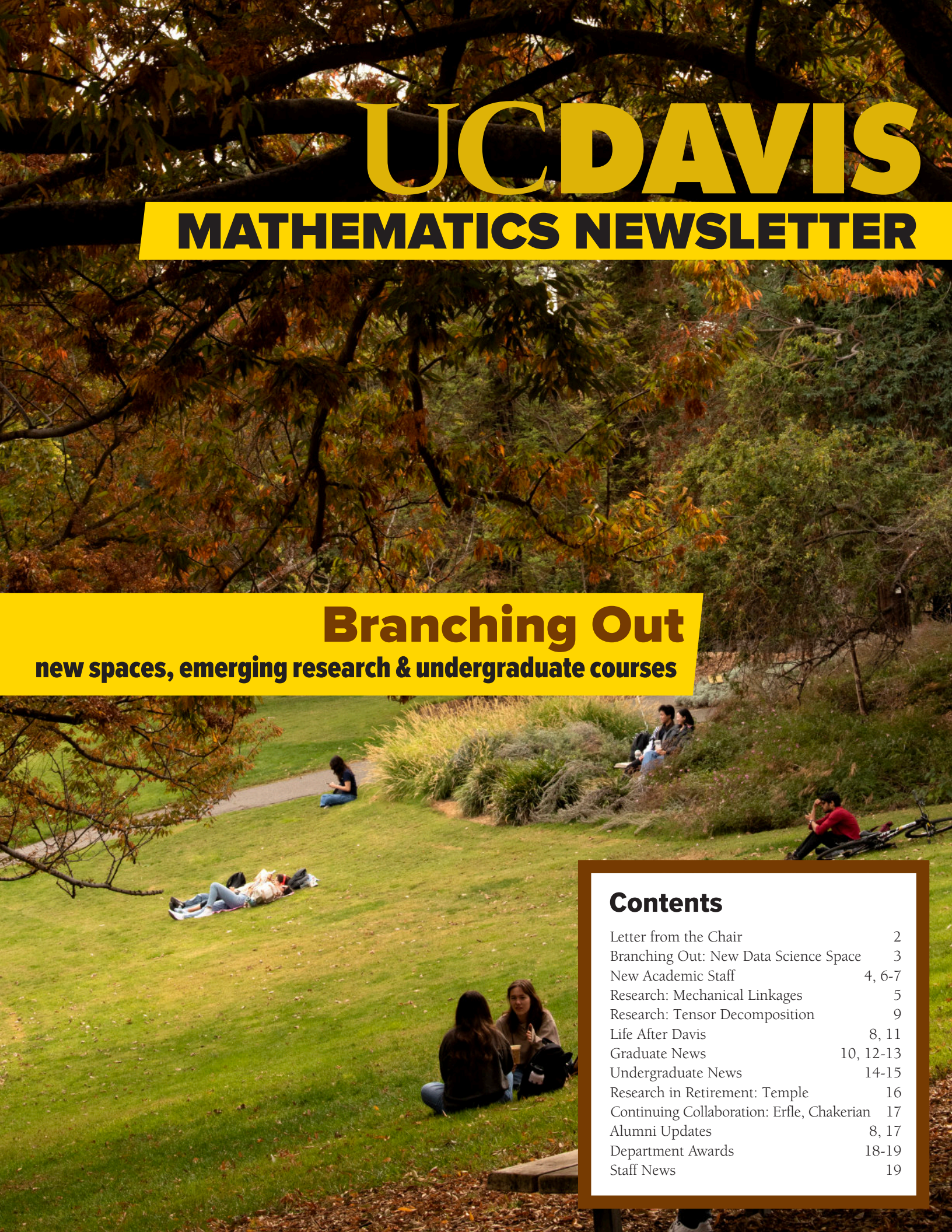
UC DAVIS
MATHEMATICS NEWSLETTER

Branching Out
new spaces, emerging research & undergraduate courses



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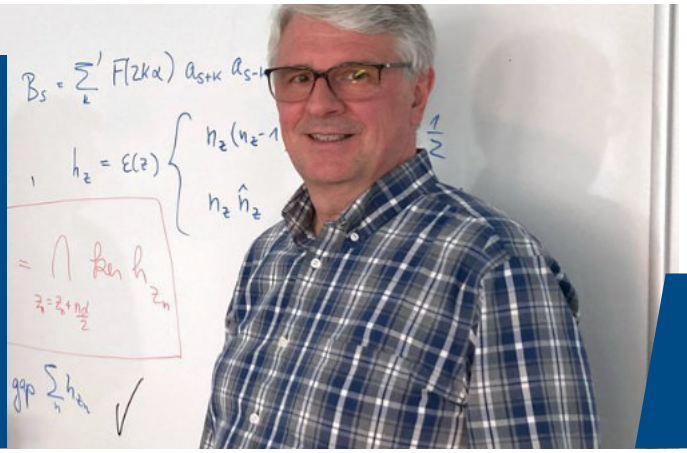
LETTER from the chair



Bruno Nachtergeale at the Technical University of Munich last year. Photo by Barbara Kraus.

by Bruno Nachtergaele, Department Chair

The academic year 2023-24 has been another year rich in accomplishments.

One ingredient to our success may be that the Department stays forever young. Distinguished Professor Blake Temple retired after a remarkable 38 years of service in our Department. You can read about his ongoing research projects in this newsletter. Blake's retirement on June 30, 2024, was followed by the hiring of three new Assistant Professors starting on July 1: Abinand Gopal, Melissa Sherman-Bennett, and Melissa Zhang. You can read their bios on page 4. Other new arrivals featured in this newsletter are six Krener Assistant Professors, a postdoc, as well as a new Undergraduate Advisor. You can also read updates on our graduate and undergraduate programs by their respective chairs, including a long list of awards won by our students.

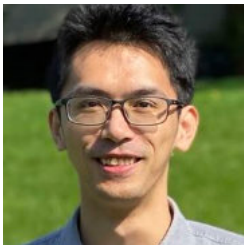
In this article, I would like to impress you with the research, mentoring, and career awards received by faculty and researchers this past academic year. I apologize for the long list! The Mathematical Association of America (MAA) honored Distinguished Professor Jesús De Loera with its T. Christine Stevens Award in recognition of his sustained efforts to provide mentoring and networking opportunities for Latinx and Hispanic early career researchers. Professor Mariel Vazquez was elected as a Fellow of the American Association for the Advancement of Science (AAAS). Distinguished Professor Steve Shkoller gave a plenary lecture at the International Congress on Mathematical Physics. Professor Anne Schilling gave the AWM-AMS Noether Lecture at the Joint Mathematics Meetings and also received the 2024 UC Davis Graduate Program Advising and Mentoring Awards. Professor Adam Jacob won a 2024 Frontiers of Science Award with his co-authors Tristan Collins and Shing-Tung Yau. Assistant Professor Alex Wein won a prestigious NSF CAREER award. Assistant Professor Sameer Iyer received a Hellman Fellowship. Krener Assistant Professor Luze Xu won the INFORMS Optimization Society 2024 Young Researchers Paper Prize and Krener Assistant Professor Anna Parlak received the Craig A. Tracy Research Prize.

There is no doubt the Department is thriving. However, we are not resting on our laurels! We always look to support new talent and room for growth. Just this year, four faculty moved into the newly renovated space in the former Physical Sciences and Engineering Library, now renamed the Physical and Data Sciences Building. This is the same building where the Center for Quantum Mathematics and Physics (QMAP) has its space on the second and third floors. If you happen to visit the campus, please drop by and have a look.

Enjoy this newsletter and let's keep in touch!

Jesús De Loera
Photo by Petra Lein (MFO)t

Mariel Vazquez



Luze Xu

Anna Parlak

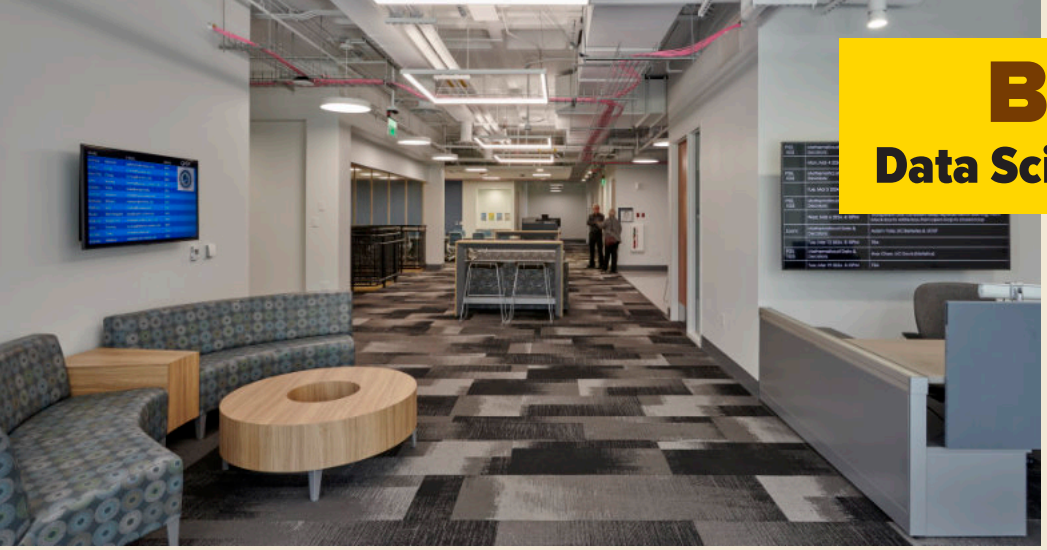
Steve Shkoller

Anne Shilling

Adam Jacob

Alex Wein

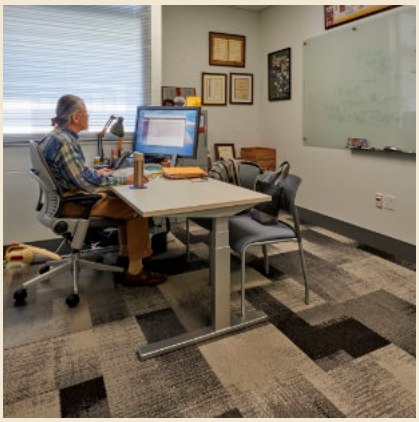
Sameer Iyer



Branching Out

Data Science & AI in a New Home

by Naoki Saito and Jesús De Loera



With the anticipation of Data Science activities in full swing at UC Davis, in Fall 2020, our campus decided to renovate the first floor and basement of the former Physical Sciences and Engineering Library (PSEL) for the use of campus-wide Data Science and Artificial Intelligence (AI) related activities. The renovation was finally completed in December 2023. Together with QMAP (Center for Quantum Mathematics and Physics), which has occupied the 2nd and 3rd floors since 2021, this renovated building has become a gathering space for research activities in physical and data sciences, and hence it has now been officially renamed as the Physical and Data Sciences Building (PDSB).

Between the two floors there are 16 offices, a seminar room for up to 50 people, two meeting/conference rooms, a 'huddle' room for small collaborations of 3, 11 cubicles, and some shared office and collaborative space.

These offices and meeting rooms are shared by various groups: AI Institute for Next Generation Food Systems (AIFS), DataLab, UC Davis TETRAPODS Institute of Data Science (UCD4IDS); and DS+AI-related researchers from the Computer Science, Math, and Statistics Departments. From our Department, faculty Naoki Saito, Jesús De Loera, Yunpeng Shi, and Abi Gopal moved into their offices on the first floor. One postdoc and two graduate students associated with these faculty have also taken spaces there. Since Bruno Nachtergaele, Andrew Waldron, and Martin Fraas are already in offices on the second floor as members of QMAP, the presence of the Department of Mathematics at PDSB has become very significant.

With all this preparation of the building, Fall quarter was perfect timing to have a symposium on "Foundations of Data Science and Machine Learning." Seventy people registered for this symposium, held on September 23-24, 2024. Three external speakers: Dustin Mixon (Ohio State Univ.); Gal Mishne (UCSD); Junwei Lu (Harvard) and four internal speakers: Thomas Strohmer (Math); Krishna Balasubramanian (Stat); Xin Liu (CS); Yubei Chen (ECE) gave excellent and stimulating talks on cutting-edge research in DS/AI. To conclude this symposium, we organized a panel discussion on the future directions of data science and machine learning both in research and education. We invited six panelists: Gal Mishne (UCSD); Patrice Koehl (CS); Junwei Lu (Harvard); Chen-Nee Chuah (ECE); and Thomas Lee (Stat). Their presentations generated heated discussions among participants, and it was an excellent way to conclude the symposium. With the ample space available and new white boards we could also host a poster session. This event clearly demonstrated the usefulness and functionality of the PDSB! Now there are a number of seminars and research meetings happening every day.

incoming Academic Staff

Faculty

Melissa Zhang

Melissa Zhang is a low-dimensional topologist who likes to use algebraic, combinatorial, and categorical methods to solve problems. Her favorite topological objects are knots and surfaces smoothly embedded in 3- and 4-dimensional spaces.

She received her Ph.D. from Boston College under the supervision of Eli Grigsby and David Treumann. She was previously a postdoc at the University of Georgia, SLMath/MSRI, and UC Davis (and is now a super-postdoc, as she never left).

Outside of mathematics, she likes creating music (piano, guitar, singing), arts and crafts (painting, knitting), translational physical activities (hiking, swimming, skating, kayaking), and baking (point at anything at a bakery and she will proudly make a worse version).

Faculty

Abi Gopal

Abi Gopal joined the Department of Mathematics in July 2024 as an assistant professor. Prior to this, he was a Gibbs assistant professor of mathematics at Yale University.

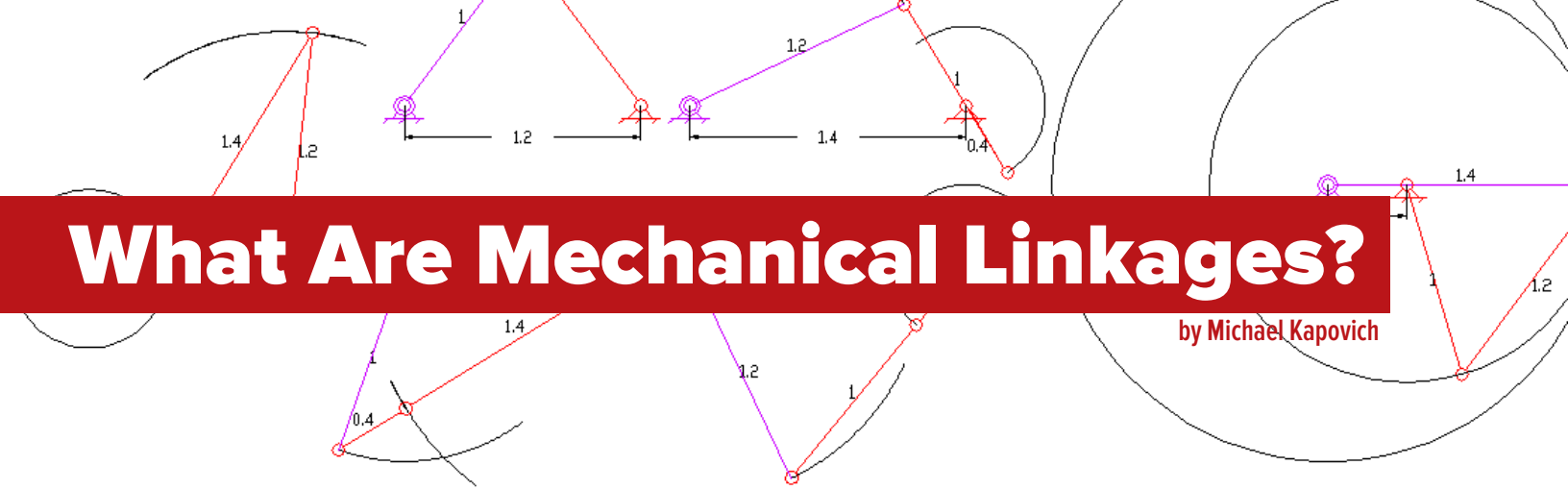
Abi's research is in the field of numerical analysis. He is particularly interested in numerical methods for integral equations, analysis-based algorithms, and numerical linear algebra. His work is primarily motivated by applications in wave propagation and quantum chemistry.

He received a bachelor's degree in Mathematics from Virginia Tech and a doctorate in Mathematics at the University of Oxford, where he was a Clarendon scholar.

Faculty

Melissa Sherman-Bennett

Melissa Sherman-Bennett does research in algebraic combinatorics, focusing recently on cluster algebras, total positivity, and connections to particle physics. She received her Ph.D. in 2021 from UC Berkeley, under Lauren Williams. Before coming to Davis, she was a President's Postdoctoral Fellow at UCLA and NSF Postdoctoral Fellow at Michigan and MIT.



What Are Mechanical Linkages?

by Michael Kapovich

Informally, a mechanical linkage is a system of rigid links (rods or bars) connected by ideal joints and moving in the plane or in space. This definition suffices for engineering purposes, and one can find it in some form in many engineering books. However, from the mathematical viewpoint, this is not a satisfactory definition. Mathematically speaking, an *abstract linkage* is a finite connected metric graph $L = (G, \ell)$, a graph G together with a length function ℓ which assigns to every edge $e \in E(G)$ of G a positive real number, its length $\ell(e)$. Given such a graph and a target metric space (X, d) (for the purpose of this article, X will be Euclidean space of some dimension), one defines the *realization space* $\mathcal{R}(L, X)$, as the space of maps from the vertex set of G to the target space X, $f : V(G) \to X$, subject to the condition

$$d(f(v), f(w)) = \ell([v, w]).$$

Here $v, w \in V(G)$ are vertices of G and $[v, w] \in E(G)$ are the edges connecting these vertices. In terms of the informal definition of a mechanical linkage, each realization $f \in \mathcal{R}(L, X)$ defines a system of rods $f([v, w])$ connected at joints $f(v)$.

If (X, d) is $\mathbb{R}^n$ with the Euclidean norm $\|\cdot\|$, then the length condition is better written as

$$\|f(v) - f(w)\|^2 = \ell^2([v, w]),$$

so that it becomes a polynomial equation on the vectors $f(v), f(w) \in \mathbb{R}^n$. With this in mind, the realization space becomes a real algebraic subset of $\mathbb{R}^{nm}$ (where m is the number of vertices in G) given by the system of k quadratic equations on m-tuples of vectors,

$$\|\mathbf{x}_i - \mathbf{x}_j\|^2 = \ell^2([v_i, v_j]),$$

with vertices of G enumerated as $v_1, \ldots, v_m$. Here k is the number of edges in G. The correspondence between $\mathcal{R}(L, \mathbb{R}^n)$ and this algebraic subset is given by

$$f \in \mathcal{R}(L, \mathbb{R}^n) \mapsto (f(v_1), \ldots, f(v_m)) = (\mathbf{x}_1, \ldots, \mathbf{x}_m).$$

Incidentally, in a similar fashion one can get *semialgebraic subsets* of $\mathbb{R}^{nm}$, i.e. ones given by systems of polynomial equations and (non-strict) inequalities. For instance, inequalities of the form

$$\|\mathbf{x}_i - \mathbf{x}_j\|^2 \le \ell^2([v_i, v_j]),$$

correspond to linkages where vertices v_i, v_j are connected not by a rigid rod, but by a *rope* of length $\ell([v_i, v_j])$. But I digress. In fact, the system of equations defined above determines not just a subset of $\mathbb{R}^{nm}$, but a more complicated algebro-geometric object. Instead of defining it, I will consider the following simple example. Take L to be the triangle (three vertices u, v, w and three edges connecting these), with edge-lengths equal to $1 = \ell([u, v])$, $1 = \ell([v, w])$ and $2 = \ell([w, u])$. Then every realization of L is a degenerate triangle, lying in a straight line. It is not hard to convince oneself that $\mathcal{R}(L, \mathbb{R}^2)$ is 3-dimensional, isomorphic (in any meaningful sense) to the product of the plane and the circle: A point in the plane corresponds to the location of $f(u) \in \mathbb{R}^2$ and a point in the circle corresponds to the length 2 vector $\overrightarrow{f(u)f(w)}$. In total, one has three degrees of freedom for our linkage. However, something interesting happens in this example: If one linearizes the defining equations for $\mathcal{R}(L, \mathbb{R}^2)$, one gets not three but four degrees of freedom, one extra is given by the infinitesimal motion which keeps $f(u)$, $f(w)$ fixed and moves $f(v)$ in a direction orthogonal to the vector $\overrightarrow{f(u)f(w)}$. An algebraic geometer will immediately recognize what is happening here (we have a nonreduced scheme), but I will keep the algebro-geometric language to a minimum.

Some of the motions of a linkage in a space are more interesting than the other: The "uninteresting ones" are obtained by modifying the given realization f by postcomposition with a rigid Euclidean motion (one which preserves orientation). Considering realizations modulo rigid Euclidean motions corresponds to taking a suitable quotient of $\mathcal{R}(L, \mathbb{R}^2)$ by the group $SE(n)$ of orientation-preserving Euclidean isometries. In the case when the target space is the Euclidean plane, with few trivial exceptions, taking such a quotient amounts to considering based realizations, ones where $f(v_1)$ is the origin and for an edge $e = [v_1, v_2]$ the image $f(v_2)$ has coordinates $(\ell(e), 0)$. The quotient $\mathcal{M}(L, \mathbb{R}^n) = \mathcal{R}(L, \mathbb{R}^n)/SE(n)$ is the moduli space of realizations of L in $\mathbb{R}^n$. Since we assumed G to be connected, the space of based realizations is a compact (and with few exceptions) algebraic subset of $V^m - 1$.

As it turns out, in a sense, one can obtain every compact real-algebraic subset Y of $\mathbb{R}^n$ using moduli spaces of planar linkages, $\mathcal{M}(L, \mathbb{R}^2)$. Here I am lying a bit: One gets not Y but several disjoint copies of Y, up to a *Nash isomorphism*: a polynomial map with algebraic inverse. This theorem has a long and complicated history, going back to the 18th century and involving steam engines, military secrets, Chebyshev polynomials, and work of A. B. Kempe (better known for the first incorrect solution of the 4-color problem). Ultimately, the theorem was proven in my paper with John Millson.

One can ask if a similar treatment, using graph theory, can be applied to more complex mechanical devices than just linkages (for instance, mechanical clocks, bicycles, analog computers...). It turns out that the answer is again positive, but one has to consider more complex objects associated with metric graphs (vector bundles, connections and parallel sections), and instead of real-algebraic sets one deals with *algebraic ordinary differential equations*. But this is another story...

Mechanical linkages image by Pasimi, CC 4.0 license, Wikipedia.

incoming Academic Staff

KAP

Chenchen Zhao

Chenchen Zhao completed her Ph.D. at the University of Southern California in May 2024, advised by Greta Panova. Her research interests lie in the area of Enumerative and Algebraic Combinatorics. Her dissertation explored the positivity of Kronecker coefficients and the Newton polytope of the Kronecker product of Schur polynomials.

KAP

Yoon Jae Nho

Yoon Jae Nho is a Krener Assistant Professor, mentored by Professor Roger Casals. His research is in symplectic geometry and topology, and he is interested in geometric structures that are related to physics. He received his Ph.D. from the University of Cambridge in August 2024, under the supervision of Professor Ailsa Keating.

He is from South Korea, and his hobbies include reading books, watching films, and listening to music.

Researcher

Isaac Neal

Isaac Neal received his Ph.D. from the Courant Institute at NYU in 2024. He studies partial differential equations with a focus on fluid dynamics. In particular, his research has delved into the formation of shocks in compressible fluids.

KAP

Anna Zarkh

Anna Zarkh received her Mathematics Education Ph.D. in May 2024 from the University of California, Berkeley. She holds B.A. and M.A. degrees in Mathematics from Bar Ilan University in Israel. Anna's research focuses on university mathematics education, specializing in socio-cultural theories, discourse analysis, and micro-ethnographic methods. She is interested in the historical development and effects of communication practices in contemporary academic mathematics.

Anna taught undergraduate math courses at UC Berkeley, Bar Ilan University, and at (an Israeli equivalent of) community college. She is dedicated to promoting math as a humanizing, sense-making experience in all contexts of human interaction.

Outside of academic work, Anna spends a lot of time with her 3 year old daughter. She also enjoys traveling, hiking, cooking, and playing board games.

KAP

Jared Krandel

Jared Krandel is a new postdoc who will be starting at UC Davis in January 2025. He graduated from Stony Brook University in Spring 2024 and is spending this Fall as a postdoc at SLMath in Berkeley. Most of his work so far has been in an area of geometric measure theory called quantitative rectifiability. He studies geometric properties of rectifiable curves and surfaces through things like analyst's traveling salesman problems, characterizations of uniform rectifiability, parameterizability problems, and more.

Outside of math I love watching movies, going to the gym, and exploring new places (especially in nature). He's looking forward to meeting all of the Department!

KAP

Oliver Siebert

Oliver Siebert works in mathematical quantum theory, mainly using tools from functional analysis (including spectral theory, operator theory, operator algebras). Currently, he is interested in many-body theory with applications to quantum information (Lieb-Robinson bounds, area laws), and in non-relativistic QED/Pauli-Fierz Hamiltonians. He completed his Ph.D. in 2021 at the University of Jena under the supervision of David Hasler. Following that, he worked as a postdoc with Marius Lemm at EPFL and the University of Tübingen.

KAP

Kiseok Yeon

Kiseok Yeon joined UC Davis as a Krener Assistant Professor this Fall quarter. His main research interest lies on analytic number theory (especially the Hardy-Littlewood method), theory of exponential sums and its applications, and analytic methods in connection with rational points on varieties.

Aside from mathematics, he loves playing tennis and running. He would love to be contacted if Department members want to do exercise together – he loves all kind of exercises!

Researcher

Shizhou Xu

Shizhou Xu, originally from China, earned his Ph.D. from the University of California, Davis in 2024 under the supervision of Professor Thomas Strohmer. His research focuses on the intersection of mathematics and trustworthy artificial intelligence, with particular emphasis on fairness, privacy, interpretability, and robustness in machine learning.

NASA: Then and Now

Life After Davis
Katy Griffith (formerly Jarvis)

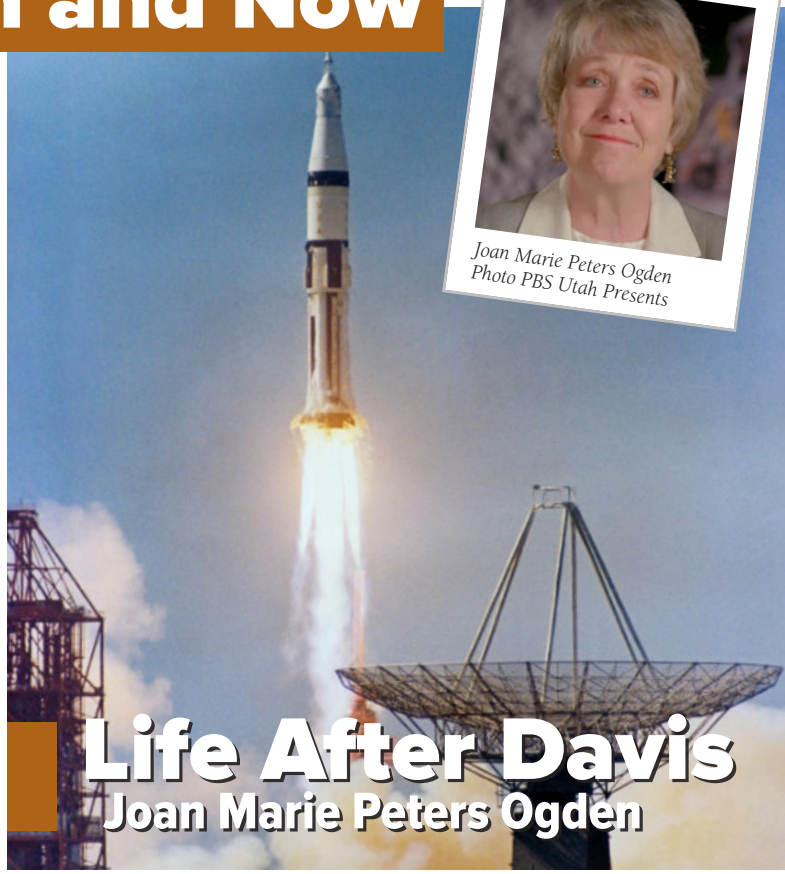
I spent 10 wonderful years at Davis, completing both my B.S. and Ph.D. in the Department. During my final year of grad school, I interned as a Pathways intern at NASA's Ames Research Center, and after completing my Ph.D. in 2021, joined NASA as a full time research scientist.

At NASA, I work with the Diagnostics and Prognostics research team. Prognostics is the science of prediction, and my team develops new tools and technologies that monitor systems, like a battery on a drone or a component on the International Space Station, and predict how they will degrade with use. One application of this work is emerging operations in aerospace through NASA's System-Wide Safety project. As new aircraft become common, like drones delivering pizzas or electric air taxis transporting passengers between cities, predictive technologies will be needed to ensure vehicle and passenger safety. I contribute new algorithms to this project that make sure drones fly safely through airspace without crashing into buildings or falling to the ground.

I love working at NASA. My days are filled with unique research that feels meaningful, and I'm surrounded by curious and kind colleagues. I'm grateful for my time at Davis for preparing me to contribute to this impactful organization.

Outside of NASA, my husband and I got married in 2023 and now live in Seattle, Washington. We recently welcomed a new puppy to our family, and we love spending our weekends on long dog walks exploring the beautiful Pacific Northwest.

Katy's team was recently awarded NASA's 2024 Software of the Year for their Python package, ProgPy. The software is for use in predicting how a system (motor, battery, etc) will degrade with use. Prognostics are used to prevent failure, improve safety, and reduce maintenance costs. ProgPy was awarded for it's robustness and ease of use in a variety of industries, without a lot of overhead. Available on github. Congratulations team!



Joan Marie Peters Ogden
Photo PBS Utah Presents

Life After Davis
Joan Marie Peters Ogden

After earning her B.S. in Mathematics in 1966, Joan Marie Peters Ogden was a GS-7 mathematician in the Ships' Engineering section in the U.S. Navy in 1966 and 1967. While there, she helped NASA with mathematic modeling for naval ships, modeling ships motions to drive the hydraulics necesary for keeping the communication dish steady, to keep the dishes trained correctly during the Apollo Program. Keeping the dishes steady and pointed precisely was instrumental in keeping communications and tracking with the space craft and helped ensure ships could be in the right spot at the right time.

After, she continued her education with a masters in Mathematics at Michigan State in 1968. She taught at Albion College, University of Missouri, St. Louis, and did an NSF in Combinatorial Theory at Bowdin College. Later, she taught at Bloomsburg State University.

She left academia and embarked on a career as an actuary, first at Blue Cross of Northeastern PA, then at Blue Cross Blue Shield of Utah.

Joan is continuing her career as a Consulting Actuary specializing in health, with clients including insurers, providers of care, employers, and regulators and legislators at her business, Joan Ogden Actuaries in Salt Lake City, Utah.

Outside of work, she's married to Stewart Ogden with one daughter, Heather VanDeventer – Dean of the Episcopal Cathedral in Spokane – and two grandkids. She and her husband love tent camping in Utah's red rock country, small boat travel in Europe, wine tasting, and gourmet food.

Watch a short interview by PBS on Joan's time collaborating with NASA as part of their series, Moon Memories.
https://tinyurl.com/pbs-moon-memories

Photo above, NASA Apollo launch.

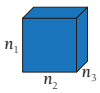
Recent Advances in Tensor Decomposition

by Alex Wein

A tensor is a multi-way array of numbers. An order-1 tensor is just a vector $u \in \mathbb{R}^n$. An order-2 tensor is a matrix $M \in \mathbb{R}^{n_1 \times n_2}$. An order-3 tensor is a 3-way array $T \in \mathbb{R}^{n_1 \times n_2 \times n_3}$, and so on.

$M \in \mathbb{R}^{n_1 \times n_2}$ $\quad M = (M_{ij})$

$T \in \mathbb{R}^{n_1 \times n_2 \times n_3}$ $\quad T = (T_{ijk})$



Analogous to the rank-1 matrix uv^T for (column) vectors u and v, a rank-1 tensor of shape $n_1 \times n_2 \times n_3$ is written $u \otimes v \otimes w$ for vectors $u \in \mathbb{R}^{n_1}$, $v \in \mathbb{R}^{n_2}$, $w \in \mathbb{R}^{n_3}$, and this notation means the tensor has entries $T_{ijk} = u_i v_j w_k$.

Tensors have a bunch of applications in statistics and data science. For instance, certain datasets might naturally be represented as a 3-way array encoding 3-way interactions between 3 different variables. Another key example in statistics is the method of moments: given many samples of an n-dimensional random vector, it may be useful to compute the *moments*. The first moment is the mean (expected value), which is an n-dimensional vector; the second moment is the $n \times n$ covariance matrix; the third moment is an $n \times n \times n$ tensor; and so on. We are used to performing various primitive computations on matrices: eigenvalues and eigenvectors, singular value decomposition (SVD), low-rank approximation, and so on. For tensors of order 3 and above, the analogous operations tend to be much more difficult to compute, or even ill-defined.

One of the most basic (and useful) computational tasks involving tensors is to decompose a given $n_1 \times n_2 \times n_3$ tensor T as a sum of rank-1 terms:

$$T = \sum_{i=1}^{r} u^{(i)} \otimes v^{(i)} \otimes w^{(i)}$$

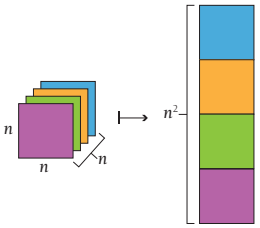
where $u^{(i)} \in \mathbb{R}^{n_1}$, $v \in \mathbb{R}^{n_2}$, $w \in \mathbb{R}^{n_3}$.

Here, addition of tensors is defined entry-wise as for matrices: $(T + S)_{ijk} = T_{ijk} + S_{ijk}$. The smallest r for which T admits a decomposition into r rank-1 terms is called the rank of T, analogous to the usual notion of matrix rank. For a rank-r matrix, a decomposition into r rank-1 terms can be found efficiently on a computer using the SVD, but the solution is not unique due to the "rotation problem." In contrast, rank-r tensors of order 3 and above tend to admit a unique decomposition into r rank-1 terms, as long as r is small enough. (Of course, one can re-order the r terms and represent a rank-1 tensor in multiple ways: $u \otimes v \otimes w = (2u) \otimes (v/2) \otimes w$. So the meaning of "unique" here is that the collection of rank-1 summands is unique.) This uniqueness is key to why tensor decomposition is a useful subroutine in many applications!

Though basic, the algorithmic question of decomposing order-3 tensors (with the minimal number of terms) is still not so well understood. In fact, the problem is known to be NP-hard, meaning we do not expect there to exist a fast (polynomial-time) algorithm that solves the problem for all input tensors. However, there are algorithms that succeed for "almost all" input tensors of low enough rank. Let's assume for simplicity that the input T is $n \times n \times n$, and assume further that it is generated as the sum of r rank-1 tensors as in (1), where the components $u^{(i)}$, $v^{(i)}$, $w^{(i)}$ are generically chosen. Here, "generic" has a formal meaning based in algebraic geometry, but essentially this means there can be a measure-zero set of "bad" components for which the algorithm fails, but otherwise it should succeed at finding the rank-r decomposition.

What is known about the generic $n \times n \times n$ decomposition task? As long as $r \le cn^2$ for a constant $c > 0$, the decomposition that generated T will be the unique rank-r decomposition, and the rank of T will be exactly r. This means the solution is identifiable in principle, but does not guarantee it's fast. (A related fact: no $n \times n \times n$ tensor can have rank larger than n^2, since each of the n "slices" is an $n \times n$ matrix which has rank at most n.) As far as algorithms are concerned, a classical method (circa 1970) called simultaneous diagonalization or Jennrich's algorithm succeeds when $r \le n$. This barrier remained unbroken for many years, and the first progress happened here at UC Davis: Ph.D. student Haolin Chen and his advisor Luis Rademacher gave an algorithm that succeeds when $r = n + k$ for any constant k. More recently, Pascal Koiran (ENS Lyon) improved this condition to $r \le 4n/3$. In forthcoming joint work with Pravesh Kothari (Princeton) and Ankur Moitra (MIT), we improve this further to $r \le (2 - \epsilon)n$ for any constant $\epsilon > 0$. All of these algorithms involve only basic linear algebraic operations such as Gram–Schmidt, matrix diagonalization, and the like, but these are combined in somewhat subtle ways. The runtime is polynomial in n, but exponential in the "constants" k or ϵ.

To explain the key ideas in our new algorithm, it is instructive to think about a related but easier task known as *rank detection*, which is a necessary prerequisite for decomposition. We are again given a tensor T that is constructed as the sum of r rank-1 terms with generic components, but now the goal is simply to determine r. Building on the Ph.D. thesis of Madalina Persu (MIT), we approach this by constructing a "flattening," that is, a map that takes a tensor and outputs a matrix, hopefully with the property that the matrix rank reflects the tensor rank in a predictable way. One basic example of a flattening is the so-called "trivial" flattening where the n "slices" of the tensor are stacked to form an $n^2 \times n$ matrix as shown below.



One can check that the trivial flattening transforms a rank-1 tensor into a rank-1 matrix. The flattening is a linear map, so a rank-r tensor flattens to the sum of r rank-1 matrices, which we might hope has rank exactly r. This indeed pans out if the tensor components are generic and $r \le n$, allowing rank detection to be solved for $r \le n$. When $r > n$, this approach breaks down because the $n^2 \times n$ matrix cannot have rank exceeding its smaller dimension n. The core component of our new algorithm is a certain non-trivial flattening, based on the so-called Koszul–Young flattening, which can solve rank detection up to rank $r \le (2 - \epsilon)n$.

So now we have new algorithms for rank detection and decomposition that tolerate higher rank tensors, by roughly a factor of 2, than the classical methods. The big question remaining is whether this can be improved further, since this is still quite far from the identifiability threshold $r \approx n^2$. I suspect that rank $2n$ might actually be a fundamental breaking point for all fast algorithms, and we can prove that a certain class of flattening-based approaches cannot surpass this. On the other hand, maybe there is a completely different strategy waiting to be discovered, that could break this barrier!

Graduate Program

by Laura Starkston, Vice Chair for Graduate Affairs

We are welcoming 11 new graduate students to the Mathematics Ph.D. program this year, and we have 75 Ph.D. students in total in the program. Last year, 11 of our students completed their Ph.D.'s and have continued their journeys in careers in academia and industry.

This also is the start of my second year as vice chair of graduate affairs. Over the last year, I have tried to approach challenges with empathy and a problem solving mentality. Here are some of the initiatives and challenges from the past year.

Grad Success & Professional Development

We held a weekly seminar in Fall 2023 and several events at need afterward. This year we will hold events throughout the year, approximately once a month, in order to discuss professional development topics, milestone expectations, skills to build as a graduate student, and challenges that grads commonly encounter. Our first meeting this year was at the end of September, giving advice to students about application materials for academic jobs.

Vice Chair Office Hours

I hold regular appointment office hours every Tuesday afternoon to allow individual or groups of students to ask questions, share their concerns, or talk through how to get through a particular barrier. I have learned a lot about difficulties some of our students have faced, tried to spread useful information on resources and program expectations, and worked with individual students on plans to get and stay on track with their milestones towards their Ph.D..

Graduate Student Funding

We have been told to expect reductions in the number of TA positions in the 2025-26 academic year based on budget constraints. While we hope these are not too severe, we are trying to prepare. Correspondingly, we have admitted slightly smaller cohorts this year and in the upcoming cycle, and are working to keep students on track towards their graduation deadlines.

External Funding

Our program was successfully awarded a GAANN (Graduate Assistance in Areas of National Need)! This grant from the Department of Education provides fellowships for Ph.D. students with demonstrated financial need. Together with dedicated mentoring and recruiting efforts by our faculty, this funding will help us support a talented and diverse group of graduate students.

Recruitment

Together with the Graduate Program Committee (GPC) members, we are working on targeted recruiting efforts to increase the number of highly qualified and diverse students applying to UC Davis. I attended the Cal-Bridge conference in September to tell these students about our program. We have plans to host tables at grad fairs at other conferences this year, such as the Field of Dreams conference in Atlanta in November, and the Joint Mathematics Meeting in Seattle in January.

Admissions

We reviewed 184 applicants to our program in the last cycle, and admitted 32, of which 11 have joined us. With input from GPC, I continue to work to improve our reviewing processes to be fair, effective, and efficient. To align ourselves with our peer institutions and avoid losing talented potential applicants, we have modified our Subject GRE requirement to optional, and this will be in effect in this year's admissions cycle.

I look forward to another year of finding ways to help our current and potential students to realize their goals and enjoy learning mathematics.

Laura Starkston, Vice Chair

Congrats to all our graduates, past and present. We love to hear from you! Fill out our form on the next page.

Life After Davis

Swati Patel and Axel Saenz Rodriguez

Swati Patel and Axel Saenz Rodriguez are Assistant Professors in the Mathematics Department at Oregon State University (OSU) in Corvallis, OR. Saenz Rodriguez and Patel were both graduate students in the Math and Applied Math Department at UC Davis, where they first met. They are now married and have two beautiful and energetic children. Patel works in math bio, modeling systems arising from evolution, disease dynamics and ecology. Saenz Rodriguez works in probability and math physics, analyzing universal probabilistic objects for one-dimensional interacting particle systems. Saenz Rodriguez and Patel both look back on their time at UC Davis as a formative stage in their career.

After UC Davis, Saenz Rodriguez and Patel held a variety of postdoctoral positions before starting their tenure-track positions at OSU. Saenz Rodriguez was a Mary Ann Pitts postdoctoral fellow at the University of Virginia, and also had postdoctoral positions at Tulane University and University of Warwick. Patel was a postdoctoral researcher at the University of Vienna, Tulane University, and University of Warwick. Patel and Saenz Rodriguez have both held visiting research positions at the Simons Laufer Mathematical Sciences Institute. Patel has been an invited researcher at the Kavli Institute of Physics and Saenz Rodriguez has been a visiting professor at the Lawrence Berkeley National Laboratory. Patel is a co-founder of the "Math for All" conference, an annual conference made up of multiple satellite events across the country aimed at building an inclusive and inviting mathematics community.

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:
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.

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 and Help Support Excellence in Mathematics

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

https://give.ucdavis.edu/Go/MathAlumniNews2324

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/resources/disclosures

Matching

Disclosures

Graduate Group in Applied Mathematics

by F. Javier Arsuaga, Chair of the Graduate Group in Applied Mathematics

During the 2023-2024 academic year, my second year as chair, I focused on getting the new degree requirements approved and on adapting the Group to the new budgetary challenges that the University is facing.

During this period, GGAM admitted eight students and graduated thirteen. The Ph.D. theses include classical topics in applied mathematics such as fluid dynamics, numerical analysis and stochastic optimization; and new topics such as machine learning, analysis of complex networks, computational imaging and optimization on Riemannian manifolds. These topics reflect the impact of applied mathematics in our everyday life, and the broad range of interest of our faculty and students. Please join me in welcoming our new student cohort and in congratulating our Ph.D. recipients.

The breadth of research of our faculty is now reflected in our new Ph.D. program. Since 2022, when I became chair, I have worked with our executive committee and faculty to redesign our curriculum. The new degree requirements were approved by the faculty and graduate council, and are now being implemented. Now students have more options to choose from for their preliminary and qualifying exams. This includes Analysis and Applied Mathematics, Data Science, Numerical Analysis, Probability, and Theoretical Computer Science. These topics provide a solid foundation for most research areas in applied mathematics. GGAM faculty considered them to be fundamental training for the new generations of applied mathematicians. I want to thank all our faculty for endorsing these changes to the degree requirements.

I also want to thank the GGAM executive committee: Professors R. Chaudhuri (Mathematics and Neurobiology, Physiology and Behavior), A. Hastings (Environmental Science and Policy), M. Lopes (Statistics) and A. Wein (Mathematics). They have been instrumental in the implementation of the new degree requirements and in student recruitment and admissions. In summer 2024 professors Chaudhuri and Lopes finished their terms in the executive committee. We welcome professors S. Aviran (Biomedical Engineering) and A. Schilling (Mathematics) to our committee.

We also welcome five faculty members who recently joined GGAM: Abi Gopal (Assistant Professor of Mathematics), Qijia Jiang (Assistant Professor of Statistics), Isaac Kim (Assistant Professor of Computer Science), Jasper Lee (Assistant Professor of Computer Science) and Yupeng Shi (Assistant Professor of Mathematics).

This year our new program coordinator started, Jennifer Lehner. Jennifer came with extensive experience managing graduate programs at other universities. Her expertise has been invaluable in moving our program forward. She coordinated the graduate student welcoming event for our prospective students, orientation for new students in the Fall, and preliminary exams for both programs. She recently started a regular newsletter that includes information for our students with important University deadlines and opportunities for professional development and outreach. Her work in coordination with Department manager Tina, and staff members Marji and Shelby have ensured the smooth running of the Graduate Group.

Our faculty was widely recognized in the national and international arenas. Two of our faculty delivered prestigious lectures at the 2024 Joint Mathematics meeting: Professor A. Schilling gave the Emmy Noether invited lecture and Professor M. Vazquez (Mathematics and Microbiology and Molecular Genetics) delivered the SIAM invited lecture at the same conference. Professor M. Koeppe (Mathematics) gave a plenary talk on his work on SageMath at the biennial International Congress on Mathematical Software. Professors A. Wein and H. Manikantan (Chemical Engineering) received the prestigious NSF CAREER award in their respective fields. Professor A. Wein was also awarded the ACHA Charles Chui Young Researcher Best Paper Award for his paper "Estimation under group actions: recovering orbits from invariants." Professor S-H. Chen (Land, Air and Water Resources) received a NASA group achievement award. Professor Woodruff (Management) was named fellow of the INFORMS Computing Society and Professor K. Balasubramanian won the 2024 annual prize of the same society for his work on operations research/Computer Science Interface. Professor M. Vazquez was named fellow of the American Association for the Advancement of Science (AAAs).

F. Javier Arsuaga, GGAM Chair

Among our students, Camille Korbut was named Hispanic Scholarship fund Scholar. Casey Duckwall and Alaina Stockdill received the Eivind Lange fellowship. Lauren Mossman received the Hazel B. Jacoby fellowship and Greg DePaul and a team of postdocs and graduate students in STEMM won first place in the EMPOWER Data Challenge held at the Institut Pascal in Orsay, France.

I am very proud of all these accomplishments and the efforts of our members that strengthen and elevate the status of GGAM in the broader community of applied mathematics.

Graduate Degrees 2023-2024

Milo Bechtloff Weising • Math • *Stable-Limit Cherednik Theory*
Post Ph.D. Placement: Post Doc, Virginia Tech
Advisor: Monica Vazirani

Alexander Black • Math • *Monotone Paths on Polytopes: Combinatorics and Optimization*
Post Ph.D. Placement: Hermann Weyl Instructor, ETH Zurich
Post Ph.D. Placement: Assistant Prof., Bowdoin College
Advisor: Jesús De Loera

Nicholas Cazet • Math • *Quandle Theoretic Knot Invariants*
Advisor: Jennifer Schultens

Wai Ho Chak • Applied Math • *On the Crossroads of Scattering Transform and Machine Learning in Image and Signal Processing*
Advisor: Naoki Saito

Yu Hin (Addie) Chan • Math • *Singularity Formation along the Line Bundle Mean Curvature Flow*
Advisor: Adam Jacob

Alvin Chen • Applied Math • *Stabilization-Free Virtual Element Methods for Solid Continua*
Advisor: Natarajan Sukumar

Xiaotie Chen • Applied Math • *Enhancing Estimation and Uncertainty Quantification in Stochastic Optimization: Importance Sampling and Bootstrap Resampling*
Advisor: David Woodruff

Yukun Du • Math • *Geometry of Selberg's bisectors in the symmetric space SL(n,R)/SO(n,R)*
Post Ph.D. Placement: Post Doc, University of Georgia
Advisor: Michael Kapovich

Xue Feng • Applied Math • *Anderson Acceleration and Dynamic Optimal Transport in Optimization: Theoretical Analysis, Algorithms, and Applications in Machine Learning*
Advisor: Thomas Strohmer

Arthur Kalb • Applied Math • *Results in Atmospheric Waves*
Advisor: Joseph Biello

Girish Kumar • Applied Math • *Differentially Private Synthetic Data Generation Of Data Collected Over Time*
Post Ph.D. Placement: Applied Scientist, Microsoft Inc.
Advisor: Thomas Strohmer

Jiaxiang Li • Applied Math • *Advances in optimization on Riemannian manifolds*
Advisor: Krishna Balasubramanian

Guga Mikaberidze • Applied Math • *Emergent Dynamics on Complex Networks: From Self-Organized Criticality to Synchronization and Flows*
Post Ph.D. Placement: Post Doc, University of Wyoming
Advisor: Raissa D'Souza

Yuan Ni • Applied Math • *Model Uncertainties in Inverse Problems: Theory, Algorithms, and Applications in Computational Imaging*
Advisor: Strohmer

Hans Oberschelp • Math • *Mixing Times of the Swap-or-Not and Overlapping Cycles Shuffles*
Advisor: Ben Morris

Rui Okada • Math • *A Quantum Analog of Delsarte's Linear Programming Bounds*
Advisor: Greg Kuperberg

Michael Ragone • Math • *SO(n) AKLT Chains as Symmetry Protected Topological Quantum Ground States*
Advisor: Bruno Nachtergaele

Raaghav Ramani • Applied Math • *PDE-based methods for multiscale gas dynamics simulations*
Advisor: Shkoller

Dong Min Roh • Applied Math • *Nonlinear Eigenvector Algorithms for Generalized Rayleigh Quotient Optimizations and Applications*
Advisor: Zhaojun Bai

Adam Rose • Applied Math • *Modeling Neural Activity in the Cardiovascular Control System: The Effects of Neural Circuit Structure and Intrinsic Cellular Properties*
Advisor: Tim Lewis

Haotian Sun • Math • *Decomposition of Transport Paths: Map-Compatibility and Capacity Constraint*
Advisor: Qinglan Xia

Chengyang Wang • Math • *Semigroups of Polyhedral Lattice Points: Convexity, Combinatorics, and Algebra*
Post Ph.D. Placement: Research Scientist, Meta
Advisor: Jesús De Loera

Haihan Wu • Math • *Graphical categories and representations of quantum groups*
Advisor: Greg Kuperberg

Shizhou Xu • Applied Math • *Fairness in Machine Learning via Optimal Transport*
Post Ph.D. Placement: Post Doc, UC Davis
Advisor: Thomas Strohmer

Ashleigh Adams • M.A., Math
Advisor: Erik Carlsson

Jillian Eddy • M.A., Math

Travis Kulhanek • M.A., Math

Evan Ortiz • M.A., Math

Jennifer Paige • M.S., Applied Math

Alexander Richardson • M.A., Math

Junhui Shen • M.S., Applied Math

Alexander Simons • M.A., Math

Alaina Stockdill • M.S., Applied Math

Zhijie Wang • M.S., Applied Math

Oliver Yau • M.A., Math

Zhenhan Zhao • M.S., Applied Math

Undergraduate Program

by Tim Lewis, Vice Chair for Undergraduate Affairs, and the Undergraduate Program Committee

Tim Lewis, Vice Chair

Undergraduate Clubs and Organizations

Information and meeting times can be found on the organization's website:
Math Club:
https://www.math.ucdavis.edu/~mathclub
AWM: http://awm.math.ucdavis.edu/

Math Club AWM

Undergraduate Research

Read our undergraduates' senior theses on our website:
https://tinyurl.com/ucdmath-ugrad-res

Our undergraduate math programs are thriving! Last Winter, undergraduate programs underwent its seven-year Program Review. The external reviewers described our Department "to be dynamic, welcoming and a great place to study Mathematics" and said that our program's strength was centered around "committed faculty, lecturers, staff and TA's that come together to deliver a strong program to incoming students through to graduate education."

This past academic year, the Department awarded 184 degrees!

- 61 majors in Mathematics
- 71 in Applied Mathematics
- 10 in Math & Scientific Computation
- 8 in Math Analytics & Operations Research
- and 34 minors.

An impressive 22 students received special citations, scholarships, and prizes for their exceptional performance and service (read more about these awards on page 18). Many of last year's graduating students went on to graduate school at prestigious institutions across the country, while other graduates went on to jobs in education or in industry – ranging from a Tech Analyst at a financial institution, a technical solutions engineer, and a Cyber Risk Analyst. These achievements testify to the commitment and dedication of our students.

The clubs and events that the Department hosts also help to create a welcoming, supportive, and educational environment for our students.

Math Club · The UC Davis Math Club is dedicated to advancing mathematics by building a strong community among people who enjoy math. In addition to fun math puzzles, snacks, and networking opportunities, meetings often include movies, workshops, and short presentations by guest speakers from academia and industry, as well as academic support, wellness, and mental health. This year, the Math Club is organizing free tutoring for students in our Real Analysis, Introduction to Abstract Mathematics, and Modern Algebra courses.

Spurred by Timothy Blanton (the President of the Math Club at the time), many of our undergrads took advantage of the close proximity of the Joint Math Meetings (JMM) in San Francisco last January. The JMM is the largest mathematics gathering in the world, and it was a great opportunity for our students to be exposed to some of the latest research in mathematics, attend the Career and Grad School Fair, and network with the other academics attending. Having JMM in our backyard was a remarkable opportunity.

AWM · Our student chapter of the Association for Women in Mathematics (AWM) is a group that encourages and supports women, girls, and otherwise underrepresented minorities to study mathematics and pursue related careers. The AWM hosts networking, professional development, and outreach activities, and is open to everyone : all gender identities, and to faculty, researchers, and non-math majors, as well as to undergraduate and graduate math students.

Student Outreach · We've continued with our most successful student outreach this year. Some favorites are Coffee/Pizza with a Prof, giving students a relaxed atmosphere to connect with faculty; Final Exam Study Night, providing a welcoming space and snacks as well as visits by grads and faculty; and the Student Spotlight, highlighting the hard work of undergrads, this year with Timothy Blanton, Lawrence Cheung, and Sabrina Zhu.

Career Night · In Spring quarter, we plan to hold our annual Career Night jointly with the Statistics Department. Career Night features mathematicians working in industry, in education/academics, or in public service — usually UC Davis alumni — who talk to our current students about their experiences pursuing their career, what their profession looks like from the inside, what skills are needed for the career, and general career advice. We would love to share what you are doing with your Math degree with current Undergrads. Let us know if you would like to participate in Spring 2025 Career Night.

Special Topic Courses · Each year, the Math Department of Mathematics offers a set of special topics courses (MAT 180) that give our undergraduate students the opportunity to learn fascinating material that is beyond our non-standard courses. This year, we are offering three special topics courses. In the Fall quarter, Prof. Anne Schilling is giving a course on Combinatorial Representation Theory; in the Winter, Professor Naoki Saito will run a course on Combinatorics and Geometry via Linear Algebra; and in the Spring, Professor Thomas Strohmer will give a course on Fairness and Privacy in Machine Learning.

Directed Reading Program · The very successful Directed Reading Program (DRP) will continue for its fourth year. The DRP is a primarily graduate-student run program that pairs undergraduates and graduate students to study advanced mathematics that are not typically covered in our undergraduate classes. Like our special topics courses, the DRP not only provides undergraduates an opportunity to explore fun new topics; it also provides them a possible entry point to research, graduate school, and beyond. This Fall there were over 100 undergrads interested in the DRP! As it did last year, the DRP plans to host a poster session in the Winter quarter and a conference for undergraduate presentations in the Spring quarter.

Undergraduate Research · Every year, many of our majors take part in undergraduate research experiences (REUs). Last year, seven of our students (Ian Chi, Yaotin Ji, Arthur Jiang, Chen Liang, Pan Lin and Wantong Zhu) spun their research experience into their senior theses. Undergraduate theses from last year and previous years can be found on our website.

On October 29, we hosted the 2024 Mathematics Undergraduate Conference. The conference was organized by our dynamic student services staff and our undergraduate research coordinator, Professor Jesús De Loera. Seven undergraduates (Amy Wang, Jenna Rashkovsky, Haotian "Simon" Bao, Jonathan Chang, Christopher Luevano, Raymond Iacobacci, Timothy Blanton, Andrew Patton, Chen Liang) gave presentations on research projects they conducted over the summer or the previous year. Professor De Loera then gave a short presentation describing the benefits of doing an undergraduate research experience and giving tips for how to get started in research, and the event ended with a Q&A session with a panel of student research and faculty. About 65 interested students attended the conference!

Also, last Spring, as part of the DRP and our undergraduate research program, we held a research presentation workshop to help our student researchers prepare effective research posters and talks. The event included a panel discussion in which faculty gave general advice to all students, and this was followed by break-out sessions in which students shared drafts of their presentations and got direct feedback from faculty. It was extremely successful, and we plan to make the workshop an annual event.

Calculus for Data Driven Applications · One big change on the course and curriculum front is that the Department launched a new calculus series, Calculus for Data Driven Applications. Unlike the traditional calculus sequence, the series covers a blend of calculus, probability, and discrete math centered around modeling and contextualized examples from economics, psychology, sociology, and environmental sciences. Furthermore, the courses in the new series have an integrated weekly computer lab component. The labs are designed to not only strengthen understanding of mathematical concepts being taught in the class, but also to expose students to computer programming, to provide them with experience in topically relevant mathematical modeling, and to offer them opportunities to analyze real data from the social sciences. The labs were developed with the help of a grant from the California Educational Learning Lab.

As you can see, our students, faculty, and staff have been extremely active with a variety of enriching activities that foster learning, engagement, and community, which is especially important in these extraordinary times.

Last but far from least, we would like to welcome our new Undergraduate Program coordinator, Dawn Chandler. Dawn brings a fresh perspective to our programs, hoping to inspire the next group of undergrads to achieve great things.

In closing, I want to thank all of the people who make these activities possible. Thank you to the wonderful faculty who volunteer their time and the many students who take leadership positions in our math community! Thanks to our tireless peer advisors, and our magnificent staff (current and past)! All of you make our undergraduate program vibrant and successful.

Directed Reading Program

To join, either as mentor or mentee:
https://www.math.ucdavis.edu/~drp/

Student Spotlight

Timothy Blanton
Fall 2023 Spotlight

"I'm especially impressed by how quickly he is able to understand the main idea of graduate level combinatorics topics."
Prof. Lewis

Lawrence Cheung
Winter 2024 Spotlight

"Lawrence is one of the most dedicated students I have ever met. His dedication to persevere is inspiring."
Dr. Burke

Sabrina Zhu
Spring 2024 Spotlight

"As a student, she excels at modeling questions and connecting math to the real world."
Dr. Burke

Research in Retirement

Blake Temple

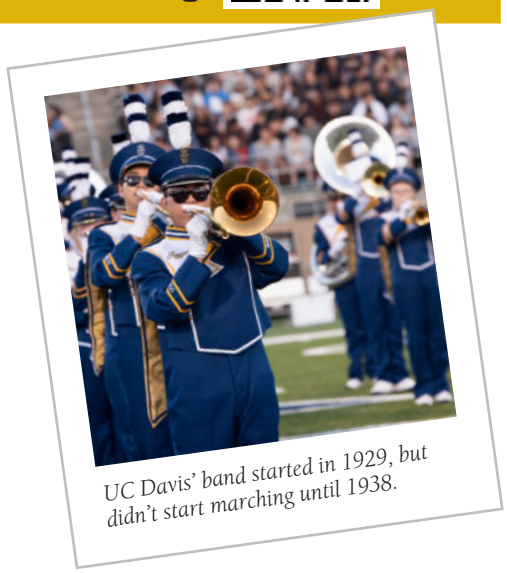
Recent emeritus Blake Temple is keeping busy reporting on new results. He recently gave a talk in Taiwan about his joint work with prior UC Davis graduate and long time collaborator Moritz Reintjes, "On the Essential Regularity of Singular Connections in Geometry." The talk featured work for an upcoming paper focused on Regularity Transformation Equations (RT-equations), an elliptic, non-invariant system of equations which determine the Jacobians of coordinate transformations which (locally) lift the regularity of a connection to one derivative above the regularity of its Riemann curvature tensor.

Read more on Professor Temple's research

Blake's work can be found on the arXiv, including some recent papers published this past academic year.

Recent works include Time-periodic solutions of the compressible Euler equations and the Nonlinear Theory of Sound with Robin Young, and Shock-Wave Refinement of the Friedmann-Robertson-Walker Metric with Christopher Alexander and Joel Smoller.

https://tinyurl.com/b-temple-research



UC Davis' band started in 1929, but didn't start marching until 1938.

Alumni Update

Joshua Michael Babich

B.S., Applied Mathematics — 2010

Like many, after graduating with my B.S. in Applied Mathematics, I was unsure of what to do next. I ended up leveraging the programming and mathematics skills learned as an undergrad and developed/self-published a small Android game. This jump-started my career in the video game industry where the journey has been an exciting one, from working on massive social games like FarmVille, to spearheading the M&A process for our small publishing company in 2022 to Team17 (publisher of the popular co-op game Overcooked!).

While it might not be a traditional career path, the critical thinking and puzzle-solving skills learned at UC Davis had a huge impact on my ability to grow in unexpected ways as a professional. You never know how or when you'll apply the things you learn in life, say YES to new opportunities and remember you miss 100% of the shots you don't take!

Joshua Babich is now Vice President and General Manager of Team17 USA in San Diego, California. Team17's first game was published for the Amiga in 1991, and as a company began focusing on indie games in 2013.

William Thomas

B.S., Mathematics — 1978
M.S., Ecology — 1982

After graduating with my bachelor's, I pursued my M.S. at UC Davis with research in modeling and analysis, specifically how it applied to biological systems in Ecology.

I subsequently embarked on a 38-year career with Hughes Aircraft (eventually Raytheon), focused on broad challenges in RF sensing and software-intensive electronic systems.

I continued my formal education with an M.S. in Engineering (UCLA, 1986) and an M.B.A. (Anderson School, UCLA, 1993).

Later career specialization included open systems architecture, secure processing and cyber defense.

Wisdom and practical lessons gleaned from UC Davis Mathematics, as well as particularly Professor Richard Plant (Plant Sciences, and Biological and Agricultural Engineering), were foundational to all subsequent achievements.

William Thomas is now retired from his job as Engineering Director at Raytheon. He lives in southern California.

Do you remember...?

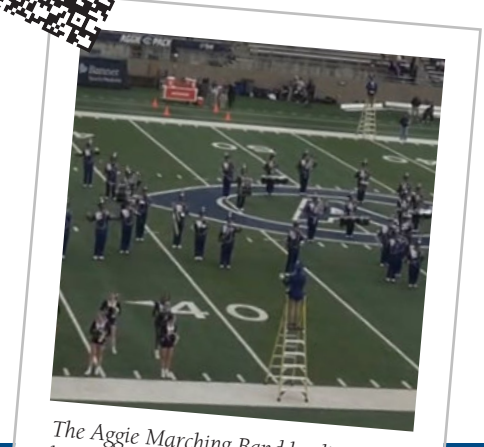
Alumnus Steve Erfle also reminisced about some favorite memories at UC Davis: "I am saddened to have note that Aggies no longer use the 'bossy cow-cow, milky moo-moo…' cheer at athletic events. No recent graduates I meet remember this ... I do, 45 years later."

Fear not! The director of the UC Davis Marching Band says, "While it's been a few years since the band has done [the cheer], we are planning on reintroducing it as part of our Pregame Show starting tomorrow!" That was November 1, so expect to see some promising Aggie-chant inspired footwork on the football field this winter.

This classic Aggie cheer came about as a parody of the UC Berkeley football cheer, the Oski Yell. While its popularity comes and goes, it endures over time, through the efforts of the band and the cheer squad, as well as the student body's continuing support of Davis' unofficial mascot, the cow.

Read more on the cheer in this in-depth article in The Aggie from 2016.

https://tinyurl.com/aggie-cheer

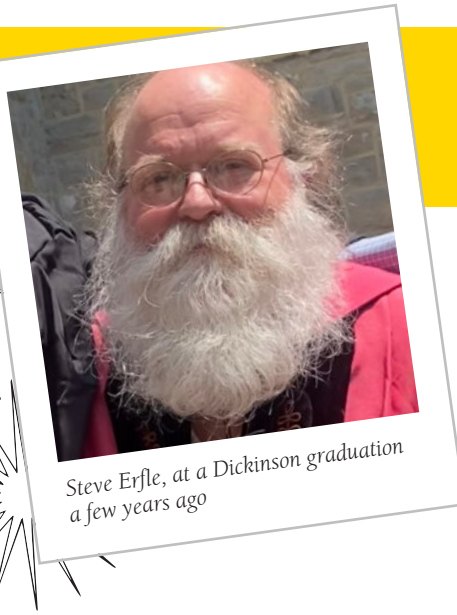


The Aggie Marching Band leading the bossy cow cheer at the Pregame Nov 2.

Continuing Collaboration

Stephen Eugene Erfle

B.S. Mathematics, B.A. Economics — 1977



Steve Erfle, at a Dickinson graduation a few years ago

After graduating from UC Davis, I went on to obtain a Ph.D. in Economics from Harvard in 1983. I taught for six years as an assistant professor at UC Irvine before moving to Dickinson College in Pennsylvania, where I still teach. Being at a liberal arts college has allowed me to stretch beyond my formal area of expertise. I have done that extensively, working in areas as far-flung as sports psychology, political geography, communications theory, public health, economics pedagogy, as well as a bit of economics.

But the project I am most excited by is the work I am now doing at the edge of art and mathematics. I was introduced to string art by my high school math teacher, and I spent a lot of time creating images during my high school and college years. I went on to other things, until 30 years later I was asked to show my son's 5th grade class some cool things you could do with Excel spreadsheets. I wondered if I would be able to recreate string art in an electronic environment using Excel. The answer was yes! And I created a file that allowed students to create their own images by simply placing vertices in the (x, y) plane.

Another few years would pass before my eldest daughter decided to attend Dickinson as a math and computer science double major. We dusted off that file and published an article in Bridges in 2020. My younger daughter was interested in early elementary education, and I knew that her students would not yet have learned about coordinates. By restricting the discussion to regular polygons and stars, I was able to write a paper with her and several elementary education teacher coauthors in Spreadsheets in Education, 2021.

As I worked on this it became clear that this restriction had enormous benefits in terms of being able to reach young people. I started writing a blog called Playing with Polygons in early 2021. Some of the images that I was able to create with the Excel files were of sufficient interest that my mentor, UC Davis professor emeritus, Don Chakerian, suggested we might write a paper together using them as a backdrop. The resulting paper, "Up the Hill and Down Again," was published in College Mathematics Journal in September 2023.

The string art chapter of Playing with Polygons became sufficiently enormous that I went to the editor of the AK Peters/CRC Recreational Mathematics Series to see if he thought I might have a book instead of a chapter in a book. He encouraged me to submit a proposal, and the resulting book, Electronic String Art: Rhythmic Mathematics, is slated for publication in January 2024. I continue to meet wonderful UCD graduates and I think we have a lot in common, despite what we studied when we were at Davis. I think that Davis is a very special place for nurturing young people, it certainly was for me.

Read more on string art and K-12 education

Erfle's blog is a wealth of polygonal information, with information for instructional use as well as explanations and videos.

https://tinyurl.com/erfle-polygons

In December Erfle will present "Machines Calculate, but Humans Evaluate" at the Generative Art Conference at UNESCO Regional Bureau for Science and Culture in Europe, in Venice, Italy. The title is taken from an email received from his mentor, Don Chakerian, when discussing humanistic elements of generative art.

Read the paper (PDF) on his website.

https://tinyurl.com/erfle-calculate

Don Chakerian, Professor Emeritus

Emeriti Focus

G. Don Chakerian

G. Don Chakerian joined the Department in 1963 after getting his Ph.D. at UC Berkeley. He retired in 1994.

Learn more about Professor Emeritus Chakerian in an interview where he talks about mathematicians who shaped his career, how he came to Davis, and what influenced his interest in his research. The interview was conducted by fellow Math emeritus Sherman Stein in 2006 as part of a series and hosted on UCD's Aggie Video.

https://tinyurl.com/chakerian-vid

Department Awards | 2024

Craig A. Tracy Research Prize

To honor Professor Emeritus Craig A. Tracy, the Department created the Tracy Research Prize, to be awarded annually for research by one of its postdoctoral researchers or Krener Assistant Professors (KAPs). This prize is given to an individual to recognize the quality of their research.

Recipient – Anna Parlak

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 – Roger Casals

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 – Nicolas Guerra

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.

Recipients – Wren Burrill, Olivia Deponte, Josiah Taylor

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 – Shanon Rubin

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 – Lauren Mossman, Ryan Pesak

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.

Recipient – Pauline Cupino

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.

Recipient – Nathan Singh

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 are deemed to be the top performing teachers.

Recipients – Alexander Simons

Alice Leung Scholarship in Mathematics

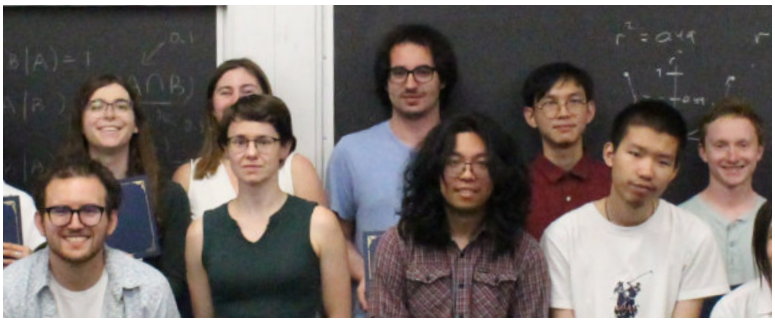
Alice Siu-Fun Leung received a Master's degree in Mathematics in 1975 from UC Davis, and remembered this time in her life fondly. This award is given to graduate students in Mathematics who have shown exceptional promise in all aspects of mathematics, including research, scholarship and teaching.

Recipient – Nicholas Cazet

Evelyn M. Silvia Scholarship for Future Mathematics Teachers

Professor Evelyn Silvia came to the UC Davis Department of Mathematics 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 – Catherine Luu



Jim Diederich Scholarship for Mathematics Majors

Made possible from an endowment that was initiated by a contribution by Jim and Paula Diederich. In making this gift, they wished to provide benefit to students whose interest in mathematics is not measured by grade point average alone, but who have special gifts deserving of support.

Recipient – Ravi Kini

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 – Sabrina Zhu, Timothy Blanton, Shizhou Xu, Alexander Simons

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 – Marji LeGrand

Departmental Citation Awards

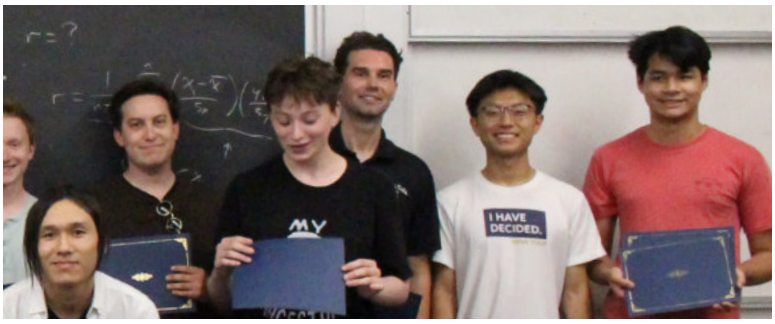
These Departmental awards recognize undergraduate students of exceptional ability who have taken both a very strong selection of mathematics courses and have made substantial contributions to the Department or their program.

Recipient – Timothy Blanton

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 – Harkins Loh, Sabrina Zhu, Yaotian Ji, Chen Liang, Sean Laurence Hearne, Arthur Wu Jiang, Ziwei Zhan, Danny Walter Van, Ian Tsai-Yi Chi, Pan Lin



Staff Update

by Tina Denena,
Chief Administrative Officer

Happy Fall Y'all! Over the summer the staff was able to take some time to focus on what we believe is our particular strength and goal of our team: customer service. Our hope was to build upon our already excellent and effective service and renew our motivation for the upcoming school year. During our conversations we created a team philosophy: Our team embraces the Golden Rule, advocating for students and ourselves. Our Department is a partnership and works best when we work together. We endeavor to empower others with information, cultivate creativity with curiosity, while still focusing on long-term impacts. While doing this, it's important to manage expectations, which also makes it easier to have accountability, fairness, and ensure follow-through.

This coming January we will celebrate *20 years* in our not-so-new Mathematical Sciences Building. We are taking measures to improve and maintain our shared space. We have enhanced technology in our scholarly seminar rooms, creating a better learning environment capable of valuable collaboration. We would like to finish equipping all graduate student offices with sit/stand desks in the near future. We hope to work with the Galois Group to improve the Alder Room with new furniture.

As we move forward into the new quarter, we have some exciting updates to share about our team.

In the business office, Jose and Thu were awarded a Star Award for their dedication and perseverance as they grapple with our new accounting system, Aggie Enterprise. It is a big change with a steep learning curve from what it once was. We appreciate Jose and Thu's diligence as they support the faculty and students pursuing their academic goals.

Our IT staff is working hard to convert all members of the Department from their old Math email addresses to their campus addresses. This transition aims to align our community with the directives of the University of California President to ensure our electronic integrity. This is not an easy endeavor as the conversion involves members who have utilized the @math email for decades.

We are thrilled to welcome new members to our team:

Jennifer Lehner, Graduate Program Coordinator: Jen comes with a previous background in graduate program matters, having worked at Physics at the University of Washington in Seattle as their Graduate Program Coordinator. Most recently, Jen has been working as the Director of Institutional Research at Palo Alto University.

Dawn Chandler, Undergraduate Program Coordinator: Dawn comes to us from the University of Hawai'i Kapi'olani Community College with over 9 years of advising experience and a Master's degree in Counseling from San Jose State University. She brings a wealth of experience and a fresh perspective to our team.

Marji LeGrand continues to anchor our undergraduate and graduate programs, as together they work to develop a robust outreach mission, forming academic communities and celebrating diversity.

We are excited about the positive impact these changes will bring and look forward to moving together on our journey towards excellence.

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