Amber Thrall

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Research Projects

Paragonimiasis Data Analysis *May 2024-Current*

- Cleaned and analyzed data in Python using pandas containing 12,401 patients and 171 features.
- Constructed several support-vector machine models in C++ using LIBSVM and Washington State University's compute cluster Kamiak.
- One of the first studies attempting to differentiate between tuberculosis and paragonimiasis. Still in progress.

Steinhaus Filtration and Stable Paths in the Mapper *Mar 2024-Dec 2024*

- Learned the standard framework for studying the homological stability of simplicial complexes.
- Provided the results on stability in our paper *Steinhaus Filtration and Stable Paths in the Mapper* (submitted).
- Presented findings at Washington State University's seminar in Discrete Math, Linear Algebra, and Number Theory in March 2025.

Variation of the Dyadic Transformation *Jan 2019-Dec 2020*

- Proved that the Dyadic transformation $2x \bmod 1$ is chaotic and used transfer operators to show that the uniform density is invariant under the Dyadic transformation. Read More.
- Modified Dyadic transformation to be non-linear in half the space. Showed experimental results via Markov chains that the modified transformation had a power law invariant density. Read More.
- Extended the modified transformation to be a continuous stochastic model. Modified the Fokker-Planck equation to construct an approximation of the invariant density matching experimental results.

Non-negative Inverse Eigenvalue Problem *Mar 2017-June 2018*

- Worked with two other undergraduates over the summer to show that the critical points of non-negative unitarily diagonalizable matrices are realizable by a non-negative matrix. Paper: j.laa.2018.06.024
- Proved a new sufficient condition for a multiset of real numbers to be realized by a non-negative matrix. Paper: j.laa.2018.12.030
- Presented results with two poster presentations: University of Washington Undergraduate Research Symposium in 2017 and Joint Mathematics Meetings in 2018.

Education

Washington State University *Aug 2023 - Current*
Ph.D. in Mathematics

- Focus: Topological Data Analysis
- Advisor: Bala Krishnamoorthy

University of Arizona *Aug 2018 - Dec 2020*
Masters in Mathematics

- Focus: Dynamical Systems
- Advisors: Kevin Lin and Shankar Venkataramani
- Incomplete. Left due to medical issues.

University of Washington - Bothell *Sep 2016 - Jun 2018*
B.S. in Mathematics

- Cum Laude
- Advisor: Pietro Paparella

Publications

- Dustin L. Arendt, Matthew Broussard, Bala Krishnamoorthy, Nathaniel Saul, and Amber Thrall. Steinhaus filtration and stable paths in the mapper. In *International Symposium on Computational Geometry*, submitted.
- P. Paparella and A. Thrall. Realizing Suleĭmanova spectra via permutative matrices, II. *Linear Algebra Appl.*, 2019. 10.1016/j.laa.2018.12.030
- S. Hoover, D. McCormick, P. Paparella and A. Thrall. On the realizability of the critical points of a realizable list. *Linear Algebra Appl.*, 2018. 10.1016/j.laa.2018.06.024

Selected Presentations

- A. Thrall. *Steinhaus Filtration and Stable Paths in the Mapper.* Washington State University's seminar in Discrete Math, Linear Algebra, and Number Theory. March 3, 2025.
- A. Thrall. *Systems with Intermittent Chaos.* University of Arizona Research Tutorial Group, Tucson, AZ. December 12, 2019.
- S. Hoover, D. McCormick, and A. Thrall. *On the realizability of the critical points of a realizable list.* MAA Undergraduate Poster Session at the Joint Mathematics Meetings, San Diego, CA. January 12, 2018.
- A. Thrall. *Permutative Matrices and the Real Nonnegative Inverse Eigenvalue Problem.* University of Washington Undergraduate Research Symposium, Seattle, WA. May 18, 2017.

Teaching Experience

Graduate Teaching Assistant — *Pullman, WA*
Washington State University — *Aug 2023 – Current*

- Primary instructor for Math 216: Discrete Structures, Math 202: Calculus for Business and Economics, Math 100: Basic Mathematics.

Graduate Teaching Assistant — *Tucson, AZ*
University of Arizona — *Aug 2018 – Dec 2020*

- Primary instructor for Math 122B: First Semester Calculus, Math 120R: Calculus Preparation.

Undergraduate Teaching Assistant — *Bothell, WA*
University of Washington - Bothell — *Sep 2017 – Jun 2018*

- Lead several weekly review sessions for precalculus.

Selected Software Projects

scomplex
Simplicial complex construction library written in rust. Allows users to classify the shape of data by constructing a simplicial complex via Vietoris-Rips and computing the complexes Betti numbers and determining orientability. Written while taking a class on computational topology to help me learn concepts.
`https://github.com/AmberThrall/scomplex`

Linear
A C++14 linear algebra all-header library supporting various matrix algorithms including QR decomposition, SVD, equation solving, and identifying eigenvalues. Built in free time as a side project.
`https://github.com/AmberThrall/Linear`

Awards and Scholarships

Mary Gates Research Scholarship — *Mar 2017*
Competitive scholarship awarded to approximately 160 students annually across all University of Washington campuses for engaging in research with a faculty mentor.

Computer Skills

Languages: Rust, C++, C, Python

Technologies: LaTeX, Git, pandas, scikit-learn

Platforms: Unix/Linux, Windows