HUGO CUI

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PROFILE

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 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
- ***Chinese*** Native
- ***English*** CEFR C2
- ***Italian*** CEFR B2
- ***German*** CEFR A1
- ***Spanish*** CEFR B1

CERTIFICATIONS

- Cambridge Proficiency Certificate CEFR C2
- Chinese Proficiency Evaluation HSK 5
- Swiss Innovation Agency Business Concepts Certificate

AWARDS

- **2024:** G-Research PhD prize in mathematics and data science, EPFL 3rd prize
- **2024** : Recipient of a competitive Harvard CMSA Postdoctoral Fellowship
- **2021:** Famelab (international science communication competition) finalist, representing Switzerland.
- **2021**: Famelab Switzerland national winner
- **2016** : Ranked 1st /1000+ at Ecole Normale Supérieure national entrance exam
- **2016** : Ranked 4th/1000+ at French Ecole Polytechnique national entrance exam
- **2014** : Bronze medal at 46th International Chemistry Olympiads
- **2014** : 2nd prize at French National Chemistry Olympiads
- **2014** : Laureate of two of the French Academy of Science thematic awards
- **2014** : 2nd prize at French National Physics & Chemistry Concours Général

EDUCATION

Harvard — 2024-

Cambridge, USA

Postdoctoral fellow in applied mathematics, at the Center for Mathematical Sciences and Applications (Harvard CMSA).

EPFL — 2020-2024

Lausanne, Switzerland

PhD candidate in machine learning theory and physics, SPOC laboratory at EPFL, advised by Lenka Zdeborová.

ENS Paris — 2016-2020

Paris, France

- **2019** : MSc in theoretical physics (ICFP), Highest Honours, rank 1
- **2017** : Bachelor in physics, Highest Honours, rank 1
- **2016** : Entrance via national competitive exam, rank 1/1000+

PROFESSIONAL EXPERIENCE

Courant Institute, NYU — 2023

New York, USA

PhD visiting student, hosted by Eric Vanden-Eijnden.

Capital Fund Management — 2020

Paris, France

Risk dept. Study and development of BARRA and Fama-French type multifactorial models for risk assessment of the fund's portfolio.

Institute of Theoretical Physics — 2019-2020

Paris, France

Master thesis at IPhT (CEA Saclay) supervised by Lenka Zdeborová.

University of Zurich — 2018

Zurich, Switzerland

Research internship, Theoretical condensed matter lab, with Titus Neupert.

NON-PROFIT

Innovation Forum — 2020-2021

Lausanne, Switzerland

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.

PUBLICATION LIST

- *High-dimensional learning of narrow neural networks,* **H. Cui**, preprint *arXiv:240913904*
- *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).
- *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)**.**
- *Asymptotics of learning with deep structured (random) features,* D.Schröder, D.Dmitriev, **H.Cui**, B.Loureiro, ICML 2024.
- *Analysis of learning a flow-based generative model from limited sample complexity,* **H. Cui**, E. Vanden-Eijnden, F. Krzakala, L. Zdeborová, ICLR 2024
- *High-dimensional asymptotics of denoising auto-encoders,* **H. Cui**, L. Zdeborová, NeurIPS 2023 ***Spotlight*** (top 3.6% of submissions)**.**; invited to the J. Stat. Mech 2024 machine learning special issue.
- *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.
- *Deterministic Equivalent and Error Universality of Deep Random Features,* D.Schröder*, **H.Cui***, D.Dmitriev, B.Loureiro, ICML 2023; invited to the J. Stat. Mech 2024 machine learning special issue.
- *Error Rates for Kernel Classification under Source and Capacity conditions,* **H. Cui**, B. Loureiro, F. Krzakala, L. Zdeborová, MLST 2023
- *Large deviations in Semi-Supervised Learning in the Stochastic Block Model,* **H. Cui**, L. Saglietti, L. Zdeborová, Phy, Rev. E 2022
- *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; invited to the J. Stat. Mech 2022 machine learning special issue.
- *Large deviations in the perceptron model and consequences for active learning,* **H. Cui**, L. Saglietti, L. Zdeborová, MSML 2020 and MLST 2021
- *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; invited to the J. Stat. Mech 2022 machine learning special issue.

REVIEWING

For ML and Physics conferences & journal – including NeurIPS, ICLR, PNAS, ICML, PRX, J. Stat. Mech.

TALKS

2024

- Harvard Stats. Probabilitas seminar (USA), ***invited speaker***
- Harvard CMSA member seminar (USA), ***talk***
- Machine Learning and Signal Processing seminar of ENS Lyon (France), ***invited speaker***
- TAU seminar of Inria Paris Saclay (France), ***invited speaker***
- European Conference on Optimization 2024 (Sweden), ***invited speaker***
- Lausanne Event on ML Theory, EPFL (Switzerland), ***invited speaker***
- Youth in High Dimensions, ICTP (Italy), ***invited speaker***
- Int. Conference on Learning Representations 2024 (Austria), poster

2023

- NeurIPS conference 2023 (USA), ***spotlight***
- EPFL NeurIPS CIS event (Switzerland), ***talk***
- 5th International Workshop on Neural Scaling Laws (USA), ***invited speaker***
- Int. Conf. on Machine Learning 2023 (USA), ***Oral***
- Machine Learning & Statistical Physics, Cargèse summer school (France), ***talk***
- ITS Seminar, City University of NY (USA)**,** ***invited speaker***
- Artificial and biological neural networks workshop, les Houches (France), poster
- Youth in high dimensions, ICTP (Italy), poster

2022

- EPFL-RIKEN Young rising stars joint workshop (Switzerland), ***invited speaker***
- Learning: Optimization and Stochastics Summer Research Institute (Switzerland), ***invited speaker***
- Learning and Optimization conference, CIRM (France), ***talk & poster***
- Workshop on the Theory of Overparameterized Machine Learning (TOPML 2022), ***talk*** (online)
- Advanced Course on Data and Learning (Italy), ***poster & talk (best presentation award)***
- Mathematical challenges of big data, Oxford (UK), poster

2021

- NeurIPS conference 2021, ***poster and short talk*** (online)
- Fundamentals of Learning and AI Research (FLAIR) seminar, EPFL (Switzerland), ***invited speaker***
- Glassy systems and interdisciplinary applications, Cargèse summer school (France), poster

2020

- 1st Mathematical and Scientific Machine Learning conference (MSML), ***talk*** (online)

TEACHING

- Machine learning for physicists (Master), EPFL, 28 hours (teaching assistant) + 2 hours (lecturer)
- Supervision of Nolan Sandgathe (*Master thesis), Belief Propagation in Binary Neural Networks*
- Statistical physics of learning (Master), EPFL, 28 hours (teaching assistant)
- Statistical Physics II (Master), EPFL, 28 hours (teaching assistant)
- Supervision of Oscar Bouverot-Dupuis (*Master internship), Theory of deep neural networks*
- ***Invited lecturer on Science Outreach and Popularization*** (PhD course), University of Geneva, 5 hours (invited lecturer)
- Statistical physics of learning (Master), EPFL, 28 hours (teaching assistant)
- Physics for Earth Scientists (Bachelor), University of Lausanne, 28 hours (teaching assistant)
- Physics I (Bachelor), EPFL, 28 hours (teaching assistant)