

# Theodor Misiakiewicz

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## Appointments

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- **Yale University** **New Haven, CT, USA**  
Assistant Professor in the Department of Statistics and Data Science 07/2024 – Now
- **Toyota Technological Institute at Chicago (TTIC)** **Chicago, IL, USA**  
Research Assistant Professor. 09/2023 – 06/2024

## Education

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- **Stanford University** **Stanford, CA, USA**  
*Ph.D Candidate*, Department of Statistics. 09/2017 – 06/2023  
PhD Advisor: Prof. Andrea Montanari.  
Title: “*Learning with neural networks in high dimensions*”.  
*M.Sc. in Statistics*, Department of Statistics. 09/2017 – 06/2020
- **École Normale Supérieure de Paris** **Paris, France**  
*M.Sc. in Theoretical Physics*, International Center of Fundamental Physics. 09/2014 – 07/2016  
*B.Sc. in Mathematics*, Department of Mathematics. 09/2013 – 09/2014  
*B.Sc. in Physics*, Department of Physics. 09/2013 – 09/2014

## Academic & Research Experience

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- **EPFL, Lausanne, Switzerland** 06/2022 – 09/2022  
Visiting student at the Mathematics Department.  
Advisor: Prof. Emmanuel Abbe.
- **G-Research, London, UK** 07/2019 – 09/2019  
Summer intern (quant intern).
- **MIT, Cambridge, MA** 02/2017 – 07/2017  
Visiting student at the Laboratory for Information and Decision Systems (LIDS) and  
Institute for Data, Systems and Society (IDSS), EECS Department.  
Advisor: Prof. Guy Bresler.
- **Los Alamos National Laboratory, Los Alamos, NM**  
Visiting student at the Center for Non-Linear Studies.

- Funded by D-Wave Quantum Computing grant. 06/2016 – 09/2016  
*Advisor:* Sct. Marc Vuffray.
- Power Grid Spectroscopy project, NMC, sponsored by the NSF. 02/2015 – 07/2015  
*Advisor:* Sct. Michael Chertkov.
- **École Polytechnique**, Palaiseau, France 01/2016 – 03/2016  
Intern at the Laboratoire Leprince-Ringuet, joint position CNRS and CERN.  
CMS experiment at Large Hadron Collider (LHC), CERN, Geneva.  
*Advisor:* Sct. Christophe Ochando.
- **Paris-Diderot University (Paris VII)**, Paris, France 06/2014 – 08/2014  
Summer intern at the Astroparticle and Cosmology Laboratory (APC).  
Cosmology and Gravitation theory group.  
*Advisor:* Prof. Daniele Steer.

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#### *Research Interests*

- Theory of Deep Learning: mean-field description and neural tangent kernel.
- Kernel and random feature methods in high-dimension (benign overfitting, multiple descent...).
- Non-convex optimization, implicit regularization, landscape analysis.
- Computational limits of learning with neural networks.
- Random matrix theory, high-dimensional probability.

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#### *Awards & Honors*

- **Theodore W. Anderson Theory of Statistics Dissertation Award**, Department of Statistics, Stanford 06/2023
- **Silver medal** at the 43rd International Physics Olympiads, Tallinn, Estonia 07/2012
- **2nd Prize Physics** and **Honors Maths**, Concours General (National Competition) 07/2011
- **1st Prize**, French National Physics Olympiads 12/2010

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#### *Teaching Experience*

- **Yale University** 07/2024 – Now
  - S&DS 410/S&DS 610: Statistical Inference Fall 2024
  - Topics in the Mathematics of Deep Learning Spring 2025
- **Teaching Assistant**, Stanford University 06/2017 – 06/2023
- **Teaching Assistant**, Deep Learning Theory Summer School, Princeton 08/2021

### Conference Proceedings:

- (C10) “SGD learning on neural networks: leap complexity and saddle-to-saddle dynamics.”  
Emmanuel Abbe, Enric Boix-Adsera, Theodor Misiakiewicz.  
In *Conference on Learning Theory*, pp. 2552–2623. PMLR, 2023.
- (C9) “Precise Learning Curves and Higher-Order Scalings for Dot-product Kernel Regression.”  
Hong Hu, Yue M. Lu, Theodor Misiakiewicz, Jeffrey Pennington, Lechao Xiao.  
*Neural Information Processing Systems Conference*, 2022.
- (C8) “Learning with convolution and pooling operations in kernel methods.”  
Theodor Misiakiewicz, Song Mei.  
*Neural Information Processing Systems Conference*, 2022.
- (C7) “The merged-staircase property: a necessary and nearly sufficient condition for sgd learning of sparse functions on two-layer neural networks.”  
Emmanuel Abbe, Enric Boix-Adsera, Theodor Misiakiewicz.  
In *Conference on Learning Theory*, pp. 4782–4887. PMLR, 2022.
- (C6) “Learning with invariances in random features and kernel models.”  
Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
In *Conference on Learning Theory*, pp. 3351–3418. PMLR, 2021.
- (C5) “When do neural networks outperform kernel methods?”  
Behrooz Ghorbani, Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
*Advances in Neural Information Processing Systems*, 33, pp. 14820–14830, 2020.
- (C4) “Mean-field theory of two-layers neural networks: dimension-free bounds and kernel limit.”  
Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
In *Conference on Learning Theory*, pp. 2388–2464. PMLR, 2019.
- (C3) “Limitations of Lazy Training of Two-layers Neural Networks.”  
Behrooz Ghorbani, Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
*Advances in Neural Information Processing Systems*, 32, 2019.
- (C2) “Solving SDPs for synchronization and MaxCut problems via the Grothendieck inequality.”  
Song Mei, Theodor Misiakiewicz, Andrea Montanari, Roberto Imbuzeiro Oliveira.  
In *Conference on learning theory*, pp. 1476–1515. PMLR, 2017.
- (C1) “Concentration to zero bit-error probability for regular LDPC codes on the binary symmetric channel: Proof by loop calculus.”  
Marc Vuffray, Theodor Misiakiewicz.  
In *53rd Annual Allerton Conference on Communication, Control, and Computing (Allerton)*, pp. 115–124. IEEE, 2015.

### Journal Papers:

- (J3) “Generalization error of random feature and kernel methods: hypercontractivity and kernel matrix concentration.”  
Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
*Applied and Computational Harmonic Analysis*, 59, 3–84, 2022.
- (J2) “When do Neural Networks Outperform Kernel Methods?”  
Behrooz Ghorbani, Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
*Journal of Statistical Mechanics: Theory and Experiment* 2021, no. 12, 124009, 2021.
- (J1) “Linearized two-layers neural networks in high dimension.”  
Behrooz Ghorbani, Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
*The Annals of Statistics*, 49(2), pp. 1029–1054, 2021.

### **Discussions/Expository Writings:**

- (D3) “Six Lectures on Linearized Neural Networks.”  
Theodor Misiakiewicz, Andrea Montanari.  
Preprint arXiv:2308.13431, 2023.
- (D2) “Learning with neural networks in high dimensions.” Theodor Misiakiewicz.  
PhD Dissertation, department of Statistics, Stanford , 2023.
- (D1) Discussion of: "Nonparametric regression using deep neural networks with ReLU activation function".  
Behrooz Ghorbani, Song Mei, Theodor Misiakiewicz, Andrea Montanari.  
*The Annals of Statistics*, 48(4), pp. 1898–1901, 2020.

### **Preprints/In Submission Papers:**

- (P5) “Dimension-free deterministic equivalents for random feature regression.”  
Leonardo DeFilippis, Bruno Loureiro, Theodor Misiakiewicz.  
Preprint arXiv:2405.15699, 2024.
- (P4) “A non-asymptotic theory of Kernel Ridge Regression: deterministic equivalents, test error, and GCV estimator.”  
Theodor Misiakiewicz, Basil Saeed.  
Preprint arXiv:2403.08938, 2024.
- (P3) “Asymptotics of random feature regression beyond the linear scaling regime.”  
Hong Hu, Yue M. Lu, Theodor Misiakiewicz.  
Preprint arXiv:2403.08160, 2024.
- (P2) “Spectrum of inner-product kernel matrices in the polynomial regime and multiple descent phenomenon in kernel ridge regression.”  
Theodor Misiakiewicz.  
Preprint arXiv:2204.10425, 2022.
- (P1) “Minimum complexity interpolation in random features models.”  
Michael Celentano, Theodor Misiakiewicz, Andrea Montanari.  
Preprint arXiv:2103.15996, 2021.

### *Invited Talks*

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(T29) <i>Random matrices and high-dimensional learning dynamics</i> , CRM, Montréal	06/2025
(T28) INFORMS, Seattle	10/2024
(T27) <i>PDE Methods in Machine Learning: from Continuum Dynamics to Algorithms</i> BIRS-IMAG workshop, Granada, Spain	06/2024
(T26) <i>Workshop on Statistical Inference and Learning Dynamics</i> , IDEAL, Northwestern	05/2024
(T25) MoDL meeting, San Diego	05/2024
(T24) <i>Random Structures, Computation, and Statistical Inference</i> AMS sectional meeting, San Francisco	05/2024
(T23) <i>Research at TTIC seminar</i> , TTIC	04/2024
(T22) NSF TRIPODS II Meeting	04/2024
(T21) <i>Statistical physics and Machine Learning</i> , Cargese	08/2023
(T20) Workshop on <i>High Dimensional Statistics and Random Matrices</i> , Porquerolles	06/2023
(T19) <i>Optimal Transport, Mean-Field Models, and Machine Learning</i> TUM Institute for Advanced Study, Munich, Germany.	04/2023
(T18) <i>Statistics seminar</i> , Yale University	03/2023
(T17) <i>Seminar</i> , Toyota Technological Institute at Chicago	01/2023
(T16) <i>Statistics seminar</i> , University of Chicago	01/2023
(T15) <i>Mathematics and Data Science seminar</i> Center for Data Science and Courant Institute, NYU.	11/2022
(T14) <i>ML theory seminar (alg-ml)</i> , Princeton	11/2022
(T13) <i>Topics in Theory of Neural Networks</i> , INFORMS	10/2022
(T12) <i>Information Systems Laboratory (ISL) Colloquium</i> , Stanford	10/2022
(T11) <i>External FLAIR seminar</i> , EPFL	09/2022
(T10) <i>Learning: Optimization and Stochastics (Summer Research Institute 2022)</i> , EPFL	06/2022
(T9) <i>Mathematics of Deep Learning</i> , ELLIS	06/2022
(T8) <i>New Interactions Between Statistics and Optimization workshop</i> , BIRS, Banff	05/2022
(T7) <i>Deep Learning Theory Symposium workshop</i> , Simons Institute, Berkeley	12/2021
(T6) <i>Geometric Methods in Optimization and Sampling</i> , Simons Institute, Berkeley	10/2021
(T5) <i>Youth in High-Dimensions</i> , ICTP, Trieste	06/2021
(T4) <i>NSF-Simons Journal Club</i>	04/2021

(T3) <i>External Seminar, G-Research</i>	02/2021
(T2) <i>ML Foundations seminar, Microsoft Research</i>	11/2020
(T1) <i>MoDL (NSF collaboration)</i>	10/2020

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*Service & Leadership*

- **Organizer:** reading group on the *Mean-Field description of neural networks*      Fall 2021  
*Geometric Methods in Optimization and Sampling* program, Simons Institute, Berkeley.
- **Consulting in Statistics,** Department of Statistics, Stanford University      2017 – 2023  
Free consulting service offered to the broader Stanford research community.  
Experimental design, data exploration, modeling, statistical inference, etc.
- **Area Chair:** ICML 2021 Workshop on Information-Theoretic Methods for Rigorous, Responsible, and Reliable Machine Learning.
- **Reviewer:** SIAM Journal on Mathematics of Data Science (SIMODS), Journal of Machine Learning Research (JMLR), Neural Information Processing Systems (NeurIPS), International Conference on Machine Learning (ICML), Conference on Learning Theory (COLT), Symposium on Foundations of Computer Science (FOCS), IEEE Transactions on Information Theory, Journal of the Royal Statistical Society: Series B (Statistical Methodology), Proceedings of the National Academy of Sciences (PNAS), International Conference on Learning Representations (ICLR), Conference on Artificial Intelligence and Statistics (AISTATS).