

XIMENA L. FERNÁNDEZ

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RESEARCH INTERESTS

Topological Data Analysis, Computational Algebraic Topology, Dynamics, Neuroscience, Foundations of Data Science.

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.

INDUSTRIAL APPOINTMENTS

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

Oct 2018 - Apr 2019 **Mathematical Models Specialist**, CAMMESA, 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 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.

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*. SIAM Journal of Data Science (accepted). arXiv:2309.03516
- 2023 X. Fernández, *Morse theory for group presentations*. Transactions of the Amer. Math. Soc. (To appear). arXiv:1912.00115
- 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). bioRxiv 2022.06.13.495956.
- 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.

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.

TEACHING

University of Oxford, UK

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

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.

SOFTWARE

2019 GAP package `Posets`. With Iván Sadofski Costa and Kevin Piterman.
Code: github.com/isadofski/posets
Documentation: mate.dm.uba.ar/~isadofski/posets/

2017 SAGE Module `Finite Topological Spaces`
Code: github.com/ximenafernandez/Finite-Spaces

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

- 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

- 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. 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 (**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 *The persistent fundamental group of point clouds.*
11th International Conference on Geometric and Topological Methods in Computer Science (GETCO 2022), EPITA, 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.*
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 *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).
- Jun 2021 *Morse theory for group presentations.*
Algebraic Topology Seminar, University of Buenos Aires, Argentina (online, **invited**).
- 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**).

SCHOLARSHIPS, FELLOWSHIPS AND GRANTS

- 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 - 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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RESEARCH VISITS

- 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.
- 2022 14 Jul. Department of Mathematics and Statistics, University of Sheffield, UK.
- 2018 20 May - 20 Jun. Department of Algebra, Geometry and Topology, University of Malaga, Spain.
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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 *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*, *Matbaires*, *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 Ñandú and Olimpiada de los Mateclubes.
- 2011 Collaborator in the organization of WATACBA *Workshop in Algebraic Topology and Combinatorics*, University of Buenos Aires, Argentina.