# UCDAVIS

MATHEMATICS NEWSLETTER
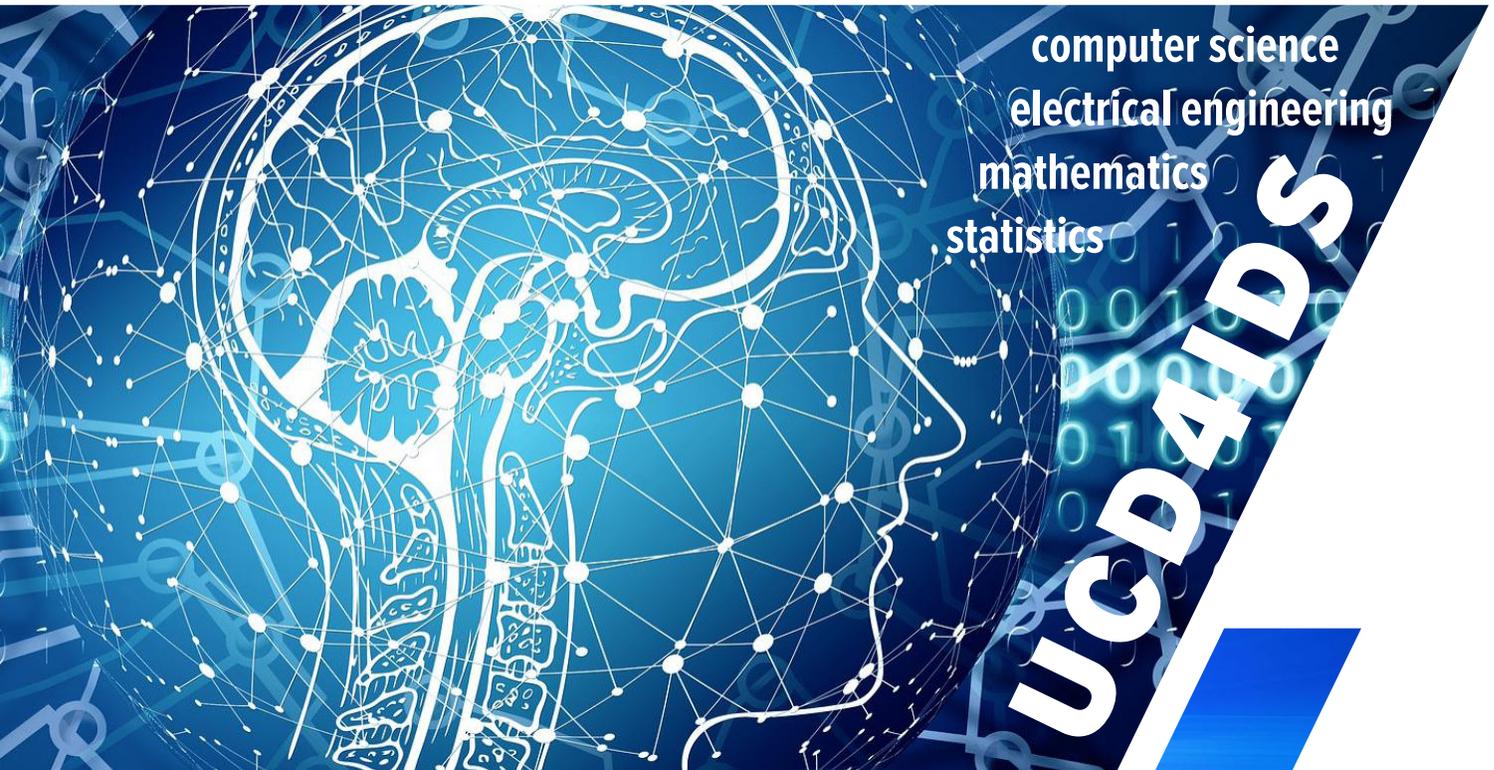
computer science
electrical engineering
mathematics
statistics

UCD4IDS

veterinary medicine
computer science
agriculture
health
biology
statistics
mathematics
engineering
astrophysics

CeDAR

New arenas in Data Science

Contents

Letter from the Chair
by Abigail Thompson, Department Chair

This was a fantastic year for awards and recognitions in the Department. Professor Craig Tracy and his co-author Harold Widom were awarded the American Mathematical Society Steele prize for Seminal Contribution to Research. Professor Kevin Luli was named a 2019 UC Davis Chancellor's Fellow. Professors Mariel Vazquez and Steve Shkoller were named to the 2020 class of Fellows of the American Mathematical Society. Professor Jesús De Loera was named a SIAM (Society for Industrial and Applied Mathematics) Fellow.

It was also a busy year for grant applications, which were very successful; 29 new proposals were funded, producing a total of $4,635,429 in new research funding. We're very excited by the newly-funded initiatives in Data Science, led by Professors Thomas Strohmer and Naoki Saito (see articles in this newsletter). The external (NSF) and internal (College of Letters and Science, Office of Research) support for these initiatives has been fantastic. In addition to ground-breaking research in this burgeoning field, we are also working on implementing a new undergraduate program in Data Science to make this exciting field available to all our students.

We continue to see growth in our class enrollments; 6,981 students are taking lower division undergraduate courses in Mathematics this Fall. We're delighted that the level of interest in mathematics among undergraduates continues to grow, and we remain committed to maintaining the high quality of our instruction. We're hoping that as the college budget stabilizes we will be able to grow our faculty to meet the demand.

I close with a note of thanks for those that have made donations to the Department. Private donations allow us to continue special programs. These range from outreach programs, research fellowships for undergraduates, conference travel funding for graduate students and postdocs and, importantly, pizza for student-organized seminars. In recent years we have also received generous donations that have established important scholarships and prizes. All these donations have a high impact and are greatly appreciated.

CeDAR
Translating Complex Data into Powerful Solutions
by Thomas Strohmer

UC Davis has just launched a new Center for Data Science and Artificial Intelligence Research (CeDAR).

Data science and related fields such as artificial intelligence are changing the way that many scientists do research and are leading to astounding advancements in a broad range of applications—from science and humanities to medicine and technology. CeDAR seeks to effectively respond to the great challenges of our society by translating complex data into powerful solutions. Data science and the development of artificial intelligence have widespread applications that if developed skillfully, can assist in feeding the growing world population, mitigating climate change, combating environmental damage, creating sustainable energy sources and providing effective, affordable healthcare for everyone.

The true effectiveness of data science and AI is unleashed through interdisciplinary collaboration. As a part of UC Davis, a top research university, CeDAR has the opportunity and resources to bring together world renowned experts from many fields of study with top data science and artificial intelligence researchers. As CeDAR advances data science foundations, methods and applications, it weaves them into the fabric of the university, promoting a highly efficient exchange of information and expertise that enhances real-world data science applications.

Thomas Strohmer serves as director of CeDAR. The center will closely collaborate with the NSF funded UC Davis TETRAPODS Institute of Data Science, which is lead by Naoki Saito.

For more information, visit
https://cedar.ucdavis.edu/
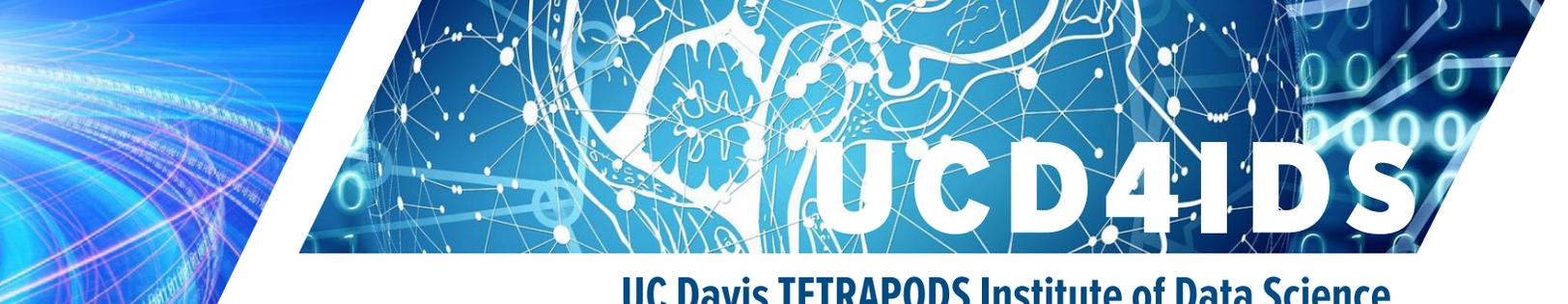
UCD4IDS

UC Davis TETRAPODS Institute of Data Science

by Naoki Saito
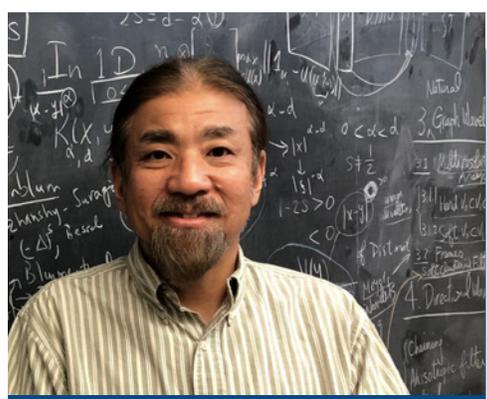
Naoki Saito, director of UCD4IDS

by Oberwolfach

Thomas Strohmer, director of CeDAR

The field of data science is experiencing rapid growth due to a confluence of several trends in science and technology: the advent of new sensors, measurement technologies, and social network infrastructure together with the availability of low-cost computing devices. This has ignited an explosion in research and development activities in both academia and industry, such as visualization of high-dimensional large volume data or complicated interconnected network structures, analyzing such data, and making inferences and diagnostics.

Advances in data science research are being adopted by industry at an alarming rate, which has caused a shortage of properly trained data scientists who understand their assigned data scientific tasks. We do not want data scientists to simply use the latest data scientific theory and tools as "blackboxes" used to cut corners to get the job done without deeply understanding the phenomena underlying the data they deal with.

We need to advance the fundamentals of data science research, the theories and algorithms that make each step of data analysis explicit and interpretable, and to properly educate and train our graduate students and postdoctoral scientists. The mission of the UC Davis TETRAPODS Institute of Data Science (UCD4IDS), which is part of the National Science Foundation's Harnessing the Data Revolution (HDR) Big Idea activity, is exactly that. This will be achieved by integrating our collective expertise and experience in research and education of thirty-five participants over four disciplines: Computer Science; Electrical Engineering; Mathematics; and Statistics.

Research at the UCD4IDS will focus on three broad themes:

1) Fundamentals of machine learning directed toward biological and medical applications;

2) Optimization theory and algorithms for machine learning including numerical solvers for large-scale nontrivial learning problems; and

3) High-dimensional data analysis on graphs and networks.

The algorithms and software tools to be developed will make a positive impact in solving practical data-analysis and machine-learning problems in diverse fields such as computer science (analyzing friendship relations in social networks); electrical engineering (monitoring and controlling sensor networks); civil engineering (monitoring traffic flow on a road network); and in particular, biology and medicine (analyzing data measured on real neural networks, detecting changes in the brain structures due to diseases, imaging live biological cells for analyzing their growth, etc.).

The technical goals of this project are:

1) geometric understanding of high-dimensional data, which may allow efficient sampling from manifolds representing certain phenomena of interest and classifying subtle yet critical differences that often appear in biological and medical applications;

2) providing theoretical guarantees and efficient numerical algorithms for non-convex optimization, which is crucial to machine learning; and

3) deepening understanding of how local interactions between individual entities (e.g., neurons) lead to global coordination and decision making.

We will collaborate closely with the new Center for Data Science and Artificial Intelligence Research (CeDAR) headed by Professor Thomas Strohmer.

For more information, visit
https://ucd4ids.ucdavis.edu/

Revolutionizing Random Matrix Theory
Craig Tracy Awarded Steele Prize
by Bruno Nachtergaele

The 2020 Steele Prize for Seminal Contribution to Research in Analysis/Probability Theory will be awarded to Craig Tracy and Harold Widom. The prize, awarded by the American Mathematical Society, recognizes the impact of their ground breaking paper "Level-spacing distributions and the Airy kernel," published in 1994 in Communications in Mathematical Physics.

With Professor Harold Widom of UC Santa Cruz, Craig introduced a new probability distribution function, now known as the Tracy-Widom distribution. This originated in the early nineties, when Tracy and Widom studied the behavior of the largest eigenvalue of random matrices. Their results, published in 1994 and the following years, not only entirely revolutionized Random Matrix Theory, but the new probability distribution they discovered turned out to be of central importance in many areas of pure and applied mathematics. Important applications have been found in a wide range of fields, including statistics, materials science, genetics, operations research, and financial mathematics.

We are all familiar with the widely occurring Gaussian distribution, often referred to as the bell curve. Underlying its universality is the all-important Central Limit Theorem, which says that, under very general circumstances, any properly scaled quantity that is the sum of a large number of independent random terms, will have a Gaussian distribution. This phenomenon is so common that the Gaussian distribution with zero mean and unit variance is often called the *normal* distribution.

There are, however, many important phenomena that are the combined effect of a large number of contributions, not as a simple sum of independent terms, but terms combined in a more complicated fashion. The mathematical example that was studied by Tracy and Widom is the largest eigenvalue of matrix with random entries, in the limit where the size of the matrix tends to infinity. Each entry contributes in some way to the largest eigenvalue but their individual effects are far from being independent. The largest eigenvalue, properly scaled, does not behave 'normally'. It fluctuates in a predictable way which is not Gaussian. Its distribution was first determined by Tracy and Widom.

Examples of situations where the Tracy-Widom Law has applications are principle component analysis in statistics, queuing theory (applications in computer networks, production lines, customer service applications and many another areas), statistical analysis of genetic data, analysis of algorithms in computer science, analysis of hedge fund performance, stochastic effects in growth phenomena in materials science and the natural world such as crystal growth in the presence of impurities, evolution of populations, and much more. In addition, the Tracy-Widom Law plays an essential role in important new developments in several areas of pure mathematics: orthogonal polynomials and special functions, complex analysis, integrable systems, discrete mathematics, algebraic geometry, and the theory of stochastic processes.

Two very recent examples of applications are

1) The recent beautiful experimental observation of yet another system that exhibits the Tracy-Widom distribution: the fluctuations (roughness) of interfaces in nematic liquid crystals by K. A. Takeuchi and M. Sano (arXiv:1001.5121).

2) The very recent solution of a long-standing open problem almost simultaneously by two sets of authors: the proof of superdiffusivity of the one-dimensional Kardar-Parisi-Zhang (KPZ) equation and its relation to the weakly asymmetric simple exclusion process and directed random polymers.

Both groups, T. Sasamoto and H. Spohn (arXiv:0908.2096 and arXiv:1002.1873) on the one hand, and G. Amir, I. Corwin, J. Quastel (arXiv:1003.0443), make use of and acknowledge the breakthrough results by Tracy and Widom published in 2009, as well as on their famous 1994 paper. That these two groups of authors, who had been studying the KPZ problem for many years, suddenly came up with the solution at the same time has a simple explanation: they needed the Tracy-Widom results of 2009 before they could proceed.

Applications of mathematics are embedded in all quantitative sciences, whether they

Craig Tracy
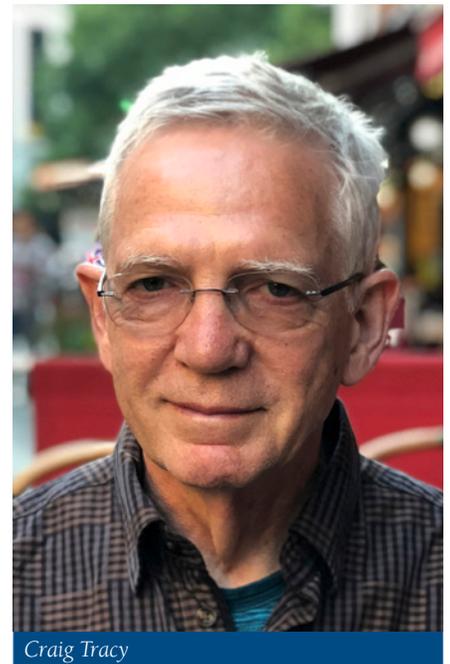
be pure or applied, physical or social. Most of that mathematics dates back one or more centuries. The Tracy-Widom distribution is a rare example of new sophisticated mathematics that answers important problems in a broad-range of sciences in less than two decades.

Craig Tracy has also played pivotal role in the development of mathematical research in UC Davis over the past two decades. His term as Department chair (1994-98) coincided with the period when the UC Davis Mathematics Department first appeared as a rising star nationally and internationally. In addition to the Steele prize, he has received prestigious prizes in recognition of this work that include: The George Pólya Prize of the Society of Industrial and Applied Mathematics in 2002 and the Nobert Wiener Prize in Applied Mathematics in 2007. He was elected Fellow of the American Academy of Arts and Sciences in 2006, and in 2008-09 he received two prestigious lectureships: the Aisenstadt Chair (University of Montreal) and the Batsheva Fellowship in Natural Sciences and Mathematics (Israel Academy of Sciences).

Incoming Academic Staff

Rishidev Chaudhuri • Assistant Professor

Rishidev Chaudhuri received a B.A. from Amherst College and a Ph.D. from Yale University before postdoctoral stints at New York University, the University of Texas at Austin and UC Berkeley. He joined UC Davis in April of this year, with a joint appointment in Mathematics and Neurobiology, Physiology & Behavior.

Rishi's research uses math to study the brain. He works on problems such as how the brain might use expander graphs to stop memories from interfering with each other, and looking for manifold structures in the brains of dreaming mice.

One research direction he is currently working on is understanding sparse network connectivity in the brain. Everything we think or feel relies on the coordinated activity of millions of neurons, yet most of these neurons are not directly connected to each other, and the brain continuously gets rid of connections. How does the brain decide which connections to keep and which ones to get rid of? Formalizing this problem mixes ideas from dynamical systems, high-dimensional probability, graph theory and the theory of algorithms.

Another current direction is understanding how the brain might use randomness for function approximation, communication, and learning.

Rishi spent much of his early life wanting to be a physicist and his work at the math-neuro interface is inspired by the conversation between mathematics and physics. He believes that, on the one hand, understanding the brain requires the careful building of mathematical theories tied to and tested by data. On the other, the brain is an exciting source of deep and beautiful mathematical ideas and these ideas deserve to be unshackled from nature and studied in their abstract generality. His research seeks to encompass both these approaches.
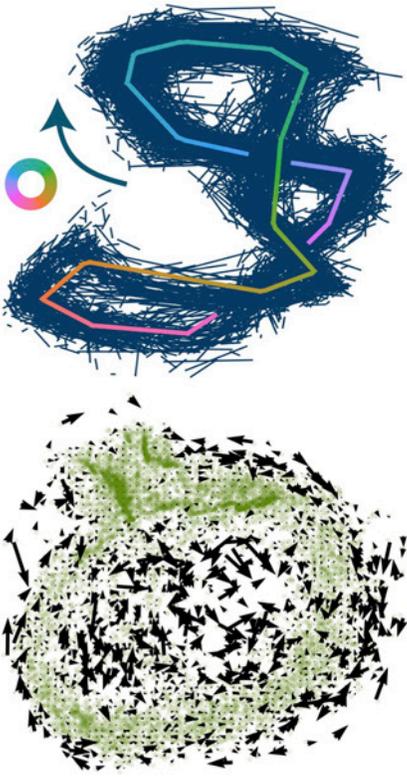
Ring attractor manifolds in the brains of mice who are awake (top) and in REM sleep (bottom)

Incoming Academic Staff

Daniel Blanquicett
Krener Assistant Professor

Daniel Blanquicett finished his Doctorate in Mathematics in February 2019 at IMPA, Rio de Janeiro, under the supervision of Professor Rob Morris. At UC Davis he is working with Professor Janko Gravner. He is interested in problems in probability theory and combinatorics that arise from the study of statistical physics. His research has so far focused on the theory of bootstrap percolation, a monotone version of the Glauber dynamics of the Ising model of ferromagnetism, and its applications to (non-monotone) dynamical models. More information is at

http://quicetor.impa.br/

Daniel comes from Las Pavas, a village located in Monteria, Colombia. He is currently exploring and enjoying the culture of Davis, and in his (short) free time likes to practice sports, such as soccer and volleyball.

Anastasia Chavez
Krener Assistant Professor

Anastasia Chavez is a native Californian, born and raised just an hour north of San Francisco. After earning her A.S. from Santa Rosa Junior College, Anastasia transferred to San Francisco State University and completed her B.S. in Applied Mathematics. She continued at SFSU as an LSAMP Bridge to the Doctorate fellow to earn her M.A. in mathematics. She received her Ph.D. from UC Berkeley in the area of algebraic combinatorics. Currently, Anastasia is an NSF Postdoctoral Fellow and Krener Assistant Professor at UC Davis under the mentorship of Professor Jesús De Loera. Anastasia is also passionate about supporting underrepresented minorities and non-traditional students in STEM. When taking a break from math, Anastasia can be found on an adventure with her incredible husband, amazing daughters, and goofy pups.

Sean Curry
Krener Assistant Professor

Originating from New Zealand, Sean Curry completed his Ph.D. in 2016 at the University of Auckland. He spent the next three years as a Stefan E. Warschawski (SEW) Assistant Professor at UC San Diego, before joining the Department of Mathematics at UC Davis in Fall 2019. Sean's research is in differential geometry and geometric analysis, particularly in conformal and CR geometry, motivated by applications in mathematical physics and in several complex variables. He is working with Andrew Waldron.

Stephanie Dodson
Krener Assistant Professor

Stephanie Dodson studied mathematics and physics as an undergraduate at the University of Massachusetts, Amherst. In May 2019, she completed her Ph.D. in Applied Mathematics at Brown University under the supervision of Björn Sandstede.

Stephanie's interests lie at the intersection of mathematical biology and dynamical systems. Her thesis research focused on using analytical and computational approaches to investigate the mechanisms driving instabilities of spiral wave patterns that are commonly observed in cardiac arrhythmias and chemical oscillations. Stephanie is currently working to understand traveling waves and defects in neurodynamical models.

Besides mathematics, Stephanie enjoys spending time outside running, hiking, and biking.

Joshua Howie
Krener Assistant Professor

Joshua Howie grew up on the South Island of New Zealand before completing his Ph.D. at the University of Melbourne in 2016 under the supervision of Hyam Rubinstein. He then worked as a postdoc at Monash University, which is also in Melbourne. His research is in the area of low-dimensional topology, where he mostly studies how surfaces intersect in 3-manifolds. He is also interested in knot theory. At UC Davis, he is working with Jennifer Schultens.

Outside of math, he enjoys running, cinema, and literature.

Kevin O'Neill
Krener Assistant Professor

Kevin O'Neill received his B.S. from Harvey Mudd College in 2013 before returning to his hometown to complete his Ph.D. at UC Berkeley in 2019 under the supervision of Michael Christ. He is excited to join the UC Davis Department of Mathematics in Fall 2019 and work with Professor Kevin Luli.

Kevin's research is in the area of harmonic analysis. A special focus of his has been extremizers of classical normed inequalities and stability theorems for near-extremizers. He has also worked with multilinear integral operators and oscillatory integrals, and is hoping to continue to expand his area of expertise.

Updates from the Undergraduate Program

by Monica Vazirani, Vice Chair for Undergraduate Affairs

In the 2018-19 academic year, the Department of Mathematics awarded 220 degrees (194 majors and 26 minors)—up by 53 from the previous year which is roughly a 30% increase! At last count, we have 874 math majors.

Eleven of our degree recipients wrote senior theses on topics ranging from Machine Learning to Knots to Wave Equations. These students were Linjun Huang, Adam Kagel, Jiayi Lei, Tzu Feng Leung, Yupeng Li, Lorenzo Mambretti, Jake Parkhurst Chutong Wu, Zekai Zhao, Xinge Zhang, and Zihao Zhu.

Their archived submissions can be found on our website at
 math.ucdavis.edu/undergrad/research/thesis

We kicked off the 2019-20 year with our Undergrad Welcome Event on September 25th. At the event, we discussed the great things that one can do with a major in mathematics, the exciting activities going on in the Department of Mathematics. We met our new Undergraduate Program Coordinator Cydney Matteson—Welcome Cydney! Advising Supervisor Tina Denena began the event, emphasizing we are here to help all our students succeed, and describing the multiple sources of support that are available.

Many of our faculty advisers introduced themselves at the event and later had individual appointments with math majors during our October 21-25 "Mandatory Advising Week." It is important for our majors to start early in planning a program of study in concert with the staff and faculty advisers.

Undergraduate Research

On October 11 we hosted the second Mathematics Undergraduate Conference, where students who were engaged in undergraduate research gave presentations and presented posters. They gave excellent presentations!

Many of the presenters were among the 9 students that our Undergraduate Research Coordinator, Professor Javier Arsuaga, helped match to summer 2019 research projects with professors.

Financial support for these REU projects came from a generous donation to the Department of Mathematics as well as from Professor Janko Gravner's NSF grant. Students were supported for 1.5 months to conduct research on a wide range of topics from braids to mathematical modeling, which included: modeling of cardiac electrophysiology, numerical simulations of swimming micro-organisms, and modeling extreme events such as hurricanes.

To see samples of the research that our students have done and to get information on how to get involved in undergraduate research visit
 math.ucdavis.edu/undergrad/research

Undergraduate research is a great way to jump start a mathematics career!
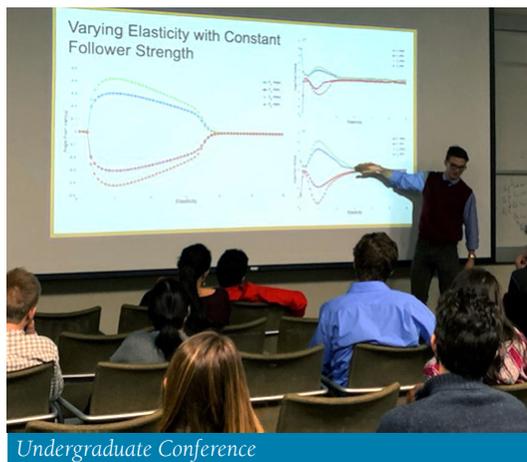
Special Topics

This year, the Department of Mathematics offers three special topics courses for undergraduates (MAT 180): "Finite Reflection Groups" (Professor Monica Vazirani) in Fall quarter, "Introduction to Physical Math" (Professor Dimofte and Professor Rangamani) in Winter, and "Manifolds" (Professor Laura Starkston) in Spring.

Math Club

In Fall Quarter, our undergraduate Math Club meets Tuesdays 3-4 in MSB 2112. The Math Club is dedicated to advancing mathematics by building a strong community among people who enjoy math. You can also contact the Math Club for math apparel. In addition to fun math puzzles, tasty snacks, and network opportunities, Math Club meetings often include short presentations by guest lecturers that range from professionals to professors.

Summer Interns

This year we started a new series of short talks: students who had mathematical summer internships are giving 10-15 minute presentations on their experiences.

Many summer interns implemented techniques they learned in theirmathematics classes at Davis, applying them to cyber-security, marketing, and data analysis.

Undergraduate Welcome

Varying Elasticity with Constant Follower Strength
Undergraduate Conference
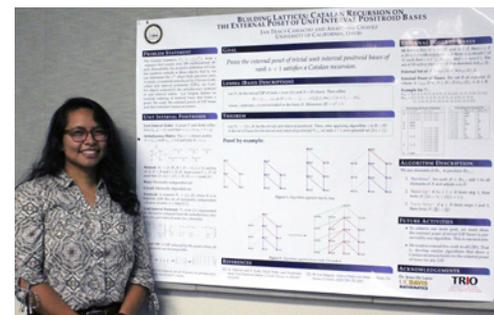
*Posters at the Undergraduate Conference*

In Memoriam
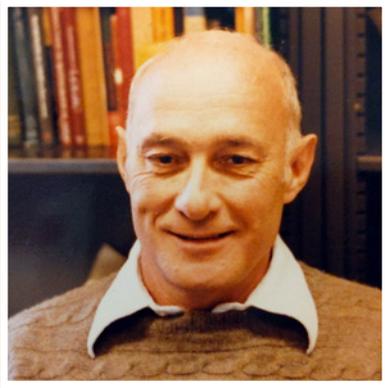
Melven R. Krom

Professor Emeritus Melven R. Krom passed away September 28, 2018. He received his Ph.D. in 1963 at the University of Michigan. He joined the Department as a Lecturer in 1962, and was brought on as a professor the year after. During his time as a professor at UC Davis, his research focused on logic. He retired in 1992.
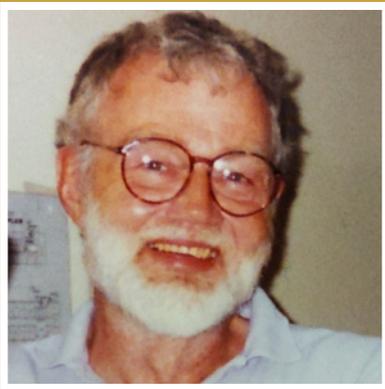
John Chuchel

John Chuchel died May 19 after a long illness. He was 80.

Born in Winona, Minn., John moved to Sacramento in 1979. A theoretical mathematician, he was educated at St. Mary's College in Winona, Minn., the University of Minnesota and Montana State University.

He taught college-level math for 53 years, 35 at UC Davis. Numerical interests led him to studies of weather, volcanoes, mountains and careful tracking of over 275,000 miles during 55 years of cycling.

Remembrance contributions may be made online to the John Chuchel Memorial Fund, using the instructions at the right, or checks sent in the included envelope, following the instructions on the flap. The memo line should say "John Chuchel Memorial Fund." Contributions will provide scholarships for UC Davis mathematics students, whom he loved and served.
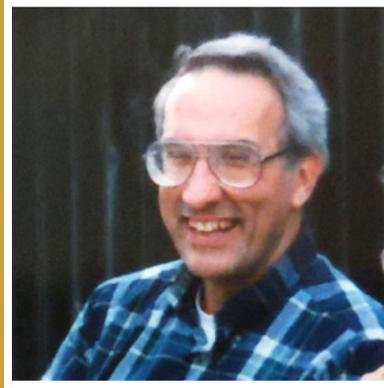
G. Thomas Sallee

George Thomas Sallee died unexpectedly in the early evening of Saturday, June 15, 2019, at the UCD Medical Center of hemorrhagic stroke.

Tom was born in Nyssa, a little farming community in eastern Oregon on the banks of the Snake River. He worked in the sugar beet fields and packing shed, became an Eagle Scout, and enjoyed a very happy childhood.

Tom attended the California Institute of Technology in Pasadena as a mathematics major and went to UC Berkeley under a NSF fellowship for his master's degree in mathematics. He earned his Ph.D. in mathematics at the University of Washington in Seattle. While at Berkeley, he met his future wife Joan. Tom was hired as an assistant professor of mathematics by UC Davis in 1966.

Teaching was his true love and he slowly moved to the field of mathematics education, a combination of the fields of both math and education. In 1989, he founded College Prep Math. Its junior high and high school textbooks are used across 49 states.

Donations may be sent for the G. Thomas Sallee Mathematics Teaching Endowment at UC Davis established at the time of Tom's retirement. You may donate online following the instructions at the right, or checks should be sent in the included envelope, following the instructions on the flap. The memo line should say "G. Thomas Sallee Mathematics Teaching Endowment."

Mathematics for the Future

The Department of Mathematics wishes to thank all alumni, parents, students, faculty, staff and friends who support the Department each year. For a list of our endowed funds, please see our web site:

http://www.math.ucdavis.edu/about/donation/

Your gift to the Department is tax deductible as allowable by law, and you can choose to have your name published or remain anonymous.

Your gift can be used towards undergraduate and graduate support, faculty and research support, and/or Departmental priorities. Your gifts ensure our future success.

Give Online

If you would like to give, please go to the UC Davis secured giving site at:

https://give.ucdavis.edu/Go/MathGift

Please click on "Donate to this Fund" and follow the prompts.

A list of donors can be found at the end of this newsletter. Thank you for your continuing support.

We appreciate the many donors who double or triple the impact of their gifts through their employers' matching gift program. For more information about matching gifts, you can go to:

http://matchinggifts.com/ucdavis/

For additional questions please contact the Development Office at (530) 752-3429. For your reference, disclosures can be viewed at: https://giving.ucdavis.edu/recognition-resources/donor-resources/disclosures

Schwarze - Samuel Fleischer

Schwarze - Jake Reschke

Wasser - Zhuoyi Chen

Wasser - Liang Gao

Department Awards for 2019

G. Thomas Sallee Mathematics Teaching Award

The G. Thomas Sallee Mathematics Teaching Award honors Professor Emeritus Tom Sallee's 40-year career with the Department, his dedication to being an excellent teacher, and his life goal of developing and supporting talented mathematics educators. The prize recognizes the best teaching of lower-division mathematics courses on an annual basis.

Recipient – Janko Gravner

G. Thomas Sallee Mathematics Prize

This prize recognizes exceptional undergraduate students of junior or senior standing who competed in this year's Spring Mathematics Competition.

Recipient – Mengzhu Yuan; Honorable Mention Yuze Luan, Michael Chu

Henry L. Alder Award

Professor Henry L. Alder was at Davis from 1948 till 1994, serving as Department Chair from 1992 to 1994.

Professor Alder was a strong advocate for quality teaching. This award provides support to mathematics graduate students at UC Davis and is given each year to the graduate students in mathematics who is deemed to be the top performing teacher.

Recipient – Katelyn Jarvis

William K. Schwarze Scholarship in Mathematics

William Karl Schwarze received a bachelor's degree at UC Davis and went on to become a mathematics teacher in San Francisco. After his death in 1988, a trust he established has donated to the Schwarze Scholarship to be presented today. This award is given to graduate students in Mathematics who have demonstrated outstanding mathematical scholarship and exceptional promise of making a strong professional contribution as a mathematics teacher and educator at the pre-college or college level.

Recipients – Samuel Fleischer, Jake Reschke

McCurdy Family Scholarship

The McCurdy Family Scholarship is awarded to undergraduate students in the College of Letters and Sciences at UC Davis. Selection of recipients is based on academic merit and promise. The Scholarship is restricted to students with junior or senior class standing, and may include any undergraduate major offered in the Department of Mathematics.

Recipients – Drew Corker, Nicole Williams

Math Outreach Recognition

This citation honors graduate students who have made exceptional contribution to the Department's mission of outreach and community engagement.

Recipients – Wencin Poh, Alaina Gibbons

Robert Lewis Wasser Memorial Scholarship

Robert Lewis Wasser began studying mathematics at UC Davis in 1991. After his tragic death in an automobile accident in 1993, prior to his Junior year, his grandmother, Vera May Wasser, initiated the Robert Lewis Wasser Endowment in his memory. Its goal is to benefit promising mathematics students at UC Davis.

Recipients – Zhuoyi Chen, Liang Gao

Hazel B. Jacoby Fellowship

The Jacoby Fellowship is awarded by the Department of Mathematics for the purposes of both recruiting intellectually promising graduate students entering their first year of graduate-level study and retaining outstanding continuing graduate students.

Recipients – Jennifer Brown, Xiaotie Chen

Alice Leung Scholarship in Mathematics

Alice Siu-Fun Leung received a Master's degree in Mathematics in 1975 from UC Davis, and remembered this time in her life fondly. This award is given to graduate students in Mathematics who have shown exceptional promise in all aspects of mathematics, including research, scholarship and teaching.

Recipient – Jingyang Shu

*Alder - Katelyn Jarvis*

Outreach - Wencin Poh
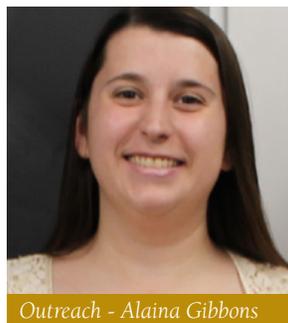
Outreach - Alaina Gibbons

Jacoby - Xiaotie Chen

Jacoby - Jennifer Brown
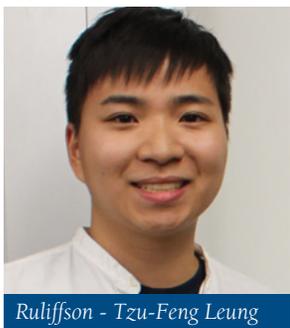
Ruliffson - Tzu-Feng Leung

Silvia - Qing Li

Lin - Alvin Moon

Galois Service - Matt Silver

Eric C. Ruliffson Scholarship in Mathematics

Eric Canady Ruliffson attended UC Davis from 1964-1968, where he both loved the study of math and excelled in it. The Eric C. Ruliffson Scholarship in Mathematics is awarded annually to students of junior or senior standing majoring in mathematics.

Recipient – Tzu-Feng Leung

Evelyn M. Silvia Scholarship for Future Mathematics Teachers

Professor Evelyn Silvia came to the Davis Mathematics Department in 1973. The focus of Evelyn's passion and unwavering commitment was to develop talented mathematics teachers at the K-12 grade level. This scholarship recognizes a junior or senior with a major in mathematics, applied mathematics or statistics who has shown an interest in teaching mathematics.

Recipient – Qing Li

Yueh-Jing Lin Scholarship in Mathematics

Yueh-Jing (Jean) Lin and Chau-Hsiung (Mike) Chuang are alumni of UC Davis who met while they were graduate students on campus. This endowment provides scholarship support to one or more mathematics students each year who are high-achieving mathematics students, either undergraduate or graduate.

Recipients – Alvin Moon, Sari Ogami

Galois Group Service Award

The Galois Group represents the voice of graduate students in the Department.

Every year, the Galois Group presents an award to recognize outstanding service and/or sustained commitment to the graduate group.

**Recipient – Matthew Silver**

Departmental Citation Awards

These Departmental awards recognize undergraduate students of exceptional ability who have taken both a very strong selection of mathematics courses and have made substantial contributions to the Department or their program.

Recipients – Tonie Scroggin, Kyle Chickering, Victoria Boiarsky, Tzu Feng Leung, Cameron Bizeau, Polina Khaptikova

Citation for Outstanding Performance

These citations honor undergraduates who have taken a very strong selection of mathematics courses and distinguished themselves with exceptionally high grade point averages.

Recipients – Tonie Scroggin, Linjun Huang, Diwen Lu, Kyle Chickering, Chutong Wu, Victoria Boiarsky, Zihao Zhu, Zekai Zhao, Tzu Feng Leung, Katelin Jones, Cameron Bizeau, Jiayi Lei, Polina Khapikova, Lorenzo Mambretti, Xinge Zhang, Calvin Leng, Sviatoslav Zinevich
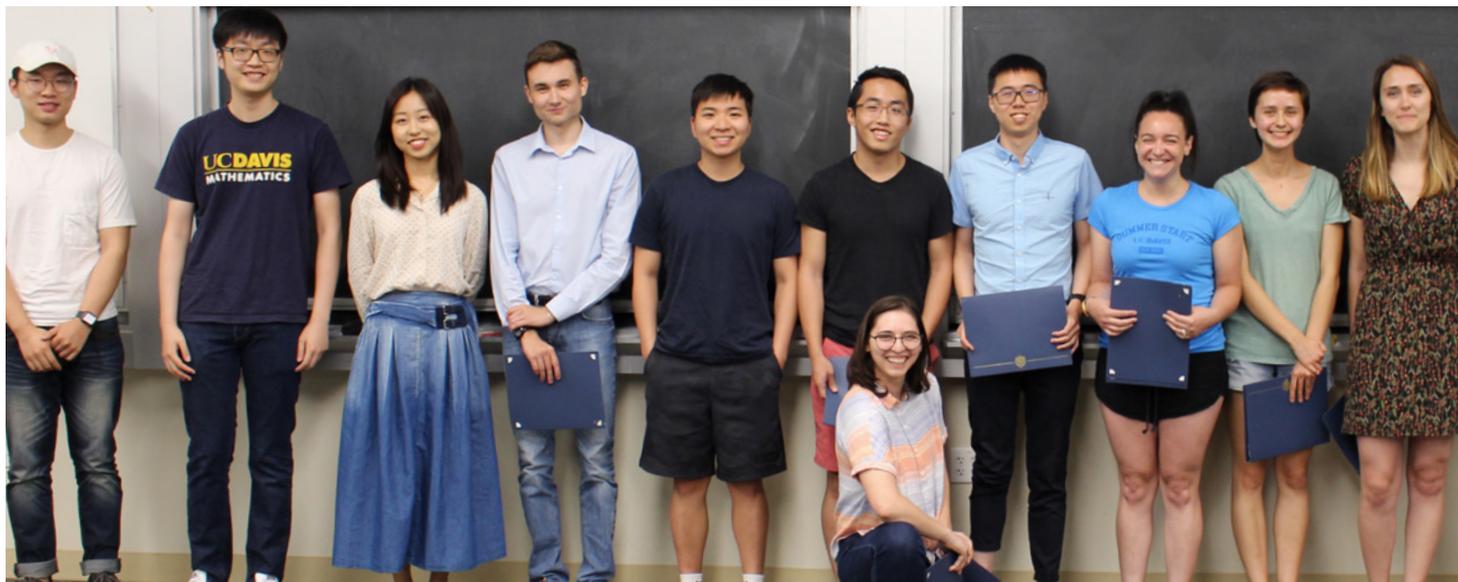
Citations - Lu, Zhao, Zhang, Mambretti, Leung, Leng, Boiarsky, Huang, Scroggin, Khapikova, Jones, Bizeau

Update from the Graduate Program

by Thomas Strohmer,
Vice Chair for Graduate Affairs

This year the Graduate Program in Mathematics welcomed 15 new graduate students. The total number of students in the program is 66.

Several of our graduate students won prestigious awards during the 2018-2019 academic year. Jake Reschke was co-winner of the Schwarze Scholarship. Jingyang Shu won the Leung Scholarshipm and Alvin Moon the Yueh-Jing Lin award. Jennifer Brown received the Jacoby Award. Subhadip Dey was the proud recipient of the Dissertation Year Fellowship from Graduate Studies. Sabrina Enriquez was awarded an NSF Fellowship.

We are pleased that our recent graduates are also doing well, many of them have moved on to interesting postdoc positions. For example, Graham Hawkes and Beibei Liu are now with the Max Planck Institute for Mathematics in Bonn (Germany), while Yang Li joined Facebook as a research scientist.

Alumni Updates

Adrian J. Scherger, B.S. 2001

Adrian Scherger has been a Stereoscopic 3D Editor at Deluxe as well as a Math High School Teacher.

Adrian is currently working at Santa Ana High School, teaching algebra, geometry, and film. He tries to encourage engagement and outreach to his mathematics students. He lives in Orange, California, and is the proud father of two children, Isabel and Oliver.

Patrick C. Tam, Ph.D. 2018

While at UC Davis, Patrick Tam worked with Professor Babson. He graduated in 2018 with his thesis *Nearly Finitary Matroids*.

Patrick is now a Scientist at Naval Surface Warfare Center. He lives in Panama City Beach, Florida.

Update from Graduate Group in Applied Math

by Jesús De Loera, Chair of the Graduate Group in Applied Math

Professor Matthias Koeppe ended four years of GGAM leadership in July 2019. He did a wonderful job growing the program and increasing recruitment and visibility. In particular, he initiated a GGAM Twitter account and a stronger online presence. In another big change, Sarah Driver, the GGAM graduate coordinator for many years, left to take a new position in the Department of Statistics. GGAM is truly grateful for their work and support.

Fall 2019 started for GGAM with many new faces: I am serving as the new chair of GGAM and Victoria Whistler is our new graduate coordinator. We welcomed a large incoming class of 17 new Ph.D. students, a record number, selected from a highly competitive pool of applicants. The total number of graduate students in GGAM has now reached 74.

Several new faculty joined GGAM, giving our graduate students additional opportunities for research interactions and collaborations. We now have faculty from 24 departments and centers across the university. Three new faculty members joined GGAM last year:

Professor Harishankar Manikantan (Chemical Engineering) works on mathematical modeling of continuum mechanics, and is broadly interested in problems involving fluid dynamics, multiphase flows, elasticity, soft matter, numerical methods, rheology, biophysics, hydrodynamic stability, nonlinear dynamics, and pattern formation.

Professor Rishidev Chaudhuri (Mathematics and Neurobiology, Physiology and Behavior) is a computational neuroscientist who works on a number of questions related to collective computation in distributed neural systems, both trying to uncover general mathematical principles and algorithms that these systems might use, and using neural data sets to test and develop models of specific computations, with a focus on memory, learning, and decision-making. Read more about him on page 3.

Finally, Professor Mariel Vazquez (Mathematics and Microbiology & Molecular Genetics) is a mathematical biologist whose research focuses on the applications of topological and discrete methods to the study of DNA, with an emphasis on DNA packing and on the topological changes affected by enzymes, as well as on the study of chromosomal rearrangements in cancer. Her contributions are characterized by the use of tools from pure mathematics (knot theory, low-dimensional topology, graph theory) to the study of questions in molecular biology.

Our program graduates continued to go on to impressive careers in academia and industry (see the list of graduates included in this newsletter). In Spring 2019 we continued our series of Ph.D. exit seminars, each with a reception to celebrate the research achievements of the graduating doctoral students. This year four students received a Ph.D.

The GGAM faculty continues to increase our reputation and prestige by winning awards, grants, and making contributions to the university. In addition to Department of Mathematics faculty discussed in the Chair's report, the 2019 INFORMS prize was awarded to our colleague David L. Woodruff for spearheading the creation and advancement of Pyomo, an open-source software package for modeling and solving mathematical programs in Python.

The academic and social activities of GGAM included the Annual GGAM meeting at Professor Blake Temple's house in December. The February GGAM Mini-Conference showcased the breadth of research that GGAM offers, with short talks from GGAM faculty members representing four different departments: Professors Javier Arsuaga, Krishna Balasubramanian, Becca Thomases, Xin Liu, and Gerry Puckett; a poster session; and a reception.

Are You a Graduate?

We want to hear from you! Please send us information about yourself so that we can stay in touch and share in your experiences outside of UC Davis.

Please complete our Alumni Questionnaire: http://www.math.ucdavis.edu/news/alumni_quest or send e-mail to:
mso@math.ucdavis.edu
We will do our best to include it in the next newsletter.

Life After Davis
Thomas Chartrand, Ph.D. 2018

I graduated from the Applied Math program in summer 2018, heading directly to my current position at the Allen Institute for Brain Science in Seattle. It's a unique place, a privately-funded nonprofit research institute focused on basic neuroscience research, guided by principles of "big science, open science, and team science." Although our primary focus is on experimental science, the computational and theoretical groups like the one I'm a part of are essential to making sense of the data, making it accessible, and guiding future experiments. More concretely, I spend most of my days running simulations of the electrical dynamics of human neurons (essentially solving very large systems of ODEs), trying to extrapolate beyond the limited set of experiments we can carry out to infer how the cells function in real life.

I began this line of research on neural dynamics at UC Davis, with professors Tim Lewis and Mark Goldman. While I can't say I use much of my coursework knowledge directly these days, the other strong benefits I've felt were from the interdisciplinary character at all levels of the graduate group: across the math biology group, the core applied math professors and shared coursework with my classmates, and the broader applied math community across departments. The ability to think about problems from different mathematical perspectives and to communicate that to my colleagues was a natural development of seminars, discussions, and group work across these communities. I think these are the most valuable skills I bring to my current position, and certainly urge students to actively develop those abilities, even (or especially) if other aspects of the program feel harder. As many fields of science are currently becoming more mathematically rigorous with data, analysis, and theoretical modeling, such roles will only become more critical for the success of large research enterprises in academia and industry.

Life After Davis
Beibei Liu, Ph.D. 2019

photo by Matthias Zepper

I graduated from the Department of Mathematics of UC Davis as a Ph.D. student in June 2019. In 2019-2020, I am a postdoc at Max Planck Institute for Mathematics in Bonn, Germany, and will be a Hale Visiting Assistant professor in the School of Mathematics at Georgia Institute of Technology for the following three years. My research is focused on two very distinct lines of inquiry within the general field of geometry and topology. One of my interests is in manifolds of negative curvature and geometric group theory. In particular, I am studying topology and geometry properties of higher-dimensional hyperbolic spaces. I am also working on low dimensional geometry and topology, mainly using the tool of Heegaard Floer homology to study 3- and 4-manifolds, and links in 3-manifolds.

I am sincerely grateful to all the people at the Department of Mathematics who constructed an amazing and extremely friendly working environment. In particular, my advisers Michael Kapovich and Eugene Gorskiy set very good examples of great mathematicians to me, and help me cultivate my research ability. Talking math with the people in the geometry and topology group, including Roger Casals, Joel Hass, Jennifer Schultens, Laura Starkston and Abigail Thompson benefits me a lot in my research. I also want to thank Motohico Mulase, Monica Vazirani and Rohit Thomas for sharing their experience of working math with me. All the staff in the Department, especially Sarah and Tina, greatly help me dealing with all kinds of administration problems, and the peer group of graduate students support and help each other. Without hesitation, I think studying at UC Davis is one of the best experience I've ever had in my life, and it surely will keep supporting me to walk further and further in my math career.
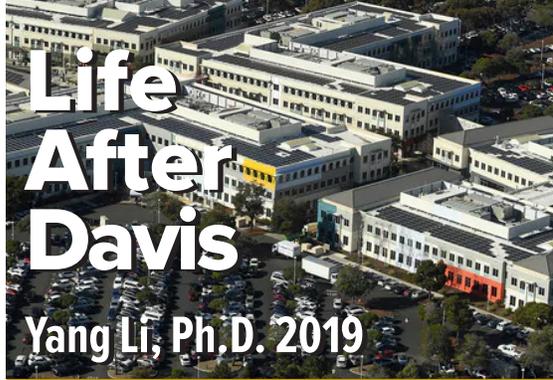
Life After Davis
Yang Li, Ph.D. 2019

I am a recent graduate from the Ph.D. program of mathematics at UC Davis. The five years I have spent there have been a great experience for me. These experiences are really beneficial for my daily work at Facebook as a Research Scientist, and will continue to be a source of inspiration and courage for my life.

At first glance, the academic training I received as a Ph.D. student in mathematics may not seem directly related to my daily routine at Facebook, a large portion of which is consisted of software engineering and data analysis. However, years of experiences in quantitative thinking help me recognize patterns from massive piles of databases at a much faster pace. Besides, familiarity with the formal language of mathematics makes me accessible to a deeper understanding of programming languages, which are comprised of abstractions at multiple levels.

There are certainly gaps to be filled. Success in academia alone does not guarantee success in industry. Necessary practical skills must be developed at a fairly fast pace. Tedious but critical working knowledge must be acquired through effective communication with coworkers. I was lucky enough to have prepared myself during my Ph.D. years. Through a variety of different projects, I was able to accumulate a bunch of skills that have proved to be useful for my career. I was also fortunate to have Professor Thomas Strohmer as my adviser, who is a good listener and an excellent communicator. Weekly meetings with him made me realize the efficacy of clear and vivid expression. Creative ideas are the ultimate source of innovation, but most ideas, even the best ones, will not survive without effective communication.

Life After Davis

Katelin Jones, B.S. 2019

After completing my B.S. in Mathematics at UC Davis, I was in the process of interviewing for a healthcare consulting firm in San Francisco. Before I had the chance to complete the interview process, I was offered a teaching position at Wheatland Union High School. Having a long-term dream of becoming a teacher, I accepted the offer and began the journey of learning how to lesson plan, write exams, and find ways to explain challenging concepts to young minds. At Wheatland High School, I teach Integrated II, III, and AP Calculus AB.

The training in mathematics and critical thinking that I received at UC Davis helped strengthen my understanding of key mathematical ideas. It also influenced the way in which I communicate ideas to my students. Rather than training them to solve specific problems, I do my best to help build their problem-solving skills and conceptual understanding of concepts. Additionally, the experience of serving as president of the Math Club at UCD improved my public speaking and leadership skills. At Wheatland, I am the teacher adviser of Mu Alpha Theta and the Environmental Club. I also run an after-school tutoring service for students struggling in their math courses.

Life After Davis

Oscar Kivinen, Ph.D. 2019

photo by Canon.vs.nikon

I first arrived at UC Davis in June 2015. My then-undergraduate adviser at Aalto University in Finland had suggested I apply to UC Davis as well. Not knowing very much about the Department at all, I hesitated but sent in the paperwork. And for better or worse, I got in, got a Fulbright scholarship, and ended up moving continents.

It was all very different from what I had expected. Luckily, the town and especially the Department of Mathematics were very welcoming places. Many active young people showed up during my first two years, and started running great seminars on topics seemingly unrelated to what I had prematurely decided to be interested in. After learning about Cherednik algebras, toric varieties, quantum field theory, and other wonderful things, it was time to find an adviser.

This was not the most straightforward task, but thankfully, Eugene Gorskiy was willing to take me under his wing. The commitment and enthusiasm with which he gave, and continues to give, mathematical and professional advice was invaluable. I feel fortunate to continue collaboration with him and many other people I met during my graduate studies. Of course, I also have many good memories from classes by Professors. Schwarz, Osserman, Vazirani, etc., as well as teaching my own 21A in fall 2018.

Thanks to great advising, a lot of work and a lot of luck, I landed an Olga Taussky-John Todd instructorship (a fancy name for a postdoc) at Caltech and have now been here for a few months. Next year, I'll run out of years on my J1 and will be joining the University of Toronto. Hopefully the colder and more representation-theoretic climate will feel fresh after the California heat. While I look fondly back at my days in UC Davis, I have been excited about the transition to a mathematical grownup and am looking forward to future projects. At the same time, I am trying to catch up on various other interests; after all graduate school took me twice as long as my undergraduate studies.

In grad school, I was able to travel to many conferences and workshops, which was important for me both professionally and personally. High points were a month spent at the IHP in Paris and a spring spent in Berkeley, which thanks to Amtrak and the Davis-Berkeley shuttle was always near if I felt a need to further satisfy my mathematical needs. And well, I did also live in Berkeley for almost two years thanks to all the external funding making my life in the Bay Area possible. I highly recommend any current grad students to travel as much as they can (even in-state), because life will only get more logistically complicated afterwards.

While in Davis, I enjoyed the town's overall walkability, many cozy coffee shops, the ARC, and many of the enology graduate students' ties to the nearby wine industry. Now I am trying to sit on as many quantum computing lectures as I can bear in Pasadena, and avoid sitting in traffic for more than an hour each day.

Life After Davis

Victoria Boiarsky, B.S. 2019

I really enjoyed my time with the UC Davis Department of Mathematics. Since graduating, I have spent several months over summer traveling before coming back to Northern California to begin a job in data analysis. I think that my time in the Department of Mathematics here helped me develop a problem solving outlook that is very helpful in my current position — especially when trying to find particular sources of error in data. I feel as though the professors I have had and the friends that I made in the Department encouraged and supported me while I was prepping for the College & Career Fair and going through the interviewing process. I was lucky that I was able to find my current job through the Fall College & Career Fair, but the recommendations and guidance from my professors was invaluable as well. I am so glad I ultimately decided to come to UC Davis and pursue a degree in Applied Math.

Staff Update

by Gladis Lopez, Department CAO

This has been an interesting year in the Administrative office. We survived the transition to UC Path (our new UC systemwide personnel System).

During the Summer, three of our student advising staff members (Sarah Driver, Malina Gillies-Doherty and Joann Pyon) accepted promotional opportunities in other UC Davis Departments, making our Summer busier than usual. Fortunately, we had three very successful recruitments and hired Victoria Whisler, graduate student adviser; Cydney Matteson, undergraduate student adviser and Stephanie Zarate as the student services coordinator. Victoria and Cydney have been with us for several weeks while Stephanie will start her employment soon.

I am pleased to share that Matthew Silver was awarded the GALOIS award and Tina Denena received a UC Davis Advising honorable mention.

We scored GOLD! Cydney Matteson completed the UC Davis Healthy Department Certification and the Mathematics Department scored Gold! We are very proud for getting such a great score.

We had a Halloween potluck with the staff from Mathematics and Statistics Departments and look forward to having more events in the future. It was fun!

Our staff members strive to provide great customer service and look forward to another great year.

Join us on Facebook!

The Department of Mathematics is on Facebook! Visit us there to get updates on current seminars, events and news. We'd be happy to include any memories or photos you have of the Department on our wall.

To "like" us, search for "Department of Mathematics - UC Davis" on the Facebook web page:

https://www.facebook.com/

Interested in the News?

Prior newsletters back to 1994 are available on the Department of Mathematics website.

https://www.math.ucdavis.edu/research/news/archive/

Graduate Degrees Awarded

Challenor, John • Math • *Positive Characteristic Phenomena in Linear Series*
Adviser: Brian Osserman
Post Degree Placement: Lecturer, University of California, Davis

Chartrand, Thomas • GGAM • *The Role of Subthreshold Phenomena in Synchronization by Electrical Synapses*
Adviser: Tim Lewis
Post Degree Placement: Scientist, Allen Institute for Brain Science

Docken, Steffen • GGAM • *Mechanisms Underlying Functional Effects of Drugs on Cardiac Dynamics (Insights from Idealized Models)*
Adviser: Tim Lewis
Post Degree Placement: Post-Doctoral Researcher, Kirby Institute, UNSW Australia

Hagemeyer, Colin • Math • *Spiders and Generalized Confluence*
Adviser: Greg Kuperberg

Hawkes, Graham • Math • *Marked Tableaux*
Adviser: Anne Schilling
Post Degree Placement: Post-Doctoral Researcher, Max Planck Institute

He, Xiang • Math • *Lifting Properties of Tropicalization and Their Connection to Brill-Noether Theory*
Adviser: Brian Osserman
Post Degree Placement: Post-Doctoral Researcher, Hebrew University of Jerusalem

Hogan, Thomas • Math • *Patterns in Classified Data: Tverberg-type Theorems for Data Science*
Adviser: Jesús De Loera
Post Degree Placement: Data Scientist, Tatari Inc.

Kivinen, Oscar • Math • *Affine Springer fibers, Hilbert schemes and knots*,
Adviser: Eugene Gorskiy
Post Degree Placement: Taussky-Todd Instructor, CalTech

Lamb, Kevin • Math • *A Distance for Circular Heegaard Splittings*
Adviser: Abigail Thompson
Post Degree Placement: Assistant Professor, University of the Pacific

Li, Yang • Math • *Sorting Data into Categories: Applying Convex Optimization to Classification and Clustering*
Adviser: Thomas Strohmer
Post Degree Placement: Research Scientist, Facebook

Liu, Beibei • Math • *Discrete Isometry Subgroups of Negatively Pinched Hadamard Manifolds*
Adviser: Michael Kapovich/Eugene Gorskiy
Post Degree Placement: Assistant Professor, Georgia Tech

Liu, Wen • Math • *Limit Linear Series on Cycle Curves*
Adviser: Brian Osserman

Ming, Shuang • Math • *On Image of TQFT representations of mapping class groups*,
Adviser: Greg Kuperberg
Post Degree Placement: Assistant Professor, Texas A&M University

Silverstein, Lily • Math • *Probability and Machine Learning in Combinatorial Commutative Algebra*
Adviser: Jesús De Loera
Post Degree Placement: Assistant Professor, California State Polytechnic-Pomona

Snyder, Jordan • GGAM • *Collective Behavior in Dynamics on Networks*
Adviser: Raissa D'Souza
Post Degree Placement: Research Associate, University of Washington

Weed, Patrick • Math • *Circular Heegaard Splittings of Knot Exteriors*
Adviser: Abigail Thompson
Post Degree Placement: Data Analyst, Department of Managed Health Care

Armas, Anthony • M.A., Math	**Li, Yang** • M.A., Math
Gaerlan, Mikhail • M.S., GGAM	**Lin, Matthew** • M.A., Math
Gibbons, Alaina • M.S., GGAM	**Litman, Matthew** • M.A., Math
Gorman, Kara • M.S., GGAM	**Mauhs-Pugh, Annie Laurie** • M.A., Math
Haley, David • M.S., GGAM	**Ponce, Michael** • M.A., Math
Kim, Albert • M.S., GGAM	**Sheng, Stephen** • M.A., Math
Kshirsagar, Priya • M.A., Math	

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Featuring the 2018-19 Academic Year

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Brent Schultz
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David and Muriel Skoug
Hannah and Sherman Stein
Seth and Jennifer Stevelman
Donald and Roslyn Sutherland
Clark and Sharon Swanson
Ernest Tam and May Chau
Abigail Thompson and Joel Hass
Allan Thompson

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Philip and Elaine Tillman
Lynda Trowbridge
Ursula Van Dijk
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Ronald Vucurevich
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