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Brian Lavallee

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C++ and Python developer with Ph.D. in computer science specializing in algorithms, graph theory, and parameterized complexity.

Education

- **University of Utah**: Ph.D. in Computing (Data Management and Analysis), May 2023.
- **Duke University**: B.S. in Computer Science, May 2017.

Teaching Experience

- **Lecturer**: University of Vermont. Intro to Python and Computability/Complexity (2024 – 2025).
- **Teaching Mentorship**: University of Utah. Algorithms (2020) and Graph Theory (2019).
- **Head Undergraduate TA**: Duke University. Data Structures and Algorithms (2014 – 2017).

Research Interests

- *An Editing-Based Approach to Extending Structural Graph Algorithms.* **ESA 2019**, **ALENEX 2020**, and **EuJC 2023**. Introduces and implements a framework for large scale network analysis which leverages the complex structure of data from real-world applications to improve performance. Proves strong theoretical guarantees and empirically demonstrates near-optimal performance for multiple problems.
- *Parameterized Complexity of Gerrymandering.* **SAGT 2023**. Examines the complexity of detecting regions vulnerable to gerrymandering by studying an abstraction of the problem on graphs.
- *Overlapping and Robust Edge-Colored Clustering in Hypergraphs.* **WSDM 2023**. Compares the efficacy of hypergraph clustering techniques in a network model where nodes can have different interaction types (e.g. friends, family, co-workers).

Awards

- NC State Department of Computer Science Graduate Fellowship, 2017.

Software Development

- **Structural Rounding**: Extensive C++ library for scalable network/graph analysis up to 1 billion nodes. Optimized performance using custom data structures (open addressing hash tables, semi-nice tree decompositions). Full-featured Python API for easy scripting. Produces high quality approximations by extending optimal solutions found on a maximal structured subgraph of the input.
- **Climate Visualization**: Interactive Javascript visualization exploring the impact of rising sea levels. Uses a novel search algorithm to determine a hypothetical coastline from topographic data derived from satellite imagery. Implemented with D3 and TopoJSON frameworks.
- **Machine Learning Library**: Python and NumPy implementations of standard machine learning techniques including linear regression, kernel methods, multi-layer neural networks, and ensemble algorithms such as AdaBoost. Emulates the scikit-learn API.