Communication Complexity – Spring 2026
Suggestions for Topics/Papers for Presentations

Everyone should pick *three* topics from the list below, one where you are the main presenter, one where you are the helper, and one where you are the reviewer. The main presenters role is to present the paper as if you are the author. The presentation should include background material and motivation, and the ideas behind the main proofs. The helpers role is to work with the main presenter to understand the paper, and to work with the main presenter on the presentation. The reviewers role is to discuss the positives and negatives of the paper, to ask questions and to suggest future open problems. For each presentation, everyone should read the paper ahead of time (or at least try to read it and understand the main statement of the results if not the proofs). It is important that everyone attend all presentations and ask questions!

Next week (Feb 18) I will send everyone a link to a spreadsheet, and you should put your name down as the main presenter for one topic (first-come first-serve). Then we will do the same process again to get the 2 secondary roles (helper and reviewer) for each presentation.

1. Lifting via Critical Block Sensitivity. This paper gives strong randomized Communication Lower Bounds via a reduction to set disjointness. It is similar but more complicated than the Zhang result (taht we will discuss in class) since it applies to search problems and not just to Boolean functions. In turn, it implies some of the strongest lower bounds known for monotone formulas and certain proof systems. Unlike many other lifting results, this one is much more elementary to prove (since it is a reduction to set disjointness).

   Communication Lower Bounds via Critical Block Sensitivity, Goos and Pitassi.
   https://arxiv.org/abs/1311.2355

2. Log Rank Conjecture. We discussed this in the first lecture. This would be a more in-depth presentation of the conjecture. The first reference below gives the state-of-the-art results towards the result. Paper (c) is the original reference, and paper (d) is the best upper bound so far.

   (a) Shachar Lovett "Recent Advances on the Log Rank Conjecture," Bulletin of EATCS 2014.
   (b) Gavinsky, Lovett "En Route to the log-rank Conjecture: New Reductions and Equivalent Formulations,"
   (c) (One of the original papers) "On Rank vs Communication Complexity," Nisan and Wigderson.
   (d) Best upper bound to date: "Communication is bounded by root of rank," Shachar Lovett. STOC 2014.

3. XOR Lemma for Deterministic CC: The paper is quite short and looks really nice. (It uses tools from information theory which is great to learn about.)

   "XOR Lemma for Deterministic CC," Iyer and Rao (FOCS 2024).
   https://arxiv.org/abs/2407.01802

4. Data Structures (and Communication Complexity)

    (a) General articles on cell probe data structure model and lower bounds using communicatin complexity: (1) "Cell Probe Complexity - A Survey," by Milterson. In Advances in Data Strutures, 1999. (Sections 4.1-4.2); (2) "Communication Complexity for Algorithm Designers" by Tim Roughgarden, Chapter 6 (Lower Bounds for Data Structures)

    (b) The basic (static) data structure lower bound that one gets from the standard reduction to communication complexity (see above references) gives a lower bound but it is far from the best upper bounds. This basic reduction could be presented, in combination with one or both of the following papers that present new communication models that could potentially achieve improved data structure lower bounds.

    "Cell Probe Lower Bounds from Online Communication Complexity," Alman, Wang and Yu. https://dl.acm.org/doi/epdf/10.1145/3188745.3188862

    "Strong Cell Probe Lower Bounds via local PRGs," Korten, Pitassi, Impagliazzo (Section 6.3) https://eccc.weizmann.ac.il/report/2025/030/

5. Property Testing (and Communication Complexity). A general reference is "Communication Complexity for Algorithm Designers" by Tim Roughgarden, Chapter 8. The following Recent papers (I haven't read them yet) look like very nice results using communication complexity lower bounds to prove that testing certain natural properties about distributions are hard.

    Distribution Testing Lower Bounds via Reductions from Communication Complexity, Blais, Canonne, Gur. ACM Trans. Comput. Theory 11(2): 6:1-6:37 (2019)

    Communication and Memory Efficient Testing of Discrete Distributions, Diakonikolas, Gouleakis, Kane, Rao. https://arxiv.org/abs/1906.04709

6. Cryptography (and NOF Communication Complexity). This paper connects multiparty NOF cc and nonmalleable extractors. This is a really interesting topic especially since the construction of extractors has been a hot topic with beautiful recent results.

    "Leakage-Resilient extractors against NOF protocols," Chattopadhyay and Goodman. https://arxiv.org/abs/2506.12595

    See also: "Leakage-Resilient Secret Sharing against Colluding Parties," Kumar, Meka, Sahai.

7. Quantum Complexity (and Communication Complexity). I haven't this paper but it is quite recent and written by Henry Yuen and some of his students/collaborators from Columbia.

    Magic and communication https://arxiv.org/abs/2510.07246

8. Graph theory (and Communication). Below is the original paper by Goos giving a strong lower bound for Clique/Coclique, and at the same time resolving the longstanding Alon-Saks-Seymour conjecture.

    Lower Bounds for Clique versus Independent Set. Mika Goos. https://eccc.weizmann.ac.il/report/2015/012/

9. Matrix Multiplication (and NOF Communication Complexity). This paper links the tensor associated with 3-Player NOF communication to the famous tensor for Matrix Multiplication, giving rise to some new questions and approaches for understanding the best runtime for Matrix Mult.

   Matrix Multiplication and Number on the Forehead Communication. Alman and Blasiok. https://arxiv.org/abs/2302.11476

10. Game Theory (and Communication Complexity).

    Tim Roughgarden's Notes "Communication Complexity (for Algorithm Designers)," Chapter 7. Gives a great survey of applications of communication complexity to Game Theory.

11. Information Complexity

    The following paper is the original one that gave a beautiful proof of the set disjointness lower bound using information theory. The book by Rao and Yehudayoff should also be a great reference for this topic.

    Ziv Bar-Yossef, T. S. Jayram, Ravi Kumar, and D. Sivakumar. "An information statistics approach to data stream and communication complexity," JCSS Vol 68, June 2004. https://www.sciencedirect.com/science/article/pii/S0022000003001855

12. Lifting (in Communication Complexity). There are a lot of papers on this subject. I was thinking that a presentation on lifting via the Sunflower lemma (reference (c)) could be a nice presentation.

    (a) Lifting for deterministic CC: "Deterministic Communication versus Partition Number." Goos, Pitassi, Watson. https://eccc.weizmann.ac.il/report/2015/050/

    (b) Lifting for randomized CC: "Query to Communication Lifting for BPP". Goos, Pitassi, Watson. https://arxiv.org/abs/1703.07666

    (c) Lifting using Sunflowers. This paper gives a different way to prove lifting theorems using the famous Sunflower Lemma from Extremal combinatorics. The second paper gives an extension of the technique .

        "Improved Lifting via Robust Sunflowers," Lovett, Meka, Mertz, Pitassi, Zhang. https://eccc.weizmann.ac.il/report/2020/048/

13. Additive Combinatorics (and NOF Communication Complexity).

    The connections between NOF Communication Complexity and famous problems in additive combinatorics has recently led to some spectacular results in additive combinatorics. These are advanced and highly technical papers to read but I am imagining a talk where the additive combinatorics problems are introduced and the connection with CC is given. And then a summary of what has been achieved, possibly with some high level description of some of the proof ideas.

    (a) The Appendix of this paper and references therein for some equivalences between CC problems and major questions in additive combinatorics.

        "An Improved Protocol for Exactly-N with more than 3 Players," Hambardzumyan,Pitassi, Sherif, Shirley, Shraibman https://arxiv.org/abs/2309.06554

(b) Here are some recent papers that make groundbreaking progress on some additive combinatorics problems via the communication complexity link.

"Strong bounds for 3-Progressions," FOCS2023
https://arxiv.org/abs/2302.05537

"Explicit separations between Randomized and Deterministic NOF Communication," STOC2024
https://arxiv.org/abs/2308.12451

"Quasipolynomial lower bounds for the Corners Theorem," (FOCS2025)
https://arxiv.org/abs/2504.07006