

XIMENA L. FERNÁNDEZ

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CURRENT POSITION

Lecturer at the Department of Mathematics, **St Georges City University of London**.

ACADEMIC APPOINTMENTS

- Sep 2024 - Present **Lecturer**, City St Georges University of London, UK.
- Sep 2023 - Aug 2024 **Postdoctoral Research Associate**, University of Oxford, UK.
Advisor: Prof. Heather Harrington.
- Sep 2021 - Aug 2023 **Postdoctoral Research Associate**, Durham University, UK.
Advisor: Prof. Jeffrey Giansiracusa.
- Oct 2020 - Aug 2021 **Postdoctoral Research Associate**, Swansea University, UK.
Advisor: Prof. Jeffrey Giansiracusa.
- Jan 2020 - Sep 2020 **Research and Teaching Fellow**, University of Buenos Aires, Argentina.
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INDUSTRIAL APPOINTMENTS

- May 2019 - Dec 2019 **Data Scientist**, Properati, OLX Group, Argentina.
Machine learning models for predictions in real state and recommendation systems.
- Oct 2018 - Apr 2019 **Mathematical Models Specialist**, CAMMESA, Argentina.
Optimization and prediction models for the distribution of electric energy in Argentina.
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EDUCATION

- 2011 - 2017 **PhD in Mathematics**, Department of Mathematics, University of Buenos Aires.
Advisor: Prof. Elías Gabriel Minian.
Thesis: Combinatorial methods and algorithms in low dimensional topology and the Andrews-Curtis conjecture.
- 2005 - 2011 **Licenciante in Mathematical Sciences (equivalent to M.Sc.)**, Department of Mathematics, University of Buenos Aires.
Advisor: Prof. Elías Gabriel Minian.
Thesis: Topology of finite spaces: an algorithmic approach.
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RESEARCH PUBLICATIONS AND PREPRINTS

Authors are listed alphabetic order unless it is marked with * the first (co-) author(s).

- 2025 X. Fernández. *Strong discrete Morse theory*. **Preprint**. (2025) [arXiv:2504.15729](https://arxiv.org/abs/2504.15729).
- 2024 X. Fernández* and D. Mateos. *Topological biomarkers for real-time detection of epileptic seizures*. **Submitted**. (2024) [arXiv:2211.02523](https://arxiv.org/abs/2211.02523).
- 2024 W. Reise*, X. Fernández*, M. Dominguez, H. A. Harrington and M. Beguerisse-Díaz, *Topological fingerprints for audio identification*. **SIAM Journal on Mathematics of Data Science** Vol. 6 Iss. 3 (2024).
- 2024 X. Fernández, *Morse theory for group presentations*. **Trans. Amer. Math. Soc.** 377 (2024), 2495-2523
- 2023 X. Fernández*, E. Borghini, G. Mindlin and P. Groisman. *Intrinsic persistent homology via density-based metric learning*. **Journal of Machine Learning Research**, 24 (2023) no. 75, 1-42.
- 2023 S. Benas*, X. Fernández* and E. Kropff. *Modeled grid cells aligned by a flexible attractor*. **eLife** 12:RP89851.

- 2020 X. Fernández and E.G. Minian. *The cylinder of a relation and generalized versions of the Nerve Theorem*. **Discrete Comput. Geom.** 63 (2020), no. 3, 549–559.
- 2016 X. Fernández and E.G. Minian. *Homotopy colimits of diagrams over posets and variations on a theorem of Thomason*. **Homology Homotopy Appl.** 18 (2016), no. 2, 233–245.
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OTHER PUBLICATIONS

- 2019 **Book** *Algebra A* (Introduction to Linear Algebra for Engineering, Computer Science and Mathematics). N. Capitelli, R. Escayola, X. Fernández and G. Rossi. Publisher: **EUDEBA**. ISBN 9789502329703. (2019)
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TEACHING

City St Georges University of London, UK

- Spring Term 2025 **Lecturer**, Department of Mathematics.
Course: Linear Algebra.

University of Oxford, UK

- Hilary Term 2024 **Tutor**, Mathematical Institute.
Course: Computational Algebraic Topology.

- Mich. Term 2023 **Tutor**, Mathematical Institute.
Course: Introduction to Probability.

University of San Andrés, Argentina

- Feb 2020 - Aug 2020 **Lecturer**, Department of Mathematics.
Course: Calculus (one variable).

Torcuato DiTella University, Argentina

- Mar 2016 - Feb 2018 **Lecturer**, Department of Mathematics.
Courses: Calculus I (one variable) and Calculus II (several variables).

University of Buenos Aires, Argentina

- Jan 2020 - Sep 2020 **Graduate Teaching Assistant**, Department of Mathematics.
Course: Probability and Statistics.

- Mar 2015 - Sep 2018 **Lead Teaching Assistant**, Department of Mathematics.
Courses: Introduction to Calculus, Introduction to Number Theory, Topology, Advanced Calculus, Probability and Statistics.

- Mar 2013 - Feb 2015 **Graduate Teaching Assistant**, Department of Mathematics.
Courses: Introduction to Number Theory, Linear Algebra, Topology, Advanced Calculus.

- Mar 2009 - Mar 2011 **Undergraduate Teaching Assistant**, Department of Mathematics.
Courses: Introduction to Calculus, Introduction to Number Theory, Linear Algebra, Topology.

- Mar 2007 - Feb 2017 **Instructor**, Course of Admission.
Courses: Introduction to Calculus, Introduction to Linear Algebra.
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INVITED LECTURE COURSES

- Jul 2022 **European TOPology Interdisciplinary Action (EUTOPIA) Summer School 2022**. Paris, France. 27 June - 6 July 2022.
Course: Persistent homology and applications in biology.
- Jun 2022 **International Summer School on Modeling Nature BIOMAT 2022**. Multiscale Models and Methods in Life Sciences. Granada, Spain. 6-10 June 2022.
Course: Topological data analysis and applications in dynamics.

MENTORING

- 2025-2028 **PhD Awarded Centrally Funded Studentship**, Department of Mathematics, School of Science and Technology, City St Georges University of London.
Student: Lola Lopez Menalled.
Project: Persistence beyond homology.
- 2024 **Summer Research Project**, University of Oxford (funded by Balliol College).
Student: Adam Cutts (Mathematical Institute, University of Oxford).
Project: An investigation into classification of initial conditions of dynamical systems using persistent homology.
- 2023-2024 **Licenciate project** (equiv. Master), Department of Mathematics, University of Buenos Aires.
Student: Lola Lopez Menalled (University of Buenos Aires).
Thesis title: Persistent homology of relations: from Dowker's theorem to topological analysis of neural data.
- 2022 **Summer Research Internship Project**. Grant URB-2022-07. **Undergraduate Research Bursary**, funded by the **London Mathematical Society**. Joint supervision with Jeffrey Giansiracusa.
Student: Leo Zhang (Imperial College of London).
Project: Reconstruction of surfaces from high dimensional point clouds and applications to data analysis.

SOFTWARE

- 2025 **SageMath** (Open-Source Mathematical Software System).
Package: **Strong Morse theory**.
Code: github.com/ximenafernandez/Strong-Morse-Theory
- 2019 **GAP** (System for Computational Discrete Algebra).
Package: **Posets**.
With Iván Sadofschi Costa and Kevin Piterman.
Code: github.com/isadofschi/posets
Documentation: mate.dm.uba.ar/~isadofschi/posets/
- 2017 **SageMath** (Open-Source Mathematical Software System).
Module: **Finite Topological Spaces**
Code: github.com/ximenafernandez/Finite-Spaces

LATEST TALKS AT CONGRESSES, CONFERENCES AND WORKSHOPS

- Apr 2025 *Discrete Morse theory as generalized collapses*.
Workshop Algebraic Topology and Related Topics, Universidad Santiago de Compostela, Spain (**invited**).
- Aug 2024 *Applying persistent homology in the music industry*.
SPIRES, University of Oxford, UK (**invited**).
- June 2024 *Topological fingerprints for audio identification*. **Complexity Workshop**, Keble College, University of Oxford, UK (**invited**).
- July 2024 *Topological fingerprints for audio identification*.
9th European Congress of Mathematics, Universidad de Sevilla, Spain (**invited**).
- Apr 2024 *Topological fingerprints for audio identification*.
British Applied Mathematics Colloquium, Newcastle University, UK (**invited**).
- Dec 2023 *Topological fingerprints for audio identification*.
Colloquium Department of Mathematics, University of Buenos Aires, Argentina (**invited**).
- Dec 2023 *Density-based persistent homology and applications to time-series analysis*.
Maths meet Biology Workshop. Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany (**invited**).

- Nov 2023 *Topological fingerprints for audio identification.*
Stats meets Math Colloquium, Mathematical Institute, University of Oxford, UK (invited).
- Oct 2023 *Morse theory for group presentations and applications to persistence*
Ibero-American Colloquium on Algebra and Knot Theory (online, invited).
- Jul 2023 *Intrinsic persistent homology via density-based metric learning.*
Topological Data Analysis Week, Kyoto University, Japan (poster).
- Jul 2023 *Density-based metric learning and applications to TDA.*
Nordic Congress of Mathematicians, Aalborg University, Denmark (invited).
- Jun 2023 *Intrinsic persistent homology via density-based metric learning.*
Foundations of Computational Mathematics Conference (FoCM 2023), Sorbonne Université, Paris, France (poster).
- Jun 2023 *Topological fingerprints for Audio Identification.*
UK Centre for Topological Data Analysis Meeting, Oxford University, UK (invited).
- May 2023 *Density-based Riemannian metrics and persistent homology.*
Dagstuhl Schloss, Germany (invited).
- Jan 2023 *Topological biomarkers for real-time detection of epileptic seizures.*
UK Centre for Topological Data Analysis Meeting, Oxford University, UK (invited).
- Nov 2022 *Morse theory for group presentations.*
3rd International Meeting on Geometric Group Theory and Low Dimensional Topology (online, invited).
- Jun 2022 *Topology of the neural connectivity of grid cells.*
Algebraic Topology: Methods, Computation and Science (ATMCS10), Oxford University, UK (poster).
- Jun 2022 *The persistent fundamental group of point clouds.*
11th International Conference on Geometric and Topological Methods in Computer Science (GETCO 2022), EPITA School, Paris, France.
- May 2022 *Morse theory for group presentations.*
Transpennine Topology Triangle Meeting 116, Liverpool University, UK (online, invited).
- Apr 2022 *Morse theory for group presentations.*
35th British Topology Meeting, Durham University, UK.
- Feb 2022 *Topological methods for real time detection of epileptic seizures in EEG recordings.*
13th Conference on Dynamical Systems Applied to Biology and Natural Sciences (DSABNS 2022), Basque Center for Applied Mathematics in Bilbao, Spain (online).
- Nov 2021 *Density-based intrinsic persistent homology and applications to time series analysis.*
UK Centre for Topological Data Analysis Meeting, Oxford University, UK (invited).
- Oct 2021 *Density-based persistent homology.*
2nd Workshop on Topological Methods in Data Analysis, Heidelberg University, Germany (online).
- Jul 2021 *Morse theory for group presentations.*
Mathematical Congress of the Americas 2021, Buenos Aires, Argentina (online, invited).
- Jun 2021 *Intrinsic persistent homology via density-based metric learning.*
The 38th Annual Workshop in Geometric Topology, USA (online).
- Apr 2021 *Intrinsic persistent homology via density-based metric learning.*
IMSI Topological Data Analysis Workshop 2021, Chicago, USA (online).
- Apr 2021 *A density-based metric learning approach to geometric inference.*
37th European Workshop on Computational Geometry (EuroCG 2021), St. Petesburg, Russia (online).

- Feb 2021 *Manifold learning for data analysis.*
V Encuentro de Jóvenes Topólogos, Universidad Distrital Francisco José de Caldas, Colombia (online, **invited**).
- Dec 2020 *Geometric and topological inference for data analysis.*
11th Meeting Applied Algebra and Geometry in the UK, University of York, UK (online, **invited**).
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LATEST INVITED SEMINARS

- Mar 2025 *Strong discrete Morse theory.*
Topology Seminar, Northeastern University, US.
- Mar 2025 *The Fermat Principle in Riemannian Geometry.*
Geometry Seminar, King's College of London, UK.
- Nov 2024 *Discrete Morse Theory (old and new).*
TDA Seminar, MPI-Dresden, Germany & Oxford University, UK.
- Oct 2024 *Computational Topology for Data Analysis.*
Math Department Seminar, City St Georges City University of London, UK.
- Oct 2024 *Density-based Topology Learning from Data.*
Statistics and Data Science Seminar, Queen Mary University, London, UK.
- Aug 2024 *Topology and Geometry from Data.*
Astrophysics Seminar, University of Nagoya, Japan.
- Jun 2024 *Morse theory for group presentations and applications.*
Applied Topology Seminar, University of Oxford, UK.
- Oct 2023 *Fermat principle in Riemannian geometry.*
GEOTOP-A Seminar (online).
- Aug 2023 *Topological biomarkers for real-time detection of epileptic seizures.*
Systems Medicine Seminar, University of Florida, USA.
- May 2023 *Intrinsic persistent homology via density-based metric learning.*
London Topological Data Analysis Seminar, Queen Mary University, London, UK.
- Apr 2023 *Density-based distance learning and applications to topological data analysis.*
Probability & Statistics Seminar, Universidad de la Republica, Uruguay.
- Mar 2023 *Morse theory for group presentations & applications to the persistent fundamental group.*
Applied Topology Seminar, CIMAT Center for Research in Mathematics, Mexico.
- Feb 2023 *Density-based intrinsic persistent homology & applications to time series analysis.*
Applied CATS Seminar, KTH Royal Institute of Technology, Sweden.
- Feb 2023 *Intrinsic persistent homology via density-based metric learning.*
DATASHAPE Seminar, Université Paris-Saclay, France.
- Jul 2022 *Morse theory for group presentations and the persistent fundamental group.*
Applied Algebraic Topology Research Network Seminar (AATRn) (online).
- Jun 2022 *From topological data analysis to computational brain modelling: the case studies of grid cells and epilepsy.*
Oxford Mathematical Brain Modelling Seminar, Oxford University, UK.
- Oct 2021 *Morse theory for group presentations.*
Geometry and Topology Seminar, Durham University, UK.
- Oct 2021 *Topological time series analysis.*
Applied Math Seminar, Durham University, UK.
- Jun 2021 *Morse theory for group presentations.*
Algebraic Topology Seminar, University of Buenos Aires, Argentina.

SCHOLARSHIPS, FELLOWSHIPS AND GRANTS OBTAINED BY COMPETITION

- 2024 **LMS Scheme 9 Grant** Celebrating New Appointments.
- 2024 **LMS Scheme 5 Grant** Collaboration with Developing Countries.
- 2023 **Travel grant** to attend the TDA Week 2023 Conference, Kyoto University, Japan.
- 2022 **LMS-EPSRC ECR ICM Travel Grant** to attend to the International Congress of Mathematicians 2022 in Saint Petersburg. (Cancelled due to Ukraine-Russia war).
- 2020 **International Travel Scholarship AUIP**, provided by the Andalusian and Iberoamerican Universities Program. Funding for a research stay at the Department of Applied Mathematics, University of Sevilla, Spain. (Cancelled due to COVID).
- 2018 **International Travel Scholarship AUIP**, provided by the Andalusian and Iberoamerican Universities Program. Funded a research stay at the Department of Algebra, Geometry and Topology, University of Málaga, Spain.
- 2011 - 2016 **Doctoral Grant CONICET**, provided by the National Scientific and Research Council, Argentina.
- 2010 - 2011 **M.Sc. Grant UBACyT**, provided by the University of Buenos Aires.

RESEARCH VISITS

- 2024 12 - 30 Aug. Division of Particle and Astrophysical Science, **Nagoya University**, Japan.
- 2023 27 Feb - 3 Mar. Department of Mathematics, **KTH Royal Institute of Technology**, Sweden.
- 2023 22 - 24 Feb. Institut de Mathématique d'Orsay, **Université Paris-Saclay**, France.
- 2018 20 May - 20 Jun. Department of Algebra, Geometry and Topology, **University of Malaga**, Spain.

SERVICE AND OUTREACH

- 2024-2025 **Co-organizer** of the *London-Oxford* TDA Seminar.
- 2023-2024 **Organizer** of the *Algebraic Systems Biology Seminar*. Mathematical Institute, University of Oxford.
- 2023 **Outreach poster presentation** at the celebration of the 10 years of the Andrew Wiles Building, Mathematical Institute, University of Oxford.
- 2021 - 2023 **Refereed for international journals:** the International Journal of Computational Geometry and Applications (IJCGA), the Journal of Applied and Computational Topology (JACT), Journal of Pure and Applied Algebra (JPAA) and Advances in Applied Mathematics (AAM).
- 2021 **Online research tutorials** *Intrinsic Persistent Homology* and *Morse Theory 2.0*, AATRN Applied Algebraic Topology Research Network YouTube Channel.
- 2006 - 2021 **Speaker** and collaborator in the following **outreach events** in Argentina: *Math's Week*, *Data Science's Week*, *Matbaïres*, *Math Festival*.
- 2020 **Diversity Panel** *Women in Science*, Swansea Science Festival 2020.
- 2015 - 2018 **Jury** member at several primary and secondary level national **Math Olympiads** (Argentina) including: *Argentine Mathematical Olympiad* (secondary school), *Nandú Mathematical Olympiad* (primary school) and **Mateclubes Olympiad** (in groups).
- 2011 Collaborator of the **Local Organization Committee** at WATACBA *Workshop in Algebraic Topology and Combinatorics*, University of Buenos Aires, Argentina.

RESEARCH BREAKS

Oct 2017 - Sep 2018 Teaching positions.

Oct 2018 - Dec 2019 Industry positions.

Mar 2020 - Sep 2020 COVID lockdown.

Updated June 11, 2025