Behrooz Zarebavani

Ph.D. Candidate - Department of Computer Science - University of Toronto

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Work Experience

Research Assistant at University of Toronto

- **Accelerating Sparse Computation via Decomposition:**
  - Developing an efficient *sparse linear system* framework using domain decomposition and reduced space computation, optimized for GPU hardware.
  - Focused on *scientific simulation* applications with dynamic sparsity patterns.
- **Adaptive Sparse Linear Solve Acceleration - Parth [1]:**
  - A framework that enhances the performance of sparse linear solvers, such as *Apple Accelerate*, achieving up to a *6x* speedup in the presence of dynamic sparsity patterns.
  - Integrates with only *3 lines* of code, boosting high-performance solvers like Apple Accelerate, Intel MKL, and CHOLMOD.
- **Sparse Kernels Scheduler - HDagg [2]:**
  - Achieves up to a 13x speedup over the advanced sparse library Intel MKL; an open-source scheduler that accelerates sparse kernel computations with loop-carried dependencies.
  - Automatically finds an optimal balance between load balancing, locality, and synchronization.
  - https://github.com/BehroozZare/HDagg-benchmark

Research Assistant at Sharif University of Technology

- **GPU-based Causal Structure Learning Algorithm - cuPC [3]:**
  - First efficient GPU implementation of the Peter-Clark (PC) algorithm.
  - Improves discovery of causal relationships in observational data; reduces runtime from *11 hours to just 4 seconds*.
  - Achieves a 1000x performance improvement over CPU and 6x over our own GPU-based baseline by offering two GPU implementation variations.
  - https://github.com/LIS-Laboratory/cupc

Publications

1. Zarebavani, B., Kaufman, D. M., Levin, D. I., and Dehnavi, M. M. Adaptive algebraic reuse of reordering in cholesky factorization with dynamic sparsity pattern. *arXiv preprint arXiv:2501.04011* (2024)
2. Zarebavani, B., Cheshmi, K., Liu, B., Strout, M. M., and Dehnavi, M. M. Hdagg: hybrid aggregation of loop-carried dependence iterations in sparse matrix computations. In *2022 IEEE International Parallel and Distributed Processing Symposium (IPDPS)* (2022), IEEE, pp. 1217–1227
3. Zarebavani, B., Jafarinejad, F., Hashemi, M., and Salehkaleybar, S. cupc: Cuda-based parallel pc algorithm for causal structure learning on gpu. *IEEE Transactions on Parallel and Distributed Systems 31*, 3 (2019), 530–542

Areas of Interest

- High-Performance Computing (HPC)
- Numerical Optimizations
- Graphics and Scientific Simulation

Skills and Courses

- **Skills**: CUDA, C/C++, Python, Java, LaTeX, OpenMP, git, scikit-learn
- **Parallel Computing Courses**: Parallel Processing (A+), Distributed Systems (A+), Advanced Computer Architecture(A+), Advanced Systems Programming(A+), Compilation Techniques for Parallel Processors (A-)
- **Machine Learning Courses**: Statistical Learning (A+), Theory of Learning (A+), Causal Inference (A+), Probability & Statistics (A+)
- **Graphic Courses**: Physics-based Animation (A+)

Honors and Awards

- **Talent Bursary** from Alberta Machine Intelligence Institute(AMII) (2023 and 2022)
- **Top 0.1**% among more than 60000 and 350000 participants in nation-wide University Entrance Exam for M.Sc. and B.Sc. programs (2017 and 2013)
- **Qualified** for double-major program (EE and CE) at Amirkabir University of Technology 2015

Education

Ph.D. Computer Science | *University of Toronto*

September 2020 – Ongoing

- Focus: High-Performance Computing (HPC) in Graphic
- Supervisors: Maryam Mehri Dehnavi

M.Sc. Electrical Engineering | *Sharif University of Technology*

September 2017 – August 2019

- Focus: High-Performance Computing (HPC) in Machine Learning
- Supervisors: Matin Hashemi and Saber Salehkaleybar