

Hugo Cui

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in linkedin

🐙 GitHub

Profile

About me —

I am an independent postdoc fellow in applied mathematics in the Center of Mathematical Sciences and Applications (CMSA) at Harvard University. Prior to that, I did my PhD studies in machine learning and physics at EPFL, advised by Lenka Zdeborová. My research lies at the crossroads of statistical physics, machine learning theory and high-dimensional probability, and aims at reaching a theoretical understanding of learning in neural networks.

Languages —

French (*native*), English (*CEFR C2*), Italian (*CEFR B1*), Spanish (*CEFR B1*), German (*CEFR A1*)

Education

Harvard University

Independent postdoc in applied mathematics at the Center of Mathematical Sciences and Applications (Harvard CMSA)

Cambridge, USA

2024 –

EPFL

PhD in machine learning theory and statistical physics, advised by Lenka Zdeborová

Lausanne, Switzerland

2020 – 2024

ENS Paris

Masters in theoretical physics

Paris, France

2016 – 2020

- MSc in theoretical physics (international center for fundamental physics), *Highest Honours*
- Bachelor in physics, *Highest Honours*
- Entrance via national competitive examination, ranked 1st/1000+.

Experience

Courant Institute of Mathematical Sciences (NYU)

Visiting PhD student, hosted by Eric Vanden-Eijnden

New York, USA

2023

Capital Fund Management

Risk management Intern

Paris, France

2020

Institute of Theoretical Physics (CEA Saclay)

Master thesis, w. Lenka Zdeborová

Paris, France

2019

University of Zurich

Master internship, theory of quantum topological materials, w. Titus Neupert

Zurich, Switzerland

2018

Non profit —

Innovation Forum

Business associate at the Swiss branch. Promotion of start-ups and technological transfer through interviews, conferences. Organisation of an accelerator and mentorship program for early stage start-ups.

Lausanne, Switzerland

2021

Awards and certifications

EPFL Physics doctoral thesis award

2024

EPFL Best 8% thesis distinction, Physics

2024

G-Research PhD prize in mathematics and data science, EPFL 3rd prize

2024

Recipient of a competitive Harvard CMSA Postdoctoral Fellowship

2024

Famelab [🔗](#) (international science communication competition) finalist, representing Switzerland.

2021

Famelab Switzerland national winner

2021

Ranked 1st /1000+ at Ecole Normale Supérieure national entrance exam	2016
Ranked 4th/1000+ at French Ecole Polytechnique national entrance exam	2016
Laureate of two of the French Academy of Science thematic awards ↗	2014
Bronze medal at 46th International Chemistry Olympiads; 2nd prize at French Chemistry Olympiads; 2nd prize at French Physics Concours Général	2014

Certificates —

- Cambridge Proficiency Certificate CEFR C2
- Swiss Innovation Agency Business Concepts Certificate

List of publications

* denotes equal contributions. All full-text versions are accessible from my [personal website](#) [↗](#).

1. *A Random Matrix Theory Perspective on the Spectrum of Learned Features and Asymptotic Generalization Capabilities*
Y. Dandi, L. Pesce, **H. Cui**, F. Krzakala, Y. M. Lu, B. Loureiro
preprint arXiv:2410.18938
2. *High-dimensional learning of narrow neural networks*
H. Cui
preprint arXiv:2409.13904
3. *A phase transition between positional and semantic learning in a solvable model of dot-product attention*,
H. Cui, F. Behrens, F. Krzakala, L. Zdeborová
NeurIPS 2024 **Spotlight** (top 3.6% of submissions).
4. *Asymptotics of feature learning in two-layer networks after one gradient-step*
H. Cui, L. Pesce, Y. Dandi, F. Krzakala, Y. M. Lu, L. Zdeborová, B. Loureiro
ICML 2024 **Spotlight** (top 3.5% of submissions).
5. *Asymptotics of learning with deep structured (random) features*,
D.Schröder, D.Dmitriev, **H.Cui**, B.Loureiro
ICML 2024.
6. *Analysis of learning a flow-based generative model from limited sample complexity*,
H. Cui, E. Vanden-Eijnden, F. Krzakala, L. Zdeborová
ICLR 2024
7. *High-dimensional asymptotics of denoising auto-encoders*
H. Cui, L. Zdeborová
NeurIPS 2023 **Spotlight** (top 3.6% of submissions); J. Stat. Mech 2024 machine learning special issue.
8. *Bayes-Optimal Learning of Deep Random Networks of Extensive Width*
H. Cui, F. Krzakala, L. Zdeborová
ICML 2023 **Oral** (top 2.4% of submissions); invited to the J. Stat. Mech 2024 machine learning special issue.
9. *Deterministic Equivalent and Error Universality of Deep Random Features*
D.Schröder*, **H.Cui***, D.Dmitriev, B.Loureiro
ICML 2023; J. Stat. Mech 2024 machine learning special issue.
10. *Error Rates for Kernel Classification under Source and Capacity conditions*
H. Cui, B. Loureiro, F. Krzakala, L. Zdeborová
MLST 2023
11. *Large deviations in Semi-Supervised Learning in the Stochastic Block Model*
H. Cui, L. Saglietti, L. Zdeborová
Phys. Rev. E 2022
12. *Generalization Error rates for Kernel Ridge Regression : the Crossover from the Noiseless to the Noisy Regime*
H. Cui, B. Loureiro, F. Krzakala, L. Zdeborová
NeurIPS 2021; J. Stat. Mech 2022 machine learning special issue.

13. *Large deviations in the perceptron model and consequences for active learning*
H. Cui, L. Saglietti, L. Zdeborová
MSML 2020 and MLST 2021
14. *Capturing the learning curves of generic features maps for realistic data sets with a teacher-student model*
B. Loureiro, C. Gerbelot, **H. Cui**, S. Goldt, F. Krzakala, M. Mézard, L. Zdeborová
NeurIPS 2021; J. Stat. Mech 2022 machine learning special issue.

Talks

(Invited talk) Harvard Stats. Probabilitas seminar (USA)	2024
(Talk) Harvard CMSA member seminar (USA),	2024
(Talk) Machine Learning and Signal Processing seminar, ENS Lyon (France)	2024
(Talk) TAU seminar, Inria Paris Saclay (France)	2024
(Invited talk) European Conference on Optimization (EUROPT 2024) (Sweden),	2024
(Invited talk) Lausanne Event on ML Theory, EPFL (Switzerland)	2024
(Invited talk) Youth in High Dimensions, ICTP (Italy)	2024
(Talk) EPFL NeurIPS CIS event (Switzerland)	2023
(Invited talk) 5th International Workshop on Neural Scaling Laws (USA)	2023
(Oral) 40th International conference on machine learning (USA)	2023
(Talk) Machine Learning & Statistical Physics back together, Cargèse (France)	2023
(Invited talk) ITS Seminar, City University of NY (USA)	2023
(Invited talk) EPFL-RIKEN Young rising stars joint workshop (Switzerland)	2022
(Invited talk) Learning: Optimization and Stochastics Summer Research Institute (Switzerland)	2022
(Talk) Learning and Optimization conference, CIRM (France)	2022
(Talk) Advanced Course on Data and Learning (Italy), <i>best presentation award</i>	2022
(Talk) Workshop on the Theory of Overparameterized Machine Learning	2022
(Talk) NeurIPS conference 2021 (Online)	2021
(Invited talk) Fundamentals of Learning and AI Research (FLAIR) seminar, EPFL (Switzerland),	2021
(Talk) 1st Mathematical and Scientific Machine Learning conference (Online)	2020

Posters —

International Conference on Learning Representations (Austria)	2024
(spotlight) Advances in Neural Processing Sys. (NeurIPS) (USA)	2023
Workshop on artificial and biological neural networks (France)	2023
Youth in high dimensions, ICTP (Italy)	2023
4th IMA conference on the mathematical challenges of big data, Oxford (UK)	2022
Summer school on glassy systems and interdisciplinary applications, Cargèse (France),	2021

Dissemination

Teaching —

Machine learning for physicists (Master), <i>28 hours (teaching assistant) + 2 hours (lecturer)</i>	EPFL, 2023
Statistical physics of learning (Master), <i>56 hours (teaching assistant)</i>	EPFL, 2022-2023
Statistical Physics II (Master), <i>28 hours (teaching assistant)</i>	EPFL, 2022
Physics for Earth Scientists (Bachelor), <i>28 hours (teaching assistant)</i>	Lausanne Univ., 2021
Physics I (Bachelor), <i>28 hours (teaching assistant)</i>	EPFL, 2020

Reviewing —

I am a reviewer for machine learning conferences (NeurIPS, ICML, ICLR) and physics journals (J. Stat. Mech)

Supervision —

Nolan Sandgathe (Master thesis)	2023
Oscar Bouverot-Dupuis (Master internship)	2022

Panels —

Invited lecturer (panelist) at the graduate course on *science outreach and popularization*

Geneva Univ., 2022