Nabil Abubaker

Parallel Computing Researcher | Software Engineer

Postdoctoral Fellow at SPCL Lab, ETH Zürich, Switzerland

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PROFILE

I work in Parallel Computing research. Specifically, I investigate and design combinatorial algorithms and methods for reducing communication overhead of parallel scientific and machine learning applications running on HPC systems. Experienced in dealing with sparse data at scale as well as graph/hypergraph partitioning.

EDUCATION

Ph.D., Computer Engineering, *Bilkent University*   **Sep. 2016 - Jul. 2022**
Thesis: Novel Algorithms and Models for Scaling Parallel Sparse Tensor and Matrix Factorizations.   **Advisor:** Prof. Cevdet Aykanat

M.Sc., Computer Engineering, *Bilkent University*   **Sep. 2014 - Aug. 2016**
Thesis: Reordering Methods for Exploiting Spatial and Temporal Localities in Parallel Matrix-Vector Multiplication

B.Sc., Computer Engineering, *An-Najah National University*   **Sep. 2009 - Jun. 2014**

EXPERIENCE

Postdoctoral Fellow, *ETH Zürich*   **Jun. 2023 - Now**
SNSF Swiss Postdoctoral Fellowship, Scalable Parallel Computing Laboratory   **Advisor:** Prof. Torsten Hoefler

Research & Teaching Assistant, *Bilkent University*   **2016-2022**
- Research: Full-stack researcher (motivate, design, implement, experiment, document) for several funded projects focusing on parallel sparse computations.
- Teaching: Assistant for several courses, mainly Algorithms I (design and analysis), Digital Design, Fundamentals of Data Structures and Algorithms, Software Verification and Validation, and OO programming courses using JAVA.

Full-Stack Software Engineer, *Etgi Grup, Ankara, Turkey*   **2017 - 2018**
- Main duties: Investigating and implementing new features for the company's *e*-learning platform: Vedubox, integrating external services through RESTful API, SQL queries optimization, back-end services optimization.

Software Engineer, *Sina Research Institute, Birzeit University*   **May 2014 - Aug. 2014**

Software Engineering Intern, *Exalt Technologies, Ramallah, Palestine*   **Jun. 2013 - Aug. 2013**

MAJOR RESEARCH PROJECTS

Efficient Training of Hypergraph NNs Through Comm-Efficient Sparse Tensor Operations
SNSF Funded Project, CHF 235,000 ≈ $265,000   2023-2025

Store-And-Forward Communication Models For Scaling Latency-Bound Parallel Applications
Funded Project, Principal Investigator: Cevdet Aykanat | My role: Senior Researcher and sub-task leader   2021-2024

Parallel Stochastic Gradient Descent Algorithms for Large-Scale Recommendation Systems
Funded Project, Principal Investigator: Cevdet Aykanat | My role: PhD Researcher and sub-task leader   2019-2021

High Performance Tensor Methods for Distributed and Shared Memory Parallel Systems
Funded Project, Principal Investigator: Cevdet Aykanat | My role: PhD Researcher and sub-task leader   2017-2019

TECHNICAL SKILLS

As an HPC Researcher:

- **Writing the code:** C, C++, MPI, openMP
- **Dev environment:** Vim, tmux, Linux
- **Experimentation setup:** Bash scripts, slurm
- **Data collection & wrangling:** Bash, awk, sed
- **Data analysis & reporting:** R, Pandas, PGFPlots
- **Preparing articles & figures:** LaTeX, TikZ, Inkscape

As a Software Engineer:

C#, Java, SQL, Python, Julia, Git, EntityFramework, RESTful API, Goolg App Engine, Matlab, JavaScript, AngularJS, VHDL, Verilog.

PUBLICATIONS

SpComm3D: A Framework for Enabling Sparse Communication in 3D Sparse Kernels 2024
Nabil Abubaker, Torsten Hoefler. *arXiv preprint arXiv:2404.19638*

Arrow Matrix Decomposition: A Novel Approach for Communication-Efficient SpMM 2024
Lukas Gianinazzi et. al. *In PPoPP '24*

Minimizing Staleness and Comm. Overhead in Dist. SGD for Collaborative Filtering 2023
Nabil Abubaker, Orhun Caglayan, M. Ozan Karsavuran, Cevdet Aykanat. *In IEEE Transactions on Computers*

Scaling Stratified Stochastic Gradient Descent for Distributed Matrix Completion. 2023
Nabil Abubaker, M. Ozan Karsavuran, Cevdet Aykanat. *In IEEE Transactions on Knowledge and Data Engineering*

Scalable Unsupervised ML: Latency Hiding in Distributed Sparse Tensor Decomposition. 2022
Nabil Abubaker, M. Ozan Karsavuran, Cevdet Aykanat. *In IEEE Transactions on Parallel and Distributed Systems*

True Load Balancing for Matricized Tensor Times Khatri-Rao Product. 2021
Nabil Abubaker, Seher Acer, Cevdet Aykanat. *In IEEE Transactions on Parallel and Distributed Systems*

Spatiotemporal Graph and Hypergraph Part. Models for SpMV on Many-Core Architectures. 2019
Nabil Abubaker, Kadir Akbudak, Cevdet Aykanat. *In IEEE Transactions on Parallel and Distributed Systems*

Privacy-Preserving Fog Computing Paradigm. 2017
Nabil Abubaker, Leonard Dervishi, Erman Ayday. *IEEE CNS'17*

(First author ratio: 88%. Erdős number = 3.)

TALKS

Communication-Efficient Stratified SGD for Matrix Completion 2024
CERFACS Sparse Days 2024 Toulouse, France

Combinatorial Opportunities for Scalability of CP Tensor Decomposition 2023
University of Texas at Austin Austin, TX, USA

Combinatorial Opportunities for Large-Scale Tensor and Matrix Factorizations 2022
Lawrence Berkeley National Labs Berkeley, CA, USA

Novel Algorithms and Models for Scaling Parallel Sparse Tensor and Matrix Factorizations. 2022
PhD Dissertation Talk at Bilkent University.

Sparse Tensor Partitioning for Scalable Distributed CPD-ALS. 2022
SIAM Conference on Parallel Processing for Scientific Computing (PP22). Seattle, WA, USA

OPEN-SOURCE SOFTWARE

- SpComm3D: A Framework for Enabling Sparse Communication in 3D Sparse Kernels. (github.com/nfabubaker/SpComm3D)
- CPD-EMB: An MPI-based Distributed CP Decomposition with Latency hiding (github.com/nfabubaker/cpd-emb)
- CESSGD: Communication-Efficient Stratified Stochastic Gradient Descent for Distributed Matrix Completion (github.com/nfabubaker/CESSGD)

Awards & Honors

- SNSF Swiss Postdoctoral Fellowship. Fellowship grant CHF 235,000 ≈ $265,000 for two years.
- Recipient of the "Bilkent University best journal article by a PhD student" award two years in a row.
- UYBT incentive award by the The Scientific and Technological Research Institution of Turkey (TÜBİTAK).
- Bilkent University tuition waiver & full support scholarship for MSc and PhD studies.
- The CocaCola - Injaz exchange program scholarship award - 2012/2013
- Ranked 1st in province and 7th country-wide in nation-wide high school diploma exams - industrial track. Honored by the mayor.

Miscellaneous

Professional Society Membership

- Association for Computing Machinery (ACM)
- Society of Industrial and Applied Mathematics (SIAM)
- The Institute of Electrical and Elecronic Engineers (IEEE)

Academic Review Service

- Future Generation Computer Systems (FGCS)
- International Journal of High Performance Computing Applications (IJHPCA)
- IEEE Transactions on Big Data (TBD)
- International Parallel & Distributed Processing Symposium (IPDPS) - 2018

Languages

- Arabic: Native
- English: Fluent
- Turkish: Intermediate
- German: Beginner

Leadership / Extracurricular

- *Co-President* of the Association of Scientific Staff at Computer Science department (VMI) of ETH Zurich.
- Served as Vice-President for the university's IEEE Student Branch in 2011-2012.
- Co-founded and co-organized the first Palestine Programming Olympiad event (PPO), a 24-hours programming contest for students and young professionals.
- Participated in IEEEXtreme 24h programming competition 5.0, 6.0, 7.0 and 8.0 (2011,2012, 2013, 2014). *Our team won the 2nd place country-wise in 2013.*