Melanie Weber

Assistant Professor of Applied Mathematics and of Computer Science, Harvard University

mweber@seas.harvard.edu | melanie-weber.com | Geometric ML Group

Primary area of research: Geometric Machine Learning

My research studies how structure in data and models affects learning and computation, and how it can be exploited to design more efficient algorithms with provable guarantees.

Academic Positions

2023– Harvard University — Assistant Professor of Applied Mathematics and of Computer Science

2021–22 University of Oxford — Hooke Research Fellow, Mathematical Institute; Nicolas Kurti Junior Research Fellow, Brasenose College

Education

2021 Ph.D. in Applied Mathematics, Princeton University (advisor: Charles Fefferman)

2016 Undergraduate degrees in Mathematics and Physics, University of Leipzig

Selected Honors & Awards

2026 Army Research Early Career Award

2025 Schmidt Sciences AI2050 Early Career Fellowship

2025 Air Force Young Investigator Award

2025 COLM Outstanding Paper Award

2025 Aramont Fellowship for Emerging Science Research

2024 Alfred P. Sloan Research Fellowship in Mathematics

2023 IMA Leslie Fox Prize in Numerical Analysis

Selected Research Publications

2026 N. García Trillos, M. Weber: Continuum Limits of Ollivier's Ricci Curvature on Data Clouds. *Discrete & Computational Geometry.*

2026 M. Hehl, M.-K. von Renesse, M. Weber: Neural Feature Geometry Evolves as Discrete Ricci Flow. *ICML.* (Spotlight)

2026 B. Tahmasebi, M. Weber: Achieving Approximate Symmetry Is Exponentially Easier than Exact Symmetry. *ICLR.*

2026 B. Tahmasebi, M. Weber, S. Jegelka: Data Augmentation: A Fourier Analysis Perspective. *COLT.*

2026 A. Cheng, V. Dixit, M. Weber: Disciplined Geodesically Convex Programming. *Mathematical Programming Computation.*

2025 Y. Tian, Z. Lubberts, M. Weber: Curvature-based Clustering on Graphs. *Journal of Machine Learning Research.*

2025 A. Lee, M. Weber, F. Viégas, M. Wattenberg: Shared Global and Local Geometry of Language Model Embeddings. *COLM.* (Outstanding Paper)

2024 B. Kiani, J. Wang, M. Weber: Hardness of Learning Neural Networks under the Manifold Hypothesis. *NeurIPS.* (Spotlight)

2024 B. Kiani, T. Le, H. Lawrence, S. Jegelka, M. Weber: On the Hardness of Learning under Symmetries. *ICLR.* (Spotlight)

2024 B. Kiani, L. Fesser, M. Weber: Unitary Convolutions for Learning on Graphs and Groups. *NeurIPS.* (Spotlight)

2022 M. Weber, S. Sra: Riemannian Optimization via Frank-Wolfe Methods. *Mathematical Programming.*

2017 M. Weber, E. Saucan, J. Jost: Characterizing Complex Networks with Forman-Ricci Curvature and Associated Geometric Flows. *Journal of Complex Networks* 5(4), 527–550.

Selected Research Funding

Total funds to Harvard: $8,127,063 | Personal share: $4,867,063

2026–28 DARPA expMath — neural combinatorial optimization ($789K; sole PI)

2026–28 Schmidt Sciences — AI2050 Early Career Fellowship ($500K; sole PI)

2026–28 Air Force Young Investigator Award — optimization under symmetry ($450K; sole PI)

2026–28 Army Research Early Career Award — optimization on learned manifolds ($360K; sole PI)

2024–27 NSF DMS — geometry-informed machine learning ($180K; sole PI)

2026–28 Google AI for Science Impact Challenge — hyperbolic machine learning for single-cell reprogramming; lab-in-the-loop research ($650K personal share; co-PI)

Selected Expository Writing

2026 *Geometry-Informed AI for Scientific Discovery.* Dædalus.

2025 *Geometric Machine Learning.* AI Magazine (invited survey).

Keynotes & Plenaries

2027 SIAM Conference on Applied Algebraic Geometry

2026 World Meeting for Women in Mathematics (WM)²

2026 ICML Workshop on Weight-Space Symmetries

2026 Discrete Laplacians Workshop

2026 NetSci Satellite “TopoNets”

2026 NetSci Satellite “Network Geometry”

2026 Sanjoy K. Mitter LIDS Student Conference, MIT

2025 Learning on Graphs Conference

2025 Annual Fall Workshop on Computational Geometry

2025 Algebraic Topology: Methods, Computation, and Science (ATMCS11)

2025 NetSci Satellite “Network Geometry”

2025 IEEE Workshop on Graph Signal Processing

2025 Boston Symmetry Day

2024 DeepMath, Conference on the Mathematical Theory of Deep Neural Networks

2024 AstroAI Conference, Harvard-Smithsonian Center for Astrophysics

2024 IAIFI Summer Workshop

2023 Mathematics and Machine Learning Conference, Caltech

2023 ICML Workshop on Topology, Algebra and Geometry in Machine Learning

2022 SIAM Workshop on Network Science

2020 NeurIPS Workshop “Differential Geometry meets Deep Learning”

Tutorials

2026 NeurIPS — *Three Geometric Lenses on Graph Machine Learning*

2026 SIAM Mathematics of Data Science — *Model-Agnostic Machine Learning with Structure: Principles and Methods* (with B. Tahmasebi)

2026 NetSci School — *Deep Learning on Networks through a Geometric Lens*

Industry Research Experience

2026– Visiting Faculty Researcher, Google Research

2020–23 Chief Scientist, Claudius Legal Intelligence — member of founding team; led machine-learning research

2018–21 Research internships at Microsoft Research, Google Research, and Facebook AI Research