

KARTHIK VISWANATHAN

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EDUCATION	University of Amsterdam (UvA) 2021 - 2025 PhD in Physics Specialization: Application of Topological Data Analysis to Physical Systems Advisor: Dr. Jan Pieter van der Schaar Expected Graduation: 31 December 2025
	University of Amsterdam (UvA) 2019 - 2021 MSc in Physics and Astronomy, track Theoretical Physics, cum laude GPA: 8.7/10
	Indian Institute of Technology Madras (IITM) 2013 - 2017 B.Tech in Engineering Physics GPA: 8.29/10
RESEARCH	Master's Thesis 2020 - 2021 Exploring the Spectral Theory/Topological Strings duality Advisor: Dr. Marcel Vonk
EXPERIENCE	Bachelor's Thesis 2017 Real Space Renormalization and Applications to Machine Learning Advisor: Dr. Ashwin Joy
PROFESSIONAL EXPERIENCE	Surveillance Analyst at Goldman Sachs, Bangalore 2017 - 2019 Developed ML models for anomaly detection in financial data Manager: Prof. Howard Karloff
	Summer Internship at Goldman Sachs, Bangalore 2016 Implemented fast Personalized PageRank in a MapReduce framework Mentor: Dr. Koushik Balasubramanian
PUBLICATIONS	K. Viswanathan , Y. Gardinazzi, G.Panerai, A. Cazzaniga and M. Biagetti The Geometry of Tokens in Internal Representations of Large Language Models arXiv:2501.10573 [cs.CL] Y.Gardinazzi*, G.Panerai*, K.Viswanathan* , A.Ansuini, A.Cazzaniga and M.Biagetti Persistent Topological Features in Large Language Models arXiv:2410.11042 [cs.CL] J.H.T. Yip, M. Biagetti, A. Cole, K. Viswanathan and G. Shiu Cosmology with persistent homology: A Fisher forecast JCAP 09 (2024), 034, arXiv:2403.13985 [astro-ph.CO]
AWARDS AND DISTINCTIONS	Sander Bais Prize to the Academic Merit 2020 Awarded by Institute for Theoretical Physics Amsterdam for exceptional academic performance in the master's program.
	ACM ICPC World Finals May 20, 2015 Represented India in the international collegiate programming contest. Marrakech, Morocco
	International Olympiad in Informatics Training Camp May, 2013 Selected for the Informatics Camp after ranking in the top 25 in the Indian National Olympiad in Informatics. Bangalore, India

* - These authors contributed equally to this work

**TECHNICAL
SKILLS**

Programming Skills: PyTorch, TensorFlow, Hadoop, MapReduce, Mathematica

Code Repositories:

1. https://github.com/RitAreaSciencePark/token_geometry
2. <https://github.com/RitAreaSciencePark/ZigZagLLMs>

Computational Resources: I have acquired expertise in analyzing cosmological N-body simulations and internal representations in transformers using geometric and TDA-based methods. To analyze these datasets, I have successfully applied for GPU and CPU time both at the LUMI consortium and at the National Dutch Computing Facilities (Snellius supercluster).

**ORGANIZATION
AND
MENTORING**

Organizer of Workshop on Interpretability in LLMs 2025
University of Amsterdam

Supporting Master Student 2024
Master's Degree Candidate: Giada Panerai AREA Science Park, Trieste
Thesis Title: Zig-Zag Persistence in Neural Networks Representations

Mentoring of Master Student 2023
Master's Degree Candidate: Sibilla Bouche University of Amsterdam
Thesis Title: The persistence of non-Gaussian features: a Neural Ratio Estimation approach

Supporting Master Student 2023
Master's Degree Candidate: Sliem el Ela University of Amsterdam
Thesis Title: From Primordials to Persistence: A Dual Exploration of Multiparameter Topology and Cosmic Origins

Organizer of the Cosmology Journal Club 2022
University of Amsterdam

TEACHING

Teaching Assistant 2020 - 2024
MSc Physics Program, University of Amsterdam
Courses: Topological Data Analysis: a Physics Perspective, Advanced Cosmology: Non-linear Structure Formation and Observations, ML for Physics and Astronomy, QFT in Curved Spacetimes, General Relativity

**RESEARCH
VISITS**

Area Science Park, Trieste, Italy September 16 - October 4, 2024
Area Science Park, Trieste, Italy February 15 - April 27, 2024

**CONFERENCES
AND
WORKSHOPS**

Short Talk December 6, 2024
PhD and PostDoc Symposium Amsterdam, Netherlands
Title: Geometry of Internal Representations in Large Language Models

Short Talk July 1 - July 5, 2024
New Strategies for Extracting Cosmology from Galaxy Surveys Sexten, Italy
Title: Information Maximizing Persistent Homology for Halo Catalogs

Long Talk June 5 - June 9, 2023
Applications of Topological Data Analysis to Cosmology and Beyond Trieste, Italy
Title: Information Maximizing Persistent Homology

Long Talk June 27 - July 1, 2022
Interpretable and Higher-Order Statistics for Late-Time Cosmology Trieste, Italy
Title: Antifragile Persistent Homology using Fisher Information

Poster May 16 - May 17, 2024
Trends in Theory Symposium Wageningen, Netherlands
Title: The Geometry and Physics of Hidden Representations in LLMs

Poster June 26 - June 30, 2023
Danish-Swedish Summer School on TDA and Spatial Statistics Aalborg, Denmark
Title: Information Maximizing Persistent Homology for Inference

Participant June 6, 2024
Complexity Across Scales Amsterdam, Netherlands

Participant May 13–May 17, 2024
Dutch Research School of Theoretical Physics Wageningen, Netherlands

Participant September 12–September 16, 2022
Physics meets Artificial Intelligence Munich, Germany

Participant July 18–July 22, 2022
Young Topologists Meeting Copenhagen, Denmark

Participant October 4–December 17, 2021
Amsterdam-Brussels-Geneva-Paris Doctoral School

REFERENCES

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Dr. Magnus Botnan
Vrije Universiteit, Amsterdam
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Dr. Alberto Cazzaniga
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