Benjamin Holmgren

(406)-599-4614 **bholmgren3@gmail.com** **https://github.com/benholmgren**

Education

Montana State University. B.S. Computer Science, Data Science Minor *8/2018-5/2022*
Montana State University. B.S. Mathematics, Honors Degree with Distinction. *8/2020-5/2022*
- 3.94 GPA, 3.99 Concentrated Computer Science GPA

Technical Experience

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

Associate Blockchain Engineer, Brightvine blockchain platform *1/2022-11/2022*
- 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.

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.
- Used computational geometry and ML 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 providing feedback on 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.

Preprints

Linear Time Computation of Discrete Morse Functions Over Two-Manifolds. Nearing submission for ICALP, 2023.
Leading a paper which reduces computation of a discrete Morse function on two-manifolds from cubic to linear time, and provides a gradient descent heuristic to rapidly optimize Morse functions given a function on the vertices.

Metric and Topological Properties of Paths and Graphs under the Fréchet Distance. (under review)
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.

Invited Talks, Poster Sessions, and Directed Reading

Co-Created NSF Workshop for Undergraduates *Topology For Data Science 2020* (Postponed, now in 4/2023)
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 to roughly 100 students in a student body of 14,668. (~2% acc. rate)

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

Academic 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

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 distance mountain running. Primarily in Montana and Alaska.