

# XIMENA L. FERNÁNDEZ

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## CURRENT POSITION

- Postdoctoral Research Associate at the Department of Mathematical Sciences, Durham University.
- Member of the UK Centre for Topological Data Analysis.

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## ACADEMIC APPOINTMENTS

Sep 2021 - Present    **Postdoctoral Research Associate**, Grade 7, Durham University, UK.  
*Advisor:* Prof. Jeffrey Giansiracusa.

Oct 2020 - Aug 2021   **Postdoctoral Research Associate**, Grade 7, Swansea University, UK.  
*Advisor:* Prof. Jeffrey Giansiracusa.

Jan 2020 - Sep 2020   **Research Assistant**, University of Buenos Aires, Argentina.

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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 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 INTERESTS

Topological Data Analysis, Applied and Computational Topology, Algebraic and Combinatorial Topology, Probability and Statistics, Neuroscience, Dynamical Systems, Data Science and Machine Learning.

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## RESEARCH PUBLICATIONS AND PREPRINTS

- 2022 (with D. Mateos) *Topological biomarkers for real-time detection of epileptic seizures*. Preprint. [arxiv:2211.02523](#).
- 2022 (with S. Benas and E. Kropff) *Modeled grid cells aligned by a flexible attractor*. Preprint. [bioRxiv 2022.06.13.495956](#).
- 2021 (with E. Borghini, G. Mindlin and P. Groisman) *Intrinsic persistent homology via density-based metric learning*. Preprint. [arXiv:2012.07621](#).
- 2021 *Morse theory for group presentations*. Preprint. [arXiv:1912.00115](#).
- 2020 (with E.G. Minian) *The cylinder of a relation and generalized versions of the Nerve Theorem*. Discrete & Computational Geometry 63(8).
- 2016 (with E.G. Minian) *Homotopy colimits of diagrams over posets and variations on a theorem of Thomason*. Homology, Homotopy and Applications. vol. 18 issue 2.

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## OTHER PUBLICATIONS

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

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## SCHOLARSHIPS, FELLOWSHIPS AND GRANTS

- 2022 *LMS-EPSCRC 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 - Andalusian and Iberoamerican Universities Program*. Research stay at the Department of Applied Mathematics, University of Sevilla, Spain. (Cancelled due to COVID). *Mentor*: Prof. Rocio Gonzalez Diaz.
- 2018 *International Travel Scholarship AUIP - Andalusian and Iberoamerican Universities Program*. Research stay at the Department of Algebra, Geometry and Topology, University of Málaga, Spain. *Mentor*: Prof. Aniceto Murillo.
- 2011-2016 *CONICET PhD Fellowship*. *Advisor*: Prof. Elías Gabriel Minian.
- 2010-2011 *UBACyT Scholarship for finalization of career*. *Advisor*: Prof. Elías Gabriel Minian.

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## SOFTWARE

- 2022 Contributor of `Giotto-tda`. Developer of the method `Fermat distance` and a tutorial *Intrinsic Persistent Homology* within the module `graphs` (*in progress*).

- 2019 GAP package `Posets`. With Iván Sadofschi Costa and Kevin Piterman.  
 Code: [github.com/isadofschi/posets](https://github.com/isadofschi/posets)  
 Documentation: [mate.dm.uba.ar/~isadofschi/posets/](http://mate.dm.uba.ar/~isadofschi/posets/)
- 2017 SAGE Module `Finite Topological Spaces`  
 Code: [github.com/ximenafernandez/Finite-Spaces](https://github.com/ximenafernandez/Finite-Spaces)
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## RECENT TALKS

- 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, 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 *The persistent fundamental group of point clouds.*  
 11th International Conference on Geometric and Topological Methods in Computer Science (GETCO 2022), EPITA School of Engineering and Computer Science, Paris, France.
- May 2022 *Morse theory for group presentations and the persistent fundamental group.*  
 Transpennine Topology Triangle Meeting 116, Liverpool University, UK (online, **invited**).
- Apr 2022 *Morse theory for group presentations and the persistent fundamental group.*  
 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, Basque Country, Spain (online).
- Nov 2021 *Density-based intrinsic persistent homology and applications to time series analysis.*  
 Centre for Topological Data Analysis Group Meeting, Oxford University, UK (**invited**).
- Oct 2021 *Morse theory for group presentations.*  
 Geometry and Topology Seminar, Durham University, UK (**invited**).
- Oct 2021 *Topological time series analysis.*  
 Applied Math Seminar, Durham University, UK (**invited**).

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).
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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## INVITED LECTURES

Jul 2022	EUropean TOPology Interdisciplinary Action (EUTOPIA) Summer School 2022. Paris, France. 27 June - 6 July 2022. <i>Course:</i> 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. <i>Course:</i> Topological data analysis and applications in dynamics.

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## PROJECT SUPERVISION

Summer 2022	Grant URB-2022-07. Undergraduate Research Bursary, funded by the London Mathematical Society. Joint supervision with Jeffrey Giansiracusa. <i>Student:</i> Leo Zhang. <i>Project:</i> Reconstruction of surfaces from high dimensional point clouds and applications to data analysis. <i>Code:</i> <a href="https://github.com/shesturnedtheweansagainstus/quotient_rml">github.com/shesturnedtheweansagainstus/quotient_rml</a>
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## RESEARCH VISITS

- 2022                    *Research visit.* 14 July. Department of Mathematics and Statistics, University of Sheffield, UK.
- 2018                    *Research stay.* 20 May - 20 June. Department of Algebra, Geometry and Topology, University of Malaga, Spain.

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## TEACHING

### University of Buenos Aires, Argentina

Jan 2020 - Sept 2020    *Lead Teaching Assistant* (requires PhD), Department of Mathematics.  
& Mar 2013 - Sep 2018.

Mar 2009 - Feb 2013.    *Teaching Assistant*, Department of Mathematics.

Mar 2012 - Feb 2017    *Instructor*, Course of Admission.  
& Mar 2007 - Jun 2010.

**Courses:** Introduction to Calculus, Introduction to Algebra, Linear Algebra, Topology, Advanced Calculus, Elementary Numerical Analysis, Probability and Statistics.

### University of San Andrés, Argentina

Mar 2020 - Jul 2020. *Senior Lecturer*, Department of Mathematics.

**Course:** Calculus.

### Torcuato DiTella University, Argentina

Mar 2016 - Feb 2018. *Senior Lecturer*, Department of Mathematics.

**Course:** Calculus I (one variable) and Calculus II (several variables).

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## SERVICE AND OUTREACH

- 2021                    Tutorials *Intrinsic Persistent Homology* and *Morse Theory 2.0*, AATRN Applied Algebraic Topology Research Network YouTube Channel.
- 2006 - 2021            Speaker and collaborator in different outreach events in Argentina: *Math's Week*, *Data Science's Week*, *Matbaire*, *Math Festival*.
- 2020                    Panel *Women in Science*, 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 *Workshop in Algebraic Topology and Combinatorics*, University of Buenos Aires, Argentina.

Updated 07/11/2022