

Melanie Weber

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Academic Positions

University of Oxford, Mathematical Institute <i>Hooke Research Fellow</i>	Oxford, UK <i>Fall 2021-</i>
University of Oxford, Brasenose College <i>Nicolas Kurti Junior Research Fellow</i>	Oxford, UK <i>Fall 2021-</i>

Education

Princeton University <i>PhD, Applied Mathematics</i> Thesis: <i>On geometric optimization, learning and control</i> ; advised by Charles Fefferman.	Princeton, NJ <i>2016 – 2021</i>
University of Leipzig <i>Diplom (joint BSc / MSc) in Mathematics, BSc in Physics</i> Undergraduate research on Discrete Geometry (advised by Jürgen Jost) and Deep Learning approaches to event classification at the ATLAS experiment at CERN's Large Hadron Collider (advised by Michael Kobel).	Leipzig, Germany <i>2011 – 2016</i>
University of Washington <i>MSc, Applied Mathematics</i> Exchange Student. Research in Computational Neuroscience, advised by J. Nathan Kutz.	Seattle, WA <i>2014 – 2015</i>

Other Research Experience

Short-term positions & Visits.....

Simons Institute for the Theory of Computing <i>Research Fellow</i> Participant in Special Program <i>Geometric Methods in Optimization and Sampling</i> .	Berkeley, CA <i>Fall 2021</i>
Microsoft Research <i>Research Intern</i> Contrastive Learning and Geometry. Hosted by Phil Bachman.	Redmond, WA <i>Summer 2021</i>
Google Research <i>Research intern</i> Role of geometry in learning robust classifiers. Adversarial learning in non-Euclidean spaces. Hosted by Manzil Zaheer, Ankit Singh Rawat, Aditya Menon and Sanjiv Kumar.	New York, NY <i>Summer 2019</i>
Massachusetts Institute of Technology <i>Visiting Student/ Ivy Exchange Scholar</i> Riemannian Frank-Wolfe Methods for Optimization on Manifolds. Hosted by Suvrit Sra.	Cambridge, MA <i>Summer 2017, Spring 2019</i>
Facebook Artificial Intelligence Research <i>Research Intern</i> Representation trade-offs in non-Euclidean embeddings. Hosted by Maximilian Nickel.	New York, NY <i>Summer 2018</i>

Entrepreneurship.....

Claudius Legal Intelligence <i>Chief Scientist</i> Claudius leverages AI to process legal case data, identify key legal issues and produce data-driven valuations. I work with a team of researchers on advancing Legal AI through research in NLP, predictive modeling and algorithmic fairness. Funding/ Memberships: NSF SBIR Grant (2021-), NSF Innovation Corps (2020), Creative Destruction Lab (AI Stream) at University of Toronto (2020), Princeton's Keller Center eLab Incubator and Accelerator (2020).	Princeton, NJ <i>2020-</i>
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Earlier Research Experience.....

Max Planck Institute for Mathematics in the Sciences

Leipzig, Germany

Student Researcher

2015 - 2016

Discrete Ricci curvature and applications in network analysis. Advised by Jürgen Jost.

TU Dresden/ CERN

Dresden, Germany

Student Researcher

Spring/ Summer 2016

Event classification at CERN's ATLAS experiment with ConvNets. Advised by Michael Kobel.

Cold Spring Harbor Laboratory, Stanley Institute

Cold Spring Harbor, NY

Visiting Student

Summer 2015

Machine Learning methods for gene function prediction. Advised by Jesse Gillis.

Max Planck Institute for Evolutionary Anthropology

Leipzig, Germany

Research Assistant

2013 - 2014

Statistical learning methods for identifying introgressed Neanderthal regions in the human genome. Advised by Kay Prüfer.

Publications & Preprints

* alphabetic order; # co-first authors;

Optimization & Machine Learning.....

18. **Controlling Unknown Linear Dynamics with Bounded Multiplicative Regret** J. Carruth*, M. Eggl*, C. Fefferman*, C. Rowley*, M. Weber*. (2021) *Under Review*. arXiv:2109.06350
17. **Projection-free nonconvex stochastic optimization on Riemannian manifolds.** M. Weber, S. Sra. (2021) *IMA Journal on Numerical Analysis* (arXiv:1910.04194)
16. **Optimal Control with Learning on the fly: A toy problem.** C. Fefferman*, B. Guillen Pegueroles*, C. W. Rowley*, M. Weber*. (2021) *Revista Matemática Iberoamericana*, vol. 37(1). (arXiv:2002.11578)
15. **Identifying biases in legal data: An algorithmic fairness perspective.** J. Sargent, M. Weber. (2021) *ACM Conference on Equity and Access in Algorithms, Mechanisms, and Optimization*.
14. **Robust large-margin learning in hyperbolic space.** M. Weber, M. Zaheer, A. Singh Rawat, A. Menon, S. Kumar. (2020) *Advances in Neural Information Processing Systems (NeurIPS)*. (arXiv:2004.05465)
13. **Neighborhood Growth Determines Geometric Priors for Relational Representation Learning.** M. Weber. (2020) *Proceedings of the Twenty Third International Conference on Artificial Intelligence and Statistics (AISTATS)*, PMLR 108:266-276. (arXiv:1910.05565)
12. **Curvature and Representation Learning: Identifying Embedding Spaces for Relational Data.** M. Weber, M. Nickel (2018) *NeurIPS Workshop on Relational Representation Learning*.
11. **Detecting the coarse geometry of networks.** M. Weber, E. Saucan, J. Jost. (2018) *NeurIPS Workshop on Relational Representation Learning*.
10. **Riemannian Optimization via Frank-Wolfe Methods.** M. Weber, S. Sra. (2017) arXiv:1710.10770 *Under Review (Journal)*.

Discrete Geometry & Network Analysis.....

9. **Forman's Ricci Curvature – From Networks to Hypernetworks.** E. Saucan#, M. Weber# (2019) *Seventh Conference on Complex Networks and Their Applications*. Appeared in: *Studies in Computational Intelligence*, vol 812. Springer, Cham. (arXiv:1810.07749)
8. **Discrete Curvatures and Network Analysis.** E. Saucan, A. Samal, M. Weber and J. Jost (2018) *MATCH*, vol. 80 (3), pp. 605–622.
7. **Coarse Geometry of Evolving Networks.** M. Weber, E. Saucan and J. Jost (2018) *Journal of Complex Networks*. vol. 6(5), pp. 706-732. (arXiv: 1608.07838)
6. **Characterizing Complex Networks with Forman-Ricci Curvature and Associated Geometric Flows.** M. Weber, E. Saucan and J. Jost. (2017) *Journal of Complex Networks*, vol. 5 (4), 527-550. (arXiv:1607.08654)

5. **Forman-Ricci Flow for Change Detection in Large Dynamic Data Sets.** [M. Weber](#), J. Jost and E. Saucan. (2016) *Axioms*. Special issue on Discrete Geometry and Applications, vol. 5(4), 26. (arXiv:1604.06634)

Computational Biology

4. **Exploration of the sputum methylome and omics deconvolution by quadratic programming in molecular profiling of asthma and COPD: the road to sputum omics 2.0.** E. Groth, [M. Weber](#), T. Bahmer, F. Pedersen, D. Börnigen, K. Rabe, H. Watz, O. Ammerpohl, T. Goldmann (2020) *Respiratory Research* 21:274.
3. **Curvature-based Methods for Brain Network Analysis.** [M. Weber](#), J. Stelzer, E. Saucan, A. Naitzat, G. Lohmann, J. Jost (2017) *Technical Report*. (arXiv: 1707.00180)
2. **Estimating Memory Deterioration Rates Following Neurodegeneration and Traumatic Brain Injuries in a Hopfield Network Model.** [M. Weber](#), P. D. Maia, J. N. Kutz (2017) *Frontiers in Neuroscience*, DOI: 10.3389/fnins.2017.00623. (arXiv:1609.07656)
1. **EGAD – Ultrafast Analysis of Genetic Networks.** S. Ballouz#, [M. Weber](#)#, P. Pavlidis, J. Gillis (2016) *Bioinformatics*, vol. 33 (4): 612-614.

Honors

Rising Stars in EECS	2021
Simons-Berkeley Fellowship	2021
US Junior Oberwolfach Fellowship	2018
Microsoft Azure Research Award	2017
Dean's Grant, Princeton University	2016
C. V. Starr Fellowship, Princeton University	2016
Full Scholarship for Undergraduate Studies, Konrad Adenauer Foundation	2012

Travel Grants

JMM (2021), NetSci (2020), IPAM (2018), ICERM (2017)

Selected Communications

Invited Talks

KU Leuven Institute for Artificial Intelligence, Research Seminar	2021
INFORMS Annual Meeting (Special Session: Optimization on Manifolds)	2021
AMS Fall Western Sectional Meeting (Session: Theoretical and Applied Perspectives in Machine Learning)	2021
Microsoft Research Montreal	2021
Oxford, Data Science Seminar	2021
SIAM Conference on Applied Linear Algebra (Minisymposium: Linear Algebra & Differential Geometry)	2021
Oxford, Networks Seminar	2021
Stitch Fix, Algo-Hour	2021
One World Seminar Series: Mathematics of Machine Learning	2021
Joint Mathematics Meeting (AMS Special Session: Geometry in the Mathematics of Data Science)	2021
NeurIPS Workshop: Differential Geometry meets Deep Learning	2020
Microsoft Research, Foundations of Machine Learning Seminar	2020
Stanford University, Hazy Lab	2020
Princeton University, Graduate Student Seminar	2020
Google Research, BigML Group	2019
EPFL, Applied Topology Seminar	2018
Max Planck Institute for Mathematics in the Sciences, Research Seminar	2018
New York Machine Learning Meetup	2018
MIT, Machine Learning Group	2017

Contributed Talks

Conference on Mathematical Theory of Deep Learning (DeepMath)	2020
Conference on Network Sciences (NetSci)	2020
International Conference on Artificial Intelligence and Statistics (AISTATS)	2020
Conference on Network Sciences (NetSci)	2017
Machine Learning on Networks (NetSci Satellite)	2017
Connectomics	2017

Teaching

Completed comprehensive teaching training through Princeton's *Teaching Transcript*.

Preceptor

ORF 350 Analysis of Big Data , taught biweekly 50-minute section.	Spring 2021
COS 126 Introduction to Computer Science , taught two 80-minute sections per week.	Fall 2018

Teaching Assistant

Homework/ exam grading, held office hours.

MAT 321/ APC 321 Numerical Methods	Fall 2020
MAT 588/ APC 588 Optimization on Smooth Manifolds , graduate course	Spring 2020
MAT 103 Calculus	Fall 2017, Fall 2019
ORF 407 Fundamentals of Queuing Theory	Spring 2018
Numerical Methods , at University of Leipzig	Spring 2016

Professional Activities

Invited Participant

Workshop on Whitney Extension Problems	2018, 2021
Oberwolfach Seminar on Mathematics of Deep Learning	2018
ICERM Workshop for Woman in Data Science Research	2017

Reviewing

Journals: Algorithmica, Axioms, Discrete & Computational Geometry, Entropy, Information and Inference, Mathematical Programming, PlosOne, Physica A

Conferences: Conference on Decision and Control (CDC), International Conference on Learning Representations (ICRL), Neural Information Processing Systems (NeurIPS)

Outreach and Service

ECR Committee, Oxford Mathematical Institute , Member	2021 –
Oxford Data Science Seminar , Organizer	2021 –
Skype a Scientist , Volunteer Scientist	2018 –
WiML Un-Workshop at ICML , Breakout session leader (Topic: Geometry and Machine Learning)	2021
Mentoring Möbius , Mentor for Princeton Undergraduate Mathematics Majors	2017 – 20
Graduate Student Seminar , Organizer	2016 – 17

Computing

Software (publicly available)

EGAD Machine Learning Toolbox for Functional Analysis of Genetic Networks and Gene Function Prediction.
Bioconductor R package (10.18129/B9.bioc.EGAD)

Other <https://github.com/MelWe>

Languages

Python, R, Matlab, Java