

Computer Science & Engineering 516A: Multi-Agent Systems

Washington University in St. Louis

Fall 2019

Instructor: Sanmay Das
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Class times: Tue, Thu 2:30-3:50 in Cupples I, Room 270
Office: Jolley 512
Office hours: TBA and by appointment.

Teaching Assistants: Alex DiChristofano and Parvathi Narayan
Office Hours: TBA

1 Course Description

1.1 Overview

This course introduces the fundamental techniques and concepts needed to study multi-agent systems, in which multiple autonomous entities with different information sets and goals interact. We will study algorithmic, mathematical, and game-theoretic foundations, and how these foundations can help us understand and design systems ranging from robot teams to online markets to social computing platforms. Topics covered may include game theory, distributed optimization, multi-agent learning and decision-making, preference elicitation and aggregation, mechanism design, and incentives in social computing systems.

1.2 Prerequisites

CSE 247, ESE 326 (or Math 3200), and Math 233 or equivalents, or permission of instructor. Some prior exposure to artificial intelligence, machine learning, game theory, and microeconomics may be helpful, but is not required. Fundamentally, this course requires mathematical maturity in addition to the ability to reason about algorithms and code fluently. If you're uncomfortable with calculus or probability (even if you've taken them in the past), please speak with me. I'm happy to talk with all who have concerns about whether their backgrounds are sufficient for this class.

1.3 Format

Class sessions will be lectures, but they may also involve (1) cooperative on-the-spot problem solving or writing up thoughts about questions, and (2) participation in games that help in understanding the concepts we will be studying. We will use Piazza for these. Participation in these tasks will count towards your grade. Therefore, attendance in lecture implicitly counts towards your grade, since you can't participate if you're not present.

There will be an in-class exam in late October or early November and a short final project due at the end of the semester. The final project can be done in teams of two, and must be picked from one of a few options we will provide. There will also be 3-4 problem sets that will involve a mix of programming/computational exercises and pencil-and-paper problems / writing assignments.

1.4 Textbooks

I will usually not post lecture notes. Instead I will give references to the parts of the textbooks that correspond to the material covered in class on a given day. If part of the lecture is not based on one of the textbooks I will post corresponding material to the website.

We will primarily use the following two textbooks, which are both available for free as on-screen PDFs:

1. *Multiagent Systems*, Y. Shoham and K. Leyton-Brown. Cambridge University Press.
Online: <http://www.masfoundations.org/>
2. *Algorithmic Game Theory*, N. Nisan, T. Roughgarden, E. Tardos and V.V. Vazirani, eds. Cambridge University Press.
Online: <http://www.cambridge.org/us/9780521872829> (click on the “Resources” tab and then on “Algorithmic Game Theory”)

We may sometimes post readings from other sources as well.

1.5 Preliminary Syllabus

This preliminary list of topics may change based on time constraints, the interests of the class, or other factors.

1. Assignment and matching problems
2. Basics of linear programming
3. Foundations of game theory and algorithmic issues; Notions of equilibrium; Bayesian games
4. Auctions, mechanism design, and sponsored search
5. Financial and prediction markets; Algorithmic market-making
6. Computational social choice and voting
7. Allocation of scarce resources from both algorithmic and moral/ethical perspectives

2 Policies

2.1 Announcements and Course Website

The main course website is at:

<http://www.cse.wustl.edu/~sanmay/teaching/cse516-fall19>.

We will use Piazza for all questions and discussions related to the class. Please post questions on Piazza – they will reach both the TAs and the instructor and are likely to be answered sooner. Individual emails about class issues will typically be met with a response saying “Please post your

question to Piazza (anonymously if you so desire).” A link to the Piazza site will be on the main course website.

All announcements related to the class will be made either in lecture or on the website or Piazza. **I will assume that any announcement made on the website or on Piazza is known to everyone in class within one business day of it being posted.** It is important to check the website regularly! You are responsible for all announcements made in lecture or on the website.

2.2 Assessment and Course Grade

Your overall course score will be determined (on a curve) using the following weights. There is no absolute correspondence of scores to grades.

1. Homework assignments: 40%
2. Midterm exam: 25%
3. Final project: 25%
4. Class participation (including participation in games): 10%

Homeworks must be submitted on Gradescope – we will make instructions available. Late assignments will not be accepted, except for cases of illness or emergency with appropriate documentation. If you would like to appeal your grade on any work, you may do so within one week of the work being handed back or the grade being received. In order to appeal the grade, please submit a regrade request on Gradescope, including a detailed statement explaining why you believe the assigned grade is incorrect. We will regrade the entire piece of work, and your grade may go up or down, or it may stay the same.

2.3 Collaboration and Academic Integrity

In this class, you are allowed to collaborate on assignments to the following extent. You are welcome to discuss problems with each other and to take your own notes during these discussions. However, you must write up solutions on your own. You must write, on the assignment, the names of students you discussed each problem with, and any external sources you used in a significant manner in solving the problem. Lack of citation of a source is a serious violation of this policy. You may not give or receive help from other students in the class on exams, and you may not use materials (solutions or exams) from prior instances of this class.

Submitting an assignment or exam that is in violation of this policy will lead to an initiation of the school’s formal academic integrity review and sanction process. If you have any questions about the level of collaboration permitted, or any other aspect of this policy, please speak with the instructor or one of the TAs about it before handing in the assignment!

2.4 Other accommodations and resources

Accommodations based upon sexual assault The University is committed to offering reasonable academic accommodations (for example, no contact order, course changes) to students who are victims of relationship or sexual violence, regardless of whether they seek criminal or disciplinary action. If you need to request such accommodations, please contact the Relationship and Sexual Violence Prevention Center (rsvpcenter@wustl.edu or 314-935-3445) to schedule an appointment with an RSVP confidential, licensed counselor. Information shared with counselors

is confidential. However, requests for accommodations will be coordinated with the appropriate University administrators and faculty. See <http://rsvpcenter.wustl.edu>.

If a student comes to me to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence or stalking, or if I otherwise observe or become aware of such an allegation, I will keep the information as private as I can, but as a faculty member of Washington University, I am required to immediately report it to my Department Chair or Dean or directly to Ms. Jessica Kennedy, the University's Title IX Coordinator. If you would like to speak with the Title IX Coordinator directly, Ms. Kennedy can be reached at (314) 935-3118, jwkennedy@wustl.edu, or by visiting the Title IX office in Umrath Hall. Additionally, you can report incidents or complaints to the Office of Student Conduct and Community Standards, or by contacting WUPD at (314) 935-5555 or your local law enforcement agency. See <https://titleix.wustl.edu/>.

Bias Reporting The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University's Bias Report and Support System (BRSS) team. See: <http://brss.wustl.edu>

Mental Health Mental Health Services' professional staff members work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: <http://shs.wustl.edu/MentalHealth>

Preferred Name and Gender Inclusive Pronouns In order to affirm each persons gender identity and lived experiences, it is important that we check in with others about pronouns. This simple effort can make a profound difference in a persons experience of safety, respect, and support. See: <https://students.wustl.edu/gender-pronouns-information/> and <https://registrar.wustl.edu/student-records/ssn-name-changes/preferred-name/>

Military Service Leave Washington University recognizes that students serving in the US Armed Forces and their family members may encounter situations where military service forces them to withdraw from a course of study, sometimes with little notice. Students may contact the Office of Military and Veteran Services at (314) 935-2609 or veterans@wustl.edu and their academic dean for guidance and assistance. See: <https://veterans.wustl.edu/policies/policy-for-military-students/>.