

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

Washington University in St. Louis, Spring 2015

Instructor: Sanmay Das

email: sanmay at seas dot wustl dot edu

Class times: Tue, Thu 11:30-1:00 in Green Hall L0160

Office: Jolley 510

Office hours: Thursdays from 1:30-3:30 and by appointment.

Teaching Assistant: Mark Heimann

email: mheimann at wustl dot edu

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 will 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 early March and a take-home final at the end of the semester. 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>. 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: 20%
3. Final exam: 25%
4. Class participation (including participation in experiments): 15%

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!