Navjot Singh

616-516-4557 | navjot2@illinois.edu | github.com/navjo2323

Education

University of Illinois at Urbana-Champaign Urbana, IL
Ph.D. in Computer Science *Advisor: Edgar Solomonik* *May 2020 – May 2025 (Expected)*

University of Illinois at Urbana-Champaign Urbana, IL
M.S. in Applied Mathematics *Advisor: Edgar Solomonik* *Aug 2018 – May 2020*

Delhi Technological University New Delhi, India
B.Tech. in Mathematics and Computing *Aug 2014 – May 2018*

Experience

Research Intern **Advisor: Ramakrishnan Kannan** June 2024 - Aug 2024
Oak Ridge National Laboratory *Oak Ridge, TN*

- Developed scalable optimization algorithms to perform generalized Tucker tensor completion for knowledge graph completion.
- Our algorithms outperform state-of-the-art optimization algorithms in terms of accuracy and time to solution on distributed-memory architecture.

Research Intern **Advisor: Xiaoye (Sherry) Li, Yang Liu** May 2023 - Aug 2023
Lawrence Berkeley National Laboratory *Berkeley, CA*

- Developed the formulation of butterfly matrix completion problem via tensor network completion.
- Formulated an ALS method, leading to completion of matrices with $O(N \log N)$ nonzeros for highly oscillatory operators.

Research Intern **Advisor: Chao Yang** May 2022 - Aug 2022
Lawrence Berkeley National Laboratory *Berkeley, CA*

- Developed tensor decomposition and floating point compression techniques for compressing eigenvectors in many-body eigenvalue problems.
- Achieved a compression rate of 10× with an increase of only 1 iteration in LOBPCG eigensolver.
- Developed a novel neural network architecture and optimization method for representing nonlinear functionals in combination with CP tensor decomposition.

Graduate Research Assistant May 2019 - Present
University of Illinois at Urbana-Champaign *Urbana, IL*

- Developing parallel numerical algorithms for compression and reconstruction of high dimensional data and operators known as tensors
- Developing efficient sparse tensor kernels for implementing algorithms for reconstruction problems in distributed-memory setting

Graduate Teaching Assistant Jan 2019- May 2019, Aug 2021 - Dec 2021, Jan 2023- May 2023
University of Illinois at Urbana-Champaign *Urbana, IL*

- Teaching assistant for the course Numerical Analysis (CS 450)
- Teaching assistant for the course Numerical Methods I (CS 357)

Technical Skills

Python, NumPy, SciPy, Matplotlib, Cython, C++, MPI, OpenMP, Git, LINUX/UNIX, randomized algorithms, Cyclops Tensor Framework, multilinear algebra, numerical optimization, sparse tensor computations

Publications

1. **Navjot Singh** and Edgar Solomonik. Alternating Mahalanobis distance minimization for accurate and well-conditioned CP decomposition. *SIAM Journal on Scientific Computing*, 45(6):A2781–A2812, 2023

2. **Navjot Singh**, Zecheng Zhang, Xiaoxiao Wu, Naijing Zhang, Siyuan Zhang, and Edgar Solomonik. Distributed-memory tensor completion for generalized loss functions in Python using new sparse tensor kernels. *Journal of Parallel and Distributed Computing*, 169:269–285, 2022

3. **Navjot Singh**, Linjian Ma, Hongru Yang, and Edgar Solomonik. Comparison of accuracy and scalability of Gauss–Newton and Alternating Least Squares for CANDECOMC/PARAFAC decomposition. *SIAM Journal on Scientific Computing*, 43(4):C290–C311, 2021

4. Chaoqi Yang, Cheng Qian, **Navjot Singh**, Cao Xiao, M Brandon Westover, Edgar Solomonik, and Jimeng Sun. ATD: Augmenting CP tensor decomposition by self supervision. In *Advances in Neural Information Processing Systems,2022*

5. Chaoqi Yang, **Navjot Singh**, Cao Xiao, Cheng Qian, Edgar Solomonik, and Jimeng Sun. Mtc: Multiresolution tensor completion from partial and coarse observations. In *Proceedings of the 27th ACM SIGKDD Conference on Knowledge Discovery & Data Mining*, KDD '21, page 1953–1963, New York, NY, USA, 2021. Association for Computing Machinery

Manuscripts in Preparation

1. **Navjot Singh**, Yang Liu, Xiaoye Li, and Edgar Solomonik. Butterfly matrix completion as tensor network completion. 2024. Manuscript in preparation

2. **Navjot Singh**, Ramakrishnan Kannan, and Edgar Solomonik. Generalized tensor completion for knowledge graph link prediction. 2024. Manuscript in preparation

Awards

Kenichi Miura Award for Outstanding Accomplishment in High Performance Computing
Graduate College Presentation Award 2022: SIAM PP'22
SIAM Student Travel Award: SIAM MDS'22 (Domestic, ∼900$), SIAM LA'24 (International, ∼1100$)

Presentations

SIAM LA'24 MS12: Invited talk on Riemannian Optimization on Low Rank Tensor Manifolds
CECAM WORKSHOP on Tensor Contractions: Invited talk on Tensor Computations with CTF
SIAM PP'24 MS10: Invited talk on Riemannian Optimization for Tucker Tensor Completion
Conference on Fast Direct Solvers'23: Contributed talk on Algorithms and Software for Tensor Network Completion
ICIAM'23 MS01211: Invited talk on Efficient Algorithms and Software for Generalized Tensor Completion
SIAM CSE'23: Poster presentation on Distributed-Memory Algorithms for Tucker Tensor Completion
SIAM MDS'22 MS36: Invited talk on Alternating Mahalanobis Distance Minimization for Well-Conditioned CPD
SIAM PP'22: Poster presentation on Distributed-Memory Generalized Tensor Completion
SIAM PP'22 MS71: Invited talk on A New Alternating Optimization Method for CPD
CSSI Workshop'21: Invited talk on Solving Linear Systems Involving Sparse Tensor Contractions and Applications
SIAM PP'20: Poster presentation on Parallel Gauss-Newton Method for CP Decomposition