Heitor Baldo, PhD

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Education

- **University of São Paulo**, São Paulo, Brazil.
  Ph.D. in Bioinformatics (Mathematical Neuroscience), August 2019 - June 2024.
  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.
- **University of Campinas**, Campinas, Brazil.
  M.Sc. in Applied and Computational Mathematics, March 2014 - March 2016.
  Thesis: "Álgebras de Clifford e de Cayley-Dickson," advised by Jayme Vaz Jr.
- **University of Campinas**, Campinas, Brazil.
  B.Sc. in Mathematics, March 2009 - December 2013.

Academic Positions

- **Institute for Globally Distributed Open Research and Education** (IGDORE).
  Affilate researcher, June 2019 - present.

Research Interests

I have experience in the areas of mathematics, applied mathematics, computer science, and bioinformatics, with an emphasis on mathematical neuroscience. More specifically, 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.

Work in Progress

1. **Baldo, H.**, Sameshima, K., Baccalá, L., & Fujita, A. (2024). Directed Q-Analysis and Directed Higher-Order Connectivity on Digraphs: A Quantitative Approach. (in preparation).
2. **Baldo, H.**, Sameshima, K., Baccalá, L., & Fujita, A. (2024). Quantifying Complexity on Graph Cellular Automata of Epileptic Brain Networks. (in preparation).

Other Academic Writings

1. Notes on Spectral Theory of Hypergraphs (notes, 2022).
2. Notes on Discrete Morse Theory on Digraphs (notes, 2022).
3. Notes on Matroids and Tropical Matroids (notes, 2021).
4. Notes on Simplicial Neural Networks for Digraph-Based Complexes (notes, 2021).

Grants and Funding

1. Ph.D. scholarship at University of São Paulo, 2019 - 2023.
   Agency: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Brazil - Finance Code 88887.464712/2019-00.

Teaching Experiences

1. Teaching Assistant, University of São Paulo, Aug 2021 - Dec 2021.
   Course: *Multivariate Data Analysis* (MAE0330).
2. Lecturer, University of Campinas, July 2017.
   Course: *Complex-Valued Neural Networks* (Minicourse).

3. Teaching Assistant, University of Campinas, Aug 2016 - Dec 2016.
   Course: *Linear Algebra* (MA327).
4. Lecturer, University of Campinas, July 2016.
   Course: *Bio-Inspired Algorithms: An Introduction* (Minicourse).

Talks

1. "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.
2. "Graph Cellular Automata and Beyond: Applications in Network Neuroscience." Institute of Mathematics and Statistics - USP. 2022.

Selected Participation in Events

1. Twelfth Symposium on Compositional Structures (SYCO 12).
2. Workshop on Algebraic Graph Theory and Quantum Information. 2021. (Fields Institute, Online).
3. 4th Workshop on Algebraic Graph Theory and its Applications. 2021. (Mathematical Center in Akademgorodok, Online).
4. XLIII Annual Meeting of the Brazilian Society for Neuroscience and Behavior. 2020.
5. Seminars on Probability and Stochastic Processes. 2019 / 2020. (USP).
6. 6th Brazilian Conference on Intelligent Systems. 2017. (UFU).
7. Minicourse on Machine Learning for Many-Body Physics. 2017. (IFT-Unesp).
8. II Brazilian Congress of Young Researchers in Pure and Applied Mathematics. 2016. (Unicamp).
9. IV School and Workshop on Lie Theory. 2015. (Unicamp).
10. Workshop Many Faces of Distances. 2014. (Unicamp).

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, unittest.
- Machine Learning: TensorFlow, Keras, PyTorch.
- Mathematical Computation: Mathematica, MATLAB / Octave, SageMath.
- Computational Neuroscience: EEGLAB, SPM, FieldTrip, FreeSurfer, Brainstorm, Brainnet, Brian2.
- Other tools: Docker, HDF5, CUDA, CuPy, Dask.
- Experienced in using Git, and experienced in using LaTeX for scientific document typesetting.

Language Skills

- Portuguese: mother tongue.
- English: advanced.
- German: reading competence.
- French: reading competence.

Last updated July 04, 2024.