Heitor Baldo, PhD

Applied Mathematician / Researcher

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heitorbaldo

Academic Appointments

2024 – 2026 **Postdoctoral Research Fellow**, *University of São Paulo*, Brazil.

2024 – 2025 **Visiting Postdoctoral Research Fellow**, *Leipzig University*, Germany.

2019 – **Affiliate Researcher**, *IGDORE Institute*, Sweden.

Education

2019 – 2024 **Ph.D. in Bioinformatics (Mathematical Neuroscience)** , *University of São Paulo*, Brazil.
Thesis: *Towards a Quantitative Theory of Digraph-Based Complexes and its Applications in Brain Network Analysis*, advised by Koichi Sameshima and co-advised by André Fujita.

2014 – 2016 **M.S. in Applied and Computational Mathematics**, *University of Campinas*, Brazil.
Thesis: *Álgebras de Clifford e de Cayley-Dickson*, advised by Jayme Vaz Jr.

2009 – 2013 **B.S. in Mathematics**, *University of Campinas*, Brazil.

Publications

Preprint Manuscripts

2026 **Baldo, H., Baccalá, L., Fujita, A., & Sameshima, K.**, *Directed Q-Analysis and Directed Higher-Order Connectivity on Digraphs: A Quantitative Approach*, arXiv:2605.14178, https://doi.org/10.48550/arXiv.2605.14178
(preprint - submitted to a peer-reviewed journal)

Under Review Manuscripts

2026 **Baldo, H. & Fujita, A.**, *A Temporal Hypergraph Motif Framework for the Analysis of Higher-Order Dynamics of Epileptic Brain Networks*, (under review).

Unpublished Manuscripts and Academic Writings

2023 **Baldo, H.**, *Notes on Multi-Agent Reinforcement Learning*, (study notes).

2022 **Baldo, H.**, *Notes on Discrete Morse Theory on Digraphs*, (study notes).

2022 **Baldo, H.**, *Topics in Clifford and Lie Algebras associated with Graphs*, (unpublished Manuscript).

Open-Source Software

Since 2022 **Research Packages: DigplexQ, TemporalHypermotifs, PyTropical, Pytroids**, *Python*, *Sphinx*, *PyPi*, *NumPy*, *SciPy*, *Pandas*, *NetworkX*, *HyperNetX*, *XGI* , `https://github.com/heitorbaldo?tab=repositories`

- Open-source Python packages providing computational tools for research in directed higher-order network analysis and directed Q-analysis, temporal hypergraphs, tropical mathematics, and graphic matroid theory.

Talks

2025 "Spectral Density of Multilayer Hypergraphs and Applications" in *6th Central German Meeting on Bioinformatics*, Leipzig University.

2022 "Path Homology Theory of Digraphs and Its Applications to Brain Network Analysis" in *Universitä Leipzig - USP Workshop 2022* at the Institute of Mathematics and Statistics - USP.

2022 "Graph Cellular Automata and Beyond: Applications in Network Neuroscience." Institute of Mathematics and Statistics - USP.

Teaching Experiences

Spring 2021 **Teaching Assistant**, *University of São Paulo*, Brazil.
Course: *Multivariate Data Analysis* (MAE0330).

Winter 2017 **Lecturer**, *University of Campinas*, Brazil.
Course: *Complex-Valued Neural Networks* (Minicourse).

Spring 2016 **Teaching Assistant**, *University of Campinas*, Brazil.
Course: *Linear Algebra* (MA327).

Winter 2016 **Lecturer**, *University of Campinas*, Brazil.
Course: *Bio-Inspired Algorithms: An Introduction* (Minicourse).

Technical Skills

Programming	Python • Julia • R • C/C++ • Rust • SQL • TypeScript • HTML/CSS
ML/DL	PyTorch • TensorFlow • scikit-learn • XGBoost • PyTorch Geometric • DGL
Backend & APIs	FastAPI • Pydantic • Uvicorn • PostgreSQL • Redis • SQLAlchemy • REST
Frontend	Streamlit • Gradio • React • Next.js • TypeScript
MLOps & Infra	Docker • MLflow • Weights & Biases • DVC • Evidently AI • Prometheus • Grafana
Math & Neuro	SageMath • Mathematica • MATLAB/Octave • NetworkX/HyperNetX/XGI • Gudhi • Giotto-TDA • EEGLAB • Brainstorm • FreeSurfer • SPM • FieldTrip • fMRIPrep • Brian2 • MNE
Others	Git • Linux • pytest • Sphinx • LaTeX

Selected Participation in Events

2026 Homotopy Theory, K-theory, and Topological Data Analysis. *Fields Institute.*

2025 Thirteenth Symposium on Compositional Structures (SYCO 13). *University of Cambridge.*

2025 Workshop "Biology and Geometry". *Max Planck Institute for Mathematics in the Sciences.*

2025 6th Central German Meeting on Bioinformatics. *Leipzig University.*

2025 40th TBI Winterseminar in Bled. *Bled, Slovenia.*

2024 Twelfth Symposium on Compositional Structures (SYCO 12). *University of Cambridge.*

2021 Workshop on Algebraic Graph Theory and Quantum Information. *Fields Institute.*

2021 4th Workshop on Algebraic Graph Theory and its Applications. *Mathematical Center in Akademgorodok.*

2020 XLIII Annual Meeting of the Brazilian Society for Neuroscience and Behavior. *Online.*

2020 Seminars on Probability and Stochastic Processes. *University of São Paulo.*

2017 6th Brazilian Conference on Intelligent Systems. *Federal University of Uberlandia.*

2016 II Brazilian Congress of Young Researchers in Pure and Applied Mathematics. *University of Campinas.*

2015 IV School and Workshop on Lie Theory. *University of Campinas.*

2014 Workshop Many Faces of Distances. *University of Campinas.*

Certifications & Training

Spring 2018 Statistical Learning. *Stanford Online – Stanford University.* [`Certification`]

Spring 2017 Introduction to Complexity. *Santa Fe Institute.* [`Certification`]

Spring 2017 Minicourse on Machine Learning for Many-Body Physics. *IFT-Unesp.*

Languages

- **Portuguese:** Mother Tongue.
- **English:** Advanced Level (C1*).
- **German:** Pre-intermediate Level (A2*)

(*) *Common European Framework of Reference (CEFR) level.*

Last updated July 20, 2026.