

# XIMENA L. FERNÁNDEZ

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## CURRENT POSITION

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

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## 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 **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.

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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](#).

2024 X. Fernández\* and D. Mateos. *Topological biomarkers for real-time detection of epileptic seizures*. **Submitted**. (2024) [arXiv: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.

## 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)

## 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.

## 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.

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## 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](https://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](https://github.com/isadofski/posets)  
Documentation: [mate.dm.uba.ar/~isadofski/posets/](http://mate.dm.uba.ar/~isadofski/posets/)
- 2017            **SageMath** (Open-Source Mathematical Software System).  
Module: **Finite Topological Spaces**  
Code: [github.com/ximenafernandez/Finite-Spaces](https://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> <b>V Encuentro de Jóvenes Topólogos</b> , Universidad Distrital Francisco José de Caldas, Colombia (online, <b>invited</b> ).
Dec 2020	<i>Geometric and topological inference for data analysis.</i> <b>11th Meeting Applied Algebra and Geometry in the UK</b> , University of York, UK (online, <b>invited</b> ).

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#### LATEST INVITED SEMINARS

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

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## SCHOLARSHIPS, FELLOWSHIPS AND GRANTS OBTAINED BY COMPETITION

2024	<b>LMS Scheme 9 Grant</b> Celebrating New Appointments.
2024	<b>LMS Scheme 5 Grant</b> Collaboration with Developing Countries.
2023	<b>Travel grant</b> to attend the TDA Week 2023 Conference, Kyoto University, Japan.
2022	<b>LMS-EPSRC ECR ICM Travel Grant</b> to attend to the International Congress of Mathematicians 2022 in Saint Petersburg. (Cancelled due to Ukraine-Russia war).
2020	<b>International Travel Scholarship AUIP</b> , 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	<b>International Travel Scholarship AUIP</b> , 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	<b>Doctoral Grant CONICET</b> , provided by the National Scientific and Research Council, Argentina.
2010 - 2011	<b>M.Sc. Grant UBACyT</b> , provided by the University of Buenos Aires.

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## RESEARCH VISITS

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

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## SERVICE AND OUTREACH

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

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## RESEARCH BREAKS

Oct 2017 - Sep 2018	Teaching positions.
Oct 2018 - Dec 2019	Industry positions.
Mar 2020 - Sep 2020	COVID lockdown.

Updated June 11, 2025