Emanuele Francazi

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linkedin.com/in/emanuele-francazi-a71717238 | 🎓 Emanuele Francazi

Machine learning PhD candidate with a theoretical physics background, set to graduate in July 2025. My current research focuses on identifying and controlling bias effects in neural networks, aiming at both theoretical advancements and practical applications. Collaborating with peers from diverse backgrounds has enabled me to leverage varied perspectives, significantly enriching the relevance and scope of my work.

Research Experience

Machine Learning - Initial Guessing Bias (IGB) | *PhD Student at EPFL & Eawag institute (ETH)*   Feb 2023 - present
- Introduced a novel theory on biased initial class predictions in untrained (deep) neural networks.
- Validated the theory through PyTorch experiments across architectures (ViT, ResNet, MLP-mixer, etc.) and datasets.
- Proceedings of **ICML 2024**, presented at institutions such as Princeton, École normale supérieure de Lyon and the ERC.
- Initiated follow-up MS thesis project on IGB effect in normalization layers, promoting collaborative research.
- Launched a personal project to bridge IGB with literature-known phenomena, fostering mutual insights.

Machine Learning - Class Imbalance | *PhD Student at EPFL & Eawag institute (ETH)*   Sep 2021 - Dec 2022
- Investigated algorithmic foundations of optimization, focusing on class imbalance in (S)GD and its deep learning variants, identifying conditions that boost performance (+0.7% to +6% peak recall) and increase convergence speed (4x to 100x).
- Provided PyTorch code linking theory to practice (e.g., computer vision) across various networks and datasets.
- Published and presented as first author at **ICML 2023**.

Statistical Physics | *BS/MS Student at Sapienza University of Rome*   Sep 2018 - May 2021
- Analyzed phase transitions in highly heterogeneous graphs for my MS thesis, employing message passing algorithms.
- Contributed to a lab project on random lasers study, gaining hands-on experimental experience.
- Explored spin glasses and low-temperature states under Prof. **G. Parisi** for my BS thesis.

Leadership Experience

Member of PhD Committee (Coordinator) of Eawag (ETH)	Jan 2023 - present
Mentoring: Co-Supervised Master's thesis on "Impact of Normalization Layers on IGB"	Oct 2023 - Mar 2024
Teaching Assistant at Environmental Systems Analysis, Eawag (ETH)	June 2022 - June 2023

Education

École Polytechnique Fédérale de Lausanne (EPFL), *PhD in Physics*	Lausanne/Zurich, Switzerland *PI : F. Krzakala, M. Baity-Jesi*	July 2021 - July 2025
Sapienza University of Rome, *MS in Theoretical Physics*	Rome, Italy *PI : F. Ricci Tersenghi Final Grade : 110/110 cum laude*	Sep 2018 - May 2021
Sapienza University of Rome, *BS in Physics*	Rome, Italy *PI : G. Parisi Final Grade : 110/110 cum laude*	Sep 2015 - Sep 2018

Skills

Languages	**Native:** Italian **Fluent:** English **Beginner:** French, German
Programming	**Advanced:** Python, PyTorch, C, Git **Intermediate:** Bash script, pandas **Familiar:** Matlab, R, Julia
Techniques	**Advanced:** Statistical analysis, Coding, Parallel computing, Supercomputing/Cluster Experience

Main Publications

- **E. Francazi**, M. Baity Jesi, A. Lucchi, A Theoretical Analysis of the Learning Dynamics under Class Imbalance
  ICML 2023 [**Conference paper**] [**arXiv:2207.00391**]
- **E. Francazi**, A. Lucchi, M. Baity Jesi, Initial Guessing Bias: How Untrained Networks Favor Some Classes
  ICML 2024 [**arXiv:2306.00809**]

Awards and scholarships

Magna cum laude MS Degree	May 2021
Magna cum laude BS Degree	Sep 2018
Merit-Based Tuition Exemption: Awarded for exceptional academic achievements.	Sep 2015 - Sep 2017

Other interests

Avid traveler, organizer of beginner-friendly Tango courses, passionate in mixology and bartending.