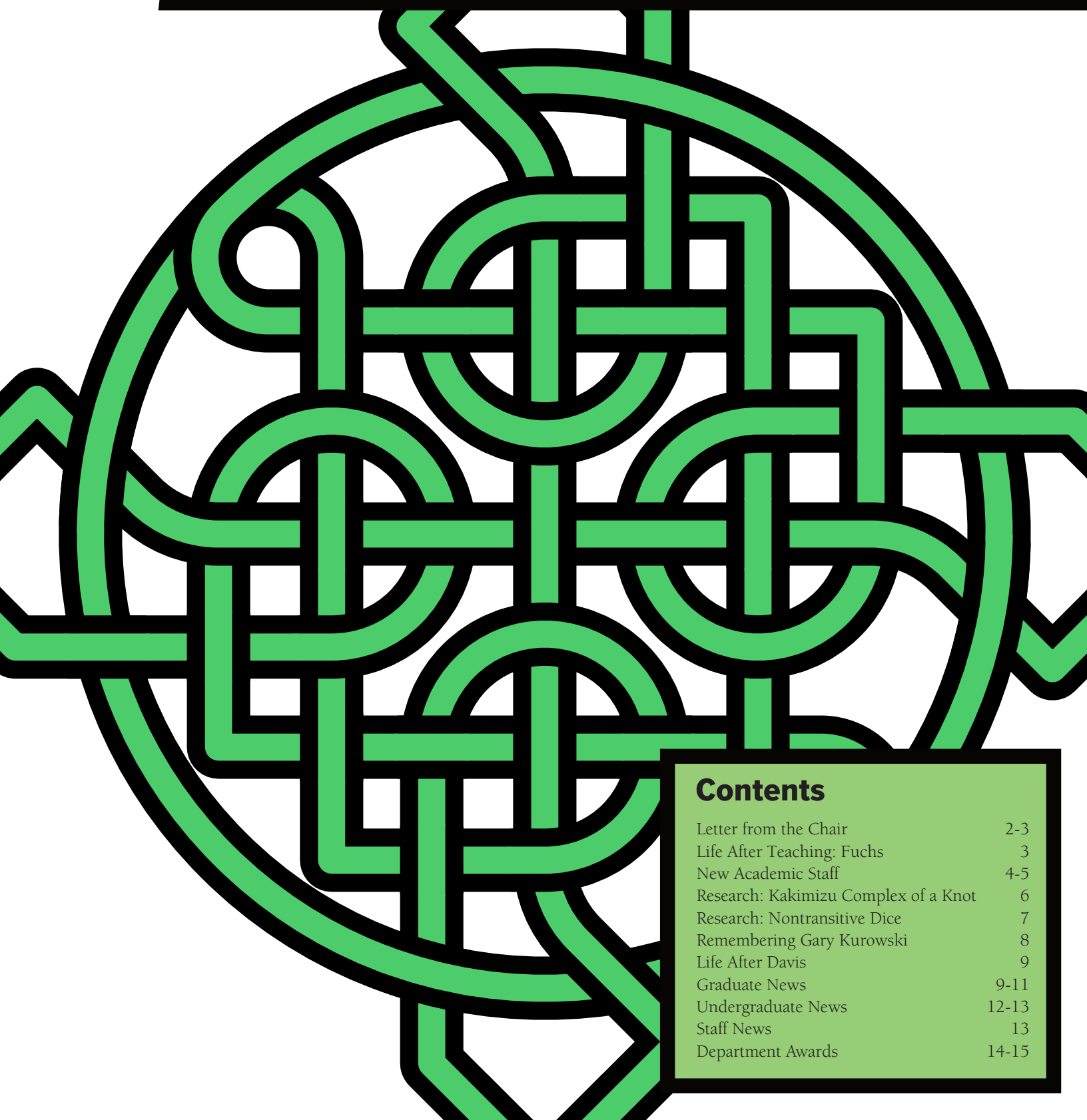


# UC DAVIS

## MATHEMATICS NEWSLETTER



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# LETTER LETTER LETTER LETTER

## from the chair

by Anne Schilling, Department Chair

Fall Welcome this year was a great way to celebrate our community and see everyone back on campus after a summer of traveling, which was finally possible again with lifted COVID travel restriction. It is very stimulating to be back in person full-time and meet the many new Department members from all over the world.

We hired a new faculty member in Data Science this past year, Alex Wein. His research is a mix of theoretical computer science, statistics, probability, and data science. He will enrich our expertise in these areas in our Department.

We hired four new Krener Assistant Professors:

- Edward Goldsmith (mentors Joseph Biello and John Hunter)
- Anna Parlak (mentor Abby Thompson),
- Luze Xu (mentor Matthias Köppe),
- Melissa Zhang (mentor Eugene Gorsky).

We wish them all a productive stay in our Department!

Our colleague Roland Freund retired this summer. He spent 18 years in our Department after employment at the Universitaet Wuerzburg, NASA Ames Research Center, and Bell Laboratories.

James Bremer and Tudor Dimofte have resigned. Tudor joined the University of Edinburgh to be closer to family. James Bremer joined the University of Toronto. We wish Roland, Tudor and James all the best!

The Department continues to attract extramural funding. During the 2021-2022 academic year, it was \$3.8 million dollars.

The summer session enrollment numbers for 2022 had a slight decrease of 13% compared to 2021, which is likely due to the fact that classes are back in person compared to remote operation in 2021 and 2020.

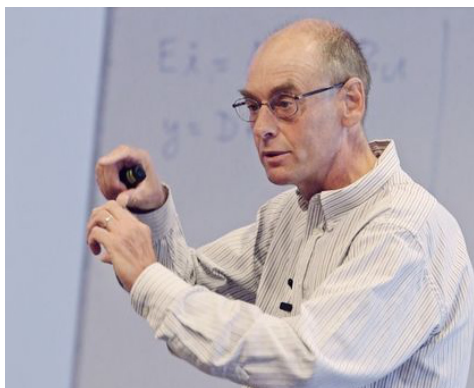
Our overall enrollments for Fall quarter 2022 are currently 4.3% higher than they were last year.



Anne Schilling, chair, with students Jianping Pan (now at NCSU) and Joseph Pappe in Minnesota

We currently have 838 mathematics majors enrolled, which is stable from 2020.

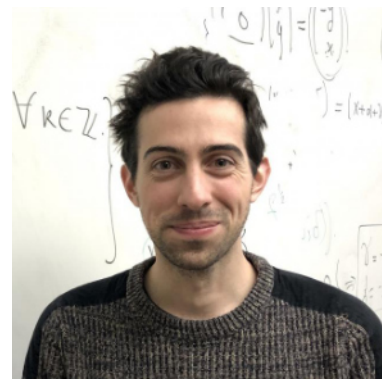
The past year was extremely successful for awards and recognitions in the Department. Roger Casals was awarded the 2022 College of Letters and Science Teaching Award at UC Davis. Together with two UC Davis Health  
...continued on next page.



Roland Freund



Thomas Strohmer (center) with Adams and Callcut at the MICU, UC Davis



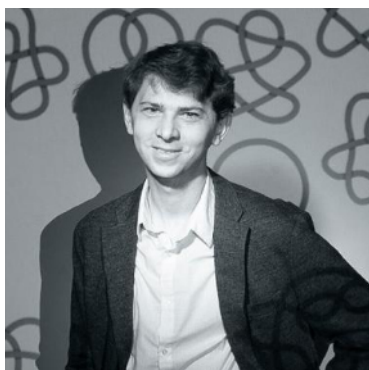
Roger Casals

# LETTER from the chair

...continued from previous page.

PIs Racheael Callcut and Jason Adams, Thomas Strohmer was awarded a \$1.2 million grant from the National Institutes of Health (NIH). Eugene Gorsky was named a 2022 Chancellor's Fellow. Jesús De Loera was elected as Vice President of the AMS. Matthias Köppe was awarded the 2015–2021 SageMath Prize. Congratulations to all!

I also wish to thank our staff, in particular our CAO Gladis Lopez, for running our Department so smoothly.



Eugene Gorsky



Matthias Köppe



Dmitry Fuchs in Reims, France at the 34 Conference, dedicated to A. Kirillov, a co-author of their recent publication, mentioned below.

## Life After Teaching Dmitry Fuchs

I retired in 2015 and bear a title of Professor Emeritus for more than 7 years. It is a common belief that after many years of hard work, emeriti enjoy their well deserved rest, not burdened by any formal duties. It may be true in general, but not in my case. I have an impression that never in my life I worked as hard as now. During my retirement I have never stopped teaching. In particular, I taught in Davis graduate courses of “Introduction to the Differential Topology” and “Differential Geometry II,” and also a reading course “Lie Groups and Algebras.” Also I taught (remotely) a semester course “Representations of Infinite-Dimensional Lie Algebras” under the auspices of Pennsylvania State University.

My notes for this course were published as an (electronic) book by AMR (Association for Mathematical Research). My teaching now is of a different nature: I conduct weekly meetings of Davis Mathematical Circle Beyond Grade 5. Also, I have never abandoned mathematical research. As always before, I do not feel myself pinned to any particular domain in Mathematics. Currently I have two articles awaiting their publication (“Jordan Types

of Triangular Matrices over a Finite Field,” joint with Alexander Kirillov, accepted by the Arnold Mathematical Journal, and “A Family of Integrable Transformations of Centroaffine Polygons,” joint with Serge Tabachnikov and Maxim Arnold, accepted by Annales d’Institut Fourier), and one paper in preparation, “Forgotten Chapters of Differential Geometry of Curves in Space,” joint with Serge Tabachnikov and three more authors.

I can only wish to all my colleagues who approach the retirement age, to retire as soon as possible: this will give you the real opportunity to work in your favorite domains with no distractions.

# incoming

## FACULTY



**Alexander  
Wein**

Alex Wein joined the Department as an Assistant Professor this past July. Previously he received his Ph.D. at MIT supervised by Ankur Moitra and then held a Courant Instructor position (postdoc) at NYU, followed by brief visiting positions at UC Berkeley and Georgia Tech.

His research is a mix of data science, probability, statistics, and theoretical computer science. He studies probabilistic models inspired by data analysis tasks ranging from finding communities in random networks, to decomposing low-rank tensors, to discovering 3-dimensional molecular structure via cryo-electron microscopy. He aims to understand fundamental limitations on the amount of data or computation time required, and to design provably optimal algorithms that reach these limits.

## KAP



**Edward  
Goldsmith**

Ed Goldsmith is an applied mathematician in the field of geophysical fluid dynamics. His research primarily focuses on using multiple-scale asymptotics to study the interactions between small-scale processes and planetary scale flows, with a particular emphasis on the parameterization of convection in the atmosphere. Whilst at UC Davis, he will be mentored by Professor Joseph Biello and Professor John Hunter. He received his Ph.D. from University College London in 2022, where he was supervised by Professor Gavin Esler.

In his spare time, Ed enjoys country music, and is a banjo player in a bluegrass band.

WELCOME

# Academic Staff

KAP

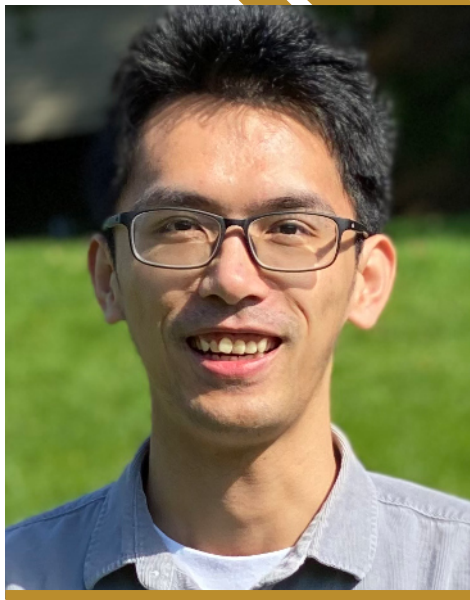


**Anna  
Parlak**

Anna Parlak did her Bachelor's and Master's degrees at the University of Gdansk, Poland. She graduated with a Ph.D. from the University of Warwick in 2021, where she was advised by Saul Schleimer. Before joining UC Davis as a Krener Assistant Professor, she was a Postdoctoral Research Associate at the University of Oxford.

Anna studies low-dimensional manifolds using combinatorial and computational methods. Her most recent research concerns veering triangulations of 3-manifolds and their applications to the study of pseudo-Anosov flows.

KAP



**Luze  
Xu**

Luze Xu is currently a Krener Assistant Professor at UC Davis, mentored by Professor Matthias Köppe. He received his Ph.D. in Industrial and Operations Engineering at the University of Michigan April 2022, advised by Professor Jon Lee. Prior to that, he received his bachelor degree in Computational and Applied Mathematics from Peking University.

His research interests include global optimization, integer programming, and mixed integer nonlinear programming.

KAP



**Melissa  
Zhang**

*Photo by Aaron Fägerstrom*

Melissa Zhang will join UC Davis as a Krener Assistant Professor in Winter 2023. She is a low-dimensional topologist who uses tools from homological algebra, homotopy theory, representation theory, and symplectic geometry to study knots and surfaces in 3- and 4-dimensional spaces. She obtained her bachelor's degree in mathematics at Caltech in 2014 and her doctoral degree in mathematics at Boston College in 2019, under the supervision of advisors Eli Grigsby and David Treumann. Afterwards, she held a postdoctoral position at the University of Georgia, and is currently a postdoctoral fellow at SLMath/MSRI.

In her spare time this semester, Melissa has been hiking the trails of the Berkeley Hills, painting spherical animals for office decorations, and playing music with other musicians at SLMath.

# The Kakimizu complex of a knot

by Jennifer Schultens

Example of Seifert surface of a trefoil knot (genus 1), by Kilom691, Wikimedia

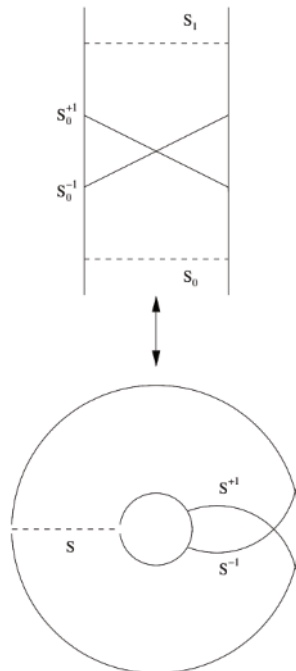
Knots provide a starting point for understanding and appreciating many facets of low-dimensional topology. Formally speaking, a knot is a smooth isotopy class of smooth embeddings of the circle into the 3-sphere. (Alternatively, knots can also be defined in a piecewise linear category.) One of the ways to study knots is via projections to a plane. Of course, the more interesting knots will not project injectively. There will be points of intersection. However, generically, there will be only finitely many points of intersection and these will consist of two arcs crossing. The image of the projection is thus a 4-valent graph. To obtain a knot diagram each crossing is modified to indicate which strand passes over the other.

Observe that a knot is a pair (circle, 3-sphere). All circles are homeomorphic to each other. Of interest is how the circle sits inside the 3-sphere. In the simplest case, we think of the unit circle in the plane, and this sits inside the 3-sphere thought of as the unit sphere in 4-space. Note how the unit circle bounds a disk in the plane. In fact, every knot bounds a surface. A compact orientable surface with the knot  $K$  as its boundary is known as a Seifert surface. The existence of such surfaces was first proved by Herbert Seifert, via an explicit algorithm in terms of knot diagrams. It can also be established via basic algebraic topology.

Given a knot  $K$  one can then ask how many Seifert surfaces the knot possesses, and how they sit with respect to each other. Interestingly, there are knots with infinitely many distinct Seifert surfaces, even infinitely many distinct isotopy classes of Seifert surfaces, and even if we insist on counting only those isotopy classes of Seifert surfaces realizing the minimum possible genus.

This question led Kakimizu to define a complex, later named after him, encoding the Seifert surfaces of a given knot  $K$ . Vertices of this complex correspond to isotopy classes of minimum genus Seifert surfaces of  $K$ . Edges correspond to pairs of vertices admitting disjoint representatives. The complex is flag, meaning that if the 1-skeleton of a  $k$ -simplex lies in the complex, then so does the rest of the simplex. (E.g., if the three edges  $(a, b)$ ,  $(a, c)$ ,  $(b, c)$  lie in the complex, then so does the triangle  $(a, b, c)$ .)

The definition of the Kakimizu complex follows in the footsteps of several similarly defined complexes, for instance the curve complex of a surface. Several questions naturally spring to mind when such a complex is defined: 1) Is this complex connected? 2) Is this complex simply-connected? 3) Is this complex locally finite? 4) Is this complex



The infinite cyclic cover

contractible? 5) Is this complex Gromov hyperbolic or something like that?

The first question was unwittingly answered by Scharlemann and Thompson. The Kakimizu complex had not yet been defined. They were simply interested in sequences of Seifert surfaces where consecutive surfaces are disjoint. In the framework of the Kakimizu complex, the sequences Scharlemann and Thompson constructed constitute paths connecting distinct vertices. So the Kakimizu complex is connected. Kakimizu gave an alternate proof involving the infinite cyclic cover of knot complements.

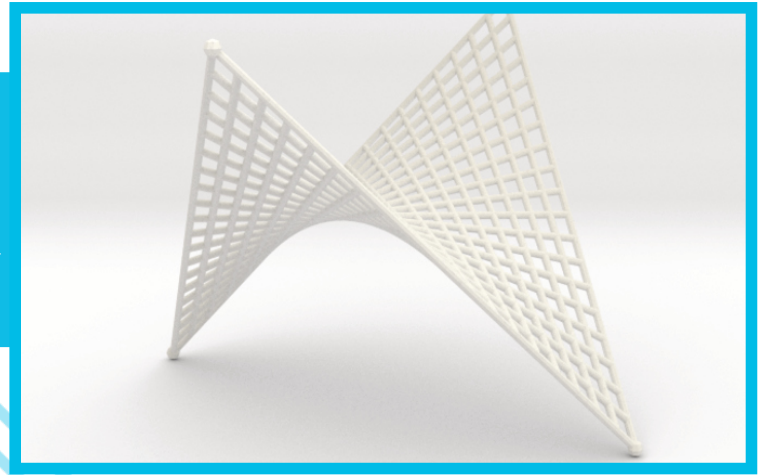
The Kakimizu complex of a knot is also simply connected. This is a result I proved employing some of Kakimizu's constructions involving the infinite cyclic cover of knot complements. Interestingly, the graph distance between two vertices in the Kakimizu complex, *i.e.*, the number of edges in a shortest path between vertices, coincides with a notion of distance defined in terms of intersection patterns in the infinite cyclic cover of the knot complement.

Kakimizu complexes of knots can be unwieldy, in the sense that they are not necessarily locally finite. Jessica Banks gave a complete characterization of knots whose Kakimizu complexes are not locally finite. That is, she gave a complete list of types of knots that fail to have locally finite Kakimizu complexes. In all other cases, the Kakimizu complex is locally finite. (As a thought experiment: Consider the Whitehead double of the trefoil.)

Together with Piotr Przytycki, I proved that the Kakimizu complex of a knot is contractible. This set the stage for a Gromov style investigation into the coarse geometry of the Kakimizu complex which was achieved by Johnson-Pelayo-Wilson. They proved that the Kakimizu complex of a knot is quasi-Euclidean. More specifically, given the JSJ-decomposition of knot, any Seifert surface can be twisted around a torus in the JSJ-decomposition an integer number of times. Generically, this yields a non-isotopic Seifert surface and if it is the result of more than one twist (in either direction), then the resulting Seifert surface can not be made disjoint from the original. This means that tori in the JSJ-decomposition give rise to a grid in the Kakimizu complex. Johnson-Pelayo-Wilson's result then tells us that there is a fixed  $C$  such that all isotopy classes of Seifert surfaces lie within  $C$  of this grid.

# Nontransitive Dice

by Eric Babson



A ruled surface like the image  $P_\sigma$  of the square in  $\Delta$  with  $n=3$  and  $\sigma = (\{1,5\}, \{2,4\}, \{3\})$ .

Moon Duchin and Dylan Thurston (erstwhile KAP and UCD faculty child respectively) brought the following question arising from gerrymandering:

Identify the subset  $P_n$  of the simplex  $\Delta$  in  $\mathbf{R}^n$  (viewed as all probability measures on permutations) obtained by fixing  $n$  (typically different) probability measures on  $\mathbf{R}$ , sampling one point from each and recording the resulting permutation.

For example the midpoint or corners of  $\Delta$  result if the measures are equal or each have distinct one point support respectively.

On the other hand  $P_n$  is not all of  $\Delta$ . In particular a global quadratic inequality follows from the correlation between the conditions  $a < b$  and  $a < c$ . Already for  $n = 3$  if  $[abc]$  is the probability that  $a < b < c$  then  $[abc][cba] \leq ([acb] + [cab])([bac] + [bca])$  so for instance the midpoint of the edge in  $\Delta$  between  $[abc]$  and  $[cba]$  is not in  $P_3$ . Many such global quadratics have been written down by Fontain, Kasteleyn and Ginibre.

This ostensibly measure related problem becomes algebra upon noting that it suffices to consider measures of finite support and that for each fixed collection  $\sigma = (\sigma_i)_{i \in [n]}$  of disjoint finite support sets the associated region  $P_\sigma \subseteq P_n$  is the image of the positive real points of a rational variety in  $\mathbf{P}^{n-1}$ . For example with  $n = 3$  and  $\sigma = (\{1, 5\}, \{2, 4\}, \{3\})$  there is a square of possible measures with these supports indexed by the probability  $x$  for 1 (rather than 5) in the first measure and  $y$  for 2 in the second. The image  $P_\sigma$  of this square in  $\Delta$  is the ruled surface given by  $[bac] = [cab] = 0$  and  $[abc][cab] = [acb][bca]$  and is the positive part of the Segre embedding of  $\mathbf{P}^1 \times \mathbf{P}^1$  into  $\mathbf{P}^3$ . More commonly the initial product of projective spaces will require some resolution away from the positive part before the rational map becomes algebraic.

A second connection to algebra is that when viewing  $\sigma$  as a sequence of numbers from  $[n]$  so that the example above becomes  $abcba$  a braid move such as to  $acbca$  does not change  $P_\sigma$  though it does change the associated coordinatization. Thus it suffices to consider  $\sigma$  indexed by elements of the  $K_n$  Coxeter group. For  $n = 2$  this is affine type  $A$  and there are up to the action of  $S_3$  only  $\lceil k/2 \rceil$  words of length  $k$  required to get all of the sets  $P_\sigma$  so for  $k = 5$  there are only  $abcba$ ,  $abcac$  and  $abcab$ .

Even for three measures there is more to the story.  $P_3$  is full (five) dimensional in  $\Delta$  and covered by the four  $S_3$  orbits of  $\{P_\sigma\}$  with  $\sigma$  of length eight. The boundaries of these  $P_\sigma$  besides the linear positivity requirements and the above FKG quadratics are defined by two other  $S_3$  orbits of divisors (of degrees three and four) which we only found by computer and which do not give global inequalities for  $P_3$ . The analogs for higher  $n$  remain quite mysterious.

The case of three measures is also essentially Efron's nontransitive or ro-cham-bo dice problem: Find three weighted dice (rock, paper and scissors) with various face values (these are the three measures) for which the probabilities that paper beats rock, scissors beats paper and rock beats scissors are all more than half. For example if you ask that all three of these probabilities agree and be as large as possible this will be a boundary point of  $P_3$  along a diagonal line and contained in  $P_{abcabca}$  which is a four dimensional divisor satisfying the quartic. (Since there are only two  $b$ 's and  $c$ 's the paper and scissors dice can be replaced with coins.)

## References

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- Fortuin, C. M.; Kasteleyn, P. W.; Ginibre, J. (1971). Correlation inequalities on some partially ordered sets, *Communications in Mathematical Physics*, 22 (2): 89–103
- Gardner, M. The paradox of the nontransitive dice and the elusive principle of indifference. *Scientific American*, 223:110-114, 1970.



# Remembering Gary Kurowski

Some of us recall Gary Kurowski, who passed away peacefully at his home on July 26, 2022. Gary was born on March 22, 1931 in Fargo, North Dakota. Summer vacations consisted of spending time at the family cabin on the lake. These experiences instilled a life-long love of being near water. Gary attended schools in Fargo, and then continued his studies at the University of Minnesota, where he graduated in 1954. Like many young men at the time, he was drafted into the army during the Korean War. After his required two years in the army, Gary returned to the study of mathematics. He entered the Ph.D. program in Mathematics at Carnegie Mellon. Military applications of mathematics motivated much of his work. During a brief stint at Duke University, Gary met his wife, Hilda, on a blind date. He then joined the UC Davis Department of Mathematics in 1963.

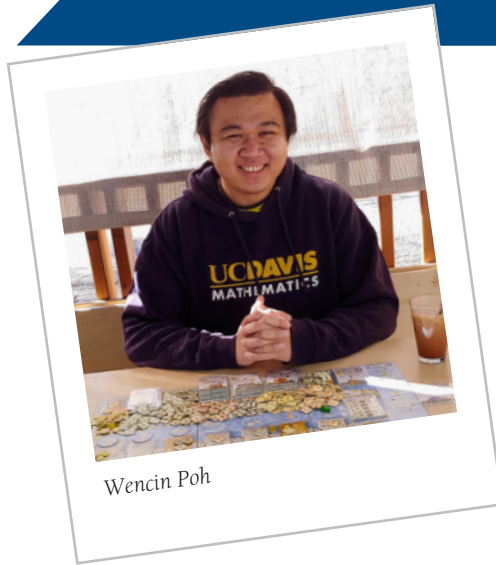
Gary is fondly remembered by friends and family. He always blended in, an unpretentious man with a dry sense of humor. He loved spending evenings in his recliner, helping his three children with their mathematics homework. He and his wife Hilda rejoiced in their 59 years of marriage. He will be missed.

A video interview of Professor Kurowski was filmed in 2002, describing what inspired him to pursue math. The video is available through AggieVideo. Visit [aggievideo.ucdavis.edu](http://aggievideo.ucdavis.edu) and search for 'Kurowski'.



# Life After Davis

## Wencin Poh



Wencin Poh

After graduating from UC Davis, I worked as an online math instructor at Mathnasium of Daly City, teaching students from grades 1 through 12. Teaching remotely during the COVID-19 pandemic came with challenges, such as reduced student-teacher interactivity as well as technological challenges in providing rigorous assessments. However, an important lesson I gathered from Mathnasium is that generous encouragement and skill reinforcement are necessary to propel students to overcome their learning and motivational setbacks.

In recent months, my academic brother, Graham Hawkes, contacted me about developing a curriculum for mathematics courses with a coding component. After receiving his Ph.D. at UC Davis, Graham worked as a postdoctoral researcher at Max Planck Institute for Mathematics and also a postdoctoral researcher in Israel. He is now a faculty at Purdue Global online university. His motivation was to develop a curriculum for math courses that is more well-suited for online teaching.

As I share his vision and that both of us possess a strong foundation in integrating coding experimentation with mathematics from the training with our advisor, Prof. Anne Schilling, we are now collaborating on an educational technology project with the aim to improve understanding of mathematics among undergraduate students through lab explorations and web applications. We would like to provide the necessary motivation and support to students while sustain-

ing rigor using assessments that involve coding in Python.

Our hope is to market this idea in the future to colleges and universities so that students who take math courses have a more effective study tool; instructors and teaching assistants would benefit from automated grading and assessment customization. While everything is at its early stages, we remain optimistic of the prospects of this idea and are motivated to make it happen.

Interested parties may contact us at either [graham.hawkes@purdueglobal.edu](mailto:graham.hawkes@purdueglobal.edu) or [wpoh@ucdavis.edu](mailto:wpoh@ucdavis.edu) for further information.



Collaborator and fellow graduate, Graham Hawkes

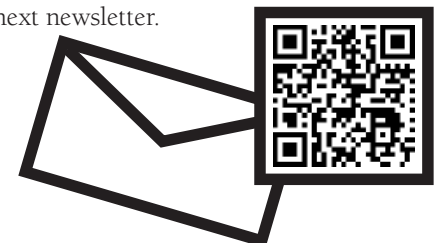
## Are you a Graduate?

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](http://www.math.ucdavis.edu/news/alumni_quest) or send e-mail to:

[mso@math.ucdavis.edu](mailto:mso@math.ucdavis.edu)

We will do our best to include it in the next newsletter.





# Graduate Program

by Adam Jacob, Vice Chair for Graduate Affairs

The Department is excited to welcome back our graduate students for another great year on campus. This year, GMAT admitted 21 new students, for a total of 87. This large cohort brings fresh energy to the Department, and we are excited to see what they will accomplish.

In September, the Geometry/Topology prelim exam was given for the first time, following last year's vote to create this new option for our graduate students. Many thanks to the hard work of the committee tasked with writing and grading this exam, as well as creating a large bank of practice problems. We would also like to thank the graduate students who ran summer workshops in each of our prelim exam areas. Your effort and dedication towards the success of your fellow students is greatly appreciated.

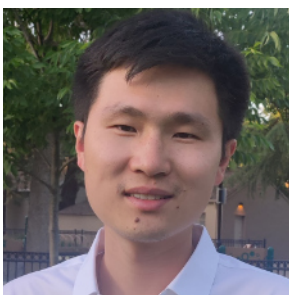
During the 2021-2022 academic year, 8 GMAT students were awarded a Ph.D. from the Department, and have moved on to promising careers in academics or the private sector. We are incredibly proud of their achievements! You can see details about our recent graduates, including their dissertations and post-degree placement, in the Graduate Degrees section of the newsletter.

The hard work of our GMAT students has certainly not gone unrecognized. This past year Wenjun Niu received the Alice Leung Scholarship award in Mathematics, as well as a final year dissertation fellowship from the university. Sharon Huh and Peyton Wood won the Henry L. Alder Prize for Excellence in Teaching, and Matthew Litman was awarded the William Karl Schwarze Scholarship. Mary Claire Simone was awarded the Hazel B. Jacoby Fellowship, and recipients of the Yueh-Jing Lin Fund include Edgar Jaramillo Rodriguez, Ryan Chris Moreno-Vasquez, and Raymond Chou. Finally, Shanon Rubin received a campus wide Outstanding Graduate Student Teaching Award for his hard work as a TA for the Department. Finally, Alex Black won the best poster award at the 2022 Mixed Integer Programming workshop (MIP), and was a finalist for the 2022 INFORMS George Nicholson paper competition.

We are looking forward to another year of mathematical study, research, collaborations, and events.



Adam Jacob



Wenjun Niu



Shanon Rubin



Alex Black



## 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/MathSupport>

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



F. Javier Arsuaga



Shirley Ahn, Chem. Eng.



Erik Carlsson, Math



Xiucai Ding, Stats



Jeremy Mason, Mat. Sci.

On July 1st, I became chair of GGAM. It is an honor to serve in this position and I thank all GGAM faculty and students for trusting me in this role.

I want to thank Professor Jesús De Loera for his leadership as chair of GGAM. Professor De Loera was GGAM chair from 2019-2022 and helped GGAM thrive during very difficult times, including those brought by the COVID pandemic. He also coordinated the review of the program and, together with Professor Becca Thomases (former chair of GMAT), implemented a new, more holistic evaluation of graduate applications. This new approach brought 38 brilliant new students to GGAM, some of them have already received prestigious awards.

During this academic year, Valerie Fond was awarded the NSF graduate fellowship, Alana Bailey and Issa Susa both received the Deans Distinguished Graduate Fellowship, Jose Arrollo Esquivel was named Laurate of the Heidelberg International Forum, and Esha Datta received an award to present her work at the Association for Women in Mathematics, her service was recognized by the Society for Industrial and Applied Mathematics.

During the academic year 2021-22, six new faculty members joined GGAM: Professors Shirley Ahn (Chemical Engineering), Erik Carlsson (Mathematics), Xiucai Ding (Statistics), Jeremy Mason (Material Science and Engineering), Sameer Iyer (Mathematics), and Alexander Wein (Mathematics). These faculty bring expertise in diverse areas of applied mathematics, including data science and statistics, material science, chemistry, and chemical engineering. We welcome our new faculty members and strive to provide a nurturing environment for their research. GGAM faculty now consists of 74 members across 23 departments with affiliations in 15 research centers and institutes.

Our faculty are being recognized nationally and internationally. Professor Leighton Izu (Pharmacology) and his colleagues in the medical school were awarded a prestigious U01 NIH grant to be part of a consortium of

six clinical centers to study heart failure with preserved ejection fraction (HFpEF). Professor Izu and his students will use and develop mathematical methods to analyze the functional connectome to help understand the mechanisms underlying HFpEF. Professor Bruno Nachtergaele (Mathematics) was elected as foreign member of the Chilean Academy of Sciences for his scientific contributions and in particular for his contributions to the Chilean scientific endeavor, Distinguished Professor John Rundle (Physics) was a keynote speaker at the Natural Disasters Exposition, the leading conference in seismic preparation and recovery that attracts global industry leaders, Professor Fernanda Valdivinos (Environmental Science and Policy) was named fellow of the Ecological Society of America for her major contributions to the ecological theory of food webs and her service to underrepresented communities, and Professor Jane-Ling Wang was elected Academician of Academia Sinica for her work on “theoretical statistics, survival analysis, functional data analysis and joint modeling of survival and longitudinal data.”

The academic year 2021-2022 marked the transition from on-line to in-person teaching after more than one year of the COVID pandemic. While being back in person sends a ‘back to normal’ message and has given us an overall sense of relief, many concerns remain including the physical and mental well-being of our students and faculty as well as their progress in their professional careers. These issues are of utmost importance, and I intend to work on them during my tenure as GGAM chair.

Student success is a priority for GGAM. This year, in collaboration with the Department of Mathematics and GMAT, we implemented a new peer-peer mentoring program for prelim preparation. Students met with graduate student instructors for three hours per day during a week in September and had access to additional office hours during the week before the prelim. Many students found this peer-peer mentoring very beneficial for their prelim readiness.

Success is more likely when the proper

# Graduate Degrees 2021-2022

social fabric is in place. With this in mind, GGAM and the Department of Mathematics organized the first annual dinner for junior women in mathematics. In this event graduate students, Krener Assistant Professors and instructors had the opportunity to interact with senior faculty representatives. All these efforts would have not materialized without the help of our highly committed student advisors Tina Denena and Vanessa Bravo. Both are the point of contact for our students and are essential in the day-to-day running of GGAM.

Our graduating students have received offers and moved on to prestigious academic institutions, national labs, and companies. We look forward to working with our faculty and advisors to help our students take advantage of the new opportunities arising in applied mathematics.

Finally, I would like to mention current efforts by the GGAM executive committee to redesign some of the academic requirements in GGAM. Students and faculty members expressed their concern that the current preliminary exam offering does not reflect their interests or the needs of our society. Since July, and following Professor De Loera's work, several groups of GGAM faculty members have been working towards redesigning our preliminary exams. Stay tuned for next year's updates!



Sameer Iyer, Math



Alexander Wein, Math

**Alexander, Christopher** • Applied • Post Ph.D. Placement: Postdoctoral Fellow, University College London  
Advisor: Temple

**Brown, Jennifer** • Math • *q-Holonomic Systems and Quantum Invariants*  
Post Ph.D. Placement: Postdoctoral Fellow, Yale University  
Advisor: Mulase

**Corcoran, Carl** • Applied • *Network Models of Epidemic Spread: Applications and Analysis*  
Post Ph.D. Placement: Steven M. Teutsch Prevention Effectiveness Fellow, CDC  
Advisor: Hastings

**Deng, Shaofeng** • Applied •  
Advisor: Strohmer

**Jiang, Fushuai (Black)** • Math • *Nonnegative Smooth Interpolation*  
Advisor: Luli

**Leroux, Brett** • Math • *Halving point configurations; techniques from algebraic and convex geometry*  
Post Ph.D. Placement: Postdoc, UC Davis  
Advisor: Rademacher

**Lin, Chao-Ping** • Applied • *Stable Algorithms for Large Sparse Eigenvalue Problems*  
Post Ph.D. Placement: Software Engineer, Siemens PLM Software  
Advisor: Bai

**Mallela, Abhishek** • Applied • *Survival of the Resilient: An Exploration of Tipping Cascades with Positive Change*  
Post Ph.D. Placement: Postdoctoral Researcher, Los Alamos National Lab  
Advisor: Hastings

**Poh, Wencin** • Math • *A trilogy of (super)crystals: the queer, the set-valued and the hook-valued*  
Advisor: Schilling

**Reschke, Jake** • Math • *Applications of Lieb-Robinson Bounds to Quantum Dynamics with and without Disorder*  
Post Ph.D. Placement: Post Doc, UCLA, Joint Institute for Regional Earth Science Systems and Engineering  
Advisor: Nachtergaele

**Santhakumar, Hamilton** • Math • *Problems in Discrete Probability Theory and Cryptography*  
Advisor: Morris

**Severson, Eric** • Applied • *Advances in Discrete Chemical Computation: Algorithms, Lower Bounds, and Software for Population Protocols*  
Post Ph.D. Placement: Instructor, Proof School  
Advisor: Doty

**Sheng, Junda (Albie)** • Applied •  
Advisor: Strohmer

**Sheng, Stephen** • Applied •  
Post Ph.D. Placement: Applied Scientist, Amazon  
Advisor: Sharpnack

**Sheu, Norman** • Math • *The Deformed Hermitian-Yang-Mills Equation with Calabi Ansatz*  
Advisor: Jacob

**Shu, Chang** • Applied •  
Post Ph.D. Placement: Data Scientist, Pay Pal  
Advisor: Rademacher

**Vogel, Kaela** • Applied • *Nonnormality and Its Influence on the Stability and Behavior of Ecological Food Webs*  
Advisor: Hastings

**Wang, Zhongruo** • Applied • Advisor: Ma

**Weber, David** • Applied • *On Interpreting Sonar Waveforms via the Scattering Transform*  
Advisor: Saito

**Wong, Ka Wai** • Applied • Advisor: Hass

**Zhang, Zhenyang** • Math •  
Post Ph.D. Placement: Software Engineer, Google MTV  
Advisor: De Loera

**Chaoqeile** • M.S., Applied

**Jaramillo Rodriguez, Edgar** • M.A., Math (De Loera)

**Johnson, Kyle** • M.A., Math (Gravner)

**Ogami, Sari** • M.A., Math

**Santhakumar, Hamilton** • M.A., Math

**Wood, Peyton** • M.A., Math

# Undergraduate Program

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



## Undergraduate Clubs and Organizations

Information and meeting times can be found on the organization's website:

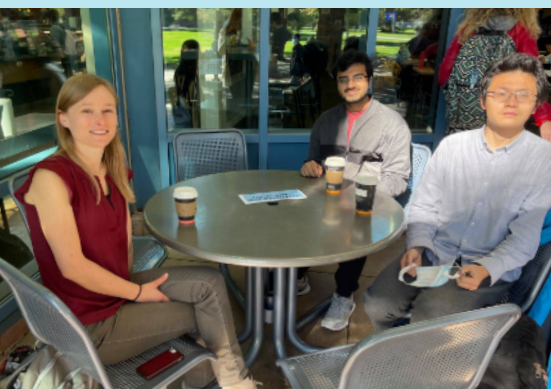
Math Club: <https://mathclubatucdavis.org/>

AWM: <http://awm.math.ucdavis.edu/>

Math Club



AWM



Coffee with a Prof: Dr. Stephanie Dodson

## Directed Reading Program

To join, either as mentor or mentee:

<https://www.math.ucdavis.edu/~drp/>



This past academic year, the Department of Mathematics awarded 240 degrees (197 majors and 43 minors)! We had 57 students graduate in Mathematics, 89 in Applied Mathematics, 16 in Mathematical and Scientific Computation, and 35 students from our Mathematical Analytics & Operations Research major. An impressive 33 students received special citations, scholarships, and prizes for their exceptional performance and service which are listed in the Department Awards article. Furthermore, many of last year's graduating students went on to graduate school at prestigious institutions, and many other graduates went on to jobs as K-12 teachers or got jobs in industry as data analysts and software engineers. These achievements testify to the commitment and dedication of our students.

**Information Sessions and Advising** • The Math Department places great importance in providing our students with a supportive and encouraging environment throughout their time with us. This starts with good advising. At the beginning of every academic year, we host an Orientation Session and an Undergrad Welcome Event. At this fall's Orientation Session, our advising team provided insight and advice to being a math major at UC Davis and life at UC Davis in general. At the Undergrad Fall Welcome Event, we discussed the great things that one can do with a major in mathematics. We also talked about the importance of students starting to plan their individual study programs in concert with the staff and faculty advisors as soon as possible. We stressed that we are here to help all our students succeed, and we described the multiple sources of support that are available when needed. ... and we ate good food!

To meet the challenge of advising our 850 majors and the many other students taking our classes, we have a multi-pronged advising approach. Students can make appointments for in-person or online meetings with our faculty or staff advisors, and there is drop-in advising with our staff advisors (online) and peer advisors (online or in-person). We also run a series of Advising Work-

shops that provide group advising.

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

**Math Club** • The 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, Math Club meetings often include movies, workshops, and short presentations by guest speakers. See the sidebar at left for links.

**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. See the sidebar at left for links.

**Final Exam Study Night** • We plan to host another Final Exam Study Night at the end of the fall quarter. On Final Exam Study Nights, we invite students to come study with their peers and form spontaneous study groups in a comfortable and welcoming space with delicious snacks. Appearances by our faculty members and graduate students help keep the atmosphere lively and productive.

**Career Night** • In spring quarter, we plan to hold our annual Career Night. 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. The 2022 Career Night last spring, which was held virtually, had a fantastic line-up. We had two UC Davis graduates: Dannie Kiel (Applied Math, UC Davis 2020), who is a technical advisor for a patent law firm and Mira Daya (Applied Statistics,

2018), who is a data scientist at Symphony RetailAI. We also had Kenneth Saldanha and Arnab Charaborty from Accenture Consulting. Kenneth is head of the Global Insurance practice and Arnab leads the Applied Intelligence branch at Accenture.

**Coffee with a Prof •** ...and Pizza with a Prof too? In 2022-2023, we will continue both the "Coffee with a Prof" and the "Pizza with Professors" program. These programs were started to facilitate undergraduate students connecting with faculty in a relaxed atmosphere. Students can ask the professors questions about careers, life-work balance, studying mathematics, or just about anything else. The coffee and pizza are on us!

**Undergraduate Research •** Every year, many of our majors take part in undergraduate research experiences (REUs). Last year, four of our students (Raymond Chan, Clara Dresselhaus, Katarina Merk, and Junhui Shen) spun their research experience into their senior theses. These topics included modeling a multipolar arms race and spectral clustering. Undergraduate theses from last year and previous years can be found on our website.

On October 12, we hosted the Mathematics Undergraduate Conference 2022 in person. The conference was organized by our dynamic student services staff and our undergraduate research coordinator, Professor Bob Guy. Following a pizza dinner, five undergraduates (Katarina Merk, Noah Wiesner, Raymond Chan, Charishma Gudala, Tyler Greiner) gave presentations on research projects they conducted over the summer or the previous year. Professor Guy 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 75 interested students attended the conference!

**Special Topics •** Each year, the 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, Dr. Alex Chandler is giving a course on the Mathematics of Deep Learning Algorithms; in the Winter, Professor Laura Starkson will run a course on the Topology of Low Dimensional Manifolds; and in the Spring, Dr. Melissa Zhang will give a course on Knot Theory.

**Directed Reading Program •** The very successful Directed Reading Program (DRP) will continue for its third 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 75 undergrads interested in the DRP. The DRP plans to host a poster session in the winter quarter and a conference for undergraduate presentations in the spring quarter.

**Student Spotlight Program •** We are also continuing the Student Spotlight program. Each month throughout the academic year, we will be selecting one of our students to be featured on our social media channels and in our undergraduate newsletter. It is an opportunity to highlight the achievements of some of our wonderful undergraduate students and celebrate their hard work. Our student spotlight for Fall 2022 is Teresa Dunn!

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.

Lastly, we would like to congratulate our student services staff, Cydney Matteson and Stephanie Zarate. Cydney, who was our Undergraduate Program Coordinator for the last two years, is now an analyst with the UC Davis Patent Office, and Stephanie, who was our Student Services Assistant, has an advising position with Public Health Sciences. These were great promotions for them, but big losses for us. Luckily, we were able to make two great hires: The new Undergraduate Program Coordinator is Viviana Gonzalez, and the new Student Services Assistant is Diana Bond. Welcome to the team, Viviana and Diana!

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 absolutely magnificent staff (current and past)! All of you make our undergraduate program vibrant and successful.

# Staff Update



by Gladis Lopez, Chief  
Administrative Officer

It is energizing to see the students coming back to campus and starting the new academic year.

The administrative staff continues with a hybrid work schedule and this has been working fine. The staff work schedule can be found on our Department webpage:

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

We recently hired Jose Alfredo Morales as a financial coordinator, Viviana Gonzalez as undergraduate staff advisor and Diana Bond as advising coordinator. We were also happy that Thu Pham's reclassification to a financial analyst was approved. This is a well deserved promotion!

Tina Denena received the Galois award this year for all the great work she does with our graduate students.

I would like to share that I have decided to retire effective July 1, 2023, after 26+ years of service at UC Davis. I have mixed feelings about my decision. By the time I retire next year, I will have worked in the Department of Mathematics for over 11 years and I will certainly miss all in the Department. At the same time, I am very excited about starting a new chapter in my life (retirement!). I am working with the L&S Dean's Office on a transition plan. It has been a privilege to work in the Mathematics Department and with all of you.

I want to thank all the staff for all they do for the Department. We are lucky to have a very strong, talented administrative staff group.

We continue with our internal Staff Recognition Program. Staff's good performance is recognized with a small token of appreciation — a \$30 Trader Joe's gift card. Please send me an email at

[gylopez@ucdavis.edu](mailto:gylopez@ucdavis.edu)

if you would like to nominate staff members for this award. We give 2-3 awards per employee a year.

We are excited about the opportunities that this new academic year may bring and look forward to a very productive and successful year.

**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 – Daniel Martin**

**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.

**Recipients – John Challenor**

**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 – Rahul George and Donald Miao**

**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 – Veronica Then, Pam Pabla, Inocencio Rangel,  
Hannah Kennedy, Gurjaap Jhaji**

**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 – Matthew Litman**

**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 – Valerie Fong and Mary Claire Simone**

**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 – Winnie Zhang**

**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 – Feng Cheng**

**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 – Sharon Huh, Eli Moore, Peyton Wood**

**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.

**Recipients – Wenjun Niu and Ye He (Leo)**

# Awards



## **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 – Miguel Torres-Mendez**

## **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 – Hannah Kennedy**

## **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 – Katarina Merk, Edgar Jaramillo Rodriguez, Ryan Chris Moreno-Vasquez, Raymond Chou, Claire Zheng**

## **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 – Tina Denena**

## **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 – Sydney Clowdus, Saud Molaib, Annie Ngo, Alexandra Vizcarra**

## **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 – Raymond Chan, Weiyi Chen, Siyuan Ding, Owen Gao, Yide Hu, Siyao Li, Zhuoying Li, Ruoyang Liu, Lukas Milos Jovanovic Mackin, Emily McPherson, Hui Qi, Brooke Schuld, Junhui Shen, Madhukar Dundapp Sodlapur, Xinyuan Wang, Ziwei Zhan, Yidong Zhao, Zhenhan Zhao**

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Marianne Waage, Designer

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