

# XIMENA L. FERNÁNDEZ

**contact:** ximena.fernandez@maths.ox.ac.uk  
**webpage:** <https://ximenafernandez.github.io/>

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## CURRENT POSITION

- Postdoctoral Research Associate at the Mathematical Institute, University of Oxford.
- Member of the Algebraic Systems Biology Research Group.

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## ACADEMIC APPOINTMENTS

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.

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## INDUSTRIAL APPOINTMENTS

May 2019 - Dec 2019 **Data Scientist**, Properati, OLX Group, Argentina.

Oct 2018 - Apr 2019 **Mathematical Models Specialist**, CAMMESA, 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 Mathematics (equivalent to Bachelor + 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).

2023 W. Reise\*, X. Fernández\*, M. Dominguez. H. A. Harrington and M. Beguerisse-Díaz, *Topological fingerprints for audio identification*. Preprint. [arXiv:2309.03516](#)

2023 X. Fernández, *Morse theory for group presentations*. Transactions of the Amer. Math. Soc. (in press).

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 (accepted under minor corrections).

2022 X. Fernández\* and D. Mateos. *Topological biomarkers for real-time detection of epileptic seizures*. Preprint. [arxiv:2211.02523](#).

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.

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## TEACHING

### University of Oxford, UK

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

### University of San Andrés, Argentina

Feb 2020 - Aug 2020 **Lecturer**, Department of Mathematics.  
*Course:* Calculus.

### 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 **Tutor**, Course of Admission.  
*Courses:* Introduction to Calculus, Introduction to Linear Algebra.

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## SOFTWARE

2019                      GAP 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/](https://mate.dm.uba.ar/~isadofski/posets/)

2017                      SAGE Module **Finite Topological Spaces**  
Code: [github.com/ximenafernandez/Finite-Spaces](https://github.com/ximenafernandez/Finite-Spaces)

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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.

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## MENTORING

- 2023      **MSc project**, Department of Mathematics, University of Buenos Aires.  
*Student:* Lola Lopez Menalled.  
*Project:* Dowker's theorem for network dynamics and applications to neural data analysis.
- 2022      **Summer Project**. Grant URB-2022-07. Undergraduate Research Bursary, funded by the London Mathematical Society. Joint supervision with Jeffrey Giansiracusa.  
*Student:* Leo Zhang.  
*Project:* Reconstruction of surfaces from high dimensional point clouds and applications to data analysis.
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## LATEST TALKS IN CONFERENCES, WORKSHOPS AND SEMINARS

- Oct 2023      *Morse theory for group presentations and applications to persistence*  
Ibero-American Colloquium on Algebra and Knot Theory (**invited**).
- Oct 2023      *Fermat principle in Riemannian geometry.*  
GEOTOP-A Seminar (**invited**).
- Aug 2023      *Topological biomarkers for real-time detection of epileptic seizures.*  
Systems Medicine Seminar, University of Florida, USA (**invited**).
- Jul 2023      *Intrinsic persistent homology via density-based metric learning.*  
TDA 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 (FoCM 2023), Sorbonne Université, Paris, France (poster).
- Jun 2023      *Topological fingerprints for Audio Identification.*  
TDA Centre Meeting, Oxford University, UK (**invited**).
- May 2023      *Intrinsic persistent homology via density-based metric learning.*  
London TDA Seminar, Queen Mary University, London, UK (**invited**).
- May 2023      *Density-based Riemannian metrics and persistent homology.*  
Dagstuhl Seminar, Germany (**invited**).
- Apr 2023      *Density-based distance learning and applications to topological data analysis.*  
Probability & Statistics Seminar, Universidad de la Republica, Uruguay (online, **invited**).
- Mar 2023      *Morse theory for group presentations & applications to the persistent fundamental group.*  
Applied Topology Seminar, CIMAT Center for Research in Mathematics, Mexico (online, **invited**).
- Feb 2023      *Density-based intrinsic persistent homology & applications to time series analysis.*  
Applied CATS Seminar, KTH Royal Institute of Technology, Sweden (**invited**).
- Feb 2023      *Intrinsic persistent homology via density-based metric learning.*  
DATASHAPE Seminar, Université Paris-Saclay, France (**invited**).
- Jan 2023      *Topological biomarkers for real-time detection of epileptic seizures.*  
Centre for Topological Data Analysis Group 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**).
- Jul 2022      *Morse theory for group presentations and the persistent fundamental group.*  
Applied Algebraic Topology Research Network Seminar (online, **invited**).
- 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 (**invited**).
- Jun 2022      *Topology of the neural connectivity of grid cells.*  
Algebraic Topology: Methods, Computation and Science (ATMCS10), Oxford University, UK (poster).

Jun 2022	<i>The persistent fundamental group of point clouds.</i> 11th International Conference on Geometric and Topological Methods in Computer Science (GETCO 2022), EPITA, Paris, France.
May 2022	<i>Morse theory for group presentations.</i> Transpennine Topology Triangle Meeting 116, Liverpool University, UK (online, <b>invited</b> ).
Apr 2022	<i>Morse theory for group presentations.</i> 35th British Topology Meeting, Durham University, UK.
Feb 2022	<i>Topological methods for real time detection of epileptic seizures in EEG recordings.</i> 13th Conference on Dynamical Systems Applied to Biology and Natural Sciences (DSABNS 2022), Basque Center for Applied Mathematics in Bilbao, Spain (online).
Nov 2021	<i>Density-based intrinsic persistent homology and applications to time series analysis.</i> Centre for Topological Data Analysis Group Meeting, Oxford University, UK ( <b>invited</b> ).
Oct 2021	<i>Morse theory for group presentations.</i> Geometry and Topology Seminar, Durham University, UK ( <b>invited</b> ).
Oct 2021	<i>Topological time series analysis.</i> Applied Math Seminar, Durham University, UK ( <b>invited</b> ).
Oct 2021	<i>Density-based persistent homology.</i> 2nd Workshop on Topological Methods in Data Analysis, Heidelberg University, Germany (online).
Jul 2021	<i>Morse theory for group presentations.</i> Mathematical Congress of the Americas 2021, Buenos Aires, Argentina (online, <b>invited</b> ).
Jun 2021	<i>Intrinsic persistent homology via density-based metric learning.</i> The 38th Annual Workshop in Geometric Topology, USA (online).
Jun 2021	<i>Morse theory for group presentations.</i> Algebraic Topology Seminar, University of Buenos Aires, Argentina (online, <b>invited</b> ).
Apr 2021	<i>Intrinsic persistent homology via density-based metric learning.</i> IMSI Topological Data Analysis Workshop 2021, Chicago, USA (online).
Apr 2021	<i>A density-based metric learning approach to geometric inference.</i> 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, <b>invited</b> ).
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, <b>invited</b> ).

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## SCHOLARSHIPS, FELLOWSHIPS AND GRANTS

2022	Travel grant to attend the TDA Week 2023 Conference, Kyoto University, Japan.
2022	<i>LMS-EPSCRC ECR ICM Travel Grant</i> to attend to the International Congress of Mathematicians 2022 in Saint Petersburg. (Cancelled due to Ukraine-Russia war).
2020	<i>International Travel Scholarship AUIP - Andalusian and Iberoamerican Universities Program.</i> Research stay at the Department of Applied Mathematics, University of Sevilla, Spain. (Cancelled due to COVID). <i>Mentor:</i> Prof. Rocio Gonzalez Diaz.
2018	<i>International Travel Scholarship AUIP - Andalusian and Iberoamerican Universities Program.</i> Research stay at the Department of Algebra, Geometry and Topology, University of Málaga, Spain. <i>Mentor:</i> Prof. Aniceto Murillo.
2011-2016	<i>CONICET PhD Fellowship.</i> <i>Advisor:</i> Prof. Elías Gabriel Minian.
2010-2011	<i>UBACyT Scholarship for finalization of career.</i> <i>Advisor:</i> Prof. Elías Gabriel Minian.

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## SERVICE AND OUTREACH

2023-2024	Organizer of the Algebraic Systems Biology Seminar. Mathematical Institute, University of Oxford.
2023	Poster presentation at the celebration of the 10 years of the Andrew Wiles Building, Mathematical Institute, University of Oxford.
2021 - 2023	Refereed for the International Journal of Computational Geometry and Applications (IJCGA) and the Journal of Applied and Computational Topology (JACT).
2021	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 teh following outreach events in Argentina: <i>Math's Week</i> , <i>Data Science's Week</i> , <i>Matbaires</i> , <i>Math Festival</i> .
2020	Panel <i>Women in Science</i> , Swansea Science Festival 2020.
2015 - 2018	Jury member at several primary and secondary math level national competitions (Argentina) including: Olimpiada Matemática Argentina, Olimpiada Matemática Nandú and Olimpiada de los Mateclubes.
2011	Collaborator in the organization of WATACBA <i>Workshop in Algebraic Topology and Combinatorics</i> , University of Buenos Aires, Argentina.