David Harry Richman

Contact Information

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Research Interests

Tropical geometry: moduli space of metric graphs, potential theory on graphs, curves and Jacobians
Number theory: bounds on rational points, Möbius function bounds
Combinatorics: effective resistance, curvature on graphs
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

"Lower rational approximations and Farey staircases," *Integers* **24** (2024), paper A37.
DOI: https://doi.org/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 Mathematical Journal **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

Preprints

"Tropical Weierstrass points and Weierstrass weights," with Omid Amini and Lucas Gierczak, submitted
preprint: arXiv:2303.07729

"Counting two-forests and random cut size via potential theory," with Farbod Shokrieh and Chenxi Wu, submitted
preprint: arXiv:2308.03859

"The Möbius function on the poset of triangular numbers under divisibility," with Rohan Pandey, submitted
preprint: arXiv:2402.07934

"A Ricci flow on graphs from effective resistance," with Aleyah Dawkins, Vishal Gupta, Mark Kempton, William Linz, Jeremy Quail, and Zachary Stier, submitted
preprint: arXiv:2403.01151

"Node resistance curvature in Cartesian graph products," with Aleyah Dawkins, Vishal Gupta, Mark Kempton, William Linz, Jeremy Quail, and Zachary Stier, submitted
preprint: arXiv:2403.01037

"The family of a-floor quotient partial orders," with Jeffrey Lagarias, submitted
preprint: arxiv:2403.04342

"Principal minors of tree distance matrices," with Farbod Shokrieh and Chenxi Wu, in preparation

"Ordered leaf attachment encoding of phylogenetic trees," with Erick Matsen and Cheng Zhang, in preparation

Honors and Awards

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

Teaching Experience

University of Washington, Seattle, WA, USA

Primary Instructor

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

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

Teaching Assistant

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

Mentoring Experience

University of Washington, Seattle, WA, USA

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

Laboratory of Geometry: Origami on a Hexagonal Lattice	Winter 2019

Invited Talks

OLA encoding of phylogenetic trees

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

Tropical weights of Weierstrass points

AMS Special Session, San Antonio	September 2024
(poster) WAGS 2023, University of Washington	April 2023

Tree distance matrices and their minors

05C50 Online, University of Manitoba	May 2024

Ricci flow on graphs from effective resistance

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

Uniform bounds for torsion packets on tropical curves

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

Derangements and the p-adic incomplete gamma function

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

Weierstrass points on tropical curves

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
(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

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

Looking for a "local" Gauss–Lucas theorem

MAA MathFest, Chicago IL — July 2017

Service

Referee for: Journal of Integer Sequences, Electronic Journal of Combinatorics, Annals of Combinatorics, Molecular Biology and Evolution, Philosophical Transactions of the Royal Society B, Annales de l'Institut Henri Poincaré D

Research Mentor, Michigan Research Experiences for Graduate Students — Summer 2021
Washington Experimental Mathematics Lab (WXML) — 2020 – 2022
Laboratory of Geometry at Michigan (LoG(M)) — Spring 2019

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

Co-organizer, JMM Special Session on Ricci curvatures of graphs and applications to data science, 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

Co-Hall Chair, East Campus Dormitory, MIT — Fall 2010 – Spring 2011

Expository Talks

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

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

Great Talks for a General Audience, MAA MathFest Chicago
Descartes' rule of signs and beyond — July 2017

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

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

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

Workshops and Conferences attended

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, 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 A-determinant philosophy,
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

Skills

- Computer: Python, Mathematica, LaTeX, PyTorch, Scala, Spark, NetworkX, Sage
- Language: English (native), Chinese (proficient), Russian (beginner)