

Dylan Peifer

CONTACT INFORMATION

Department of Mathematics
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RESEARCH INTERESTS

The design, analysis, and implementation of algorithms for mathematical and scientific computing, particularly the efficient computation of Gröbner bases in computational commutative algebra and algebraic geometry and the application of reinforcement learning techniques to improve algorithm heuristics.

EDUCATION

Cornell University, Ithaca, NY
Ph.D., Mathematics, expected May 2021
- Advisor: Michael Stillman
- Thesis: Reinforcement Learning in Buchberger's Algorithm
M.S., Computer Science, December 2017

Carleton College, Northfield, MN
B.A., Mathematics, June 2014
- Undergraduate Thesis: Presentations of Arc Algebras

PUBLICATIONS

- [1] Dylan Peifer, Michael Stillman, and Daniel Halpern-Leistner. Learning selection strategies in Buchberger's algorithm. In *Proceedings of the 37th International Conference on Machine Learning (ICML 2020)*.
- [2] Dylan Peifer. An algorithm for enumerating difference sets. *Journal of Software for Algebra and Geometry* 9 (2019), 35-41.
- [3] Omar A. AbuGhneim, Dylan Peifer, and Ken W. Smith. All $(96, 20, 4)$ difference sets and related structures. *Bull. Inst. Combin. Appl.* 85 (2019), 44-59.
- [4] Martin Bobb, Stephen Kennedy, Dylan Peifer, and Helen Wong. Roger and Yang's Kauffman bracket arc algebra is finitely generated. *J. Knot Theory Ramifications* 25:6 (2016).
- [5] Martin Bobb, Stephen Kennedy, Dylan Peifer, and Helen Wong. Presentations of Roger and Yang's Kauffman bracket arc algebra. *Involve, a Journal of Mathematics* 9:4 (2016), 689-698.

PROJECTS

DeepGroebner (<https://github.com/dylanpeifer/deepgroebner>) Applications of reinforcement learning to Gröbner basis computation using SymPy and TensorFlow. Used in publication [1] and still in active development.

DifSets (<https://github.com/dylanpeifer/difsets>) A refereed package for GAP that efficiently implements an exhaustive search for difference sets using group theory and dynamic programming. Presented in publication [2] and used in [3].

FGLM (with Mahrud Sayrafi, <https://github.com/dylanpeifer/FGLM>) An accepted package for Macaulay2 that implements the FGLM algorithm for efficiently computing Gröbner bases of zero-dimensional ideals.

GroebnerWalk (<https://github.com/dylanpeifer/GroebnerWalk>) An accepted package for Macaulay2 that implements the standard and generic Gröbner walk algorithm for efficiently computing Gröbner bases.

Macaulay2 (contributor, <https://github.com/Macaulay2/M2>) A system for computing in commutative algebra, algebraic geometry and related fields.

CONFERENCE
PRESENTATIONS

- [1] *Reinforcement Learning in Buchberger's Algorithm* (poster), Summer School on Randomness and Learning in Nonlinear Algebra, Max Planck Institute for Mathematics in the Sciences, Leipzig, July 2019.
- [2] *All (96, 20, 4) Difference Sets*, Joint Mathematics Meetings, San Diego, January 2018.
- [3] *An Algorithm for Enumerating Difference Sets*, Binghamton University Graduate Conference in Algebra and Topology, Binghamton University, October 2017.
- [4] *Generators of the Arc Algebra*, Binghamton University Graduate Conference in Algebra and Topology, Binghamton University, November 2015.
- [5] *A Finite Set of Generators for the Arc Algebra*, Joint Mathematics Meetings, San Antonio, January 2015.
- [6] *Difference Set Transfers* (poster), Joint Mathematics Meetings, Baltimore, January 2014.
- [7] *Difference Set Transfers*, Northfield Undergraduate Mathematics Symposium, St. Olaf College, October 2013.

INVITED
PRESENTATIONS

- [1] *Learning Selection Strategies in Buchberger's Algorithm*, Seminar in Symbolic-Numeric Computing, CUNY Graduate Center, October 2019.
- [2] *Reinforcement Learning in Buchberger's Algorithm*, CACAO Seminar, UC Davis, April 2019.

OTHER
PRESENTATIONS

- [1] *Policy Gradient*, Olivetti Club, Cornell University, December 2019.
- [2] *Q-Learning*, Olivetti Club, Cornell University, March 2019.
- [3] *Signature Gröbner Bases*, Olivetti Club, Cornell University, November 2018.
- [4] *Selection Strategies in Buchberger's Algorithm*, Olivetti Club, Cornell University, April 2018.
- [5] *The LLL Algorithm*, Olivetti Club, Cornell University, October 2017.
- [6] *The F_4 Algorithm*, MATH 6140 Final Presentations, Cornell University, May 2017.
- [7] *Hidden Field Equations*, Olivetti Club, Cornell University, March 2017.
- [8] *The Gröbner Walk*, Olivetti Club, Cornell University, October 2016.
- [9] *Hadamard Difference Sets*, Olivetti Club, Cornell University, April 2016.
- [10] *The Arc Algebra of a Surface*, Math Comps Gala, Carleton College, May 2014.

TEACHING

Cornell University, Ithaca, NY

Head Teaching Assistant, Mathematics Department

- Fall 2018 – MATH 2940 Linear Algebra for Engineers
- Fall 2016 – MATH 1920 Multivariable Calculus for Engineers

Teaching Assistant, Mathematics Department

- Spring 2020 – MATH 2940 Linear Algebra for Engineers
- Fall 2019 – MATH 2940 Linear Algebra for Engineers
- Spring 2019 – MATH 2940 Linear Algebra for Engineers

	<ul style="list-style-type: none"> • Spring 2018 – MATH 1920 Multivariable Calculus for Engineers • Fall 2017 – MATH 1920 Multivariable Calculus for Engineers • Fall 2015 – MATH 1920 Multivariable Calculus for Engineers • Spring 2015 – MATH 1106 Calculus for the Life and Social Sciences • Fall 2014 – MATH 1910 Calculus for Engineers
	<p>Carleton College, Northfield, MN</p> <p><i>Course Grader</i>, Mathematics Department September 2011 – June 2014</p> <p><i>Tutor</i>, Mathematics Department September 2011 – June 2014</p> <p><i>Instructor</i>, Physical Education Department January 2012 – June 2014</p>
EXPERIENCE	<p>Susquehanna International Group, Bala Cynwyd, PA</p> <p><i>Quantitative Researcher Intern</i>, Equity Options June 2020 – August 2020</p> <p>The D. E. Shaw Group, New York City, NY</p> <p><i>Quantitative Analyst Intern</i>, Options May 2019 – August 2019</p> <p>Carleton College, Northfield, MN</p> <p><i>Research Assistant</i>, Department of Mathematics June 2014 – August 2014</p> <p>San Diego State University, San Diego, CA</p> <p><i>Participant</i>, SDSU Mathematics REU June 2013 – August 2013</p> <p>Independent University of Moscow, Moscow, Russia</p> <p><i>Participant</i>, Math in Moscow September 2012 – December 2012</p>
GRADUATE COURSEWORK	<p>Algebra I, Real Analysis, Differentiable Manifolds, Algebra II, Algebraic Geometry, Non-commutative Algebra, Commutative Algebra, Algebraic Number Theory, Homotopical Algebra, Lie Algebras, Topics in Analysis, Topics in Algebraic Geometry</p> <p>Analysis of Algorithms, Matrix Computations, Advanced Programming Languages, Theory of Computing</p>
AWARDS	<p>Cornell University</p> <ul style="list-style-type: none"> • 2019 Graduate Student Teaching Award, Mathematics Department • Fall 2018 Olivetti Egg (award for best grad student talk), Mathematics Department <p>Carleton College</p> <ul style="list-style-type: none"> • <i>summa cum laude</i> • distinction in senior integrative exercises and in major, Mathematics Department • Dean's List 2011-2013 <p>Other</p> <ul style="list-style-type: none"> • Phi Beta Kappa • National Merit Scholar
SKILLS	<ul style="list-style-type: none"> • Programming Languages: C, C++, Python, Scheme • Mathematical Software: GAP, Macaulay2, Mathematica, MATLAB, Singular • Python Packages: Cython, Matplotlib, NumPy, Pandas, Scikit-Learn, Seaborn, SciPy, StatsModels, SymPy, TensorFlow
LANGUAGES	<p>English (native), Spanish (basic proficiency), Russian (basic proficiency)</p>
REFERENCES	<p>Michael Stillman, Professor of Mathematics, Cornell University Graduate Advisor</p>

Daniel Halpern-Leistner, Assistant Professor of Mathematics, Cornell University
Research Advisor

Jesús De Loera, Professor of Mathematics, UC Davis
Research Advisor

Helen Wong, Associate Professor of Mathematics, Claremont McKenna College
Undergraduate Research Advisor