Benjamin Holmgren

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Education

Montana State University. B.S. Computer Science, Data Science Minor   *May 2022*
Montana State University. B.S. Mathematics, Honors Degree with Distinction.   *May 2022*
- 3.94 GPA, 3.99 Concentrated Computer Science GPA

Technical Experience

Associate Blockchain Engineer, Brightvine blockchain platform   *1/2022-Present*
- Primary contributor to Brightvine's blockchain network infrastructure, currently storing $150 million in financial data. Built using the Hyperledger Besu ecosystem and Kubernetes.
- Assisted in smart contract and blockchain related backend development, using Solidity and Golang.

Research Assistant, *Computational Topology & Geometry Group*, Montana State University   *8/2018-Present*
- Lead author of two international conference papers in computational topology, with one in submission.
- Co-created a nationwide NSF workshop for 50 undergraduates to occur in 2022.
- Served as the CompTaG Club President, leading weekly research seminars and reading groups.

Undergraduate Capstone Project: *Topo Health*, a Lung Cancer Diagnostic AI   *Spring 2022*
- Winner of "Best Undergraduate Capstone Award" $1,000 prize for the MSU school of computing.
- Created a machine learning model to diagnose lung cancer in a CT scan, hosted within a fully usable web application. This achieved greater accuracy than the average radiologist at diagnosing lung cancer.

Teaching Assistant, *CSCI 276 - Discrete Mathematics*, Montana State University   *Spring 2021*
- TA in Discrete Mathematics class of ~60 undergraduates. Assisted in grading assignments, substitute lecturing, student help sessions, and generating course assignments.

Peer Reviewed Articles

If You Must Choose Among Your Children, Pick the Right One. **Canadian Conference on Computational Geometry, 2020**
In this paper we proposed efficient algorithms to generate discrete Morse functions, which are useful for topologically faithful data simplification. Reduced the problem from cubic to pseudo-linear time complexity.

Path-Connectivity of Fréchet Spaces of Graphs. **CG Week: Young Researcher's Forum, 2022**
This short article provides proof of basic path-connectedness properties of the Fréchet distance extended to graphs in the Euclidean ambient space. Motivated to improve the underlying theory behind these ubiquitous structures.

Path-Connectivity of Paths and Graphs under the Fréchet Distance. **Learning on Graphs Conference, 2022** (submitted)
Here we expand upon the results given in the previous paper, generalizing metric properties of the Fréchet distance and extending our results for the path-connectivity of metric balls.

In Progress

Practical Methods to Generate Discrete Morse Functions from Point Data. Nearing submission for SoCG, 2023.
Leading a followup experimental paper to that which was published in CCCG, where we give a new hardness result and implement several algorithms in discrete Morse theory which have experimental promise despite their hardness.

Invited Talks, Poster Sessions, and Directed Reading

Co-Created NSF Workshop for Undergraduates *Topology For Data Science 2020* (Postponed, to occur 2022)
Created an open source [tutorial project](#) in 2018 on techniques in TDA became a national workshop in 2020.
(Postponed due to Covid-19). To be held in 2022. The MSU news wrote an article about my work [here](#)

CG Week 2022 (Berlin) *Path-Connectivity of Fréchet Spaces of Graphs*

MSU Research Symposium 2022 (Bozeman) *Topo Health*, a Lung Cancer Diagnostic AI [poster](#)

National Conference on Undergraduate Research 2020 (Postponed to 2021) *Using Hasse Diagrams to Compute a Gradient Vector Field* [poster](#)

CCCG 2020 (Remote) *If You Must Choose Among Your Children, Pick the Right One* [presentation](#)

Simplicial Collapsing Visualization Project *[Poking a Simplicial Complex](#)*
Multidisciplinary Project to visualize Morse theory as part of a thesis project for students in the art department.

MSU Research Symposium 2019 (Bozeman) *Updating the R Package 'TDA'* [poster](#)

MSU Geometry & Topology Summer Book Club 2022 *Discrete Differential Geometry: An Applied Introduction*
MSU Geometry & Topology Summer Book Club 2021 *Quantum Computation and Quantum Information*
MSU Geometry & Topology Summer Book Club 2020 *Applications of Linear Algebra*
(Book club presentations given weekly each summer)

Honors & Awards

MSU Cameron Presidential Scholarship   Full tuition + $1,500 stipend per semester. Most prestigious scholarship offered at Montana State University, granted by the Honors College.

2021 Computing Research Association Outstanding Undergraduate Award, Honorable Mention
Recognized as one of the top 105 computer science undergraduates in North America demonstrating "outstanding research potential in an area of computing research."

Alternate, Budapest Semesters in Mathematics Fulbright Scholarship
Institutional Nominee, Barry M. Goldwater Scholarship and Rhodes Scholarship
2019/20 MSU School of Computing Undergraduate Researcher of the Year
2022 Department of Mathematics Outstanding Graduating Senior Award
Phi Kappa Phi and Pi Mu Epsilon Honors Societies
Montana State University Big Idea Challenge "Biggest Idea" and "Best Pitch" Awards for Cancer AI

Service & Leadership

Club President, MSU Computational Geometry & Topology Club
  - Club president, coordinated weekly seminars and book clubs, and directed research.

Referee, Canadian Conference on Computational Geometry
Referee, Journal of Applied and Computational Topology
Web Coordinator, Committee on Diversity, Equity, and Inclusion in Computational Topology

Skills & Interests

- Python, Tensorflow, C++, Git, Latex, Golang, Kubernetes, Theoretical Computer Science & Algorithms (excellent)
- Java, C, R, Matlab, Solidity, HTML/Javascript/CSS, PyTorch, OpenGL (proficient)
- Linear algebra, analysis, topology, geometry, quantum computing, graphics, combinatorics, & machine learning.
- Alpine rock and ice climbing, and trail ultrarunning. Primarily in Montana, Alaska, and the Canadian Rockies
- Rich teamwork