Henry Abrahamson

Education

Northwestern University — **Evanston, IL**
BS in Electrical Engineering, Cum Laude, Minor in Mathematics — *June 2022*

Northwestern University — **Evanston, IL**
PhD in Electrical Engineering — *Expected 2027*
Advisor: Professor Ermin Wei

Current Projects

2022- NEAR-DGD with Gradient Tracking

- A modification of the NEAR-DGD distributed optimization algorithm that employs an additional gradient tracking step. NEAR-DGD is a highly flexible first-order method that allows for variable amounts of communication and local computation. However, NEAR-DGD requires infinite communication (in the limit) to converge to the optimum. We add a gradient tracking step and split it into communication and computation steps to address this problem.

2022- Prime-number-based Consensus

- A finite-time consensus algorithm for integer data. Agents are assigned unique primes, and transmit their prime number raised to the power of their data times their incoming messages from the previous timestep. Because each agent has a unique prime, by performing a prime factorization, it is possible to recover the data, all implicitly ID-tagged, from multiple agents within one message composed of a single integer. Applications include those with relatively small ranges of data, such as coordinating different actions within a group of autonomous vehicles.
- Arxiv: https://arxiv.org/abs/2304.09288

2023- Better Guarantees for Newton-like Methods

- 2nd order optimization methods, such as Newton's root finding algorithm, are often used when they can be due to their superlinear convergence rates when minimizing strongly convex functions. However, current theoretical guarantees can only provide a superlinear rate by splitting the problem into different regions of convergence. We want to use control theory-inspired methods to come up with broader conditions under which we can achieve a superlinear rate, and apply it to distributed algorithms.

Undergraduate Research Experience

2020 Summer Undergraduate Research Grant winner

- Used computational methods in julia to investigate how accelerated dynamic average consensus would perform with communication failures

2019-2022 Independent research with Professor Randy Freeman

- Investigated a version of dynamic average consensus that allowed for privacy between the different agents in the network under certain topological constraints
- Wrote a proof demonstrating various properties on a generalization of Sontag's formula

Honors and Awards

2020-2021 Member of Northwestern Chapter of Eta-Kappa-Nu, IEEE honors society

2021 2nd place, Innovations in Science and Technology Panel, Northwestern Undergraduate Research Expo

Leadership and Teaching Experience

2023-2024 Course Coordinator for Engineering Analysis-1 (Northwestern University)

- Ran all logistical elements of Engineering Analysis-1, a 400-500 person freshman class on linear algebra and programming in MATLAB. Duties included co-writing of homework sets and exams with professors, weekly discussions on what course material to cover, creating and managing the course's canvas page, handling student emails, and filling in for lectures when professors were unable to teach their sections.

2021 Summer Undergraduate Research Grant Peer Mentor (Northwestern University)

- Acted as a mentor to a group of grant winners, answering questions and concerns about research and the administrative requirements for the final report

2020 Eta-Kappa-Nu Freshman Mentor (Northwestern University Chapter)