KARTHIK VISWANATHAN

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EDUCATION

University of Amsterdam (UvA) 2021 - today
PhD in Physics
Specialization: Application of Topological Data Analysis to Physical Systems
Advisor: Dr. Jan Pieter van der Schaar

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 EXPERIENCE

Masters Thesis *2020 - 2021*
Exploring the Spectral Theory/Topological Strings duality
Advisor: Dr. Marcel Vonk

Bachelors 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*
Fast Personalized PageRank in a MapReduce framework
Mentor: Dr. Koushik Balasubramanian

TEACHING

Teaching Assistant *2020 - 2024*
Physics Master Programme, 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 Space-times, General Relativity

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]
Code: https://github.com/RitAreaSciencePark/token_geometry

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]
Code: https://github.com/RitAreaSciencePark/ZigZagLLMs

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]*

[*] - These authors contributed equally to this work

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

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 — *Marrakech, Morocco*
programming contest.

International Olympiad in Informatics Training Camp — *May, 2013*
Selected for the Informatics Camp after ranking — *Bangalore, India*
in the top 25 in the Indian National Olympiad in Informatics.

ORGANIZATION AND MENTORING

Organizer of the Cosmology Journal Club *2022*
University of Amsterdam

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 of 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

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

TECHNICAL SKILLS

***Programming Languages**: PyTorch, TensorFlow, GUDHI, 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).*

REFERENCES

Dr. Jan Pieter van der Schaar
University of Amsterdam
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Dr. Matteo Biagetti
Area Science Park, Trieste
Email: matteo.biagetti@areasciencepark.it

Dr. Magnus Botnan
Vrije Universiteit, Amsterdam
Email: M.B.Botnan@vu.nl

Dr. Alberto Cazzaniga
Area Science Park, Trieste
Email: alberto.cazzaniga@areasciencepark.it

Dr. Koushik Balasumbramanian
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Email: koushikiitm@gmail.com