

# Marco Nurisso

PHD STUDENT IN PURE AND APPLIED MATHEMATICS

Politecnico di Torino, Turin, Italy

CENTAI Institute, Turin, Italy

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## Summary

I am a PhD student in mathematics, passionate about how topology and geometry can give us insights about neural networks and cognitive systems.

## Education

### Politecnico di Torino

PHD IN PURE AND APPLIED MATHEMATICS

Turin, Italy

Nov. 2022 - Jan. 2026 (expected)

- In collaboration with CENTAI Institute of Turin
- Theme: Topological Methods for Explainable Artificial Intelligence
- Supervisors: Prof. Francesco Vaccarino (Politecnico di Torino), Prof. Giovanni Petri (Northeastern University London / CENTAI Institute)

### Politecnico di Torino

MASTER'S DEGREE IN MATHEMATICAL ENGINEERING

Turin, Italy

Sep. 2020 - Oct. 2022

- 110/110 cum laude
- Thesis title: Analytical Characterization of the Simplicial Kuramoto Model
- Thesis supervisors: Prof. Francesco Vaccarino, Prof. Giovanni Petri
- External collaborators: Dr. Alexis Arnaudon, Dr. Maxime Lucas, Dr. Paul Expert, Dr. Ropert Peach

### Politecnico di Torino

BACHELOR'S DEGREE IN MATHEMATICS FOR ENGINEERING

Turin, Italy

Sep. 2017 - Sep. 2020

- 110/110 cum laude
- Member of Young Talent Project: additional courses and scholarship awarded to the top 2% of Politecnico di Torino's students
- Thesis title: Symmetries of the Geodesic Equation
- Thesis supervisor: Prof. Giovanni Manno (Politecnico di Torino)

## Publications

- [1] **M. Nurisso**, J. Fernando, R. Deshpande, A. Perotti, R. Marjeh, S. M. Frankland, R. L. Lewis, T. W. Webb, D. Campbell, F. Vaccarino, *et al.*, "Bound by semanticity: Universal laws governing the generalization-identification tradeoff," *arXiv preprint arXiv:2506.14797*, 2025.
- [2] A. Santoro, **M. Nurisso**, and G. Petri, "From nodes to edges: Edge-based laplacians for brain signal processing," in *33rd European Signal Processing Conference (EUSIPCO)*, 2025.
- [3] P. Leroy, A. Mastropietro, **M. Nurisso**, and F. Vaccarino, "Attributes shape the embedding space of face recognition models," in *Forty-Second International Conference on Machine Learning*, 2025.
- [4] **M. Nurisso**, P. Leroy, and F. Vaccarino, "Topological obstruction to the training of shallow relu neural networks," in *Advances in Neural Information Processing Systems*, vol. 37, 2024.
- [5] **M. Nurisso**, M. Morandini, M. Lucas, F. Vaccarino, T. Gili, and G. Petri, "Higher-order laplacian renormalization," *Nature Physics*, pp. 1–8, 2025.
- [6] **M. Nurisso**, A. Arnaudon, M. Lucas, R. L. Peach, P. Expert, F. Vaccarino, and G. Petri, "A unified framework for simplicial kuramoto models," *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 34, no. 5, 2024.
- [7] **M. Nurisso**, M. Raviola, and A. Tosin, "Network-based kinetic models: Emergence of a statistical description of the graph topology," *European Journal of Applied Mathematics*, pp. 1–22, 2024.

## Technical Skills

Programming	Python, Deep Learning (Pytorch), MATLAB, Mathematica, R, LaTeX
Graphics	Inkscape, Adobe Photoshop
Languages	Italian, English

## Academic Experience

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### VISITING PERIODS

#### Princeton Neuroscience Institute

Princeton, US

VISITING STUDENT

June 2025 - July 2025

- Worked with Prof. Jonathan Cohen on the information-theoretic formulation of the fundamental tradeoff between generalization and identification in cognitive systems.

#### RWTH Aachen

Aachen, Germany

VISITING STUDENT

April 2025 - May 2025

- Worked with Prof. Michael Schaub on the formulation of diffusion geometry for graphs and point clouds.

#### Network Science Institute, Northeastern University London

London, UK

VISITING STUDENT

Nov. 2025 - Jan. 2025

- Collaborated with the institute's students on a information and graph-theoretic formalization of generalization and parallel processing.

### INTERNSHIPS

#### CENTAI Institute

Turin, Italy

MASTER'S THESIS

May 2022 - Oct. 2022

- Worked with researchers at CENTAI Institute and performed a full analytical study of the topological variant of the Kuramoto model.

**PEER REVIEW** Nature Communications, Complexity, Applicable Algebra in Engineering, Communication and Computing (AAECC)

## Awards & Grants

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### AWARDS

- 2022 **National Recovery and Resilience Plan (NRRP) PhD Grant**, Italian Ministry of Education, University and Research, CENTAI Institute
- 2022 **Sergio Marchionne Student Achievement Award**, Stellantis NV — scholarship awarded to students graduating with top marks
- 2020 **1st place**, Promoting the Sustainability of College Campuses through Serious Games
- 2020 **Winner**, EUvsVirus Hackathon Challenge
- 2017 **Young Talent Project**, Politecnico di Torino — scholarship awarded to top students in the entry test

## Conferences & Talks

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#### Network Science Institute seminar

Boston, US

TALK: *Bound by semanticity: universal laws governing the generalization-identification tradeoff*

July 2025

#### Thirty-Eighth Annual Conference on Neural Information Processing Systems

Vancouver, Canada

POSTER: *Topological obstructions to the training of shallow ReLU networks*

Dec. 2024

#### WINQ Program on Complex and Quantum Systems

Stockholm, Sweden

PHD TALK: *Interactions and peculiarities of simplicial dynamical models*

May 2024

#### NetSciX 2024, International School and Conference on Network Science

Venice, Italy

SPEAKER: *Higher-order Laplacian renormalization of simplicial complexes*

Jan. 2024

#### Mini-Workshop: TDA in Turin

Turin, Italy

SPEAKER: *Interactions and topological synchronization in the simplicial Kuramoto model*

Nov. 2023

#### ECML PKDD 2023

Turin, Italy

VOLOUNTEER STAFF

Oct. 2023

#### Lipari school. Complex networks: from socio-economic systems to biology and the brain

Lipari, Italy

PHD TALK: *Interactions and topological synchronization in the simplicial Kuramoto model*

July 2023

**Extra-Professional Activity**

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HOBBIES AND PASSIONS Illustration, guitar playing, literature, RPGs.