CS 388M Communication Complexity
Spring 2022

Time: TTh 12:30 - 2:00. **Unique Number:** 51625

Lectures will start virtually. Please see canvas for more details.

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Office hours:

Mondays (Shourya Pandey) 2pm - 3pm
Tuesdays (Anna Gal) 3pm - 4pm
Wednesdays (Shourya Pandey) 11am - 12pm
Access links through CANVAS using your UT zoom account.

Piazza: Find our class page at: https://piazza.com/utexas/spring2022/cs388m

Course description: Many aspects of computation can be viewed as communication processes. A mathematical model for studying communication processes was introduced by Yao. In this model, several participants wish to compute the value of a function while each participant has access to only part of the input. The communication complexity of a function is the number of bits the players have to send to each other in order to determine the value of the function on an arbitrary input. This model and many of its variants have been widely studied. Communication complexity has many applications in different areas including computer networks, VLSI circuits, data structures, cryptography, pseudorandom generators, distributed computing, property testing and learning theory. It also provides methods for proving lower bounds on computational complexity in various models, which is one of the most challenging research areas in theoretical computer science.

The course will cover the most important models of communication complexity and their applications, including recent research results and many open problems.

Textbook: We will use the book "Communication Complexity" by Eyal Kushilevitz and Noam Nisan. The lectures will also cover material not included in the book.

Grading: The course grade will be based on homework (50%), a midterm (25%), class participation and a final project (25%).

Test: There will be a midterm on Thursday, March 3.

A partial list of topics to be covered:

- The basic model: 2-party communication complexity, protocols, basic tools (fooling sets, rectangles, rank method).
- Nondeterminism and randomization: determinism vs. nondeterminism and randomness, private vs. public coins, distributional complexity, discrepancy.
- Multiparty communication complexity: cylinder intersections, Ramsey theoretic methods, simultaneous messages.
- Relations to computational complexity: circuit lower bounds, branching programs, time-space tradeoffs, separating complexity classes.
- Other applications: VLSI, pseudorandom generators, streaming algorithms, data structures and cell probe complexity.
- Direct sum problems and their applications.
- Information complexity.
- Recent developments