Luca Pesce

Personal Information

Luca Pesce,
École Polytechnique Fédérale de Lausanne, Bâtiment ELD,
Bureau ELD331, Station 11,
CH-1015 Lausanne, Switzerland

luca.pesce@epfl.ch | Google Scholar | LinkedIn | GitHub

Education

PhD in Physics & Machine Learning 09.2021 - Present
École Polytechnique Fédérale de Lausanne Lausanne (CH)
Advisor: Prof. Florent Krzakala

International M. Sc. in Physics of Complex Systems 09.2019 – 07.2021
Politecnico di Torino Turin (IT)
Jointly with: ICTP, Paris Cité U., SISSA, Sorbonne U., and U. Paris-Saclay Trieste (IT), Paris (FR)
Final mark: 110/110 cum laude
Thesis supervisors: Prof. Florent Krzakala and Prof. Alfredo Braunstein

B. Sc. in Physics 09.2016 – 07.2019
Università di Napoli Federico II Naples (IT)
Final mark: 110/110 cum laude
Thesis supervisor: Prof. Gennaro Miele

Visits & Internships

Research Internship 03.2025 – 06.2025
Generative AI algorithms for structure-based drug discovery | Aqemia Paris (FR)

Research Internship 04.2021 – 07.2021
Kernel methods performance in high-dimensional phase retrieval | IdePHICS Lab Lausanne (CH)

Visiting Student 09.2020 – 02.2021
Paris Cité Université, Sorbonne Université, and Université Paris-Saclay Paris (FR)

Visiting Student 09.2019 – 02.2020
ICTP & SISSA Trieste (IT)

Publications & Preprints

The symbol [⋆] denotes shared first authorship; the order of the authors is alphabetical in these cases.

1. **The Computational Advantage of Depth: Learning High-Dimensional Hierarchical Functions with Gradient Descent** Yatin Dandi, Luca Pesce, Lenka Zdeborová, Florent Krzakala. Preprint arXiv (2025). [Link]

2. **A Random Matrix Theory Perspective on the Spectrum of Learned Features and Asymptotic Generalization Capabilities.** Yatin Dandi, Luca Pesce, Hugo Cui, Florent Krzakala, Yue M. Lu, and Bruno Loureiro. Artificial Intelligence and Statistics (AISTATS) 2025 (**Oral**, Notable top 2%). [Link]

3. [⋆] **Repetita Iuvant: Data Repetition Allows SGD to Learn High-Dimensional Multi-Index Functions.** Luca Arnaboldi, Yatin Dandi, Florent Krzakala, Luca Pesce, Ludovic Stephan. Preprint arXiv (2024). [Link]

4. [⋆] **Online Learning and Information Exponents: On The Importance of Batch size, and Time/Complexity Tradeoffs.** Luca Arnaboldi, Yatin Dandi, Florent Krzakala, Bruno Loureiro, Luca Pesce, Ludovic Stephan. International Conference on Machine Learning (ICML) 2024. [Link]
5. **Asymptotics of feature learning in two-layer networks after one gradient-step**. Hugo Cui, Luca Pesce, Yatin Dandi, Florent Krzakala, Yue M. Lu, Lenka Zdeborová, Bruno Loureiro. International Conference on Machine Learning (ICML) 2024 (Spotlight, Notable top 3.5%). [Link]
6. **The Benefits of Reusing Batches for Gradient Descent in Two-Layer Networks: Breaking the Curse of Information and Leap Exponents**. Yatin Dandi, Emanuele Troiani, Luca Arnaboldi, Luca Pesce, Lenka Zdeborová, Florent Krzakala. International Conference on Machine Learning (ICML) 2024. [Link]
7. **Theory and applications of the Sum-Of-Squares technique**. Francis Bach, Elisabetta Cornacchia, Luca Pesce, Giovanni Piccioli. Journal of Statistical Mechanics: Theory and Experiment (JSTAT) 2024. [Link]
8. [⋆] **How Two-Layer Neural Networks learn, One (Giant) Step at a Time**. Yatin Dandi, Florent Krzakala, Bruno Loureiro, Luca Pesce, Ludovic Stephan. Journal of Machine Learning Research (JMLR) 2024. [Link]
9. **Are Gaussian data all you need? Extents and limits of universality in high-dimensional generalized linear estimation**. Luca Pesce, Florent Krzakala, Bruno Loureiro, and Ludovic Stephan. International Conference on Machine Learning (ICML) 2023. [Link]
10. **Subspace clustering in high-dimensions: Phase transitions & Statistical-to-Computational gap**. Luca Pesce, Bruno Loureiro, Florent Krzakala, and Lenka Zdeborová. Conference on Neural Information Processing Systems (NeurIPS) 2022. [Link]

Awards

- Top Reviewer of NeurIPS 2023 (10.2 %, 1,197 of 11,725 reviewers) 07.2023
- Université Paris-Saclay International Master's Scolarship. 2020 – 2021
- Mobility scolarship for International PCS M. Sc. alumni. 2019 – 2021
- Admitted at International PCS M. Sc. by a competitive exam (ranked 2nd). 07.2019
- Excellence scolarship - University of Naples Federico II. 2016 – 2019

Teaching Experience

- TA - Elements of statistics for data science (Language: French). spring 2024
- TA - Statistical Physics for Optimization and Learning (Language: English). spring 2023
- TA - Quantum Physics II (Language: French). spring 2022
- TA - Fundamental of Inference and Learning (Language: English). fall 2021 – 2024

Scientific Reviewing

- Transactions on Machine Learning Research (TMLR), Referee
- Conference on Uncertainty in Artificial Intelligence (UAI), Referee
- Conference on Neural Information Processing Systems (NeurIPS), Referee.
- Journal of Statistical Mechanics: Theory and Experiment, Referee.

- International Conference on Machine Learning (ICML), Referee.
- International Conference on Learning Representations (ICLR), Referee.

Advising and Mentoring

- MSc thesis (2024). Topic: Evolution of the spectrum in trained networks with large GD steps.
- Semester project (a.k.a. TP IV) (2023). Topic: Theoretical limits of clustering structured data.

Conferences, Schools, and Workshops

- **Poster** STATPHYS 29, Florence (IT). 07.2025
- **Poster** Artificial Intelligence and Statistics (AISTATS) , Phuket (TH). 05.2025
- **Poster** International Conference on Learning Representations 2025, Singapore (SG). 04.2025
- **Poster** International Conference on Machine Learning 2024, Vienna (AT). 07.2024
- **Poster** The Beg Rohu Summer School, Beg Rohu (FR). 06.2024
- **Poster** Statistical Physics and Machine Learning back toghether again, Cargèse (FR). 08.2023
- **Poster** International Conference on Machine Learning 2023, Honolulu (US). 07.2023
- **Talk** EPFL CIS NeurIPS 2022 Regional Post-Event, Lausanne (CH). [Video] 11.2022
- **Poster** Conference on Neural Information Processing Systems 2022, New Orleans (US). 11.2022
- **Poster** Les Houches school on Statistical Physics & Machine Learning, Les Houches (FR). 07.2022
- **Poster** AI4Science Day, Lausanne (CH). 06.2022
- **-** Mathematics Meets Physics on Disordered Systems, Cortona (IT). 04.2022
- **-** Unite! Spring school on energy, Virtual. 05.2021
- **-** Spring College on the Physics of Complex Systems, Virtual. 03.2021

Computer Skills

Basic	MATLAB
Intermediate	Julia, Mathematica, C++
Advanced	Python, LaTeX

Languages

Italian	Mothertongue
English	Advanced
French	Intermediate