Marco Guerra

Curriculum Vitae

Institut Fourier, Université Grenoble-Alpes CNRS
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Research Positions and Education

Dec. 2023 - Present **Postdoctoral Fellow**
Institut Fourier - Université Grenoble Alpes, CNRS
PI: Prof. Rémi Molinier

Feb. 2022 **Postdoctoral Fellow**
Politecnico di Torino - *Department of Mathematical Sciences.*
PI: Prof. Francesco Vaccarino - Research project: "Topological Machine Learning"

Oct. 2018 - Oct. 2022 **PhD in Pure and Applied Mathematics**, cum laude
Joint PhD Program of *Università di Torino* and *Politecnico di Torino*
Thesis: *"Persistent Homology, from localizing cycles to generating cycles"*
Advisor: Prof. Francesco Vaccarino.

Jul. 2018 **MSc** in **Mathematical Engineering**
Politecnico di Torino - Prof. Francesco Vaccarino
Thesis: *"Graphlet counting in topological data analysis"*
Grade: 110/110

Aug. 2017 **Internship at AddFor S.p.A.** - Torino
Applications and TensorFlow implementation of DeepMind's *Differentiable Neural Computer.*

Mar. 2015 **BSc** in **Mathematics for Engineering**
Politecnico di Torino - Prof. Stefano Berrone
Thesis: *"Simulating potential flow in a fractured rock matrix"*
Grade: 102/110

Jul. 2011 **High School Diploma**
Liceo Scientifico B. Pascal, Giaveno
Grade: 100/100

Jul. 2010 **Internship at San Luigi Gonzaga Hospital**, Haematology
Orbassano (To)

Teaching Experience

Jan. 2023 **Instructor**
Introduction to TDA, University of Torino - 16 hours
PhD-level course on Topological Data Analysis, in "Advanced Mathematical Methods" for the Master in Space Science, UniTo.

Oct.-Nov. 2022 **Instructor**
Introduction to TDA, Politecnico di Torino - 14 hours
PhD course on Topological Data Analysis for the PhD students at PoliTo.

Sep. 2022 **Instructor**
Introduction to TDA, Tashkent, Uzbekistan - 9 hours
Retraining course on TDA at Turin Tashkent Polytechnic University, Tashkent Uzbekistan, within the EU project ELBA.

May 2022 **Instructor**
Introduction to TDA, Bukhara, Uzbekistan - 12 hours
Retraining course on TDA at Bukhara Engineering Technological Institute, Bukhara Uzbekistan, within the EU project ELBA.

Apr. 2022 **Instructor**
Introduction to TDA, Politecnico di Torino - 24 hours
Course delivered to an audience of scholars from Central Asia universities, given in the framework of the EU project ELBA.

Spring 2021 **Teaching Assistant**
Linear Algebra and Geometry, Politecnico di Torino - 40 hours

Spring 2020 **Teaching Assistant**
Linear Algebra and Geometry, Politecnico di Torino - 40 hours

Spring 2019 **Teaching Assistant**
Linear Algebra and Geometry, Politecnico di Torino - 40 hours

Fall 2015 **Teaching Assistant**
Scientific Computing, Politecnico di Torino - 20 hours

Talks

Jun. 2024 SIS24 Bari: *A topology-based algorithm for the isomorphism check of 2-level orthogonal arrays - Joint work with R. Fontana*

Dec. 2023 The 16^{th} Conference of Computational and Methodological Statistics, Berlin: *Topological Data Analysis meets Design of Experiments: an exploration of 2-level non-isomorphic Orthogonal Arrays. - Joint work with R. Fontana*

Dec. 2023 Talk at *Séminaire de Topologie de l'Institut Fourier*

Jul. 2023 YTM23 EPFL - Poster: *Stratification of d-variate Bernoulli distributions via a parametrized family of persistence modules - Joint work with R. Fontana*

Jul. 2023 Intesa - San Paolo, Turin, ML Seminar - *Topological Data Analysis meets Machine Learning: differentiating the concept of shape*

Mar. 2023 EPFL Lausanne, Prof. Kathryn Hess's group - *Choosing representatives in persistent homology* - Invited

Jun. 2022 ATMCS10, Oxford - Poster: *Preliminaries on interval matchings induced by persistence module morphisms - Joint work with S. Scaramuccia*

Sep. 2020 TopoNets - Networks beyond pairwise interactions - NetSci Rome (remote) - *Homological scaffold via minimal homology bases*

Oct. 2019 ComplexSimplex - Topological and Network Data Science Workshop - Torino - *Principled network skeletonization via minimal homology bases*

Sep. 2019 Applications of Topological Data Analysis - ATDA@ECML Würzburg - *Principled network skeletonization via minimal homology bases*

May 2019 Complex Networks: Theory, Methods, and Applications - Lake Como School - *Principled homological scaffold for the brain functional connectome via minimal bases*

Reviewer for

2024 NeurReps - Workshop at NeurIPS24
2023 NeurReps - Workshop at NeurIPS23
2023 TAGML - Workshop at ICML23

Schools

Jul. 2023 Young Topologist Meeting 2023 - EPFL Lausanne
Jul. 2020 Applied Category Theory - MIT (remote)
Jul. 2019 TAGSS Trieste Algebraic Geometry Summer School - Trieste
May 2019 Complex Networks: Theory, Methods, and Applications - Lake Como School

Programming

Proficient Python, LaTeX, C
Intermediate Bash/linux, Cython, C++, MATLAB
Basic PyTorch, Macaulay2

Languages

Italian Native
English Proficient
French Basic
Spanish Basic

Certificates

2009 **First Certificate of English** - Cambridge ESOL
with Distinction

Master Students

Dec. 2019 Nicola Porru *A computational approach to homological skeletonization*, Co-Advisor
Oct. 2021 Marina D'Amato *Computational neuroscience between machine learning and topology*, Co-Advisor
Ongoing Giovanni Barbarani - TBD, topics in topological losses for deep convolutional neural networks, Co-Advisor

Publications

Published and accepted

[1] Guerra, M., De Gregorio, A., Fugacci, U., Petri, G., Vaccarino, F. Homological scaffold via minimal homology bases. Sci Rep 11, 5355 (2021)

[2] Barbarani G., Vaccarino F., Trivigno G., Guerra M., Berton G., Masone C. Scale-free image keypoints using differentiable persistent homology. Accepted at ICML 2024. arXiv:2406.01315 (2024)

[3] Fontana, R. , Guerra, M. A topology-based algorithm for the isomorphism check of 2-level

Orthogonal Arrays. To appear in Springer, Methodological and Applied Statistics and Demography I. SIS 2024, Short Papers, Plenary and Specialized Sessions - Ed. A. Pollice, P. Mariani (due Nov 24) - arXiv:2409.20077 (2024)

Submitted

[4] De Gregorio, A., Guerra, M., Scaramuccia, S., Vaccarino, F. Parallel computation of interval bases for persistence module decomposition. arXiv:2106.11884v2 (2021). Under review.