

# Computer Science and Engineering 516A: Multi-Agent Systems

Washington University in St. Louis, Spring 2016

Instructor: Sanmay Das  
email: sanmay at wustl dot edu  
Class times: Tue, Thu 11:30-1:00 in Louderman 458  
Office: Bryan 307E  
Office hours: TBA and by appointment.

Teaching Assistants: Zhuoshu Li (Head TA), Tony Ginart, Robert Miller, Alicia Sun  
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 240 and 241 and ESE 326 (or Math 320) 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. 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, and (2) participation in games that help in understanding the concepts we will be studying. Participation in these games 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 midterm exam in March (after Spring Break) and a 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 3-5 problem sets that will involve a mix of programming/computational exercises and pencil-and-paper problems.

## 1.4 Textbooks

I will 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/journals/nisan/downloads/Nisan\\_Non-printable.pdf](http://www.cambridge.org/journals/nisan/downloads/Nisan_Non-printable.pdf)

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. Matching
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. Learning in multi-agent systems
8. Collective wisdom and peer production

## 2 Policies

### 2.1 Announcements and Course Website

The main course website is at <http://www.cse.wustl.edu/~sanmay/teaching/cse516-spring16>. All announcements related to the class will be made either in lecture or on the website. **I will assume that any announcement made on the website is known to everyone in class within 24**

**hours 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.

We will use Piazza for all questions and discussions related to the class. Please post questions on Piazza – they will reach both the TA 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.

## 2.2 Assessment and Course Grade

Your overall course score will be determined (on a curve) using the following weights.

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

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 10 days of the work being handed back or the grade being received. In order to appeal the grade, please provide a detailed written statement explaining why you believe the assigned grade is incorrect, in addition to the work itself. 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.

Submitting an assignment or exam that is in violation of this policy will automatically lead to receiving no credit for the assignment and a reduction of at least one grade modifier (e.g. from B to B-) beyond that in the overall course grade. However, depending on the circumstances, it could also lead to harsher penalties, for example, a failing grade in the class and initiation of the school’s formal academic integrity review 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 to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support

services and accommodations. If you need to request such accommodations, please direct your request to Kim Webb ([kim\\_webb@wustl.edu](mailto:kim_webb@wustl.edu)), Director of the Relationship and Sexual Violence Prevention Center. Ms. Webb is a confidential resource; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain as confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

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](mailto:jwkennedy@wustl.edu), or by visiting her office in the Womens Building. Additionally, you can report incidents or complaints to Tamara King, Associate Dean for Students and Director of Student Conduct, or by contacting WUPD at (314) 935-5555 or your local law enforcement agency.

You can also speak confidentially and learn more about available resources at the Relationship and Sexual Violence Prevention Center by calling (314) 935-8761 or visiting the 4th floor of Seigle Hall.

**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>