

# MANUEL LECHA

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## SUMMARY

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**ELLIS PhD student** under the supervision of **Alessio Del Bue** at the Italian Institute of Technology and **Michael Bronstein** at the University of Oxford. With a robust background in mathematics and computer science, I am committed to bridging theoretical foundations with transformative real-world AI solutions.

## EDUCATION

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**ELLIS PhD Program** Nov 2024 – Nov 2027  
*European Laboratory of Learning and Intelligent Systems (ELLIS),  
Italian Institute of Technology,  
University of Oxford*

**Master of Advanced Mathematics and Mathematical Engineering** Sep 2021 – Nov 2022  
*Polytechnique University of Catalonia*  
Coursework: Graph Theory, Algorithmic Geometry, Machine Learning, Differential Manifolds, Non-Commutative Algebra, Computational Algebra, and Representation Group Theory. During my master's thesis, I explored the topic of 'Multiparameter Persistent Homology'.

**Bachelor of Computer Science and Software Engineering** Sep 2015 – Feb 2021  
*University of Barcelona*

**Bachelor of Mathematics** Sep 2015 – Feb 2021  
*University of Barcelona,  
University of Warwick*

Both bachelor's degrees were undertaken through a joint program at the University of Barcelona, with the third year of the Bachelor of Mathematics completed entirely at the University of Warwick. I presented a joint thesis project titled 'Functional Summaries of Persistence Diagrams for Time Series Analysis'.

**Postgraduate Diploma in Financial Mathematics** Oct 2020 – Jun 2021  
*Polytechnique University of Catalonia*

## RESEARCH EXPERIENCE

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**Fellow Researcher** May 2024 – Nov 2024  
*Italian Institute of Technology*

Upcoming...

**Fellow Researcher** Feb 2023 – Mar 2024  
*University of Barcelona*

I developed a High-Order Attention Neural Network Model for Mesh Classification and delved into the intersection of algebraic topology, geometry, and deep learning. The primary motivation for the research was the urgent theoretical and practical need to address the limitations of graph-based models in representing complex systems with multiway and geometry-aware interactions among entities.

## OTHER WORK EXPERIENCE

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### Data Analyst

Mar 2021 – Sep 2021

*KPMG Spain*

I worked closely with cross-functional teams to enhance and refine risk and forecasting models, increasing their accuracy and reliability. I conducted thorough analyses and significantly improved the documentation of established models, ensuring their clarity and ease of understanding. This work directly contributed to a measurable boost in team efficiency and overall productivity.

### Data Analyst Intern

Dec 2020 – Mar 2021

*IMath Sherpa*

I played a key role in developing and implementing machine learning models using Python and libraries such as NumPy, Pandas, and Scikit-learn, focusing on analyzing stock market companies and modeling financial products. Additionally, I collaborated on creating socially responsible investment portfolios, employing ESG metrics to integrate ethical and social considerations into our financial strategies.

## TECHNICAL SKILLS

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Programming Languages	Python, R, C++, Java, Mathematica.
Deep Learning libraries	PyTorch, TensorFlow, Keras, PyTorch Geometric.
Topological Data Analysis	Ripsler, Gudhi, Giotto, RIVET.
Other Libraries	NumPy, Pandas, Scikit-learn, Matplotlib.

## PUBLICATIONS



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Hajij, Mustafa and Papillon, Mathilde, ..., and **Lecha, Manuel**, ..., and Miolane, Nina (17 Feb 2024). TopoX: A Suite of Python Packages for Machine Learning on Topological Domains. In: **arXiv**: 2402.02441 [cs.LG]. url: <https://arxiv.org/abs/2402.02441>

Papillon, Mathilde and Hajij, Mustafa ... , and **Lecha, Manuel**, ..., and Miolane, Nina (28 Jul 2023). "ICML 2023 Topological Deep Learning Challenge: Design and Results". In: **Proceedings of Machine Learning Research** 221. Ed. by Timothy Doster et al., pp. 3–8. url: <https://proceedings.mlr.press/v221/papillon23a.html>.

## AWARDS AND HONORS

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Secured first place in the ICML 2023 Topological Deep Learning Challenge, Combinatorial Complex category, for implementing a Higher Order Attention Neural Network Model for Mesh Classification.  · 

Awarded with Excellence María de Maetzu Grant for graduate research assistantship, recognizing academic merit and research potential.

Recipient of "Matricula de Honor", a national scholarship for students with excellent academic record, covering the expenses of the first year of university.

Featured as the main speaker at the opening session of the ExperimentAI conference, a distinguished AI scientific dissemination project organized by the Computer Vision Center (CVC), which secured the first position as the best AI dissemination project by the Artificial Intelligence Catalan Association.