About CSC304 – Fall 2017

Essential Information

Time:	Mon-Wed 3p-4p
Location:	BA 1230
Instructor:	Nisarg Shah
	http://www.cs.toronto.edu/∼nisarg/
	nisarg@cs.toronto.edu
	SF 2301C, (416) 946-8477
TA:	Tyrone Strangway
	(http://www.cs.toronto.edu/ tyrone/)
Office Hours:	Held by the instructor, Fri, 3p-4p, SF 2301C

Course Page and Discussion Board

- Course Page: This will be frequently updated with course information, schedule of lectures, slides, homeworks, and announcements. Posted slides are *not* a substitute for class attendance and participation.

  http://www.cs.toronto.edu/∼nisarg/teaching/csc304-f17/

- Discussion Board: Piazza will be the preferred forum for asking questions about class material or other topics that are likely to be of general interest to the class. It will also contain the relevant course information.

  http://piazza.com/utoronto.ca/fall2017/csc304

Course Content

This is a relatively new interdisciplinary course that introduces students from computer science and related disciplines to the well established fields of algorithmic game theory and mechanism design. These fields sit at the interface between computer science and economics, and have recently seen a growing number of real-world applications. This course will review the basic models and core theoretical insights that have been instrumental in the development of these fields. The course will be organized in three parts: game theory, mechanism design with money, and mechanism design without money. In particular, it will cover (possibly a subset of) the following topics:

- *Game theory*: Nash equilibria, Price of anarchy (PoA), congestion games and Braess paradox, zero-sum games and the minimax theorem, Stackelberg equilibrium and security games, and equilibria computation.

- *Mechanism design with money*: Bayes-Nash equilibria, dominant strategy equilibria, the revelation principle, VCG auction, Myerson's auction, 1st and 2nd price auctions, the revenue equivalence theorem, greedy approximation algorithms.

- *Mechanism/algorithm design without money*: facility location, matching markets, social choice theory — axiomatic, statistical, and utilitarian approaches, Arrow's and Gibbard-Satterthwaite impossibility, fair division of divisible and indivisible goods.

Textbook

Our primary reference will be a textbook that is being developed by Professor David C. Parkes at Harvard University and Professor Sven Seuken at University of Zurich. The book can be accessed, chapter-by-chapter, through a password-protected webpage (link below, and on the course page). Because the book is under development, you are advised to not share any part of the book publicly. Please send any feedback you have about the book (including technical errors) to `nisarg@cs.toronto.edu`, and add "[PS-Book]" to the subject line.

`http://www.cs.toronto.edu/~nisarg/teaching/csc304-f17/parkes-seuken/`

Email me for the username and password.
Here are additional textbooks that you may find useful (links also available on the course page):

- *Game Theory, Alive* by Anna Karlin and Yuval Peres. Online version at: `https://homes.cs.washington.edu/~karlin/GameTheoryBook.pdf`
- *Algorithmic Game Theory* edited by Noam Nisan, Tom Roughgarden, Eva Tardos and Vijay Vazirani. Online version at:
`http://www.cs.cmu.edu/~sandholm/cs15-892F13/algorithmic-game-theory.pdf`
- *Handbook of Computational Social Choice* edited by Felix Brandt, Vincent Conitzer, Ulle Endriss, Jrme Lang, and Ariel D. Procaccia. Online version at: `http://procaccia.info/papers/comsoc.pdf`
- *Introduction to Game Theory* by Martin Osborne (a faculty member in the Department of Economics at the University of Toronto). Online version at: `http://pioneer.netserv.chula.ac.th/~ptanapo1/gamebook.pdf`
- *Networks, Crowds and Markets* by David Easley and Jon Kleinberg. Online version at:
`http://www.cs.cornell.edu/home/kleinber/networks-book/networks-book.pdf`

There are a number of similar courses with excellent lecture notes, slides and/or videos. In particular, you may want to have a look at:

- Tim Roughgarden's notes on Algorithmic Game Theory:
`http://theory.stanford.edu/~tim/notes.html`
- Ariel Procaccia's slides on Truth, Justice, and Algorithms:
`http://www.cs.cmu.edu/~arielpro/15896s16/schedule.html`

Prerequisites

Foundational probability and calculus courses are official prerequisites, but it is recommended to simultaneously take the 3rd year algorithms course CSC373. Some familiarity with linear algebra, graph theory, and calculus is helpful.

Important Notice: Pre/co-requisites are *not* checked at time of enrollment. However, they are checked later, and if you do not meet the requirements (or have not obtained an official waiver), you will not be allowed to take the course. If you are unsure of your status (e.g., coming from another faculty, campus, or university), please consult with the DCS Undergraduate Office.

Homeworks and Tests

Homeworks will be theoretical in nature (thus may involve proving theorems). They will not involve programming, but may involve the use of installed software to work with or visualize specific phenomena in action.

Homeworks will be posted on the course page as well as on Piazza. The *tentative* due dates are as follows. (NOTE: These are TENTATIVE DATES to help you plan for the semester; the actual due dates will be posted on the course page.)

TENTATIVE DATES:

- Homework 1: due Oct 9, 2017
- Midterm 1: Oct 13, 2017
- Homework 2: due Nov 3, 2017
- Midterm 2: Nov 17, 2017
- Homework 3: due Dec 4, 2017
- Final exam: As scheduled by the registrar.

Homeworks will be due by the beginning of class on the specified date. To save paper and quickly return graded work, we will use the MarkUs system for online submission homeworks. You are encouraged to submit LaTeXed work. Scanned copy of handwritten solutions will be acceptable, but it is solely your responsibility to ensure that the handwriting is legible!

`https://markus.teach.cs.toronto.edu/csc304-2017-09/?locale=en`

Grading

Course evaluation will be as follows.

- Three homeworks: 15% each
- Two midterm exams: 15% each
- Final exam (third midterm+overview): 15%+10% = 25%

The first midterm exam will follow and cover the game theory part of the course. The second midterm will follow and cover the mechanism design with money part of the course. The final exam will consist of two parts: a "third midterm" which will cover the mechanism design without money part, and an overview that will cover the entire syllabus.
For homeworks and exams, we may grade a randomly selected subset of questions, and extrapolate the marks obtained.

Other Policies

- Please do not schedule courses that conflict with the MWF 3p-4p slot alloted to this course. While we may not have lectures on some Fridays, we *will* use other Fridays for tutorials and exams. No adjustments will be made for classes, assignments, or exams missed due to scheduling conflicts.
- Each student will receive a total of 3 late days to use across the three homeworks, with at most 2 late days applied to a single homework. You can manage your late days as needed within the MarkUs system. You *do not* earn extra late days for illness, University activities, or other legitimate reasons; these is precisely what the 3 late days are for. If, for some legitimate reason, you absolutely need more late days, you will need to personally request them from the instructor using proper documentation.
- Please make yourself aware of the University regulations concerning plagarism. When solving homeworks, you are free to collaborate with your classmates or read online material. However, you *must* cite the classmates or the online sources from which you derived any insight. To do this, add a note in your solution to each problem that mentions the classmates or links to the online sources. Also, you *must* write the solution in your own words. I would advise you to not take any notes or pictures when you collaborate, and re-derive the solution when you prepare your submission. Failure to cite will be treated as plagiarism.
- Partial marks will be awarded (at the sole discretion of the TA or the instructor) in homeworks and exams based on how close your approach is to a complete solution. On the other hand, leaving your solution to a question blank[1] and writing "I do not know how to answer this question." will also get you 20% of the marks assigned to that question.[2] That is, you should try to solve a question whenever you believe you have a reasonable approach. But leaving the solution blank and including the magic statement is better than writing something that makes no sense.
- If you feel that a question was not properly graded or if there's an error in tallying, please consult the instructor within a week of the work being returned.

[1] Or crossing off what you have written.
[2] A blank solution without this magic statement will not carry any marks.