive) lecture style on classic materials occasionally supplemented with modern research papers. Students will lead presentations on additional topics in pairs (or small groups). A key part of the course will be a final project.

Text Book: We will use the Parkes and Seueken text “Algorithmic Economics: A Design Approach” as a foundation. Electronic access will be provided on the Perusall site. You can sign up via Canvas. Please do not share access to this with people outside the class.

Prerequisites: I encourage students from a variety of diverse disciplines to consider this course. No previous knowledge of game theory or algorithms will be assumed, but familiarity with mathematical reasoning and basic probability theory will be essential to getting the most out of this course. If you are interested in the course but aren’t sure if you have the necessary training, please contact the instructor and ask!
Learning Goals:

**Mastery:** Solve for equilibrium of games; modeling real-world systems with game theory; understanding different equilibrium types and when they apply.

**Competence:** ability to read and explain a modern algorithmic game theory research paper, identifying key features of mechanism design problems, being able to explain incentive structures of computational systems (e.g. auctions, reputation systems, prediction markets, and crypto-currencies) in terms of game theory concepts.

**Exposure:** social choice theory, revenue maximizing auctions, computational aspects of mechanism design.

Tentative Schedule

This is likely to change. Readings will be posted in the class Perusall site; email the course staff if you do not have access!

- (1) Introduction: Motivating examples, high level terrain of course of study. Reading: Parkes and Seueken Chapter 1
- (2) Simultaneous Move Games. Reading: Parkes and Seueken Chapter 2 (skip §2.5, 2.6), also Bayesian Nash Equilibria.
- (2) Finding Equilibrium. Reading: Parkes and Seueken Chapter 3 (skip/skim §3.3, §3.4, and §3.5).
- (2) Social Choice. Reading: Parkes and Seueken Chapter 13. Choose how to choose additional topics.
- (2) Extensive Form Games. Reading: Parkes and Seueken Chapter 4
- (1) Peer-to-peer Systems. Reading: Parkes and Seueken Chapter 5
- (2) Auction Design. Reading: Parkes and Seueken Chapter 6 (skip §6.4 and §6.5)
- (2) Mechanism Design. Reading: Parkes and Seueken Chapter 7 (skip §7.3 and §7.4, skim §7.5 )
- (1) Midterm
- (10) Additional topics will be chosen and presented by students in the course. The following list gives possible topics (but others could be suggested). We will use the procedure designed by the class to choose the topics. See schedule here: https://tinyurl.com/3fks6j6s
  - Social Computing and Human Computation (Parkes and Seueken Chapter 13)
  - Behavioral Economics (Parkes and Seueken Chapter 28)
  - Information Elicitation (Parkes and Seueken Chapter 17)
  - Prediction Markets (Parkes and Seueken Chapter 18)
  - Blockchains and Digital Currency (Parkes and Seueken Chapter 22)
  - Reputation Systems (Parkes and Seueken Chapter 20)
  - Recommendation Systems (Parkes and Seueken Chapter 19)
  - Privacy (Parkes and Seueken Chapter 29)
  - Revenue Optimal Auctions (Parkes and Seueken Chapter 6 and 8)
  - Price of Anarchy (Parkes and Seueken Chapter 26)
  - Online Ad Markets (Parkes and Seueken Chapter 10)
  - Combinatorial Auctions (Parkes and Seueken Chapter 11)
  - Matching Markets (Parkes and Seueken Chapter 12)
  - Online Platforms with Network Effects (Parkes and Seueken Chapter 27)
  - Algorithmic Mechanism Design (Parkes and Seueken Chapter 8)
  - Networks (Parkes and Seueken Chapter 23)
  - Network Formation Games (Parkes and Seueken Chapter 24)
  - Networks, Cascades, and Influence (Parkes and Seueken Chapter 25)
  - Kidney Exchange
  - Security Games
  - Fairness and Incentives
  - Cloud Computing
– Adversarial Machine Learning
• (2) Information Elicitation or other topics (no reading)
• (1) Final Project Presentations

Additional topics will be added according to time and student interest.

Grade Components:

Reading Responses: You are required to read materials before each class. You must upload reading worksheet responses the day before class. Problems testing technical understanding on these are to help with understanding the reading, and will be graded on effort not correctness. Your response will be marked highly if it is clear that you have read and thought about the readings and questions. It is okay to have typos as long as your response is easily understood. We will drop the lowest two marks of the term.

Final Project: A main component of this course will be a final project. The goal of this project is to gain a deeper understanding of some specific topic related to algorithmic game theory, and to use that understanding to perform independent research. Students should work in small groups of 2-3 in order to complete this project. Members of the group should equally contribute to the project. The final project must be approved, but, in general, students are free to pick any topic related to the course. We will have a poster sessions where final projects are presented (around the last day of class). Additionally, students should turn in a write up of their final projects due the final day of class (April 17). The project should be written up in 10 pages (max) but may include appendices for completeness. A project proposal is due March 15 before class (2 pages max), but students are encouraged to get an earlier start.

Midterm Exam: A midterm exam will be administered. The exam will be closed book, but students will be allowed one sheet of paper (8.5" x 11"), front and back, for any notes. While the focus of the class will be on projects, this exam will ensure that students keep up with foundational material of the course. A practice exam will be available to help students study (and to indicate what the exam will focus on). Technical problems will ape those on the problem sets. Conceptual problems will be added. February 22, 2023.

Problem Sets: There will be three problem sets, concentrated during the first half of the course, due the evening before a class. Late assignments will receive a 10% grade deduction per day up to 3 days late after which they will not be accepted. Students may collaborate, but should state with whom they collaborated.

In-class Participation: Students are expected to actively contribute comments to class discussion. Quality is much more important than quantity. Both thoughtful questions and thoughtful answers are valued. Students should not be working on other things (e.g. email, Facebook, other coursework) during the course.

Course Leading: Students will be put in small groups and assigned a day to present. The presenters should prepare a worksheet for the other students to fill out to help them understand important themes of the readings. The leaders should prepare to lead a section of class that includes an engaging activity, lecture, and discussion. Worksheets should be provided to the instructor two weeks ahead of the class presentation.

Research Paper Presentation: Students will choose a recently published paper or theme to present on. The student will give a 20-30 minute oral presentation on the work. During the presentation students will be asked about its main contribution and relation to material in the course. This will be done outside of class at a mutually agreed upon time. Feel free to schedule it at any time. If not done by the end of March, scheduling may become more restrictive.

Proposed Mechanism: Students will propose a mechanism for selecting topics, assigning students to present topics, and assigning topics to dates for the 2nd half of the course.
Grades will be aggregated according to the standard scale, A+: 100-97, A: 96-93, A-, 92-90, etc. Individual grades will be rescaled. For example, a 75% on the midterm need not correspond to a “C”, since the midterm may be written to be harder than the typical grading curve.

Key Dates:

January 4, 2023 First Class.

February 22 Midterm

March 15 Proposal for Final Project Due

April 17 Final Project Due

April 17: noon-2pm Final Project Poster Session

Platforms and Technology:

Even offline, this class relies on software. Here is a summary of the different software platforms we will use. Canvas Assignments will be posted and turned in on Canvas. Also announcements made (though you should receive email versions of these).

Zoom Virtual office hours will be held on Zoom.

Perusall Use this to access readings and comment on, and ask/answer questions about readings. Accessible through Canvas.

MobLab Use this to play (virtual) games against classmates. Also, may be able to design games for your week presenting.

email Direct contact with instructor.

Other

Accommodation for students with disabilities: If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way we teach may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Office of Services for Students with Disabilities (SSD) to help us determine appropriate accommodations. SSD (734-763-3000; ssd.umich.edu/) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. I will treat any information that you provide in as confidential a manner as possible.

Academic integrity: Unless otherwise specified in an assignment all submitted work must be your own, original work. Any excerpts, statements, or phrases from the work of others must be clearly identified as a quotation, and a proper citation provided. Any violation of the School’s policy on Academic and Professional Integrity (stated in the Master’s and Doctoral Student Handbooks) will result in serious penalties, which might range from failing an assignment, to failing a course, to being expelled from the program. Violations of academic and professional integrity will be reported to UMSI Student Affairs.
Consequences impacting assignment or course grades are determined by the faculty instructor; additional sanctions may be imposed by the assistant dean for academic and student affairs.

**I encourage students to work together** (except on the actual midterm)! You may discuss any problem, project, etc. There is a concrete standard for what is permissible and what is not: your write-up should be your own. You should not look at someone else’s assignment or allow them to look at yours. There should not be any similarities between the writing on different students’ assignments (e.g. the solution was collaboratively written on a whiteboard, and two students copied it down).

**Mental Health:** University Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressures and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc. If you are experiencing concerns, seeking help is a courageous thing to do for yourself and those who care about you. If the source of your stressors is academic, please contact me so that we can find solutions together. Ashley Evearitt, a Counseling and Psychological Services (CAPS) counselor, is embedded in UMSI, schedule an appointment with her by copying and pasting the following url into your browser: https://bit.ly/Evearitt-CAPS-UMSI

For personal concerns, U-M offers a variety of resources, many which are listed on the Resources for Student Well-being webpage. You can also search for additional well-being resources on that website.

**Laptops:** Students are welcome to use Laptops in class for the purposes of the class: taking notes, referring to papers, referring to student responses. Laptops should not be used for email, Facebook, Youtube etc. This will affect class discussion and distract your neighbor.

**Class Recordings:** We will be doing audio and video recording of all sessions to enable those who cannot attend class in person on a given day to access the content. These recordings will not be made available publicly. Recordings of all sessions will be available on Canvas only to students registered for this class. As part of your participation in this course, you may be recorded. If you do not wish to be recorded, please contact the professor during the first week of class to discuss alternative arrangements. The camera only picks up the front of the room (instructor and slides), but this may require you to sit in a particular place in the room, outside the cameras’ view. Our classroom, Mason Hall 1449 does/does not have a ceiling mike that picks up student voices, in addition the instructor’s microphone records audio in the room. Students may not copy and share the lecture videos with those not in the class, or upload them to any other online environment (this is a violation of the Federal Education Rights and Privacy Act (FERPA)).

Personal recordings are prohibited except with permission.

Students are prohibited from recording/distributing any class activity without written permission from the instructor, except as necessary as part of approved accommodations for students with disabilities. Any approved recordings may only be used for the student’s own private use.

**Plagiarism** All written submissions must be your own, original work. Original work for narrative questions is not mere paraphrasing of someone else’s completed answer: you must not share written answers with each other at all. At most, you should be working from notes you took while participating in a study session. Largely duplicate copies of the same assignment will receive an equal division of the total point score from the one piece of work. You may incorporate selected excerpts, statements or phrases from publications by other authors, but they must be clearly marked as quotations and must be attributed. If you build on the ideas of prior authors, you must cite their work. You may obtain copy editing assistance, and you may discuss your ideas with others, but all substantive writing and ideas must be your own, or be explicitly attributed to another. See the (Doctoral, MSI, BSI) student handbooks available on the UMSI intranet for the definition of plagiarism, resources to help you avoid it, and the consequences for intentional or unintentional plagiarism.