NETS 412 (Spring 2018)
Algorithmic Game Theory
Bo Waggoner

This version: *January 8, 2018*

Course webpage: `https://www.bowaggoner.com/courses/2018/nets412/`

Description

Game theory is the study of systems of agents, each of which acts toward its own goals and is impacted by the decisions of the others. In this course, we will study game theory and related problems from an algorithmic perspective. We will consider questions such as: how should an auction for scarce goods be structured if the seller wishes to maximize his revenue? How badly will traffic be snarled if drivers each selfishly try to minimize their commute time, compared to if a benevolent dictator directed traffic? How can couples be paired so that no two couples wish to swap partners in hindsight? How can we find kidney-exchange cycles to incentivize people to participate in the exchange, without using money? How can you be as successful at betting on horse races as the best horse racing expert, without knowing anything about horse racing?

The goal of this course is to give students a rigorous introduction to game theory from a computer science perspective, and to prepare students to think about economic and algorithmic interactions from the perspective of incentives. Grading will be based on participation, problem sets, a midterm, and a final exam.

Prerequisites

This course will be theoretical and mathematical rigorous. Ideally (though not mandatory), students will have taken, or be taking concurrently, a course on algorithms (such as CIS 320) and will be familiar with big-O notation. "Mathematical maturity" and experience with proofs will be very helpful. Experience with game theory is not assumed.

Grading

The grade will be based on 6 homework sets, one in-class midterm and one in-class final exam. Your final grade will depend on

- Homework (30 %)

- Midterm (30 %)

- Final (35 %)

- Participation (in-class and on Piazza) (5%).

Homework assignments to be submitted by the beginning of class on the due date. Submissions will be made online via Gradescope.

Submissions **must** be written in clear, concise English. Preferably, submissions will be typed in LaTeX. Scanning handwritten solutions is permissible if handwriting is very clear and intelligible.[1]

Late homework will not be accepted and will be graded zero. However, the single lowest homework grade will be dropped.

Course Material

There is no required textbook for this course. Some optional and supplementary material you may be interested in: *Twenty Lectures in Algorithmic Game Theory* by Tim Roughgarden; the *Algorithmic Game Theory* book edited by Nisan, Roughgarden, Tardos, and Vazirani, which can be found online; and much of *Multiagent Systems* by Shoham and Leyton-Brown, available at http://www.masfoundations.org/mas.pdf.

Lecture notes and homework solutions will be posted on the course webpage.

Weekly Reading and Discussion

After each lecture, the lecture notes will be posted to the course webpage. **Students are expected to read through the notes** after each lecture to check their understanding and aid in recall.

We will use Piazza as a forum to ask and answer questions about course material. A small part of your grade will be participation on Piazza, so please do ask questions, answer others' questions, post follow-ups or interesting speculation, or post related links that you think might interest the class.

Homework and Academic Integrity

Students are permitted and encouraged to work together on understanding the homework assignments in terms of ideas, course material, and solution approaches. The goal of the course is to gain new understanding, knowledge, and insight; not test ability to solve puzzles. Use of outside resources such as Wikipedia is also allowed if you think it will help. However, **each student MUST write up her/his own solutions separately**. If your solution makes use of a fact found elsewhere and not covered in the course notes, cite the source.

---

[1]The notes as as well as model solutions to homeworks are a guide to the level of detail and explanation needed in a solution.

Clarification questions on homework may be posted on Piazza, but do not make posts that can spoil the solutions or approach for other students. If in doubt, post the question to instructors only.

Exams

No assistance may be given or received during an exam. Midterm and final exam attendance is mandatory. The date of the midterm will be announced in the second week of the course. Students who miss the midterm for an allowable reason must report this as far in advance as possible. There will be no make-up midterm; students who are excused from the midterm will see the weights on the final adjusted upwards to account for the absence.