

# Benjamin Holmgren

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<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

**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**

## 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.