

## Edgar Solomonik

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POSITION	<b>Assistant Professor</b> , Department of Computer Science, University of Illinois at Urbana-Champaign
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WEB PAGE	<a href="http://solomonik.cs.illinois.edu/">http://solomonik.cs.illinois.edu/</a>
EDUCATION	<b>Ph.D. University of California, Berkeley</b> August 2010 – August 2014 Computer Science, Advisor: James W. Demmel Dissertation: <i>Provably efficient algorithms for numerical tensor algebra</i>  <b>B.S. University of Illinois at Urbana-Champaign</b> August 2008 – May 2010
AWARDS AND FELLOWSHIPS	UIUC CS Department C.W. Gear Outstanding Junior Faculty Award, 2021 UIUC Dean's Award for Excellence in Research, 2021 UIUC List of Instructors Ranked as Excellent, Fall 2020 NSF CAREER Award, 2020 SIAM Activity Group on Supercomputing Early Career Prize, 2020 IEEE TCHPC Early Career Researchers Excellence Award in High Performance Computing, 2018 Alston S. Householder Prize XX, 2016 ETH Zurich Postdoctoral Fellowship, 2014-2016 Berkeley EECS Department David J. Sakrison Memorial Prize, 2014 NERSC Award for Innovative Use of High Performance Computing, 2013 ACM/IEEE-CS George Michael Memorial High Performance Computing Fellowship, 2013 Distinguished Paper Award, Euro-Par, 2011 Department of Energy Computational Science Graduate Fellowship (DOE CSGF), 2010-2014 Finalist for CRA Outstanding Undergraduate Research Award, 2010
TEACHING	<i>CS 554 / CSE 512: Parallel Numerical Algorithms</i> , UIUC, Fall 2017, Fall 2019, Fall 2021 <i>CS 450 / CSE 401 / ECE 491 / MATH 450: Numerical Analysis</i> , UIUC, Spring 2018, Fall 2018, Spring 2021 <i>CS 598-EVS: Tensor Computations</i> , UIUC, Fall 2020 <i>CS 598-EVS: Provably Efficient Algorithms for Numerical and Combinatorial Problems</i> , UIUC, Spring 2020 <i>CS 357 / MATH 357: Numerical Methods</i> , UIUC, Spring 2017 <i>CS 598-EVS: Communication Cost Analysis of Algorithms</i> , UIUC, Fall 2016
ADVISING	Current PhD students: Edward Hutter, Samah Karim, Linjian Ma, Yuchen Pang, Navjot Singh, Mengyuan (Mina) Sun, MS: Wentao Yang  Past thesis advisees: Navjot Singh (MS 2020), Yiqing Zhou (BS 2020), Tianyi Hao (BS 2020), Youcef Hadjarab (BS 2020), Zecheng Zhang (BS 2019), Pavle Simonovic (BS 2018), Edward Hutter (DOE CSGF fellow, BS 2017), Tobias Wicky (BS 2016, MS 2017, ETH Zurich, co-advised with Torsten Hoefer)  PhD thesis committee member: James Stevens (2021), Hadi Asgharimoghaddam (2021), Si Zhang (2020), Amanda Bienz (2018)

## TALKS

**Keynote Talks:** PMAA (2018)

**First-Author Conference Paper Presentations:** SC (2011, 2017), SPAA (2014, 2017), IPDPS (2013 x2, 2011), VECPAR (2012), Euro-Par (2011, Distinguished Paper Award)

**Invited Talks at Chemistry/Physics/Quantum Meetings:** Quantum Information for Mathematics, Economics, and Statistics (2021), Quantum Information and Quantum Entanglement (2019), NSF Workshop on Enabling Quantum Leap: Quantum Algorithms for Quantum Chemistry and Materials (2019), American Chemical Society Annual Meeting (2018), Simons CCQ Tensor Network Workshop (2017), MolSSI Workshop on Core Software Blocks in Quantum Chemistry: Tensors and Integrals (2017), ISTCP (2016), QESC (2015), NSF S2I2 Workshop on Tensor Libraries (2013)

**Talks at Applied Mathematics and Scientific Computing Meetings:** E-NLA (2021), SIAM AN (2021), SIAM CSE (2013, 2017, 2019, 2021), SIAM PP (2012, 2014, 2016, 2020), Invited Workshop on Compiler Techniques for Sparse Tensor Algebra (2019), Fast Solvers (2018), PASC (2018), Householder symposium (2014, 2017), Householder prize lecture (2017), SIAM ALA (2015, 2012)

**Seminars at National Laboratories:** Argonne National Laboratory (2011, 2017), Sandia National Laboratory (2017), Lawrence Livermore National Laboratory (2012), Max-Planck-Institute for Solid State Research in Stuttgart, Germany (2016), Max-Planck-Institute for Chemical Energy Conversion in Muelheim, Germany (2015), Swiss National Supercomputing Center (2013)

**External Seminars at Universities:** Massachusetts Institute of Technology (2021), ETH Zurich (2020), University of Utah (2019), University of Chicago (2017), University of California, Davis (2016), University of Toronto (2016), Stony Brook University (2016), California Institute of Technology (2016), University of Colorado, Boulder (2016), Georgia Institute of Technology (2016), Cornell University (2016), TU Munich (2016), EPFL (2015), University of Tokyo (2012)

## SERVICE

**Editorships:** Associate Editor for ACM Transactions on Mathematical Software (TOMS), Review Editor for Frontiers in Applied Mathematics and Statistics

**Organization:** SIAM PP 2020 (minisymposium organizer), PASC 2018 (minisymposium organizer), ARRAY 2017 (organizing committee)

**Program committees:** SC (2018, 2019, 2020, 2022), ICPP 2022, IPDPS (2018, 2019, 2021, 2022), ISC (2019, 2021), EuroPar 2020, SIAM PP 2020, IA<sup>3</sup> (2018, 2019), EuroMPI 2019, HIPC 2018, SPAA 2018, GABB 2017, PACT 2017

**Departmental committees:** student awards (2016-2020), faculty recruiting (2019-2020), outreach (2018-2019), faculty advisory (2016-2018)

## PUBLICATIONS

1. [arXiv] Navjot Singh and Edgar Solomonik. *Alternating Mahalanobis Distance Minimization for Stable and Accurate CP Decomposition*. arXiv:2204.07208 [cs.LG], May 2022.
2. [arXiv] Wentao Yang, Vipul Harsh, and Edgar Solomonik. *Optimal round and sample-size complexity for partitioning in parallel sorting*. arXiv:2204.04599 [cs.DC], April 2022.
3. [NLAA] Linjian Ma and Edgar Solomonik. *Accelerating alternating least squares for tensor decomposition by pairwise perturbation*. Numerical Linear Algebra with Applications, 2022.
4. [SIAM PP] Tim Baer, Raghavendra Kanakagiri, and Edgar Solomonik. *Parallel minimum spanning forest computation using sparse matrix kernels*. Proceedings of SIAM Conference Parallel Processing for Computational Science and Engineering, February 2022.
5. [arXiv] Caleb Ju, Yifan Zhang, and Edgar Solomonik. *Communication lower bounds for nested bilinear algorithms*. arXiv:2107.09834 [cs.DC], July 2021.
6. [NeurIPS] Linjian Ma and Edgar Solomonik. *Fast and accurate randomized algorithms for low-rank tensor decompositions*. Conference on Neural Information Processing Systems, 2021.
7. [arXiv] Chaoqi Yang, Cheng Qian, Navjot Singh, Cao Xiao, Brandon Westover, Edgar Solomonik, Jimeng Sun. *Augmented tensor decomposition with stochastic optimization*. arxiv:2106.07900 [math.NA], June 2021.

8. [KDD] Chaoqi Yang, Navjot Singh, Cao Xiao, Cheng Qian, Edgar Solomonik, Jimeng Sun. *MTC: Multiresolution tensor completion from partial and coarse observations*. ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, 2021.
9. [arXiv] 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*. arXiv:1910.02371 [cs.DC], May 2021.
10. [SISC] Edgar Solomonik, James Demmel, and Torsten Hoefer. *Communication lower bounds of bilinear algorithms for symmetric tensor contractions*. SIAM Journal of Scientific Computing, 2021.
11. [arXiv] Samah Karim and Edgar Solomonik. *Efficient preconditioners for interior point methods via a new Schur complementation strategy*. arxiv:2104.12916 [math.NA], April 2021.
12. [SISC] Navjot Singh, Linjian Ma, Hongru Yang, and Edgar Solomonik. *Comparison of accuracy and scalability of Gauss-Newton and alternating least squares for CP decomposition*. SIAM Journal of Scientific Computing, 2021.
13. [IPDPS] Edward Hutter and Edgar Solomonik. *Confidence-based approximation for performance prediction using execution path analysis*. IEEE International Parallel and Distributed Processing Symposium, May 2021.
14. [IPDPS] Linjian Ma and Edgar Solomonik. *Efficient parallel CP decomposition with pairwise perturbation and multi-sweep dimension tree*. IEEE International Parallel and Distributed Processing Symposium, May 2021.
15. [arXiv] Yang Gao, Phillip Helms, Garnet Kin-Lic Chan, and Edgar Solomonik. *Automatic transformation of irreducible representations for efficient contraction of tensors with cyclic group symmetry*. arXiv:20001.08056 [physics.comp-ph], July 2020.
16. [SC] Yuchen Pang, Tianyi Hao, Annika Dugad, Yiqing Zhou, and Edgar Solomonik. *Efficient 2D tensor network simulation of quantum systems*. ACM/IEEE Supercomputing Conference, November 2020.
17. [SC] Ryan Levy, Edgar Solomonik, and Bryan Clark. *Distributed-memory DMRG via sparse and dense parallel tensor contractions*. ACM/IEEE Supercomputing Conference, November 2020.
18. [PACT] Linjian Ma, Jiayu Ye, and Edgar Solomonik. *AutoHOOT: Automatic High-Order Optimization for Tensors*. International Conference on Parallel Architectures and Compilation Techniques, October 2020.
19. [SIREV] Caleb Ju and Edgar Solomonik. *Derivation and analysis of fast bilinear algorithms for convolution*. SIAM Review, 2020.
20. [CMAM] Edgar Solomonik and James Demmel. *Fast bilinear algorithms for symmetric tensor contractions*. Computational Methods in Applied Mathematics, 2020.
21. [arXiv] Yifan Zhang and Edgar Solomonik. *On stability of tensor networks and canonical forms*. arXiv:2001.01191 [math.NA], January 2020.
22. [IPDPS] Maciej Besta, Raghavendra Kanakagiri, Harun Mustafa, Mikhail Karasikov, Gunnar Rätsch, Torsten Hoefer, and Edgar Solomonik. *Communication-efficient Jaccard similarity for high-performance distributed genome comparisons*. IEEE International Parallel and Distributed Processing Symposium, May 2020.
23. [MICRO] Kartik Hegde, Hadi Asghari-Moghaddam, Michael Pellauer, Neal Crago, Aamer Jaleel, Edgar Solomonik, Joel Emer, and Christopher W. Fletcher. *ExTensor: An accelerator for sparse tensor algebra*. IEEE/ACM International Symposium on Microarchitecture, October 2019.

- 24.[SPAA] Vipul Harsh, Laxmikant Kale, and Edgar Solomonik. *Histogram sort with sampling*. ACM Symposium on Parallelism in Algorithms and Architectures, June 2019.
- 25.[IPDPS] Edward Hutter and Edgar Solomonik. *Communication-avoiding Cholesky-QR2 for rectangular matrices*. IEEE International Parallel and Distributed Processing Symposium, May 2019.
- 26.[SC] Edgar Solomonik, Maciej Besta, Flavio Vella, and Torsten Hoefler. *Scaling betweenness centrality using communication-efficient sparse matrix multiplication*. ACM/IEEE Supercomputing Conference, November 2017.
- 27.[arXiv] Edwin Pednault, John A. Gunnels, Giacomo Nannicini, Lior Horesh, Thomas Magerlein, Edgar Solomonik, Erik W. Draeger, Eric T. Holland, Robert Wisnieff. *Breaking the 49-qubit barrier in the simulation of quantum circuits*. arXiv:1710.05867 [quant-ph], October 2017.
- 28.[SPAA] Edgar Solomonik, Grey Ballard, James Demmel, and Torsten Hoefler. *A communication-avoiding parallel algorithm for the symmetric eigenvalue problem*. ACM Symposium on Parallelism in Algorithms and Architectures, 2017.
- 29.[HPDC] Maciej Besta, Michal Podstawski, Linus Groner, Edgar Solomonik, and Torsten Hoefler. *To push or to pull: on reducing communication and synchronization in graph computations*. 26th ACM Symposium on High Performance Parallel and Distributed Computing, Washington DC, 2017.
- 30.[IPDPS] Tobias Wicky, Edgar Solomonik, and Torsten Hoefler. *Communication-avoiding parallel algorithms for solving triangular systems of linear equations*. IEEE International Parallel and Distributed Processing Symposium, 2017.
- 31.[IPDPS] Maciej Besta, Florian Marending, Edgar Solomonik and Torsten Hoefler. *SlimSell: A vectorizable graph representation for breadth-first search*. IEEE International Parallel and Distributed Processing Symposium, 2017.
- 32.[TOPC] Edgar Solomonik, Erin Carson, Nicholas Knight, and James Demmel. *Tradeoffs between synchronization, communication, and computation in parallel linear algebra computations*. ACM Transactions on Parallel Computing, 2016.
- 33.[arXiv] Edgar Solomonik and Torsten Hoefler. *Sparse tensor algebra as a parallel programming model*. arXiv:1512.00066 [cs.MS], 2015.
- 34.[JPDC] Edgar Solomonik, Devin Matthews, Jeff Hammond, James Demmel, and John F Stanton. *A massively parallel tensor contraction framework for coupled-cluster computations*. Journal of Parallel and Distributed Computing, 2014.
- 35.[SPAA] Edgar Solomonik, Erin Carson, Nicholas Knight, and James Demmel. *Tradeoffs between synchronization, communication, and work in parallel linear algebra computations*. ACM Symposium on Parallelism in Algorithms and Architectures, 2014.
- 36.[IPDPS] Grey Ballard, James Demmel, Laura Grigori, Mathias Jacquelin, Hong Diep Nguyen, and Edgar Solomonik. *Reconstructing Householder vectors from Tall-Skinny QR*. IEEE International Parallel and Distributed Processing Symposium, 2014.
- 37.[IPDPS] Edgar Solomonik, Devin Matthews, Jeff Hammond, and James Demmel. *Cyclops Tensor Framework: reducing communication and eliminating load imbalance in massively parallel contractions*. IEEE International Parallel and Distributed Processing Symposium, 2013.
- 38.[IPDPS] Edgar Solomonik, Aydin Buluc, and James Demmel. *Minimizing communication in all-pairs shortest-paths*. IEEE International Parallel and Distributed Processing Symposium, 2013.
- 39.[IPDPS] Michael Driscoll, Evangelos Georganas, Penporn Koanantakool, Edgar Solomonik, and Katherine Yelick. *A communication-optimal n-body algorithm for direct interactions*. IEEE International Parallel and Distributed Processing Symposium, 2013.

- 40.[VECPAR] Edgar Solomonik and James Demmel. *Matrix multiplication on multidimensional torus networks*. Lecture Notes in Computer Science. Springer Berlin Heidelberg, 2013.
- 41.[SC] Evangelos Georganas, Jorge Gonzalez-Dominguez, Edgar Solomonik, Yili Zheng, Juan Tourino and Katherine Yelick. *Communication avoiding and overlapping for numerical linear algebra*. ACM/IEEE Supercomputing Conference, 2012.
- 42.[UCB] Edgar Solomonik, Jeff Hammond, and James Demmel. *A preliminary analysis of Cyclops Tensor Framework*. Technical Report, University of California, Berkeley, 2012.
- 43.[SC] Edgar Solomonik, Abhinav Bhatele, and James Demmel. *Improving communication performance in dense linear algebra via topology aware collectives*. ACM/IEEE Supercomputing Conference, 2011.
- 44.[Euro-Par] Edgar Solomonik and James Demmel. *Communication-optimal parallel 2.5D matrix multiplication and LU factorization algorithms*. Lecture Notes in Computer Science, Euro-Par, 2011.
- 45.[Enc. Par. Comp.] Laxmikant Kale and Edgar Solomonik. *Parallel sorting*. Encyclopedia of Parallel Computing, Springer, David Padua, Ed., 2011.
- 46.[IJHPCA] Abhinav Bhatele, Lukasz Wesolowski, Eric Bohm, Edgar Solomonik, and Laxmikant V. Kale. *Understanding application performance via micro-benchmarks on three large supercomputers: Intrepid, Ranger and Jaguar*. International Journal of High Performance Computing Applications, 2010.
- 47.[IPDPS] Edgar Solomonik and Laxmikant V. Kale. *Highly scalable parallel sorting*. IEEE International Parallel and Distributed Processing Symposium, 2010.
- 48.[ParaPLOP] Vivek Kale and Edgar Solomonik. *Parallel sorting pattern*. Workshop on Parallel Programming Patterns, 2010.

## FUNDING

1. [NSF MPS] QLCI-CI: NSF Quantum Leap Challenge Institute for Hybrid Quantum Architectures and Networks. senior personnel, total amount \$7,700,000 (PI Brian DeMarco), 2020-2025.
2. [NSF OAC] PPOSS: Planning: A cross-layer approach to accelerate large-scale graph computations on distributed platforms. co-PI, total amount \$250,000 (PI Josep Torrellas, Co-PIs Sasa Misailovic, Chandra Chekuri), 2020-2021.
3. [NSF OAC] CAREER: Next-generation infrastructure for tensor computations. PI \$500,000, 2020-2025.
4. [NSF OAC] Collaborative Research: Frameworks: Scalable modular software and methods for high-accuracy materials and condensed phase chemistry simulation. PI, total amount \$1,854,820 (co-PIs Lucas Wagner, Garnet Chan, Timothy Berkelbach), 2019-2022.
5. [NSF CCF] RAISE/TAQS: Quantum simulation of materials and molecules using quantum computation. co-PI, total amount \$1,000,000 (PI Fernando Brandao, co-PIs Garnet Chan, Austin Minnich), 2018-2021.