Heitor Baldo, PhD

Curriculum Vitae

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Academic Appointments

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

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

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

Education

2019 – 2024 **Ph.D. in Bioinformatics**, *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.

Research Interests

I am interested in the mathematical foundations of methods coming from various areas of pure and applied mathematics, such as abstract algebra, combinatorics, algebraic topology and geometry, discrete geometry, graph theory, category theory, complex systems, and complexity science, and how these methods, together with probabilistic, statistical, and computational methods, can be useful in mathematical neuroscience and mathematical biology.

Manuscripts in Progress

Baldo, H., Sameshima, K., Baccalá, L., & Fujita, A. (2024). Directed Q-Analysis and Directed Higher-Order Connectivity on Digraphs: A Quantitative Approach. (in preparation).

Baldo, H., Sameshima, K., Baccalá, L., & Fujita, A. (2024). Quantifying Complexity on Graph Cellular Automata of Epileptic Brain Networks. (in preparation).

Other Academic Writings

Baldo, H., Notes on Spectral Theory of Hypergraphs (notes, 2022).

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

Baldo, H., Notes on Matroids and Tropical Matroids (notes, 2021).

Baldo, H., Notes on Simplicial Neural Networks for Digraph-Based Complexes (notes, 2021).

Grants and Funding

1. Postdoctoral Scholarship at Leipzig University, Germany, November 2024 - July 2025.
   Agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brazil - Finance Code 88887.988468/2024-00.
2. Ph.D. Scholarship at University of São Paulo, Brazil, 2019 - 2023.

Agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brazil - Finance Code 88887.464712/2019-00.

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).

Talks

2022 "The Theory of Path Complexes and its Applications in the Analysis of Brain Networks" 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.

Selected Participation in Events & Training

2024 Introduction to Molecular Modeling and Docking (Minicourse). *ISCB/RSG-Brazil.*

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.*

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

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.*

Software

- **DigplexQ**. Python package to perform computations with digraph-based complexes.Current version: v0.0.7 (PyPi). Soon available for Julia (DigplexQ.jl).
- **PyTropical**. Python package for tropical mathematics. Current version: v0.0.2 (PyPi).

Computing Skills

- **Programming Languages:** Python, R, Julia, C/C++, Haskell, HTML/CSS, PHP.
- **Operational Systems:** Linux, MS Windows.

- **Python Tools:** Jupyter, NumPy, SciPy, Pandas, Sklearn, NetworkX, unittest.
- **Parallel Programming:** CUDA, CuPy, Dask, Numba.
- **Machine Learning:** TensorFlow, Keras, PyTorch.
- **Mathematical Computation:** Mathematica, MATLAB / Octave, SageMath.
- **Computational Neuroscience:** EEGLAB, SPM, FieldTrip, FreeSurfer, Brainstorm, Brian2.
- **Bioinformatics Tools:** Bioconductor, BioPython, Galaxy Server (several tools), ViennaRNA, PyMol, DockThor.
- **Other Tools:** Experienced in using Docker, Git, and experienced in using LaTeX for scientific document typesetting.

Languages

- **Portuguese:** Mother Tongue - Reading:C2, Listening:C2, Writing:C2, Speaking:C2 (*)
- **English:** Advanced - Reading:C1, Listening:C1, Writing:C1, Speaking:B2 (*)
- **German:** Basic - Reading:A1, Listening:A1, Writing:A1, Speaking:A1 (*)
- **French:** Basic - Reading:A1, Listening:A1, Writing:A1, Speaking:A1 (*)

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

Last updated September 03, 2024.