Eren C. Kızıldağ

CONTACT INFORMATION

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https://kizildagerenc.github.io

RESEARCH INTERESTS

My current research interests revolve around *theory of machine learning* and *high-dimensional statistics*, using tools from probability theory and insights from statistical physics. I am particularly interested in devising computationally efficient algorithms for solving machine learning problems and understanding fundamental computational limits by studying the regimes of computational hardness where such algorithms cease to exist.

EMPLOYMENT

Columbia University

Distinguished Postdoctoral Fellow at the Department of Statistics (July 2022 -)

EDUCATION

Massachusetts Institute of Technology

Ph.D. in Electrical Engineering and Computer Science (September 2017 - May 2022), GPA: 5.0/5.0

- Advisor: Prof. David Gamarnik
- Thesis Title: Algorithms and Algorithmic Barriers in High-Dimensional Statistics and Random Combinatorial Structures

M.S. in Electrical Engineering and Computer Science (June 2017), GPA: 5.0/5.0

- Advisor: Prof. Elfar Adalsteinsson
- Thesis Title: Improved Magnetic Resonance Chemical Shift Imaging at 3 Tesla using a 32-channel Integrated RF-Shim Coil Array

Minor in Mathematics (February 2017)

Bogazici University, Turkey

B.Sc. in Electrical and Electronics Engineering (June 2014), GPA: 3.99/4.00

- 2^{nd} rank in the university.
- Specialized in control theory.

PUBLICATIONS

David Gamarnik, Eren C. Kızıldağ, Will Perkins, and Changji Xu. *Algorithms and Barriers in the Symmetric Binary Perceptron Model.* arXiv:2203.15667. https://arxiv.org/abs/2203.15667
(To appear in 2022 IEEE Symposium on Foundations of Computer Science (FOCS).)

David Gamarnik, Eren C. Kızıldağ, and Ilias Zadik. *Self-Regularity of Non-Negative Output Weights for Overparameterized Two-Layer Neural Networks.* arXiv:2103.01887. https://arxiv.org/abs/2103.01887
(IEEE Transactions on Signal Processing, Volume: 70 (March 2022), pp 1310-1319.)
(Conference version appeared in 2021 IEEE International Symposium on Information Theory (ISIT); and is available at https://ieeexplore.ieee.org/abstract/document/9517811.)

David Gamarnik and Eren C. Kızıldağ. *Algorithmic Obstructions in the Random Number Partitioning Problem.* arXiv:2103.01369. https://arxiv.org/abs/2103.01369
(Annals of Applied Probability, Major Revisions.)
(Conference version appeared in 2022 IEEE International Symposium on Information Theory (ISIT); and is available at https://ieeexplore.ieee.org/abstract/document/9834647.)

Matt Emschwiller, David Gamarnik, Eren C. Kızıldağ, and Ilias Zadik. *Neural Networks and Polynomial Regression. Demystifying the Overparametrization Phenomena.* arXiv:2003.10523. https://arxiv.org/abs/2003.10523
(Preprint.)

David Gamarnik, Eren C. Kızıldağ, and Ilias Zadik. *Stationary Points of Shallow Neural Networks with Quadratic Activation Function.* arXiv:1912.01599.
https://arxiv.org/abs/1912.01599
(Submitted to Mathematics of Operations Research.)

David Gamarnik, Eren C. Kızıldağ, and Ilias Zadik. *Inference in High-Dimensional Linear Regression via Lattice Basis Reduction and Integer Relation Detection.* arXiv:1910.10890.
https://arxiv.org/abs/1910.10890
(IEEE Transactions on Information Theory, Volume: 67, Issue: 12 (December 2021), pp 8109-8139.)

David Gamarnik and Eren C. Kızıldağ. *Computing the Partition Function of the Sherrington-Kirkpatrick Model is Hard on Average.* arXiv:1810.05907.
https://arxiv.org/abs/1810.05907
(The Annals of Applied Probability, Volume: 31, No: 3 (June 2021), pp 1474-1504.)
(Conference version appeared in 2020 IEEE International Symposium on Information Theory (ISIT); and is available at https://ieeexplore.ieee.org/document/9174373.)

David Gamarnik and Eren C. Kızıldağ. *High-Dimensional Linear Regression and Phase Retrieval via PSLQ Integer Relation Algorithm.*
https://ieeexplore.ieee.org/document/8849681
(2019 IEEE International Symposium on Information Theory (ISIT).)

Kızıldağ, Eren, et al. *Improved spiral chemical shift imaging at 3 Tesla using a 32-channel integrated RF-shim coil array.*
https://www.ismrm.org/16/program_files/O61.htm
(Proceedings of the 24th Annual Meeting of International Society for Magnetic Resonance in Medicine (ISMRM), Singapore, 2016.)
(Summa cum laude award, among top 5% of all submitted works.)

Honors and Awards

- *Summa cum laude* award (top 5%) in the 24th annual meeting of International Society for Magnetic Resonance in Medicine (ISMRM), 2016
- Ranked 2nd in the graduating class of Bogazici University, 2014
- Presidential Fellowship of Bogazici University, 2010-2014
- Turkish Ministry of Education Scholarship, 2010-2014
- Semi-Finalist in Oyun'2010, 15th Turkish Intelligence Competition, 2010
- Ranked 2nd in the graduating class of Ankara Science High School[1], 2010
- Ranked 11th among 1.8 million students in Centralized University Entrance Exam, 2010
- Candidate for Turkish team for International Mathematical Olympiad (IMO), 2010
- Silver Medal at International Silk Road Mathematical Competition, 2010
- Bronze Medal at National Mathematical Olympiad, held by Scientific and Technological Research Council of Turkey (TUBITAK[2]), 2009
- First rank at Mediterranean Mathematical Olympiad, 2009
- First rank at Middle East Technical University (METU) Mathematical Competition, 2008
- Bronze Medal at Mediterranean Mathematical Olympiad, 2007
- Ranked 4th in Centralized High School Entrance Exam, 2006
- Gold Medal at National Junior Mathematical Olympiad, held by TUBITAK, 2006

Talks

- Random Structures and Algorithms, August 2022.
- IEEE International Symposium on Information Theory, July 2022.
- MIT Statistics and Data Science Conference (SDSCon), April 2022.
- MIT SIAM Seminar, March 2022.
- UIC Combinatorics and Probability Seminar, March 2022.
- MIT LIDS and Statistics Tea Talk, February 2022.
- MIT LIDS Student Conference, January 2022.
- Stanford Information Theory Forum, January 2022.
- Stanford CS Theory Lunch, January 2022.

[1] A special high school that was modeled after Bronx High School of Science, with a curriculum tailored for gifted students.
[2] Turkish equivalent of NSF.

- Bilkent University, Electrical & Electronics Engineering Seminar, January 2022.
- Simons Institute at UC Berkeley, Graduate Seminar, November 2021.
- Cornell ORIE Young Researchers Workshop, October 2021.
- IEEE International Symposium on Information Theory, July 2021.
- MIT LIDS and Statistics Tea Talk, May 2021.
- MIT LIDS Student Conference, January 2021.
- MIT Machine Learning Tea Talks, July 2020.
- IEEE International Symposium on Information Theory, July 2020.
- Machine Learning at MIT Retreat, February 2020.
- IEEE International Symposium on Information Theory, July 2019.

Graduate Coursework

- ❑ Information Theory (A+)
- ❑ Fundamentals of Probability (A+)
- ❑ Inference and Information (A)
- ❑ Topics in Discrete Probability (A+)
- ❑ Real Analysis (A+)
- ❑ Optimization Methods (A+)
- ❑ Digital Image Processing (A)
- ❑ Data Acquisition and Image Reconstruction in MRI (A)
- ❑ Fourier Analysis: Theory and Applications (A+)

Teaching Experience

Massachusetts Institute of Technology

Residential:

- Teaching Assistant for 6.436 Fundamentals of Probability (Fall 2019).
- Teaching Assistant for 6.344 Digital Image Processing (Spring 2019).
- Teaching Assistant for 6.S077 Introduction to Data Science (Spring 2018).
- Teaching Assistant for 6.437 Inference and Information (Spring 2017).
- Conducted weekly recitations and office hours, helped with exam questions, prepared and graded problem sets and exams.

Online:

- Teaching Assistant for 6.431x, Probability - The Science of Uncertainty and Data (Fall 2018).
- Worked in development team of 6.431x, Probability - The Science of Uncertainty and Data (Fall 2017); and of 18.650x Fundamentals of Statistics (Summer 2018).
- edX-based MOOC's, with $\sim$ 2000 verified enrollments. Responsibilities include answering and moderating forum posts, developing problem set and exam problems.

Computing Skills

C, MATLAB, LaTeX.

Languages

Turkish (Native), English (Fluent).

Personal

Citizen of Turkey, born in 1992. F-1 visa holder.