

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.

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.

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 **Licenciate 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.

RESEARCH PUBLICATIONS AND PREPRINTS

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

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| 2025 | X. Fernández. <i>Strong discrete Morse theory</i> . Preprint . (2025) arXiv:2504.15729 . |
| 2024 | X. Fernández* and D. Mateos. <i>Topological biomarkers for real-time detection of epileptic seizures</i> . Submitted . (2024) arXiv:2211.02523 . |
| 2024 | W. Reise*, X. Fernández*, M. Dominguez. H. A. Harrington and M. Beguerisse-Díaz, <i>Topological fingerprints for audio identification</i> . SIAM Journal on Mathematics of Data Science Vol. 6 Iss. 3 (2024). |
| 2024 | X. Fernández, <i>Morse theory for group presentations</i> . Trans. Amer. Math. Soc. 377 (2024), 2495-2523 |
| 2023 | X. Fernández*, E. Borghini, G. Mindlin and P. Groisman. <i>Intrinsic persistent homology via density-based metric learning</i> . Journal of Machine Learning Research , 24 (2023) no. 75, 1-42. |
| 2023 | S. Benas*, X. Fernández* and E. Kropff. <i>Modeled grid cells aligned by a flexible attractor</i> . 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.
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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 Sadofski Costa and Kevin Piterman.
Code: github.com/isadofski/posets
Documentation: mate.dm.uba.ar/~isadofski/posets/
- 2017 **SageMath** (Open-Source Mathematical Software System).
Module: **Finite Topological Spaces**
Code: github.com/ximenafernandez/Finite-Spaces
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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	<i>Manifold learning for data analysis.</i> V Encuentro de Jóvenes Topólogos , Universidad Distrital Francisco José de Caldas, Colombia (online, invited).
Dec 2020	<i>Geometric and topological inference for data analysis.</i> 11th Meeting Applied Algebra and Geometry in the UK , University of York, UK (online, invited).

LATEST INVITED SEMINARS

Mar 2025	<i>Strong discrete Morse theory.</i> Topology Seminar , Northeastern University, US.
Mar 2025	<i>The Fermat Principle in Riemannian Geometry.</i> Geometry Seminar , King's College of London, UK.
Nov 2024	<i>Discrete Morse Theory (old and new).</i> TDA Seminar , MPI-Dresden, Germany & Oxford University, UK.
Oct 2024	<i>Computational Topology for Data Analysis.</i> Math Department Seminar , City St Georges City University of London, UK.
Oct 2024	<i>Density-based Topology Learning from Data.</i> Statistics and Data Science Seminar , Queen Mary University, London, UK.
Aug 2024	<i>Topology and Geometry from Data.</i> Astrophysics Seminar , University of Nagoya, Japan.
Jun 2024	<i>Morse theory for group presentations and applications.</i> Applied Topology Seminar , University of Oxford, UK.
Oct 2023	<i>Fermat principle in Riemannian geometry.</i> GEOTOP-A Seminar (online).
Aug 2023	<i>Topological biomarkers for real-time detection of epileptic seizures.</i> Systems Medicine Seminar , University of Florida, USA.
May 2023	<i>Intrinsic persistent homology via density-based metric learning.</i> London Topological Data Analysis Seminar , Queen Mary University, London, UK.
Apr 2023	<i>Density-based distance learning and applications to topological data analysis.</i> Probability & Statistics Seminar , Universidad de la Republica, Uruguay.
Mar 2023	<i>Morse theory for group presentations & applications to the persistent fundamental group.</i> Applied Topology Seminar , CIMAT Center for Research in Mathematics, Mexico.
Feb 2023	<i>Density-based intrinsic persistent homology & applications to time series analysis.</i> Applied CATS Seminar , KTH Royal Institute of Technology, Sweden.
Feb 2023	<i>Intrinsic persistent homology via density-based metric learning.</i> DATASHAPE Seminar , Université Paris-Saclay, France.
Jul 2022	<i>Morse theory for group presentations and the persistent fundamental group.</i> Applied Algebraic Topology Research Network Seminar (AATRN) (online).
Jun 2022	<i>From topological data analysis to computational brain modelling: the case studies of grid cells and epilepsy.</i> Oxford Mathematical Brain Modelling Seminar , Oxford University, UK.
Oct 2021	<i>Morse theory for group presentations.</i> Geometry and Topology Seminar , Durham University, UK.
Oct 2021	<i>Topological time series analysis.</i> Applied Math Seminar , Durham University, UK.
Jun 2021	<i>Morse theory for group presentations.</i> 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 <i>London-Oxford</i> TDA Seminar.
2023-2024	Organizer of the <i>Algebraic Systems Biology Seminar</i> . 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 <i>Intrinsic Persistent Homology</i> and <i>Morse Theory 2.0</i> , AATRN Applied Algebraic Topology Research Network YouTube Channel.
2006 - 2021	Speaker and collaborator in the following outreach events in Argentina: <i>Math's Week</i> , <i>Data Science's Week</i> , <i>Matbaire</i> , <i>Math Festival</i> .
2020	Diversity Panel <i>Women in Science</i> , Swansea Science Festival 2020.
2015 - 2018	Jury member at several primary and secondary level national Math Olympiads (Argentina) including: <i>Argentine Mathematical Olympiad</i> (secondary school), <i>Nandú Mathematical Olympiad</i> (primary school) and <i>Mateclubes Olympiad</i> (in groups).
2011	Collaborator of the Local Organization Committee at WATACBA <i>Workshop in Algebraic Topology and Combinatorics</i> , 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