



University of Colorado **Boulder**

Department of Mathematics

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This issue of Prime Bits was edited by Professor David Grant, working with designer Rémy Jambor. It is available online at math.colorado.edu/alumni. If you would prefer to receive only the online version in the future, please just feel free to drop us an email at mathalumni@colorado.edu

In any format, we will endeavor to keep our loyal alumni and friends abreast of what's going on at their alma mater, and express our gratitude for what their continuing support has meant for the Department and its continuing generations of students.

Be Boulder.



University of Colorado **Boulder**



Prime Bits
Department of Mathematics

2020-2021

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Chair's Communiqué

Alexander (Sasha) Gorokhovskiy

Dear Alumni and Friends --- thanks for checking in to see how the Math Department is doing as we, and the world, contend with the COVID pandemic.

We know many of you are suffering, and some have faced tragic loss. Our collective hearts go out to you.

Despite the challenges, we have adapted to our new environment --- with most of our faculty and staff working remotely --- and due to the heroic efforts of many, we are managing to thrive.

It has long been our privilege to teach generations of future doctors, nurses, and epidemiologists, as well as countless others who attend to our society's greatest needs, and we are busy now training the next generation -- this time largely through online classes.

Special thanks go to our Instructors Joseph Timmer and Elizabeth Grulke, who worked to train our 130 faculty, graduate students, and lecturers how to teach online --- and to Undergraduate Chair Nathaniel Thiem, Undergraduate Assistant Tiffany Dowd, and Instructor Albert Bronstein, who handle all our undergraduate courses and their

scheduling, who have had to contend with sometimes sudden logistical shifts between in-person and online instruction this past year.

And there is good news to report. Our classrooms may be mainly closed, but in the words of the great Paul Erdős, our brains are open. You will read in these pages how a number of faculty have been recognized for their research expertise, and how our students are excelling just as their predecessors have done. With departmental funds freed up by generous alumni donations, we have

been able to hire Senior Instructor Divya Vernerey to serve as the inaugural Director of Undergraduate Research (see an article about her and the new position in this issue.)

In these times, our university -- like many others -- has taken a financial hit. This led to a 5 per cent pay cut for the faculty, and a program to incentivize retirements. We have three full professors who are choosing to retire this year:

Continued ►

► From the Editor

We are sorry that amid the chaos of the pandemic, the 2019-2020 edition of Prime Bits never saw the light of day.

Rest assured that our friends and alumni were not forgotten in this trying time -- quite the opposite. We keep you in our thoughts and hope you all are weathering the pandemic as well as you can. Our hearts go out to those of you who have suffered during these times. We are especially thankful at times like these for the tremendous support we get from our alumni and friends family, and hope that the good news these pages provide of the successes of our students and faculty provides a happy respite.

As this edition went to press, a shooting in Boulder left many innocent people dead, and a whole community scarred and bereft. We know many of you still live near Boulder -- and the rest keep Boulder near in your hearts. Our profound condolences go to all the families and friends of the victims of this senseless tragedy.

► *Chair's Communiqué Continued*

Peter Elliott who joined the faculty as an associate professor in 1971, Martin Walter who joined the faculty as an assistant professor in 1973, and Agnes Szendrei who has been with us since 2003. They join Karl Gustafson who retired in 2020 after 52 years in the Department. We are grateful for all they have provided for us and our students over these many years, and we wish them all the best for the next chapter of their lives.

In such a time we take great solace in the support that you --- our friends and alumni --- provide. When the pandemic struck, alumna Marlene Pratto called to see how she could help out. We are deeply grateful that she responded with a generous donation that allowed us to buy computers for lecturers and graduate students who needed them to teach online.

Never before has such caring been more important. Our students are dispersed, some scared of the present, and many fearful about their future. Anything you could do to help them find employment would be a godsend.

I hope that next year's communiqué will provide news of CU returning to normal. In the meantime, may this find you, and all your loved ones, safe and well.

New Director of Undergraduate Research

The Math Department is thrilled to announce that in 2019 it hired Senior Instructor Divya Vernerey as its inaugural Director of Undergraduate Research.

Dr. Vernerey said that the job has two important goals. One is to foster undergraduate research, helping prepare majors who might want to go into research careers. The other is to build contacts with industry to help the employment prospects of students who might not want to go to graduate school — indeed, she added, this second group constitutes the majority of the department's students.



New Director of First-Year Curriculum



Instructor Joseph Timmer has been named Director of Undergraduate Curriculum. This means he will be overseeing our first-year mathematics courses, which teach more students than all our other courses combined. Timmer got his PhD at USC in 2014 and has been teaching at CU since the Fall of 2015.

Undergraduate news

The Math Club, which is dubbed “QED” — standing for Quest, Explore, Discover — is run by Dr. Divya Vernerey with the help of Professor Magda Czubak, and despite the pandemic, continued providing (as necessary, remote) faculty talks aimed at undergraduates — which are very

popular with our math majors and minors. You can follow its activities at <https://math.colorado.edu/mathclub>

Vernerey has started a New Math Club Newsletter. Check it out at:

<https://www.colorado.edu/math/undergraduate-program/research-industry-undergraduate-students>

Our Summer Research Experience for Undergraduates program continues to thrive under the able leadership of Professor Nathaniel Thiem. For summer 2019 there were 39 undergraduate applicants, and we were able to fund 23 undergraduates and 9 first year graduate students.

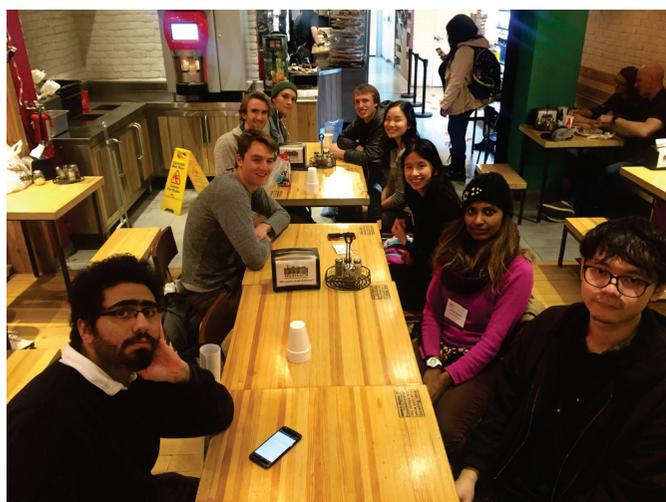
We had eight different projects mentored by Professors Agnès Beaudry, Sebastian Casalaina-Martin, Jeanne Clelland, Magda Czubak, Peter Mayr, Markus Pflaum, Nat Thiem, and Martin Walter, covering a broad swath of mathematical disciplines. We also had a senior graduate student (Athena Sparks) co-advise one of the projects with Mayr. In summer 2020, despite the pandemic, the program continued remotely. Of the 45 undergraduate applicants, we funded 19 undergraduates, and 12 first-year graduate students. We had seven projects mentored by Professors Agnès Beaudry, Sean O'Rourke, Markus Pflaum, Nat Thiem, Divya Vernerey, Jonathan Wise, and Tianyuan Xu.

In October 2019, our department got a departmental Mathematical Association of America membership, which

provides membership for up to 450 graduate and undergraduate students. The members receive discounts to various conferences and online journal subscriptions, including The American Mathematical Monthly.

Graduating CU math major Elizabeth Chambers is becoming a 2021 Teach For America Corps Member. Elizabeth will be teaching secondary mathematics in San Francisco. She stated: "I have always loved kids and watching them grow. I am excited to use this passion to fight for educational equity."

Some of our Math majors and minors — Liam Mulhall, Angel Zhang, Joshua Meyer, Hannah Carlsen, Aazer Rae, Maghana Yarlagadda, Elle Meyer, Michael Walker, Angeli Antony, Pierce Spinelli — have started to volunteer at Girls Inc Metro Denver (<https://www.girlsincdenver.org>), which is a non-profit organization helping mostly Latina, lower-income, single-family girls in K-12 schools. Our students are helping within the STEM elementary and high school tutoring program.



The Joint Mathematical Meetings — the largest mathematics conference in the world — was held in Denver in January 2019, and faculty members Jeanne Clelland, Peter Mayr, Sean O'Rourke, Markus Pflaum, and Agnès Beaudry all had undergraduate groups represented at the undergraduate research poster session. Here is a picture of our students preparing for the session, by contemplating pi (well, pizza pi).

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In 2019 the Department had 38 of its students inducted into the local Pi Mu Epsilon's (PME) Chapter. In 2020 26 department students were also honored. PME is an honor's math society which recognizes undergraduate achievements.



A picture of the 2019 PME honorees, flanked by faculty sponsors Divya Vernerey and Magda Czubak.

Every year the Mathematical Association of America holds the William Lowell Putnam Mathematical Competition for university students in mathematics. Students attempt to solve twelve notoriously difficult problems over the course of six hours on a Saturday in November. The top three scorers in 2019 were Toby Aldape, Jenna Allen, and Bingrui Zheng, who all received cash prizes from the Department of Mathematics in recognition of their achievement. The 2020 exam was canceled because of the pandemic.

As we described in the last Prime Bits, Professor Kate Strange has set up an experimental math lab where our students can research experimental problems. In 2019 and 2020, the Experimental Mathematics Lab ran eight student projects involving 33 undergraduates in mathematical research, under the guidance of faculty, postdoctoral fellow, and graduate student advisors. The topics included some with connections to current affairs — a project with Professor Jeanne Clelland on the mathematics of redistricting, and a project with Professor Eric Stade on the mathematics of COVID — as well as other topics, including number theory and Coxeter groups.

Welcoming Kyle Luh



The Department was thrilled to welcome Dr. Kyle Luh as a new tenure-track Assistant Professor in Fall 2020. A native of Washington State, Luh went to college at Harvey Mudd and did his PhD at Yale under the supervision of Van Vu.

Luh then spent three years on a prestigious NSF postdoctoral fellowship at Harvard, mentored by Jelani Nelson, before coming to Boulder. Luh researches Probability theory and its applications. This includes work in random matrix theory, random graph theory and probabilistic combinatorics. He also has interests in applications to computer science and machine learning, and the emerging field of deep learning.

Kyle married an officemate from Yale, and his wife is now a postdoctoral fellow in our department.

He reports that they love Boulder. They got a dachshund as a pet before they moved to town, who he says makes a great hiking partner in the local mountains, adding that its low center-of-gravity helps it sturdily make an ascent, while Kyle has to carry it on the way down!

Luh arrived in Boulder during the pandemic, so he says it has been tough to get to know everyone, but said that in virtual communication, “everybody has been incredibly friendly, and a lot of people have reached out.

Faculty News

Our colleague, Professor Sebastian Casalaina-Martin has initiated a series of lectures entitled: “*What next? Jobs after a Math PhD.*” The seminar is geared towards graduate students pursuing employment opportunities outside of academia. Such opportunities can be very rewarding, and having a Math PhD can be an excellent step in pursuing these careers. In this seminar, current and former University of Colorado Math PhD students, current and former Math PhD students from other universities, as well as other experts with Math backgrounds, speak about their current work. Interested alumni who would like to help the series are encouraged to contact Professor Casalaina-Martin at casa@math.colorado.edu.

Promotions

In 2020 Professors Magda Czubak, Peter Mayr, and Jonathan Wise were promoted to Associate Professor and granted tenure.

Dr. Czubak is an expert in Partial Differential Equations and Differential Geometry who joined our Department in 2016 after being as assistant professor at Binghamton University.

Dr. Mayr is an expert in Algebra and Logic who joined the CU Boulder faculty in 2015 after being at Johannes Kepler University Linz.

Dr. Wise is an expert in Algebraic Geometry who joined the Department in 2012 after a postdoctoral position at Stanford University.

In 2020 Professor János Engländer was promoted to Full Professor. Dr. Engländer is an expert in Probability and stochastic processes who has been on the CU Boulder faculty since 2009.

Also in 2020 Instructor Kevin Manley was promoted to Senior Instructor. Dr. Manley has been an Instructor in our Department since 2014.

Instructor Divya Vernerey has been named director of undergraduate research (see an article about her and this new position in this issue of Prime Bits).

Grants and Awards

Professor Agnès Beaudry won in 2019 a 3-year NSF grant entitled: “Chromatic Phenomena with an Equivariant Perspective.”

Professor Robin Deeley was awarded in 2020 a 3-year NSF grant entitled: “Dynamics, Groupoids, and C^* -Algebras.” Deeley was also a 2019 recipient of a Simons Foundation Collaboration Grant for Mathematicians.

Professor David Grant is co-PI on a 2020 NSF Improving Undergraduate STEM Education Grant on “Determining the Characteristics of Equitable Mathematics Programs,” on which he is working with David Webb and Nancy Kress of the CU School of Education.

In 2020 Instructor Elizabeth (Boo) Grulke was named an ASSETT (Arts & Sciences Support of Education Through Education Technology) Faculty Fellow. The ASSETT Faculty

Fellows Program is a collaborative community of faculty from the College of Arts & Sciences who address teaching, learning, and technology challenges within their individual departments. Boo received in 2019 her Doctor of Education degree, and after many years as a Lecturer for the Department, was hired to the faculty as an Instructor.

Professor Su-ion Ih was a 2019 recipient of a Simons Foundation Collaboration Grant for Mathematicians.

Professor Markus Pflaum received an NSF award as a co-PI jointly with Aurora Clark of Washington State University, Yang Zhang of the University of Illinois, Ravishankar Sundararaman of Rensselaer Polytechnic Institute and Henry Adams of Colorado State University for their project “Descriptors of Energy Landscapes via Topological Analysis” (DELTA).

Professor Katherine Stange has been named a fellow of the Association for Women in Mathematics (AWM). The honor of being named a fellow is: “to recognize members who have demonstrated a sustained commitment to the support and advancement of women in the mathematical sciences, consistent with the AWM mission: `to encourage women and girls to study and to have active careers in the mathematical sciences, and to promote equal opportunity and the equal treatment of women and girls in the mathematical sciences.’”

► Faculty News Continued

Strange also won a Simons Fellowship in Mathematics, which will allow her to take a full-year sabbatical instead of the one-semester sabbatical the University offers.

Jonathan Wise was a 2019 recipient of a Simons Foundation Collaboration Grant for Mathematicians. Wise also won a Simons Fellowship in Mathematics.

You can read more about Stange and Wise's awards at:

<https://www.colorado.edu/asmagazine/2021/04/06/cu-boulder-mathematicians-named-simons-fellows-mathematics>

Recognition

In Fall 2020, Professor Kyle Luh, Meyer Postdoctoral Fellow Florencia Orosz, and Instructor Harrison Stalvey were part of a group of eight College of Arts and Sciences faculty selected to participate in ASSETT's Learning by Design program in the Active Learning Academy. In this program, participants learned research-based instructional strategies and course design principles in order to facilitate active learning in an undergraduate STEM course they teach or will teach.

Professor Kate Strange was one of the organizers in Fall 2019 of the semester-long program "Illustrating

Mathematics," that was held at the NSF-sponsored Institute for Computational and Experimental Research in Mathematics located at Brown University. The program brought together mathematicians, artists and others to create visualizations and illustrations of mathematics. Its goals were threefold: (a) to introduce mathematicians to new computational illustration tools to guide and inform their research; (b) to spark collaborations among and between mathematicians, other makers of visualizations, and artists; and (c) to find ways to communicate research mathematics to as wide an audience as possible.

Department Research News

In both 2019 and 2020, the Department brought aboard two new postdoctoral fellows.

In 2020 we welcomed:

Meyer Postdoctoral fellow Dr. Florencia Orosz Hunziker, who received her Ph.D. at Yale University in 2019 under the supervision of Igor Frenkel. She spent last year as a Lecturer at Harvard. Her research interests are vertex algebra theory, Lie theory, and representation theory.

Dr. Rodrigo Ribeiro, who received his Ph.D. at Universidade Federal de Minas Gerais under the supervision of Remy Sanchis in 2016 and held postdoctoral Positions at PUC Chile in Santiago with Alejandro Ramirez and at IMPA (Instituto Nacional de Matemática Pura e Aplicada) in Rio de Janeiro with Roberto Imbuzeiro Oliveira. His research interests are random graphs and random walks in random environments.

In 2019 we welcomed:

Meyer Postdoctoral fellow Dr. Tianyuan Xu, who got his PhD in 2017 at the University of Oregon under the supervision of Victor Ostrik. He was a Coleman Postdoctoral Fellow at Queens University for two years working under Ivan Dimitrov and David Wehlau before coming to Boulder. His research interests are representation theory and algebraic combinatorics, with an emphasis on Kazhdan–Lusztig theory of Coxeter groups and Hecke algebras.

Dr. Yining Zhang, who got his PhD at Indiana University working under the supervision of Ajay Ramadoss. His research interests are homological algebra, homotopical algebra, and noncommutative geometry.

Postdoctoral Fellows are crucial for the research life of the department and expose our students to the very latest in mathematical progress. The funding for them comes from a generous bequest by our former colleague, Burnett (Bernie) Meyer and from support of the College.

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► Department Research News Continued

The Department has had three Ulam Visiting Professors in the past two years (most visits in the past year had to be delayed because of the pandemic):

In Fall 2019, George Wilkens of the University of Hawai'i at Mānoa; in Spring 2020, Pedro Berrizbeitia of Simon Bolívar University, Caracas; and in Spring 2021, Alexandr Kazda of Charles University, Prague.

The Department hosted a number of conferences in the past two past years (virtually after the pandemic hit):

The 5-day BLAST 2019 (Boolean Algebras, Lattices, universal Algebra, Set theory, Topology) conference, was organized and hosted by Professors Keith Kearnes, Peter Mayr, Agnes Szendrei and postdoctoral fellow William DeMeo (now at Iowa State). The conference was supported

by the NSF, our Department, and the CU Research and Innovation Office.

The semi-annual Front Range Number Theory Day, jointly sponsored by our Department and the Math Department at Colorado State, has continued for the past two years through the efforts of Boulder organizers graduate student Hanson Smith (now a postdoctoral fellow at the University of Connecticut), graduate student Sarah Arpin, and Professor Kate Stange.

Professors Agnès Beaudry and Markus Pflaum organized the third annual Topology Day. Satyan Devadoss (University of San Diego) gave a talk on "Unfolding Mathematics at Burning Man" and Ezra Getzler (Northwestern) spoke on "Derived stacks and symplectic forms."

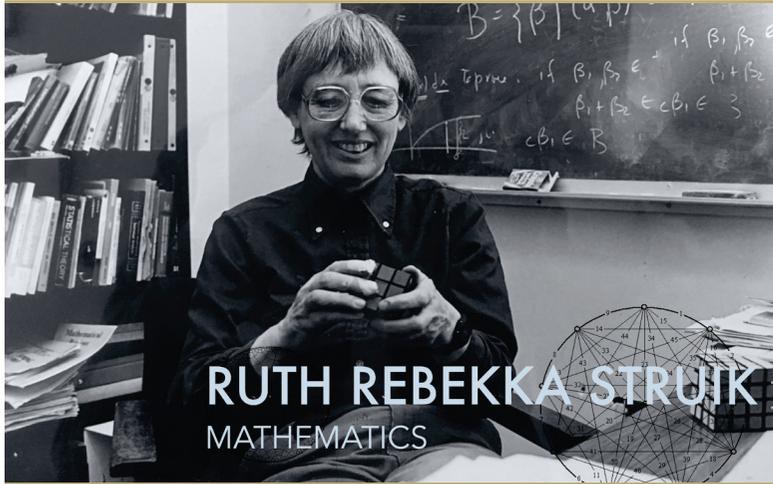
DeLong Lectures

The 2019 DeLong Lectures were delivered by Dr. Kristin Lauter of Microsoft Research. She gave two lectures, the first of which was entitled, "Private AI (or: How to Keep your Location Data Secret)," and the second was entitled "Supersingular Isogeny Graphs in Cryptosystems (or: How to Keep your Secrets in a Post-Quantum World)." Lauter is a co-founder of the Women in Numbers Network, a research collaboration community for women in number theory, and she is the lead PI for the AWM NSF Advance Grant to create and sustain research networks for women in all areas of mathematics. While visiting Boulder, she met with our local AWM chapter.

The 2020 DeLong Lectures were delivered via Zoom by Barry Simon, Professor emeritus of the California Institute of Technology. He gave two lectures, the first entitled "Tales of

Our Forefathers," which Simons described as "not a mathematics talk but it is a talk for mathematicians." His abstract said "Too often, we think of historical mathematicians as only names assigned to theorems. With vignettes and anecdotes, I'll convince you they were also human beings and that, as the Chinese say, 'May you live in interesting times' really is a curse." His second talk was entitled, "Poncellet's Theorem, Paraorthogonal Polynomials and the Numerical Range of Truncated GGT matrices."

The Lecture Series is funded by an endowment given by Professor Ira M. DeLong, who came to CU in 1888 at the age of 33, and played a vital role in the life of the University and the City of Boulder until his death in 1942. The lectures were organized by Professors János Engländer and Sebastian Casalaina-Martin.



RUTH REBEKKA STRUIK
MATHEMATICS

In 2019 CU undergraduate Aubrey Kroger created an exhibit called “Wonder Women” for the Gemmill Math Library, showcasing women in STEM Departments at CU. Included was our own Professor Emerita Ruth Rebekka Struik, a group theorist, pictured above with her Rubik’s cube. Rebekka was on the faculty in our Department from 1970 until her retirement in 1999.

Departmental Staff News

Donna Maes is honored

We are thrilled to announce that in 2019 our Department’s Office Manager, Donna Maes, was named an employee of the year by the College of Arts and Sciences at the University of Colorado Boulder.

As reported in the College of Arts and Sciences Magazine, College Dean James W. C. White said “Maes was cited for her professionalism, knowledge, sense of responsibility, and ‘invaluable guidance to multiple department chairs’” over her now 16 years in the Department.

“One nominator couldn’t imagine a staff member having a more positive, steady, long-term impact on the well-being of a unit than Maes has had in the Department of Mathematics.”

Donna and husband Reuben have three sons: Ryan and Austin who graduated from CU with degrees in engineering, and Evan, a sergeant in the US Army.



Donna and Reuben with son Austin at his May 2019 graduation.

Welcome Jackie Caridi

In 2019 the Department was happy to welcome Jacquelyn (Jackie) Caridi as our new Finance and HR Liaison. Jackie previously worked for The Facility Management Department since coming to CU in 2017.

Jackie reports that: "The people have to be my favorite part of working in the Math Department. There is such a mix of different personalities from all over the world and everyone is just

so sweet, kind, and fun to work with. I feel very appreciated by my colleagues, and feel that they genuinely care about the Math Department, the students, and that the Math Department is successful."

Awards won by students in the Department

Undergraduate Students

(funded by gifts from our readers)

Alexandra Hope Schwein is the recipient of the 2019-2020 — and **Theodore Gonzales** and **Darian Hall** are the recipients of the 2020-2021 — Jack Hodges Award for Excellence in Mathematics, given annually to advanced undergraduate students majoring in Mathematics who have demonstrated the greatest promise in the mathematical sciences.

Samuel Scheere is the recipient of the 2020-2021 Marlene Massaro and David Pratto Scholarships in Mathematics. This scholarship is awarded annually to an exceptional upper-level undergraduate Mathematics major.

Ryan Andrew Mike and **Mohammad Ozaslan** are recipients of the 2019-2020 — and **Emmett Kibbee** and **Chance Yung** are the recipients of the 2020-2021 — Mr. and Mrs. J. Tour Scholarship, which was established to benefit full-time “senior class or graduate students in the advancement of the study of physical sciences and engineering.”

Khaled Allen, Jerett Cherry, Alici Edwards, Michelle MacLennan, Michael Neuder, Wei Qu, and Sam Serra received 2019-2020 — and **Tobias Aldape, Khaled Allen, Raymond Baker, Parker Gara, Emma Goodwill, Adam Nelson, Brenna Royersmith, and Bentley Scholz** received 2020-2021 — Sieglinde Talbott Haller Scholarships, given annually to graduate and undergraduate students

in Mathematics who show exceptional mathematical promise.

Megan Hannah Collins won the 2019 — and **Sam Serra** won the 2020 — Collin Starkweather Award in Mathematics.

Rachel Swanson was awarded the 2019-2020 — and **Sarah Segó** was awarded the 2020-2021 — Jack N. Hyatt Award, given annually to provide scholarship support for students majoring in Mathematics and planning on becoming high school or junior high school math teachers or attorneys in the State of Colorado.

Awards won by Graduate Students

(funded by gifts from our readers)

Hunter Davenport, Mateo Muro, and Peter Rock are the winners of the 2019 — and **Levi Lorenzo and Breann Wilson** are the winners of the 2020 — W. E. Briggs Teaching Excellence Awards, given annually to first-year graduate teaching assistants or graduate part-time instructors in the Department in recognition of outstanding accomplishments in teaching.

Daniel Martin, Matthew Pierson, and Athena Sparks are the winners of the 2019 — and **Jordan DuBeau, Shen Lu, and Sarah Salmon** are the winners of the 2020 — Burton W. Jones Teaching Excellence Award, given annually to a veteran graduate teaching assistants or graduate part-time instructors in the Department in recognition of outstanding accomplishments in teaching.

The Briggs and Jones Teaching Excellence Awards are supported by the B. W. Jones and W. E. Briggs Teaching Excellence Award funds.

Sarah Salmon was awarded the 2019 — and **Ruofan Li** was awarded the 2020 — Richard Laver Graduate Fellowship. The Laver Fellowship is awarded annually to support graduate education.

Mark Pullins was supported by the William N. Reinhardt Fund.

Ali Lotfi, Shen Lu, and Zhenhua Wang are recipients of the 2019 — and **Albany Thompson and Sangman Lee** are recipients of the 2020 — Adele V. Leonhardy Memorial Scholarships. These scholarships are awarded annually to outstanding students who plan careers in teaching mathematics.

Katharine Adamyk, Ruofan Li, Hanson Smith and Athena Sparks won the 2019 — and **Andrew Campbell, Lucas Gagnon, Joel Ornstein, and Andrew Stocker** won the 2020 — Frances C. Stribic/University Summer Fellowships.

Jordan DuBeau was the winner of the 2019 — and **Michael Wheeler** was the winner of the 2020 — W. J. Thron Summer Fellowships, awarded annually to the most outstanding third or fourth year graduate students.

Sebastian Bozlee, Lucas Gagnon, Daniel Martin, Joel Ornstein, and Matthew Pierson won the 2019 — and **Braden Balentine, Jordan DuBeau, Carlos Pinilla,**

Continued ►

► Awards Continued

and **Patrick Wynne** won the 2020 — Sieglinde Talbott Haller Scholarships, which get awarded annually to select students in the Math Department.

Sarah Arpin, Braden Balentine, Jun Hong, Trevor Jack, Saeed Khalili, Caroline Matson, Cherry Ng, Carlos Pinilla, Tyler Schrock, and **Albany Thompson** were recipients in 2019 — and **Sarah Arpin, Andre Davis, Krisztina Dearborn, Jun Hong, Ali Lotfi, Shen Lu, Cherry Ng, Jonathan Quartin, Sarah Salmon,** and **Matthew Pierson** were recipients in 2020 — of University Fellowships.

Degrees Awarded

In 2019, the Department awarded 10 doctorate degrees.

The recipients are:

Jonathan Belcher, PhD

Graduate Advisor: Dr. Markus Pflaum

Dissertation Title: Bridge cohomology: A generalization of Hochschild and cyclic cohomologies

Kevin M. Berg, PhD

Graduate Advisor: Dr. Keith Kearnes
Dissertation Title: The Complexity of Homomorphism Factorization

Nathan Kim Davidoff, PhD

Graduate Advisor: Dr. Judith Packer
Dissertation Title: On the K-Theory of Generalized Bunce-Deddens Algebras

Leo S. Herr, PhD

Graduate Advisor: Dr. Jonathan Wise
Dissertation Title: The log product formula and deformations of modules

Robert Hines, PhD

Graduate Advisor: Dr. Katherine Stange
Dissertation Title: Applications of hyperbolic geometry to continued fractions and Diophantine approximation

Paul Roy Lessard, PhD

Graduate Advisor: Dr. Jonathan Wise
Dissertation Title: Spectra as Locally Finite Z-groupoids

Nicole Sanderson, PhD

Graduate Advisor: Dr. Carla Farsi
Dissertation Title: Topological Data Analyses of Time Series Using Witness Complexes

Steven Weinell, PhD

Graduate Advisor: Dr. Keith Kearnes
Dissertation Title: On the descending central series of higher commutators

Noah Williams, PhD

Graduate Advisor: Dr. Sean O'Rourke
Dissertation Title: On the pairing between zeros and critical points of random polynomials with independent roots

John Willis, PhD

Graduate Advisor: Dr. Jonathan Wise
Dissertation Title: Topological foundations of tropical geometry

In 2020, the Department awarded 13 doctorate degrees.

The recipients are:

Katharine Lauren Marie Adamyk, PhD

Graduate Advisor: Dr. Agnès Beaudry
Dissertation Title: A classification of \mathbb{Q}_0 -local $A(1)$ -modules

Sebastian Bozlee, PhD

Graduate Advisor: Dr. Jonathan Wise
Dissertation Title: An Application of

Logarithmic Geometry to Moduli of Curves of Genus Greater Than One

Andrew Scott Healy, PhD

Graduate Advisor: Dr. Alexander Gorokhovsky
Dissertation Title: Explicit Quasi-Isomorphisms Between the Koszul and Bar Resolutions of Weyl Algebras

Trevor Jack, PhD

Graduate Advisor: Dr. Peter Mayr
Dissertation Title: Computational complexity of semigroup properties

Saeed Khalili, PhD

Graduate Advisor: Dr. Yu-Jui Huang
Co-Advisor: Dr. Sergei Kuznetsov
Dissertation Title: Stochastic Analysis for Problems in Mathematical Finance and Economics

Taylor Joseph Klotz, PhD

Graduate Advisor: Dr. Jeanne Clelland
Dissertation Title: Geometry of cascade feedback linearizable control systems

Daniel Everett Martin, PhD

Graduate Advisor: Dr. Katherine Stange
Dissertation Title: The geometry of imaginary quadratic fields

Caroline Liggett Matson, PhD

Graduate Advisor: Dr. David Grant
Dissertation Title: Multidimensional formal group laws with complex multiplication

Mark Pullins, PhD

Graduate Advisor: Dr. Keith Kearnes
Dissertation Title: Generically 6-transitive algebraic group actions with solvable point stabilizers

Continued ►

► *Degrees Continued*

Tyler Schrock, PhD

Graduate Advisor:

Dr. Nathaniel Thiem

Co-Advisors: Dr. Josh Grochow, Dr.

Rafael Frongillo

Dissertation Title: On the complexity of isomorphism in finite group theory and symbolic dynamics

Hanson William Smith, PhD

Graduate Advisor:

Dr. Katherine Stange

Dissertation Title: Monogeneity and Torsion

Athena Crystine Sparks, PhD

Graduate Advisor: Dr. Peter Mayr

Dissertation Title: Clonoids and Promise Constraint Satisfaction Problems

Zhenhua Wang, PhD

Graduate Advisor:

Dr. János Engländer

Co-Advisor: Dr. Yu-Jui Huang

Dissertation Title: Random processes and Stochastic Control

The Department also awarded 12 Masters Degrees (departmental advisors listed in parentheses) in 2019 to:

Sarah Arpin, MS

(Dr. Katherine Stange)

Andrew Campbell, MA

(Dr. Sean O'Rourke)

Suzanne Craig, MA

(Dr. Markus Pflaum)

Jordan Daniel DuBeau, MA

(Dr. Keith Kearnes)

Lucas Gagnon, MA

(Dr. Nathaniel Thiem)

Leo S. Herr, MA

(Dr. Jonathan Wise)

Jun Suk Hong, MA

(Dr. Peter Elliott)

Joel Ornstein, MA

(Dr. Keith Kearnes)

Nicole Sanderson, MA

(Dr. Carla Farsi)

Andrew Stocker, MA

(Dr. Robin Deeley)

Albany Rose Thompson, MA

(Dr. Magdalena Czubak)

Yu Wang, MA

(Dr. Sebastian Casalaina-Martin)

and three awarded concurrently with a BA degree:

Richard Dyer, BA/MA

(Dr. Martin Walter)

Connor Meredith, BA/MA

(Dr. Keith Kearnes)

Shumin Zeng, BA/MA

(Dr. Sean O'Rourke)

The Department also awarded 7 Masters Degrees (departmental advisors listed in parentheses) in 2020 to:

Andrew James Campbell, MA

(Dr. Sean O'Rourke)

Andre Davis, MA

(Dr. Agnès Beaudry)

Sangman Lee, MA

(Dr. Peter Mayr and Dr. Rafael Frongillo)

Ali Lotfi, MA (Dr. Keith Kearnes)

Jonathan Randall Quartin, MA

(Dr. Jonathan Wise)

James VanMeter, MA

(Dr. Judith Packer)

Patrick Michael Wynne, MA

(Dr. Peter Mayr)

and two awarded concurrently with a BA degree:

Brandon Breeden, BA/MS

(Dr. Laila Andersson and Dr. Agnès Beaudry)

Xiaoliu Chen, BA/MA

(Dr. János Engländer)

In 2019 three undergraduates graduated with honors in Mathematics:

Jesse Franklin (magna cum laude), **Ryan Israel Ibarra** (cum laude), **Justin T. Willson** (magna cum laude).

In 2020 six undergraduates graduated with honors in Mathematics:

Jerett Charles Cherry (summa cum laude), **Megan Hannah Collins** (summa cum laude),

Ram Diego Ekstrom (summa cum laude), **Henry Charles Fontana** (cum laude), **Ryan Andrew Mike** (summa cum laude), **Poramate Nakkirt** (magna cum laude).

In 2019 thirty eight graduating seniors were awarded memberships in the Pi Mu Epsilon (PME) Math Honor's Society:

Glenn Adams, Darius Dominic Alizadeh, Talal Al Refae, David Ian Atkinson, Nicholas Drew Bossenbroek, Kevin Thomas Boyce, James Daniel Cates, James Cross, Armaan Singh Dhillon, Christopher Patrick Dudley, Richard George Dyer, Michael Houston Evans,

Continued ►

► *Honors Continued*

Atakan Hilmi Firat, Jesse Franklin, Amy Brooke Harmon, Zijin Liu, Zachary Lawrence Maas, Andrew Macmaster, Connor M. Meredith, Eric Noel Minor, Juan Lawrence Gee Montoya, Yueqi Pan, Dominic Jean Pontious, Chloe Allison Pradeau, Hannah Jean Rieder, Bradley Johnathan Sain, Katrina Marie Schwarzenberger, Ian Conrad Smith, Holden Russell Southard, Gabriel Adam Tauber, John Wolfgang Werner, Justin Thomas White, Justin T. Willson, Joseph Douglas

Wroe, Qiaojun Yang, Yuehua Yang, Talia Zalesne, Shumin Zeng

In 2020 twenty six graduating seniors were awarded memberships in the Pi Mu Epsilon (PME) Math Honor's Society:

Crossland Joseph Beer, Susan Edith Born, Jonathan Micah Bosnich, Anthony Maurel Carroll, Xiaoliu Chen, Megan Hannah Collins, Ram Diego Ekstrom, Sergey Gitalov,

Braden Thomas Griebel, Briana Jo Hackos, Jason Linnebjerg Haw, Kevin Charles Headrick, Liam Richard David Merz Hoffmeister, Ryan Andrew Mike, Megan Elizabeth Nelson, Justin Nicoski, Simon D. Pasillas, Arthur Charles Denis Pellegrino, Connor Ries Plooy, Dante Antonio Salas, Alexandra Hope Schwein, Erin Isabella Smith, Jade VanAusdall, Megan Elizabeth Walters, Alison Michelle Weinberger, Megan Grace Wettstein



► **Commencement Keynote Speakers**

In 2019, the Department was thrilled to have one of its own, Ann Gragg Lowdermilk, as its third annual Commencement Speaker. Lowdermilk earned her BA in mathematics from CU Boulder and used her education to give back to society. She is Vice President of Strategic Planning and Fund Development for the ARCS (Achievement Rewards for College Scientists) Foundation. The Colorado Chapter of ARCs is working to advance science in Colorado.



In 2020, we were incredibly grateful to Professor Emeritus Kent Goodrich for being the Department's fourth annual Commencement Speaker.

The 2020 graduation was forced to be online, and Goodrich delivered a much needed address of reassurance and hope for the future.

Goodrich was awarded his PhD in 1966 from the University of Utah and started teaching mathematics at CU Boulder that fall. He retired at the end of 2010. We was a visiting Scientist at NCAR from 1985 until 2013. At NCAR he worked on wind shear, turbulence and icing algorithms related to air safety (the team he worked with at NCAR on turbulence was cited for producing one of 50 outstanding scientific achievements by Scientific American in 2003).

A famously excellent teacher, Goodrich won several teaching awards while at CU and he produced eleven PhD students. He reports that he loved every minute of it

A random walk to proteomics



It is perhaps cosmic justice that the life of a statistician be guided by seemingly random events. Several of those critical junctions made all the difference to CU alum Jonathon O'Brien.

Jonathon came to CU in 1998 and started as a philosophy major before deciding that mathematics provided more employment opportunities. His path changed again when he took (now Emertitus) Professor Arlan Ramsay's course in Euclidean and non-Euclidean Geometry.

"I owe an awful lot of my career to Arlan," said Jonathon, saying that they would have conversations about "random intellectual subjects." Jonathon said that Ramsay convinced him to pursue a master's degree in mathematics when the idea had never before crossed his mind.

After graduation, O'Brien did some SABR-metric work for the CU Football team and worked for a local start-up, when another random event made him tack. This time a

melanoma scare made him want to learn more about biology and have a life that really affects people.

He entered a PhD program in Biostatistics at the University of North Carolina, doing his thesis on the crucial "missing data problem" of proteomics (the large-scale study of proteins). His PhD work landed him a postdoc at a proteomics lab at Harvard Medical School, where he discovered that certain proteomics experiments generated outcomes that are best classified as "compositional data" (so can be represented by points on a simplex.)

This in turn earned him a job at Calico Labs, an Alphabet subsidiary that is focused on doing basic research into aging. Now a Principal Data Scientist at Calico, Jonathon is grateful for the path that led him there "My current work is very rewarding and none of it would be happening if it weren't for my time in the CU math department. The ability to continually stare at a perplexing problem until it starts to make sense has consistently been one of my most valuable skills and I clearly picked this up studying pure math. More importantly, I realize that if it weren't for a couple of professors who showed me more kindness and encouragement than their jobs required, very little of my current life would exist at all."

Alumni News

Our Alumni Website: AfterMath

We recently built a website for our Department's alumni and friends, aptly dubbed "AfterMath," which is a one-stop portal for everything having to do with our cherished alumni and friends. It contains links to:

- 1) Alumni events (like our annual departmental Homecoming reception);
- 2) A repository of past Prime Bits;
- 3) Information on how to donate to the Department, with a list of funds that you can donate to with the proverbial click of a button;
- 4) An online copy of a book written by former professors Burton Jones and Wolfgang Thron, chronicling the history of the Department during its first century,

starting from the time the first mathematics instructor arrived in Boulder in 1878;

- 5) We're developing a webpage for old friends and colleagues remembered in memoriam; and,
- 6) Most importantly, there is a site where you can provide us with information about yourself for future issues of Prime Bits! (If you've tried before — we've made submitting information easier.)

Check out AfterMath at:

<https://math.colorado.edu/alumni>.

You can also get to the site by pressing the "Alumni" button atop our department's home page, at

<https://www.colorado.edu/math/>

Continued ►

► *Alumni News Continued*

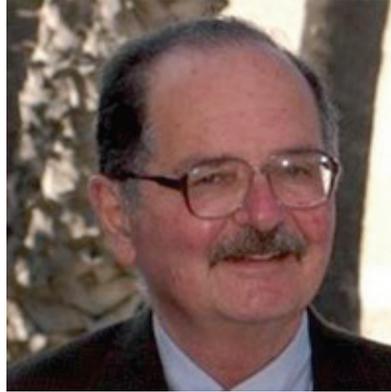
Professor Karl Gustafson retired in 2020 after 52 years in the Department and was honored by being named professor emeritus.

In his long and illustrious career, Karl published 300 papers and more than a dozen books, had 22 PhD students, and countless masters students. His research interests were exceptionally broad, encompassing computational fluid dynamics, computational linear algebra, neural networks, partial differential equations, financial engineering, optoelectronic computing, and mathematical physics. He long served as the Department's Director of the Mathematical Physics PhD program, and served the department and university in myriad other roles.

A proud Buff, he earned two BS degrees from CU in 1958, and was then an instructor in the Department of Applied Mathematics before heading to Maryland for his PhD, which he received in 1965.

He then was an NSF-NATO Postdoctoral Fellow in Geneva and Rome for a year before taking a position at the University of Minnesota. He then came home to Boulder in 1968, and it was lucky for us that he did.

World renowned, he was a visiting fellow and invited professor in more than a half-dozen countries, and gave more than 100 international talks. More about his career inside and outside academia can be found in his memoir: "The Crossing of Heaven," published by Springer in 2012.



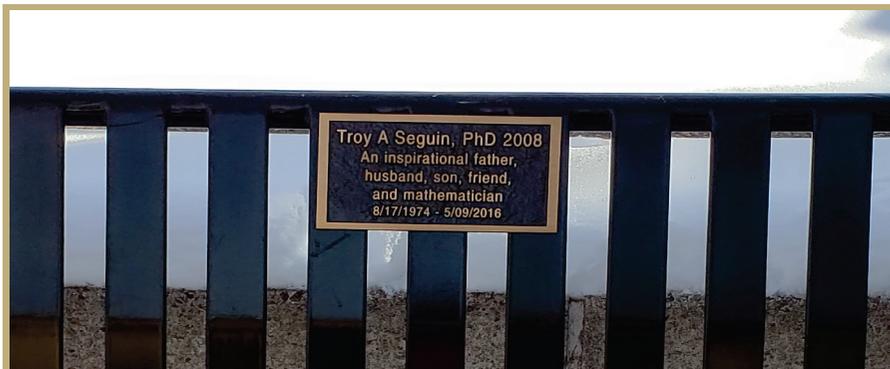
We are sorry to report that Professor Emeritus Richard Roth passed away in October 2020. Born in 1936 in the Bronx, his family moved to Tucson in 1947. He went back East to college at Harvard before getting his PhD at Berkeley. He then joined our faculty in 1963, where he did research in algebra, and played a key role in our undergraduate program until his retirement in 2001. Fluent in Spanish, he was a Fulbright lecturer in Colombia, and spent a year as a mathematical curriculum advisor to

the national universities of Central America.



We are sad to report that former Senior Instructor Alejandro Spina passed away in August 2019. Dr. Spina had two PhDs, one in Physics and one in Applied Mathematics, and he taught in our Department until illness forced him to curtail his career in 2016. He was known for his dedication to his students. *Que en paz descanse, Alejandro.*

We are also sorry to report that Professor Emeritus Duane Sather passed away in November of 2016. Duane was born in 1933, and got his PhD in 1963 from the University of Minnesota. He joined the Boulder faculty as an associate Professor in 1969 and did research on Partial Differential Equations and Fluid Mechanics until he retired in 1998.



As reported in the 2016-17 Prime Bits, our graduate Dr. Troy A. Seguin left us much too soon. His friends and the Department contributed funds to dedicate a bench outside the math building in his memory.

Gifts from our generous donors

We are thrilled to report that our alumni and friends have been incredibly generous to the Mathematics Department in the past two years. University policy now precludes us from individually listing all the donors from 2019-2020, but the Mathematics Department had 73 donors giving a total \$934,654. We are overwhelmed by your generosity and eternally grateful. It is these gifts that allow us to provide our students with the type of education they so richly deserve.

A few of these gifts stand out for special recognition:

William B. Jones Endowed Scholarship Fund

William B. "Bill" Jones and his wife Martha Hadley Jones have established the new William B. Jones Endowed Scholarship Fund to support math students. Now emeritus, Bill was a Professor in the Math Department from 1963-1996, and is no stranger to readers of these pages. Bill was the founding editor of Prime Bits and edited the publication for three decades. Many of our alumni will remember Bill as one of their favorite teachers from their college days. He has long been beloved by his colleagues, who appreciate his selfless dedication to the institution and its students.

Interested in donating?

We are deeply grateful for these and all our donors. The easiest way to donate to the Department is to go to <https://math.colorado.edu/alumni/donor.php>, which has a list of funds that you can donate to with the click of a button.



The College of Arts and Sciences have honored Bill and Martha with a wonderful article

<https://giftplanning.cu.edu/meet-our-donors/william-jones>.

In it Bill said he is grateful for scholarships he received for both graduate and undergraduate studies without which he would not have been able to complete his education. "I feel as though I owe a lot to what I've received, and we want to pass on some of what we have received for future generations," he said.

Marlene Pratto

Alumna Marlene Pratto has for many years been a great benefactor to our department and our students, having endowed and expanded the Marlene Massaro and David Pratto Scholarships in Mathematics. This scholarship is awarded annually to an exceptional upper-level undergraduate Mathematics major.

During this pandemic year, Marlene contacted the Department to see how she could help. She responded with a generous five-figure gift that allowed us to buy computers for our instructors so they could conduct on-line classes. The old adage about "a friend in need" has never been more true.

Marlene got her B. A. from our Department in 1960, and shared some happy remembrances with our readers in the 2013 issue of Prime Bits:

<https://math.colorado.edu/documents/primebits/PrimeBits2013.pdf>

Supporting the MARC

In the last issue of Prime Bits <https://math.colorado.edu/alumni/primebits/PrimeBits2018.pdf> we highlighted some of the amazing work being done at the Department's Mathematics Academic Resource Center (MARC) to help our undergraduate students.

We are pleased to report that the parents/grandparents of a current student gave a five-figure leadership gift -- which included an additional 1:1 corporate match -- to establish an independent fund for philanthropic support of the MARC. This means people can now directly support MARC's wonderful mission, at <https://giving.cu.edu/fund/mathematics-academic-resource-center-fund>