Nicola Muça Cirone

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EDUCATION

PhD Mathematics - CDT Mathematics of Random Systems, 2022-2026
Imperial College London - University of Oxford
- Machine Learning, Mathematical Finance, Rough Paths Analysis.
- Supervised by *Dr. Cristopher Salvi* and *Prof. Thomas Cass*.
- Researching scaling limits of Neural Networks.
- Developing new Kernel Methods for Time Series analysis.

MSc Mathematics, University of Pisa - ETH Zürich 2021-2022
- Honour's degree (110/110 cum Laude) | GPA 30 e Lode
- Stochastic Calculus, Stochastic PDEs, Mathematical Finance, ML in Finance.
- Thesis: *Kernel Methods on Path Spaces* supervised by *Prof. Josef Teichmann*.

BSc Mathematics, University of Pisa 2018-2021
- Honour's degree (110/110 cum Laude) | GPA 29.88/30
- Thesis on advanced topics in Geometrical Model Theory.

PUBLICATIONS

[1] Nicola Muca Cirone, Maud Lemercier and Cristopher Salvi.
Neural signature kernels as infinite-width-depth-limits of controlled ResNets.
Proceedings of the 40th International Conference on Machine Learning, 25358–25425, 2023.
url: https://proceedings.mlr.press/v202/muca-cirone23a.html

[2] Nicola Muca Cirone, Antonio Orvieto, Benjamin Walker, Cristopher Salvi and Terry Lyons.
Theoretical Foundations of Deep Selective State-Space Models.
Arxiv Preprint
url: https://arxiv.org/abs/2402.19047

[3] Nicola Muca Cirone, Jad Hamdan and Cristopher Salvi.
Graph Expansions of Deep Neural Networks and their Universal Scaling Limits.
Arxiv Preprint
url: https://arxiv.org/abs/2407.08459

TALKS

DataSig - Rough Paths Interest Group , Alan Turing Institute May 2024
Title: *Signature Reconstruction from Randomized Signatures*.

Computer Vision Group Seminar , University of Michigan April 2024
Title: *Theoretical Foundations of Deep Selective State-Space Models*.

Talks in Financial and Insurance Mathematics , ETH Zürich Dec 2023
Title: *Neural Signature Kernels (and Trees)*.

7th London-Paris Bachelier Workshop, Imperial College London Sept 2023
Title: *Rough Kernel Hedging*.

CDT Mathematics of Random Systems Workshop, University of Oxford June 2023
Title: *Neural Signature Kernels*.

16th Oxford-Berlin Young Researchers Meeting, University of Oxford Dec 2022
Title: *Signatures and the infinite-width-depth limit of Data Driven ResNets*.

EXPERIENCE

Industry Project - Neural Signature Kernels, Imperial College London June 2024
Co-organized one of the 2024 CDT Industry Projects. Supervised a group of PhD students exploring the empirical advantages of various Neural Signature Kernels

over established Time Series Analysis techniques.

Teaching Assistant - Stochastic Calculus for Finance, ICL Business School — Oct - Dec 2023
MSc Risk Management & Financial Engineering. Taught exercise classes.

Industry Project - Brain signal analysis with Signatures, Imperial College London — June 2023
Challenge: analyze MEG data from several subjects, detect the one who had a seizure.
Our team used Signature techniques, the success and clarity of our results won the competition.

Teaching Assistant - Numerical Methods for Finance, Imperial College London — Feb 2023
MSc Mathematics and Finance. Taught exercise classes.

Teaching Assistant - Data Analysis, Università di Pisa — 2021-2022
MSc Mathematics. Provided tutoring support.

NLP Project - Classification of mathematical papers, Università di Pisa — 2021-2022
Task: classify which mathematical subjects an academic paper belongs to, given its title and abstract. The implementation was done in Python.

AWARDS

INDAM Scholarship, Istituto Nazionale di Alta Matematica — 2022
Two year scholarship from the Italian Institute of Higher Mathematics.
Placed 2nd at National level.

COMPETENCES

Languages Italian (*native*), English (C1), French (*basic*)

Technical Skills Python, Pytorch, Jax, TensorFlow, R, Matlab, Java