# David Harry Richman

CONTACT INFORMATION

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RESEARCH INTERESTS   Combinatorics: random spanning trees, effective resistance, curvature on graphs
Tropical geometry: curves and Jacobians, potential theory on graphs, moduli space of metric graphs
Number theory: bounds on rational points, Möbius function bounds
Phylogenetics: distance methods, metrics on tree space, applications of $p$-adic distance

EMPLOYMENT

**National Center for Theoretical Sciences**, Taipei, Taiwan
Postdoctoral Fellow, Division of Mathematics                                  2024 – present

**Fred Hutchinson Cancer Center**, Seattle, WA
Postdoctoral Fellow, Matsen Group, Herbold Computational Biology Program      2023 – 2024

**University of Washington**, Seattle, WA
Postdoctoral Scholar, Department of Mathematics                               2020 – 2022

EDUCATION

**University of Michigan**, Ann Arbor, MI
Ph.D. in Mathematics                                                          2014 – 2020
   Thesis: Weierstrass points and torsion points on tropical curves
   Advisor: David Speyer

**Independent University of Moscow**, Moscow, Russia
Math in Moscow Study Abroad Program                                           2013 – 2014

**Massachusetts Institute of Technology**, Cambridge, MA
S.B. in Mathematics with Computer Science                                     2009 – 2013

RESEARCH PAPERS

"A Ricci flow on graphs from effective resistance," with Aleyah Dawkins, Vishal Gupta, Mark Kempton, William Linz, Jeremy Quail, and Zachary Stier, accepted to *J. Combinatorics*

"Node resistance curvature in Cartesian graph products," with Aleyah Dawkins, Vishal Gupta, Mark Kempton, William Linz, Jeremy Quail, and Zachary Stier, accepted to *J. Combinatorics*

"The family of $a$-floor quotient partial orders," with Jeffrey Lagarias, in *Proceedings of Combinatorial and Additive Number Theory VI* (2025), 283–318.
DOI: 10.1007/978-3-031-65064-2_15

"Lower rational approximations and Farey staircases," *Integers* **24** (2024), paper A37.
DOI: 10.5281/zenodo.10944039

"The distribution of Weierstrass points on a tropical curve," *Selecta Math. New Ser.* **30** (2024).
DOI: 10.1007/s00029-024-00919-5

"The floor quotient partial order," with Jeffrey C. Lagarias, *Adv. Appl. Math.* **153** (2024).
DOI: 10.1016/j.aam.2023.102615

"The tropical Manin–Mumford conjecture," *Int. Math. Res. Not. IMRN* **2023** (2023) no. 21, 18714–18751.
DOI: 10.1093/imrn/rnad098

"Counting tripods on the torus," with Jayadev S. Athreya and David Aulicino, *Arnold Math. J.* **9** (2023) 359–379.

DOI: 10.1007/s40598-022-00216-z

"Derangements and the $p$-adic incomplete gamma function," with Andrew O'Desky, *Trans. Amer. Math. Soc.* **376** (2023) no. 2, 1065–1087.
DOI: 10.1090/tran/8716

"Dilated floor functions with nonnegative commutators II: Negative dilations," with Jeffrey C. Lagarias, *Acta Arithmetica* **196** (2020) no. 2, 163–186.
DOI: 10.4064/aa190628-14-1

"Dilated floor functions with nonnegative commutators I: Positive and mixed sign dilations," with Jeffrey C. Lagarias, *Acta Arithmetica* **187** (2019) no. 3, 271–299.
DOI: 10.4064/aa180602-21-9

"Dilated floor functions that commute," with Jeffrey C. Lagarias and Takumi Murayama, *Amer. Math. Monthly* **123** (2016) no. 10, 1033–1038.
DOI: 10.4169/amer.math.monthly.123.10.1033

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| CONFERENCE PROCEEDINGS | "PhyloVAE: unsupervised learning of phylogenetic trees via variational autoencoders," with Tianyu Xie, Jiansi Gao, Frederick A. Matsen, and Cheng Zhang, in *Proceedings of the 13th International Conference on Learning Representations (ICLR 2025)* |
| PREPRINTS | "Counting two-forests and random cut size via potential theory," with Farbod Shokrieh and Chenxi Wu, in revision.<br>preprint: arXiv:2308.03859 |
| | "Tropical Weierstrass points and Weierstrass weights," with Omid Amini and Lucas Gierczak, in revision.<br>preprint: arXiv:2303.07729 |
| | "Vector encoding of phylogenetic trees by ordered leaf attachment," with Erick Matsen and Cheng Zhang, in revision.<br>preprint: arXiv:2503.10169 |
| | "Principal minors of tree distance matrices," with Farbod Shokrieh and Chenxi Wu, submitted.<br>preprint: arXiv:2411.11488 |
| | "The Möbius function on the poset of triangular numbers under divisibility," with Rohan Pandey, submitted.<br>preprint: arXiv:2402.07934 |
| | "Tutte evaluations and rank-generating power series for metric graphs," in preparation. |
| | "Origami hexagon deformations, flip operations, and Pythagorean 4-tuples," with Erica Yuqing Liu, in preparation |

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| HONORS AND AWARDS | NSTC (Taiwan) International Conference Travel Funding for Domestic Scholars | 2025 |
| | AMS-Simons Travel Grant ($5,000) | 2020 – 2022 |
| | Rackham Predoctoral Fellowship ($32,640) | 2019 – 2020 |
| | AMS Graduate Student Travel Grant | Fall 2019 |
| | Rackham Conference Travel Grant | Summer 2016, 2017, 2019 |
| | AARMS award for best student poster, CMS Meeting | Summer 2016 |
| | AMS Math in Moscow Scholarship ($8000) | Fall 2013 |

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| TEACHING EXPERIENCE | **University of Washington**, Seattle, WA, USA | |

*Primary Instructor*

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| Math 208, Linear Algebra | Winter 2022, Spring 2022 |
| Math 308, Linear Algebra | Autumn 2020, Spring 2021 |

**University of Michigan**, Ann Arbor, MI, USA

*Primary Instructor*

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| Math 116, Calculus II (Primary Instructor) | Winter 2015, Winter 2016, Winter 2018, Winter 2019 |
| Math 115, Calculus I (Primary Instructor) | Fall 2014 |

*Teaching Assistant*

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| Math 215, Multivariable calculus (TA) | Fall 2016 |
| Math 216, Differential equations (TA) | Fall 2015 |

MENTORING EXPERIENCE

**University of Washington**, Seattle, WA, USA

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| WXML: Counting spanning trees on the Kagome lattice | Autumn 2021 – Winter 2022 |
| WXML: Zeros and critical points of complex polynomials | Autumn 2020 – Spring 2021 |

**University of Michigan**, Ann Arbor, MI, USA

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| MREG: Rational Catalan combinatorics (online) | Summer 2021 |
| Laboratory of Geometry: Origami on a Hexagonal Lattice | Winter 2019 |

INVITED TALKS

**Tropical weights of Weierstrass points**

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| NCTS Tropical Geometry in Taiwan | August 2025 |
| Taipei Postdoc Seminar, NCTS | March 2025 |
| Informal Tropical Geometry Conference, National Taiwan University | March 2025 |
| AMS Fall Sectional Meeting, University of Texas San Antonio | September 2024 |
| (poster) WAGS 2023, University of Washington | April 2023 |

**Tree distance matrices and their minors**

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| (poster) FPSAC 2025, Sapporo Japan | July 2025 |
| ILAS 2025, Kaohsiung Taiwan | June 2025 |
| 05C50 Online, University of Manitoba | May 2024 |

**OLA encoding of phylogenetic trees**

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| (poster) Current Methods and Open Problems in Phylogenetics, ICERM | September 2024 |

**Ricci flow on graphs from effective resistance**

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| JMM 2024, Special Session on Ricci curvatures on graphs and applications | January 2024 |

**Uniform bounds for torsion packets on tropical curves**

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| (poster) CCAAGS in honor of Bernd Sturmfels, University of Washington | June 2022 |
| Tropical Geometry in Frankfurt (online), Goethe University Frankfurt | January 2022 |
| Algebra and Algebraic Geometry Seminar, University of Washington | January 2021 |

**Derangements and the $p$-adic incomplete gamma function**

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| (poster) FPSAC 2022, Bangalore India | July 2022 |
| Algebra and Algebraic Geometry Seminar, University of Washington | November 2021 |

**Weierstrass points on tropical curves**

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| Algebra and Number Theory Seminar, University of Kentucky | November 2019 |
| Algebra and Algebraic Geometry Seminar, University of Washington | October 2019 |
| SIAM Applied Algebraic Geometry, Bern Switzerland | July 2019 |

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| | (poster) FPSAC 2019, Ljubljana Slovenia | July 2019 |
| | Analysis and Geometry Seminar, Central Michigan University | February 2019 |
| | Algebraic Geometry Seminar, Brown University | November 2018 |
| | Combinatorics Seminar, University of Michigan | November 2018 |
| | Algebraic Geometry Seminar, The Ohio State University | October 2018 |
| | Algebra Seminar, Georgia Tech | October 2018 |
| | (poster) AGNES Fall Meeting, Brown University | September 2018 |

**Dilated floor functions and their commutators**

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| AMS Fall Sectional Meeting, Madison WI | September 2019 |
| Department of Mathematics Colloquium, University of Findlay | December 2018 |
| INTEGERS Conference 2018, Augusta GA | October 2018 |
| (poster) MAA MathFest, Chicago IL | July 2017 |
| (poster) CMS Summer Meeting, University of Alberta | June 2016 |

Sᴇʀᴠɪᴄᴇ    Referee for: Journal of Integer Sequences, Electronic Journal of Combinatorics, Annals of Combinatorics, Molecular Biology and Evolution, Philosophical Transactions of the Royal Society B

Contributor to open-source software projects: SageMath, ETE (Environment for Tree Exploration) Toolkit

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| Co-organizer, Taipei Postdoc Seminar | Fall 2025 - Spring 2026 |
| Co-organizer, JMM Special Session on Ricci curvatures of graphs and applications (MRC) | January 2024 |
| Co-organizer, Hyperplane Arrangements Reading Group, University of Washington | Winter 2021 |
| Co-organizer, Student Combinatorics Seminar, University of Michigan | 2018 − 2019 |
| Organizer, Junior Colloquium, University of Michigan | Summer 2017 |

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**National Chung Hsing University Colloquium**
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| Tree distance matrices and their minors | December 2024 |

**National Yang Ming Chiao Tung University Colloquium**
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| Perspectives on tropical geometry, old and new | December 2024 |

**University of Findlay Colloquium** (undergraduate audience)
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| Dilated floor functions | December 2018 |

**Michigan Math Club** (undergraduate audience)
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| The square tile problem | November 2018 |
| Descartes' rule of signs and beyond | September 2017 |

**MAA MathFest**, Chicago IL
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| Descartes' rule of signs and beyond | July 2017 |
| Looking for a "local" Gauss–Lucas theorem | July 2017 |

**University of Washington Seminars**
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| Weierstrass points of algebraic curves and tropical curves | February 2023 |
| Continuity over $p$-adic numbers | November 2021 |

**Michigan Graduate Student Seminars**
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| What is the Jacobian of a curve? | October 2019 |
| Bidding games and random-turn games | March 2019 |

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| Electrifying random trees II: edge correlation | October 2018 |
| Introduction to $p$-adic geometry | October 2018 |
| A brief tour of outer space | October 2018 |
| Equidistribution of tropical Weierstrass points | September 2018 |
| Tropical Grassmannians and friends | February 2018 |
| Exponentially many perfect matchings | October 2017 |
| Weierstrass subgroup of the Jacobian | February 2017 |
| The $p$-adic icosahedron | February 2017 |
| Matching polynomials and double covers | January 2017 |
| What is a tropical curve? | October 2016 |
| Tate curves and Berkovich space | March 2016 |
| Partition identities, generating functions, and physics | February 2016 |
| What is a Néron model? | January 2016 |
| Riemann–Roch on graphs | November 2015 |
| Combinatorics of stable curves | November 2015 |
| How to prove the Riemann hypothesis | September 2015 |
| Rationality of motivic zeta functions | April 2015 |

**Michigan Summer Mini-courses** for graduate students

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| Stratifying moduli spaces of curves by Weierstrass semigroups | Summer 2020 |
| Combinatorial Hodge theory | Summer 2019 |
| Tropical methods in Brill–Noether theory (5 lectures) | Summer 2018 |
| Moduli space of tropical curves (4 lectures) | Summer 2017 |
| Algebraic groups (5 lectures) | Summer 2016 |
| Hodge theory for matroids (3 lectures) | Summer 2016 |

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| WORKSHOPS AND CONFERENCES ATTENDED | Autoformalization for the Working Mathematician, ICERM | April 2025 |
| | AI for Mathematics and Theoretical CS, Simons Institute | April 2025 |
| | Combinatorics of Moduli of Curves, BIRS | July 2024 |
| | MRC on Ricci curvature on graphs and applications to data science, New York | May 2023 |
| | SageDays 114, IMS (Chennai, India) | July 2022 |
| | GATTACA Conference, Georgia Tech | March 2019 |
| | Arithmetic of Algebraic Curves, University of Wisconsin | April 2018 |
| | Tropical geometry, logarithmic geometry, and curve counting, Stockholm University | Summer 2017 |
| | Tropical geometry, mirror symmetry, and GKZ [...] KIAS (Seoul, Korea) | Winter 2017 |
| | Combinatorial Algebraic Geometry, Fields Institute | Summer 2016 |
| | Explicit Methods for Abelian Varieties, PIMS, University of Calgary | Summer 2016 |
| | Gaps between Primes and Analytic Number Theory, MSRI | Summer 2015 |
| | Arithmetic and Higher-Dimensional Varieties, University of Arizona | March 2015 |

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| SKILLS | • Computer: Python, Mathematica, LaTeX, NetworkX, PyTorch, Scala, SageMath |
| | • Language: English (native), Chinese (proficient), Russian (beginner) |