Nicholas Sale

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Research interests

Topological Data Analysis, Data Science, Phase Transitions, Statistical Physics, Lattice Field Theory, Complex Systems, Machine Learning

Employment

Swansea University — Swansea, UK
Postdoctoral Research Assistant in Mathematics — Oct 2022 – Present

Education

Swansea University — Swansea, UK
PhD in Mathematics — Oct 2019 – Sep 2022
Supervisors: Prof. Jeff Giansiracusa, Prof. Biagio Lucini
Title: Applications of Topological Data Analysis to Statistical Physics and Quantum Field Theories

University of Oxford — New College, Oxford, UK
MMathCompsci Mathematics & Computer Science — Oct 2015 – Jul 2019
Parts A & B: First Class; Part C: First Class

Scholarships

Swansea University Research Excellence Scholarship	2019-2022
Undergradute Scholarship (New College, Oxford)	2016-2019
CyberFirst Bursary (UK Civil Service)	2015-2019
Arkwright Engineering Scholarship (Arkwright Foundation)	2013-2015

Prizes and awards

Swansea University Rowland Wilson Prize for best PhD paper	Jul 2022
SIAM Student Travel Award (to attend SIAM AG21)	Aug 2021
Winner of TopFlavours Gongshow	Jun 2021
2nd place in Welsh Mathematics 3-Minute Thesis Competition	Mar 2021

Publications

Quantitative analysis of phase transitions in two-dimensional XY models using persistent homology
Nicholas Sale, Jeffrey Giansiracusa, Biagio Lucini.
Phys. Rev. E 105, 024121 – Published 14 February 2022

Proceedings

Persistent homology as a probe for center vortices and deconfinement in SU(2) lattice gauge theory
Nicholas Sale, Biagio Lucini, Jeffrey Giansiracusa.
arXiv:2211.16273 – Submitted 29 November 2022

Preprints

Probing center vortices and deconfinement in SU(2) lattice gauge theory with persistent homology
Nicholas Sale, Biagio Lucini, Jeffrey Giansiracusa.
arXiv:2207.13392 – Submitted 27 July 2022

Invited Talks

Applications of topological data analysis to condensed matter and high energy physics May 2022
aQa Seminar, Leiden University

Detecting vortices with persistent homology Feb 2022
UK Centre for TDA, University of Oxford (hybrid)

Quantitative analysis of phase transitions in two-dimensional XY models using persistent homology Sep 2021
Machine Learning for High Energy Physics, On and Off the Lattice
ECT* Trento (hybrid)

Persistent homology for phase transitions Nov 2020
UK Centre for TDA, University of Oxford (online)

Contributed Talks

Probing center vortices and deconfinement in SU(2) lattice gauge theory with persistent homology Aug 2022
Lattice 2022, University of Bonn

Detecting vortices with persistent homology Jul 2022
Young Topologists Meeting 2022, Copenhagen University

Quantitative analysis of phase transitions in two-dimensional XY models using persistent homology Aug 2021
SIAM Conference on Applied Algebraic Geometry 2021 (online)

Persistent homology and phase transitions Jun 2021
TopFlavours 2021, University of Warwick (online)

Teaching experience

Teaching assistant, Department of Mathematics (Swansea University)

MA-282: Game Theory and Optimization	Lent Term 2022
MA-006: Fundamental Mathematics	Michaelmas Term 2021
MA-308: Machine Learning	Lent Term 2021
MA-131: Geometry, Logic, and Communication	Michaelmas Term 2020
MA-262: Numerical Methods	Lent Term 2020
MA-121 Methods of Algebra and Calculus	Michaelmas Term 2019

Other Service

Organiser of Swansea Maths PhD Seminar Jun 2021 - Jun 2022

Co-organised minisymposium for SIAM AG21 Aug 2021
Invited speakers for and hosted a 7-speaker minisymposium on Persistent Homology for Phase Transitions, co-organised with Quoc Hoan Tran.

Assisted with the LMS Undergraduate Summer School Jul 2021

Research experience

Applied Research Summer Placement
UK Civil Service Jul 2018 – Sep 2018

An 11-week placement researching how machine learning and other data science techniques could be applied to aid my team with data annotation.

Applied Research Summer Placement

UK Civil Service Jul 2017 – Sep 2017

An 11-week placement researching the feasibility of using data science techniques to identify certain types of network devices based on limited information about their traffic.

Technical skills

Programming

Python (numpy, scipy, sci-kit learn, pandas), Java, C♯, C(++), Javascript

Cluster Computing

Non-academic positions

New College Boat Club Committee New College, Oxford

President	2018-2019
Secretary	2017-2018
Lower Boats Captain	2016-2017
Women's 3rd Boat Coach	2018-2019