Introduction to Multiagent Systems

CPSC 532A Lecture 1

September 12, 2006

Lecture Overview

Syllabus

Pictures and Introductions

Overview of Multiagent Systems

Theories of MAS

Fun games

Course Description

This course examines the mathematical and computational foundations of modern multiagent systems, with a focus on game theoretic analysis of systems in which agents cannot be guaranteed to behave cooperatively. The course emphasizes student participation, featuring seminar-style discussion as well as traditional lectures. The course will culminate in a small research project in which students survey existing literature and possibly explore open research questions.

Course Topics

Overall, problems at the interface of economic theory and computer science. (No prior experience in economics is assumed.) Specific topic include: Games: normal-form; extensive-form; repeated; stochastic; Bayesian. Computation of game-theoretic solution concepts. Mechanism design: key positive and negative results. Single-good auctions. Combinatorial auctions: bidding; mechanisms; computational issues.

Prerequisites

There are no formal prerequisites, and it is assumed that most students in the class will be unfamiliar with Game Theory, Mechanism Design, Auction Theory, and the literature on Multiagent Systems. Since some of the material to be covered is quite formal mathematically, students will need to be able to construct and follow formal proofs. Relevant mathematical/CS background would include introductory knowledge of probability theory, computational complexity and combinatorial optimization. Much of the work associated with the course will revolve around reading papers from the Multiagent Systems literature, writing a survey or research paper, and presenting findings to the class. Students who have trouble reading, speaking or writing comfortably in English will find themselves at a disadvantage.

Academic Honesty

Plagiarism is a serious offence and will be dealt with harshly. I consider plagiarism to be the unattributed use of an external source (e.g., another student, a web site, a book) in work for which a student takes credit. The seriousness of the offence depends on the extent to which the student relied upon the external source. Assignments and midterms will include an "honour code" statement which you will be required to sign, specifying forms of collaboration and reference to non-course materials that are acceptable.

Grading Scheme

Assignments (three or four)	20 %
Test 1 (probably in-class)	20 %
Test 2 (probably take-home)	20 %
Project outline	7 %
Project writeup	20 % (10% instructor; 10% peer) + up to 2 bonus marks
Peer review of other students' final project papers	3 %
Participation in Discussions; Attendance	10 %

Assignments

The course will include three or four assignments. Dates on which assignments will become available and due dates are given in the schedule on the web page; assignments are always due at the beginning of class. Assignments will probably not be weighted equally: weighting will be proportional to the total number of available points. In particular, the last assignment may be weighted substantially more heavily since it will cover material not reviewed on the midterm exam. Students will be given three late days for use on the assignments. These are intended to help avoid scheduling conflicts with other courses, personal commitments, and emergencies. Therefore, no additional late days will be granted except under truly exceptional circumstances. Late assignments will be penalized at 20% per day.

Project

CPSC 532A will culminate with a final project that allows students to explore material that was not covered in class and to share that material with other students. The project involves students writing a paper on a topic of interest within Multiagent Systems, and then reading and evaluating each other's papers. Here is the "pipeline":

- submit a one-page outline of the paper you intend to write
- hand in the paper itself, which will be sent out to other students for peer review
- perform peer review of papers from other students in the class

The topic of the final project need not be too ambitious; it's fine to perform a survey of a subarea in Multiagent Systems or a compare-and-contrast study of two or more influential papers. If you plan to do more work in the area, you can also use the project to develop your own research ideas. In future weeks a list of possible topics will appear in this space. Please note that assignment late days cannot be applied to the final project.

Curving Grades and Peer Review

Final grades will be curved to give the overall distribution of grades a desired mean and standard deviation. Bonus marks will be applied after grades are curved. Peer review is an important component of the class, and will be taken into account when evaluating papers. Since this is a Multiagent Systems course, a grading scheme has been constructed that does not provide students with any ability to influence their own grades by reviewing other students strategically. The curve for a given student x will be calculated disregarding x's presentation and paper reviews of other students.

Textbook

We will be using a new text under development, which is currently only available in electronic form. An address will be provided in class from which this book can be downloaded. Please do not distribute this file. Also, please note that this book will be updated throughout the year; thus, I recommend printing individual chapters as we come to them, or simply using the book electronically, rather than printing the whole book at the beginning of the year. Supplemental texts are listed on the course web page.

Schedule

Date	Lecture Topic	Milestones
Tuesday, September 12	Introduction	
Thursday, September 14	Games in normal form	
Tuesday, September 19	Games in normal form	
Thursday, September 21	Games in normal form	
Tuesday, September 26	Games in extensive form	
Thursday, September 28	Imperfect information games	
Tuesday, October 3	Repeated games	
Thursday, October 5	The folk theorem	
Tuesday, October 10	Stochastic games; Bayesian games	
Thursday, October 12	Bayesian games; Social choice	
Tuesday, October 17	Social choice	
Thursday, October 19	Social choice	
Tuesday, October 24	Mechanism design	
Thursday, October 26	Mechanism design	
Tuesday, October 31	Quasilinear utility and risk attitudes	
Thursday, November 2	Groves mechanism, Clarke tax	
Tuesday, November 7	Auctions	
Thursday, November 9	Auctions	
Tuesday, November 14	Auctions	
Thursday, November 16	Multi-good Auctions	
Tuesday, November 21	Combinatorial Auctions	
Thursday, November 23	Combinatorial Auctions	
Tuesday, November 28	TBD	
Thursday, November 31	TBD	
Tuesday, December 5	TBD	
Monday, December 11	TBD	

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Pictures and Introductions

Please:

- Write your name on a piece of paper
- Introduce yourself by saying what country you're from, where you did your undergrad, your favourite flavour of ice cream, and anything else you'd like...
- Pose for a photo, holding your piece of paper!

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What is Multiagent Systems?

There are different levels of agency.

- A single-agent
  - Logic
  - Uncertainty
- A distributed single agent
- Multiple agents
  - What distinguishes these 'agents' from the setting above?

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- A single-agent
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- A distributed single agent
- Multiple agents
  - What distinguishes these 'agents' from the setting above?
  - autonomy
  - asymmetric information
  - choose how to share it

Example of e-commerce agent on the internet

- must keep track of various online merchants
- must understand my preferences, budget, background knowledge
- must understand other agents it will interact with (sellers; other buyers–both human and computer)

Disciplines that contribute to this subject

- computer science (AI, distributed systems, algorithms, theory)
- economics (particularly micro)
- operations research
- analytic philosophy
- linguistics

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Modeling Language

There are two fundamental approaches that are used in modeling multiagent systems (or AI systems generally):

- qualitative
  - usually uses some form of logic
- quantitative
  - usually Bayesian; probability theory and/or utility theory

Subject Matter

What subject matter does the theory describe?

- informational vs. motivational
  - knowledge and beliefs of agents
  - goals, preferences, utility functions
- individual-based or team-based
- strategic vs. non-strategic
  - non-strategic explicitly models agents' motivations; don't consider how or why they reach these motivations
  - strategic explicitly models agents' reasoning about their motivations

This course will focus on quantitative, motivational, individual-based, strategic theories. However, we'll briefly touch on some others.

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- Let's buy and sell some money...