William DeMeo

Curriculum Vitæ

Contact Information

Department of Algebra
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Research Interests

Theory: Universal algebra, equational logic, complexity theory, type theory, category theory.

Practice: Proof mechanization in Agda and Lean, functional programming in Scala and Spark.

Education

Doctor of Philosophy in Mathematics — University of Hawaii, Honolulu, May 2012
Thesis: Congruence lattices of finite algebras — *Advisor:* Ralph Freese

Master of Science in Mathematics — Courant Institute, New York University, New York
Thesis: Approximating eigenvalues of large stochastic matrices — *Advisor:* Jonathan Goodman

Bachelor of Arts in Economics — University of Virginia, Charlottesville

Academic Appointments

Postdoctoral Research Fellow	Algebra Dept. Charles University Prague 2019–
Burnett Meyer Instructor	Mathematics Dept. University of Colorado Boulder 2017–2019
Visiting Assistant Professor	Mathematics Dept. University of Hawai'i Honolulu 2016–2017
Postdoctoral Associate	Mathematics Dept. Iowa State University Ames 2014–2016
Visiting Assistant Professor	Mathematics Dept. Univ South Carolina Columbia 2012–2014

Industry Experience

Senior Research Scientist — Imaging Research Dept. Textron Systems Corp. Maui 2001–2006

Worked full-time on AFOSR contracts developing new algorithms and parallel (SMP and MPI) programs for processing images acquired by Haleakala Observatories, including *Multi-frame Blind Deconvolution* removing distorting effects of Earth's atmosphere from images of satellites and other NEOs; executed our programs on the MHPCC supercomputer.

Publications

1. Constraint Satisfaction Problems over Finite Structures, with Libor Barto and Antoine Mottet; *CoRR abs/2010.04958;* accepted: *LICS 2021*; available on arXiv [cs.LO].

2. Universal algebraic methods for constraint satisfaction problems, with Clifford Bergman; accepted: *Logical Methods in Computer Science*; available on arXiv [cs.LO].

3. Bounded homomorphisms and finitely generated fiber products of lattices, with Peter Mayr and Nik Ruškuc; *International Journal of Algebra and Computation;* **30**:693–710, 2020; available on arXiv [math.LO] abs/1907.08046.

4. Polynomial-time tests for difference terms in idempotent varieties, with Ralph Freese and Matthew Valeriote; *International Journal of Algebra and Computation;* **29**:927–949, 2019; available on arXiv [math.LO] abs/2011.07879.

5. Isotopic algebras with nonisomorphic congruence lattices, *Algebra Universalis;* **72**:295–298, 2014; available on arXiv [math.RA] abs/1301.7481.

6. Expansions of finite algebras & their congruence lattices, *Algebra Universalis;* **69**:257–278, 2013; available on arXiv [math.RA] abs/1205.1106.

7. Proceedings of Algebras and Lattices in Hawaii 2018; (editor) with K. Adaricheva, J. Hyndman; available at Lulu.com.

8. Topics in nonabelian harmonic analysis and DSP applications (best paper award); *Proceedings of the International Symposium on Musical Acoustics;* Nara, Japan 2004; available at Github.com.

9. Characterizing musical signals with Wigner-Ville interferences; *Proceedings of the International Computer Music Conference (ICMC);* Göteborg, Sweden 2002; available at Github.com.

10. Approximating eigenvalues of large stochastic matrices; *Proceedings of the 8th Copper Mt. Conference on Iterative Methods* Colorado, 1998 available at Github.com.

(IN PROGRESS)

. The Agda Universal Algebra Library, Part 1: Foundation. *Equality, extensionality, truncation, and dependent types for relations and algebras. CoRR abs/2103.09092;* available: arXiv [cs.LO].

. The Agda Universal Algebra Library, Part 2: Structure. *Dependent types for homomorphisms, terms, and subalgebras. CoRR abs/2103.09092;* available: arXiv [cs.LO].

. The Agda Universal Algebra Library, Part 3: Identity. *Dependent types for equational classes, free algebras, and Birkhoff's theorem. to appear: CoRR;* see http://arxiv.org/a/demeo_w_1.

BOOKS (IN PROGRESS)

Category Theory: a concise course, with C. Aten and V. Capretta `https://categorytheory.gitlab.io`
The Agda Universal Algebra Library, with Jacques Carette `https://ualib.github.io/agda-algebras`
Complex Analysis Exams `http://complexanalysis.gitlab.io`
Real Analysis Exams `http://realanalysis.gitlab.io`

GRANTS & AWARDS

NSF Research Grant (no. 1500218) 2015–2018
Project Title: Algebras and algorithms, structure and complexity theory
Role: Postdoctoral research fellow on a team with 6 senior scientists and 3 postdocs
Description: 3-yr collaborative research on algebraic approaches to constraint satisfaction problems

Magellan Scholar Grant 2013–2014
Project Title: What does a nonabelian group sound like?
Role: Faculty mentor for undergraduate research
Description: See soundmath.github.io/GroupSound/GroupSound

ARCS Sarah Ann Martin Award for Outstanding Research in Mathematics Honolulu 2011

Best Paper Award, International Symposium on Musical Acoustics Nara 2004

SUMMER SCHOOLS ATTENDED

Midlands Graduate School in the Foundations of Computing Science — Univ. of Sheffield (virtual)
Topics: category theory, homotopy type theory, proof theory — April 12–16, 2021

Midlands Graduate School in the Foundations of Computing Science — University of Birmingham
Topics: lambda calculus, category theory, univalent type theory in Agda — April 14–18, 2019

Oregon Programming Languages Summer School — University of Oregon
Topics: parallelism and concurrency — July 3–21, 2018

Computer-aided Mathematical Proof — Cambridge University
Topics: bringing proof technology into mainstream mathematics — July 10–14, 2017

Oregon Programming Languages Summer School — University of Oregon
Topics: dependent, gradual, substructural type systems — June 26–July 8, 2017

Midlands Graduate School in the Foundations of Computing Science — University of Birmingham
Topics: type theory, denotational semantics, category theory — April 11–15, 2016

Oregon Programming Languages Summer School — University of Oregon
Topics: type theory, logic, semantics, verification — June 16–28, 2014

Midlands Graduate School in the Foundations of Computing Science — University of Nottingham
Topics: simply typed lambda calculus, domain theory, category theory — April 22–26, 2014

LMS/EPSRC Short Course in Computational Group Theory — University of St. Andrews
Topics: permutation & finitely presented groups, constructive recognition — Jul 29–Aug 2, 2013

NATO ASI on Computational Noncommutative Algebra — Il Ciocco, Italy, 2003

DATA SCIENCE CREDENTIALS

Blockchain Basics — SUNY at Buffalo
4-week Coursera course; grade: 100% — Verified Certificate earned 6 Aug 2021

Big Data Analysis with Scala and Spark — École Polytechnique Fédérale de Lausanne
4-week Coursera course; grade: 93.4% — Verified Certificate earned 24 Nov 2017

Functional Programming Principles in Scala — École Polytechnique Fédérale de Lausanne
6-week Coursera course; grade: 100% — Verified Certificate earned 17 Nov 2016

Functional Program Design in Scala — École Polytechnique Fédérale de Lausanne
4-week Coursera course; grade: 100% — Verified Certificate earned 6 Aug 2016

Parallel Programming in Scala — École Polytechnique Fédérale de Lausanne
4-week Coursera course; grade: 100% — Verified Certificate earned 27 Jun 2016

Synergistic Activities

Organizer, *BLAST 2019 Conference*	Boulder 2019
Organizer, *Algebras and Lattices in Hawai'i Conf. to honor Freese, Lampe & Nation*	Honolulu 2018
Organizer, *Workshop on Computational Universal Algebra*	Louisville 2013
Editor for *Algebra Universalis*	2018–present
Referee for *Algebra Universalis*, *Order*, and *J. Logic & Analysis*	2012–present

University of Colorado, Boulder

Served on doctoral candidacy exam committee for the following ph.d. students:
Jordan DuBeau, *Ali Latfi*, *Athena Sparks*, *Michael Wheeler*.
Served on dissertation defense committee for *Jeffrey Shriner*.

Iowa State University

REU mentor for Charlotte Aten (mathematics major, University of Rochester)
Honors thesis advisor for Joshua Thompson (mathematics major, honors program)
Putnam Exam mentor at weekly exam practice meetings
Iowa 4-H Youth Conference volunteer mentor (link)

Teaching Experience

Charles University in Prague (as Postdoctoral Research Fellow)

NMAG 405: Universal Algebra	Winter 2020

University of Colorado, Boulder (as Burnett Meyer Instructor)

Math 2001: Discrete Mathematics (with Lean prover component)	Spring 2019
Math 2001: Discrete Mathematics (with Lean prover component)	Fall 2018
Math 3140: Abstract Algebra	Fall 2018
Math 6000: Model Theory (graduate course)	Spring 2018
Math 2130: Linear Algebra	Spring 2018
Math 2130: Linear Algebra	Fall 2017

University of Hawaii (as Visiting Assistant Professor)

Math 215: Applied Calculus	Spring 2017
Math 480: Senior Seminar	Spring 2017
Math 244: Calculus IV	Fall 2016
Math 321: Introduction to Advanced Math	Fall 2016

Iowa State University (as Postdoctoral Associate)

Math 317: Linear Algebra	Spring 2016
Math 317: Linear Algebra	Fall 2015
Math 160: Survey of Calculus	Fall 2015
Math 207: Elementary Linear Algebra	Spring 2015
Math 165: Calculus I	Spring 2015
Math 301: Abstract Algebra	Fall 2014
Math 165: Calculus I	Fall 2014

University of South Carolina (as Visiting Assistant Professor)

Math 700: Linear Algebra (graduate course)	Spring 2014
Math 141: Calculus I	Spring 2014
Math 374: Discrete Structures	Fall 2013
Math 122: Calculus for Business and Social Sciences	Fall 2013
Math 374: Discrete Structures	Spring 2013
Math 122: Calculus for Business and Social Sciences	Spring 2013
Math 241: Vector Calculus	Fall 2012
Math 122: Calculus for Business and Social Sciences	Fall 2012

Talks

Complexity of the Homomorphism Problem for Boolean Models (preprint) — Online, 2020
European virtual CSP seminar

Computational Tools for Universal Algebra Research — Völs am Schlern, Italy 2020
CSP World Congress 2020

Formalizing Universal Algebra with Dependent and Inductive Types (html docs) — Denver, CO 2020
AMS Joint Mathematics Meetings; Special Session: Algebras and Algorithms

Computing Difference Term Operations in Polynomial Time (preprint) — Denver, CO 2018
BLAST Conference, University of Denver

Why Universal Algebra Needs Inductive, Dependent Types — Eugene, OR 2018
Oregon Programming Languages Summer School

A Tutorial Introduction to the Lean Prover — Boulder, CO 2018
University of Colorado Logic Seminar

The Lambda Calculus and Dependent Type Theory — Boulder, CO 2018
University of Colorado Logic Seminar

Representing Finite Lattices as Congruence Lattices — Fort Collins, CO 2017
Colorado State University Algebra Seminar

A Polynomial-time Test for Difference Terms in Idempotent Varieties (preprint) — Nashville, TN 2017
BLAST Conference, Vanderbilt University

Algebraic approach to complexity of constraint satisfaction (preprint) — Honolulu, HI 2017
University of Hawaii Logic and Analysis Seminar

Universal Algebraic Methods for Constraint Satisfaction Problems (preprint) — Denver, CO 2016
AMS Fall Western Sectional Meeting: Special Session in Algebraic Logic

The Rectangularity Theorem of Barto and Kozik — Boulder, CO 2016
Algebras and Algorithms: Structure and Complexity Theory

Constraint Satisfaction Problems and Universal Algebra — Birmingham, England 2016
Midlands Graduate School in the Foundation of Computing Science

Permutability in Diamonds — Ames, IA 2016
Iowa State Algebra and Combinatorics Seminar

Which Commutative Idempotent Binars are Tractable? — Nashville, TN 2015
Vanderbilt Shanks workshop: Open Problems in Universal Algebra

Which Commutative Idempotent Binars are Tractable? — Nashville, TN 2015
Vanderbilt Shanks workshop: Open Problems in Universal Algebra

Some Small Finite Algebras Yielding Tractable CSP Templates — Ames, IA 2015
Iowa State Algebra and Combinatorics Seminar

Algebraic CSP and Tractability of Commutative Idempotent Binars — Denton, TX 2015
BLAST Conference, University of North Texas

Isotopic Algebras — Ames, IA 2015
Iowa State Algebra and Combinatorics Seminar

What Does a Nonabelian Group Sound Like? — Baltimore, MD 2014
MAA Special Session: At the Intersection of Mathematics and the Arts

Interval Enforceable Properties of Finite Groups (slides) — Louisville, KY 2013
AMS Special Session on Finite Universal Algebra

Tutorial: UACalc at the command line and in the cloud — Louisville, KY 2013
Workshop on Computational Universal Algebra

Talks (continued)

Approximating Eigenvalues of Large Stochastic Matrices — Columbia, SC 2013
University of South Carolina Combinatorics Seminar

Congruence Lattices of Finite Algebras (plenary lecture) (slides) — Orange, CA 2013
BLAST Conference, Chapman University

Transposition Principles for Subgroups and Equivalence Relations (slides) — Asheville, NC 2013
Zassenhaus Group Theory Conference

Isotopic Algebras with Nonisomorphic Congruence Lattices (slides) — Boulder, CO 2013
AMS Special Session on Algebras, Lattices, and Varieties

Synchronizing Automata and the Černý Conjecture (slides) — Boulder, CO 2013
Graduate Algebra Seminar, University of Colorado

The Finite Lattice Representation Problem in Four Parts — Columbia, SC 2012
University of South Carolina Algebra and Logic Seminar

Interval Sublattice Enforceable Properties of Finite Groups (slides) — Columbus, OH 2012
The 31st Ohio State-Denison Mathematics Conference

Expansions of Finite Algebras and their Congruence Lattices (slides) — Honolulu, HI 2012
American Mathematical Society sectional meeting

Intervals in Subgroup Lattices and Permutation Representations — Cullowhee, NC 2012
Western Carolina University Group Theory Seminar

Recent Progress on the Finite Lattice Representation Problem — Honolulu, HI 2011
Achievement Rewards for College Scientists: Scholar Presentations

The Finite Lattice Representation Problem — Seoul, KOR 2009
First Joint Meeting of the Korean and American Mathematical Societies

References

Clifford Bergman†
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† teaching reference