Kedar Karhadkar

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Education

Ph.D. Mathematics, *University of California, Los Angeles* 08/2021 – 05/2025 | Los Angeles, CA
- Research interests: machine learning theory, optimization, graph neural networks.
- GPA: 3.95.
- Passed all qualifying exams (Analysis, Algebra, Basic) upon entry.
- Selected coursework: Machine Learning, Optimization, Numerical Linear Algebra, High-dimensional Statistics.

B.S. Mathematics, *Pennsylvania State University* 08/2017 – 05/2021 | University Park, PA
- GPA: 3.93.
- Selected coursework: Data Structures and Algorithms, Probability, Mathematical Statistics, Real/Complex/Functional Analysis (Graduate), Abstract Algebra (Graduate), Algebraic Geometry (Graduate).

Skills

- Software Development: Python, C++, JavaScript.
- Machine Learning/Data Science: PyTorch, Tensorflow, Numba, NumPy, SciPy, Matplotlib, Pandas, Scikit-learn, SQL, Julia, MATLAB, Maple.

Experience

Quantitative Research Intern, 06/2024 – 08/2024
Susquehanna International Group (SIG)

Visiting Researcher, 06/2023 – 09/2023
Max Planck Institute for Mathematics in the Sciences
- Conducted research on optimization landscapes and graph neural networks and presented results to other researchers.

Graduate Student Researcher, *UCLA* 08/2021 – present
- Conducted research on graph neural networks and deep learning theory accepted to major conferences.
- Designed architectures for graph neural networks (GNNs) to prevent bottlenecks, increasing accuracy on graph classification tasks by up to 20% while achieving a 10x speedup over existing state-of-the-art rewiring algorithms. Implemented all methods in PyTorch.
- Served as a reviewer for NeurIPS, ICML, ICLR, TMLR, TPAMI, Discrete Applied Mathematics.

Teaching Assistant, *UCLA* 08/2021 – present
- Served as a teaching assistant for several undergraduate math classes, including Machine Learning, Stochastic Processes, Discrete Math, and Calculus.

Undergraduate Researcher, *University of Minnesota REU* 06/2020 – 08/2020
- Determined and proved necessary algebraic conditions for the Yang-Baxter equation to hold in a more general setting than previously known.
- Found new combinatorial interpretations of the six-vertex and eight-vertex models from statistical mechanics in terms of discrete differential forms and graph coloring.

Undergraduate Researcher, *Moravian University REU*
- Conducted research on graph theory, number theory, and combinatorics, leading to two publications in Discrete Applied Mathematics.

Publications

Asterisk (*) indicates alphabetical order.

1) *Bounds for the smallest eigenvalue of the NTK for arbitrary spherical data of arbitrary dimension*
Kedar Karhadkar, Michael Murray, and Guido Montúfar. Preprint: arxiv:2405.14630 .
2) *Benign overfitting in leaky ReLU networks with moderate input dimension*
Kedar Karhadkar, Erin George, Michael Murray, Guido Montúfar, and Deanna Needell. Preprint: arXiv:2403.06903 .
3) *Mildly Overparameterized ReLU Networks Have a Favorable Loss Landscape*
Kedar Karhadkar, Michael Murray, Hanna Tseran, and Guido Montúfar. Submitted. Preprint: arXiv:2305.19510 .
4) *FoSR: First-order spectral rewiring for addressing oversquashing in GNNs*
Kedar Karhadkar, Pradeep Kr. Banerjee, and Guido Montúfar. ICLR 2023. Preprint: arXiv:2210.11790 .
5) *Oversquashing in GNNs through the lens of information contraction and graph expansion*
Pradeep Kr. Banerjee, **Kedar Karhadkar**, Yu Guang Wang, Uri Alon, and Guido Montúfar. 58th Annual Allerton Conference on Communication, Control and Computing (2022). Preprint: arXiv:2208.03471 .
6) *Sum index and difference index of graphs*
*Joshua Harrington, Eugene Henninger-Voss, **Kedar Karhadkar**, Emily Robinson, Tony W.H. Wong. Discrete Applied Mathematics (2023). Preprint: arXiv:2008.09265 .
7) *Two dependent probabilistic chip-collecting games*
*Joshua Harrington, **Kedar Karhadkar**, Madeline Kohutka, Tessa Stevens, and Tony W.H. Wong.
8) *Parity of the partition function p(n, k)*
Kedar Karhadkar. International Journal of Number Theory (2019). Preprint: arXiv:1809.07459 .
9) *Lattice models, differential forms, and the Yang-Baxter equation*
Kedar Karhadkar. Preprint: arXiv:2207.13282 .

Awards

- Putnam Mathematics Competition, Top 500
- Leonhard Euler Memorial Scholarship
  - Awarded by Penn State math department based on academic performance.
- Provost's Award
  - Four-year scholarship awarded by Penn State to incoming freshmen based on academic performance.