Overview

This sheet summarizes information related to CSC304H1F, *Algorithmic Game Theory and Mechanism Design*) during Fall 2022 at St. George. All times listed below are in the **Eastern time zone**.

Course Page

Please consult the course webpage for full and up-to-date details regarding the course. It will be frequently updated with announcements, lecture schedule, slides, recordings, and assignments. *You are responsible for checking the course website*; please check at least once a week.

https://www.cs.toronto.edu/~nisarg/teaching/304f22/

Instructor Contact

Instructor	Nisarg Shah
Webpage	https://www.cs.toronto.edu/~nisarg/
Email	csc304-2022-09@cs.toronto.edu
Office	SF 2301C (Please do not drop by unless you have scheduled an in-person meeting)
TAs	Soroush Ebadian, Mohamad Latifian, Devansh Shringi

Please note that due to personal commitments, I will be unable to deliver the last few lectures of the course. There is plan to add a co-instructor, who will deliver them. This will not affect the course syllabus or any other course information, but please use the course email, `csc304-2022-09@cs.toronto.edu`, for all communications instead of my personal email.

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. While it may be quicker than scheduling an office hour with an instructor, please do not expect ultra-quick responses.

http://piazza.com/utoronto.ca/fall2022/csc304

Course Delivery

Lectures will be delivered in a hybrid mode. Students are welcome to attend them in-person or via Zoom. Lectures will be recorded (your participation may also be recorded), and recordings will be made available via the course web page.

Tutorials will be delivered in-person only and will NOT be recorded.

Office hours will be conducted online via Zoom.

Assignment submissions will be online via MarkUs (https://markus.teach.cs.toronto.edu/2022-09).

Tests may be administered in-person or online.

Please consult the course web page for up-to-date details regarding the course delivery as this information may change during the semester.

All Zoom links will be posted to the course web page. All Zoom links have the same password (emailed to all registered students in advance, posted on Piazza, and available from the instructor upon request). Students will need to *log into Zoom via their *.utoronto.ca or *.toronto.edu email*. Students will be expected to follow common Zoom etiquette.

Tutorials

Tutorials will be on Thursdays, 4-5pm. The class is broken into three tutorials based on students' birth month: **A = Jan-Apr, B = May-Aug, C = Sep-Dec**. If tutorial attendance declines, the number of partitions may be reduced.

A problem set will be released prior to each tutorial. Students are encouraged to attempt the problems before coming to the tutorials. During the tutorials, the TAs will explain the problems and go over key steps of the solutions. Written solutions will be posted after the tutorial.

Tests

Midterm tests will be conducted during the tutorial slots on Thursdays, 4-5pm. All students are expected to be available during this time.

Assignments

A total of **three assignments** will be posted throughout the course. Assignments will be theoretical in nature and thus may involve proving theorems. **Assignments can be done in groups of size up to 3.** Students can form their own groups on MarkUs. Only one group member should create a group and invite others to the group, and only one member should should submit the assignment.

Only a single PDF will be accepted. You are encouraged to use LaTeX. Scanned copy of handwritten solutions will be acceptable, but it is your responsibility to ensure that the handwriting is legible!

https://markus.teach.cs.toronto.edu/2022-09

Late Days

- Each student will receive a total of three (3) late days on MarkUs; **no more than two (2) late days** can be used towards a single assignment.
- If a group wants to use X late days towards an assignment, **every** member must have at least X late days available, and X late days will be deducted from every group member upon submission.
- You **do not** earn extra late days for illness, University activities, or other legitimate reasons; these reasons is precisely what the 3 late days are for. You are responsible for managing your late days.
- If, for some legitimate reason, you absolutely need more late days, you will need to personally request them from the instructor with proper documentation.

Room Information

Lectures	BA 1190
Tutorial A (birth month: Jan-Apr)	BA 2135
Tutorial B (birth month: May-Aug)	BA 2195
Tutorial C (birth month: Sep-Dec)	BA 2165

Grading Scheme

Course evaluation will be as follows.

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

The first midterm exam will cover approximately the game theory part of the course. The second midterm will cover approximately the mechanism design with money part of the course. The final exam will consist of two parts: a "third midterm", which will cover approximately the mechanism design without money part of the course, and an "overview" that will cover the entire syllabus.

No Garbage Policy

Partial marks will be awarded (at the sole discretion of the TA or the instructor) in assignments and exams based on how close your approach is to a complete solution. On the other hand, leaving your solution to a question blank (or crossing off what you have written) and writing "I do not know how to answer this question." will also get you 20% of the marks assigned to that question. If you do not write this or a similar statement, you will receive 10% of the marks assigned to that question. Thus, 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.

Due Dates

Assignment 1	Oct 14
Assignment 2	Nov 11
Assignment 3	Dec 2
Midterm 1	Oct 20
Midterm 2	Nov 17

Course Content

This is an interdisciplinary course on 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 foundational models and core theoretical insights that have been instrumental in their development. The course will be organized in three parts and will cover (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.

References

The lecture slides will be the primary reference material for this course. The most relevant textbook to the course is one 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/parkes-seuken/`

Username and password required to access the page will be emailed to you and posted on Piazza.

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, Jerome Lang, and Ariel D. Procaccia. Online version at:

  `http://procaccia.info/wp-content/uploads/2020/03/comsoc.pdf`

- *A Course in Game Theory* by Martin J. Osborne (a faculty member in the Department of Economics at the University of Toronto) and Ariel Rubinstein. Online version at:

  `https://arielrubinstein.tau.ac.il/books/GT.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`

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.

Petitions

- If you are unable to complete homework or if you miss a test due to major illness or other circumstances completely outside your control, please **contact your instructor immediately**.
- Special consideration will be evaluated on a case-by-case basis and will *not* be given automatically. In other words, you risk getting a grade of zero for missed work unless you contact your instructor *promptly*.
- In the case of illness, students will need to fill out an absence declaration form on ACORN and notify the instructor for special consideration.
- If you have any concern or question regarding your situation, please contact your College Registrar—they are best equipped to help you with anything you may be going through.

Remark Requests

- Assignment remark requests will be handled through MarkUs. Remark requests for midterm tests will be handled in office hours. For each work, the deadline for remark requests will be announced (either on MarkUs, in class, or on course webpage). It is your responsibility to submit remark request by the deadline.
- Be specific when you write up your request: either clearly demonstrate that the grading scheme was not followed correctly, or ask questions about specific elements in the grading scheme. Note that grades are awarded based on *merit*, not on need—that is the only fair way to award grades —so statements like "I worked really hard" or "I really need those grades" are not good reasons.

Collaboration

Everything that you submit for grades (assignments, tests and exam) must not contain anyone else's work or ideas *without proper attribution.* In particular, for assignments, you are free to discuss with other groups. However, you should not take notes or pictures from this discussion. You must write your own solutions in isolation from other groups, without copying from notes or other sources. This ensures that your solution is truly your own. If you derived a critical insight relevant to the exact problem you're solving from discussion with a classmate or from an online source, you *must* cite the source of your insight. *To be safe, do not let others look at your solutions, even in draft form and even after the due date.*