

Zachary Charles

Postdoctoral Researcher

University of Wisconsin-Madison

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Education

- 2013–2018 **PhD in Mathematics**, *University of Wisconsin-Madison*.
Supervisor: Nigel Boston
Dissertation: Algebraic and geometric structure in machine learning and optimization algorithms
- 2011–2013 **M.A. in Mathematics**, *University of Pennsylvania*.
Supervisor: Philip Gressman
Dissertation: Nonstandard analysis and the principle of transfer, and its applications to Ramsey theory
- 2009–2013 **B.A. in Mathematics**, *University of Pennsylvania*.

Publications

Preprints

Zachary Charles, Dimitris Papailiopoulos, and Jordan Ellenberg. Approximate gradient coding via sparse random graphs. *arXiv preprint arXiv:1711.06771*, (in submission), 2018.

Hongyi Wang, Scott Sievert, Zachary Charles, and Dimitris Papailiopoulos. Atomo: Communication-efficient learning via atomic sparsification. (in submission), 2018.

Conference Papers

Zachary Charles and Dimitris Papailiopoulos. Stability and generalization of learning algorithms that converge to global optima. *International Conference on Machine Learning (ICML)*, 2018.

Lingjiao Chen, Zachary Charles, Dimitris Papailiopoulos, et al. Draco: Robust distributed training via redundant gradients. *International Conference on Machine Learning (ICML)*, 2018.

Zachary Charles and Dimitris Papailiopoulos. Gradient coding via the stochastic block model. *International Symposium on Information Theory (ISIT)*, 2018.

Zachary Charles, Amin Jalali, and Rebecca Willett. Subspace clustering with missing and corrupted data. *Data Science Workshop (DSW)*, 2018.

Alisha Zachariah, Zachary Charles, Nigel Boston, and Bernard Lesieutre. Distributions of the number of solutions to the network power flow equations. In

Circuits and Systems (ISCAS), 2018 IEEE International Symposium on, pages 1–5. IEEE, 2018.

Alisha Zachariah and Zachary Charles. Efficiently finding all power flow solutions to tree networks. In *Communication, Control, and Computing (Allerton), 2017 55th Annual Allerton Conference on*, pages 1107–1114. IEEE, 2017.

Journal Papers

Zachary Charles and Nigel Boston. Exploiting algebraic structure in global optimization and the belgian chocolate problem. *Journal of Global Optimization*, May 2018.

Zachary Charles. Generating random factored ideals in number fields. *Mathematics of Computation*, 87(312):2047–2056, 2018.

Zachary Charles. *Algebraic and Geometric Structure in Machine Learning and Optimization Algorithms*. The University of Wisconsin-Madison, 2017.

Zachary Charles, Miriam Farber, Charles R Johnson, and Lee Kennedy-Shaffer. Nonpositive eigenvalues of hollow, symmetric, nonnegative matrices. *SIAM Journal on Matrix Analysis and Applications*, 34(3):1384–1400, 2013.

Zachary Charles, Miriam Farber, Charles R Johnson, and Lee Kennedy-Shaffer. Nonpositive eigenvalues of the adjacency matrix and lower bounds for laplacian eigenvalues. *Discrete Mathematics*, 313(13):1441–1451, 2013.

Zachary Charles, Miriam Farber, Charles R Johnson, and Lee Kennedy-Shaffer. The relation between the diagonal entries and the eigenvalues of a symmetric matrix, based upon the sign pattern of its off-diagonal entries. *Linear Algebra and its Applications*, 438(3):1427–1445, 2013.

Awards

- 2017 **John Nohel Prize in Applied Mathematics**, Department of Mathematics, University of Wisconsin-Madison
- 2015–2017 **NSF Graduate Research Fellowship**, Department of Mathematics, University of Wisconsin-Madison
- 2015 **Graduate Student Teaching Award**, Department of Mathematics, University of Wisconsin-Madison
- 2012 **Richard Garfield Award for Combinatorics**, Department of Mathematics, University of Pennsylvania
- 2009–2013 **Dean’s Scholar Award**, University of Pennsylvania

Presentations

- June 2018 **ISIT 2018, Vail, CO**.
Title: Gradient coding using the stochastic block model.

- June 2018 **IEEE Data Science Workshop**, *Lausanne, Switzerland*.
Title: Subspace clustering with missing and corrupted data.
- Apr 2018 **IFDS Student Workshop**, *University of Wisconsin-Madison*.
Title: Stability and generalization of convergent learning algorithms.
- Nov 2017 **GODDESSES Seminar**, *University of Wisconsin-Madison*.
Title: A farewell to strong convexity.
- Jul 2017 **SILO Seminar**, *University of Wisconsin-Madison*.
Title: Gradient coding using sparse random graphs.
- Jul 2017 **SILO Seminar**, *University of Wisconsin-Madison*.
Title: One weird trick to improve concentration of graphs.
- Apr 2017 **Applied Algebra Seminar**, *University of California-Berkeley*.
Title: Algebraic approaches to the Belgian chocolate problem.
- Mar 2017 **SIAM Student Chapter**, *University of Wisconsin-Madison*.
Title: Subspace clustering with missing data.
- Mar 2016 **Graduate Algebraic Geometry Seminar**, *University of Wisconsin-Madison*.
Title: Toric geometry and Newton polytopes.
- Feb 2016 **AMS Student Chapter**, *University of Wisconsin-Madison*.
Title: #P and me: a tale of permanent complexity.
- Dec 2015 **Graduate Number Theory Seminar**, *University of Wisconsin-Madison*.
Title: Generating random factored ideals in number fields.
- Oct 2015 **Graduate Algebraic Geometry Seminar**, *University of Wisconsin-Madison*.
Title: Real algebraic geometry and the real spectrum.
- Sep 2015 **Mathematics Computation Workshop**, *University of Wisconsin-Madison*.
Title: Using SageMath in algebraic and number-theoretic research.
- Mar 2015 **SILO Seminar**, *University of Wisconsin-Madison*.
Title: Algebraic approaches to the Belgian chocolate problem.
- Dec 2014 **AMS Student Chapter**, *University of Wisconsin-Madison*.
Title: Addition chains: to exponentiation and beyond.

Professional Experience

- Jun 2016 – **MIT Lincoln Laboratory**, *Lexington, MA*.
Sep 2016 Machine Learning Research Intern
- Jun 2014 – **Center for Communications Research**, *Princeton, NJ*.
Sep 2014 Adjunct Researcher
- May 2013 – **National Security Agency**, *Fort Meade, MD*.
Sep 2013 Director's Summer Program
- May 2012 – **National Security Agency**, *Fort Meade, MD*.
Sep 2012 Director's Summer Program

Teaching Experience

- 2013 – 2015 **University of Wisconsin-Madison**, *Department of Mathematics*.
Teaching Assistant for Calculus and Analytic Geometry courses.
- 2012 – 2013 **University of Pennsylvania**, *Department of Mathematics*.
Teaching Assistant for Calculus, Linear Algebra, and Discrete Mathematics courses.