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AfTERMATH

UNIVERSITY OF UTAH DEPARTMENT OF MATHEMATICS

1970 - 2020

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50 YEARS

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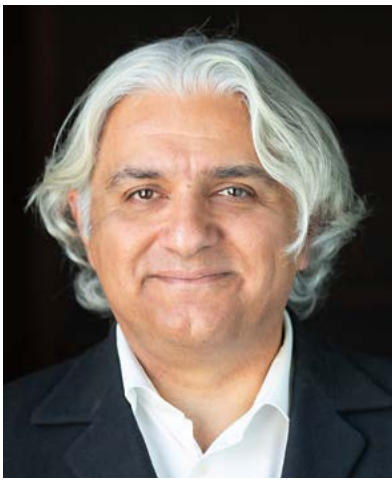
Message from the Chair

Due to the ongoing COVID-19 pandemic, the year 2020 has presented a number of novel challenges for our faculty, students, and staff in the Department of Mathematics. As we prepared to return to campus for the fall semester, the University of Utah and the Department of Mathematics developed coronavirus guidelines, in partnership with the university's public health professionals, keeping in mind the primary goals of ensuring our community's health and safety, students' continued academic success, and ongoing excellence of our department's many research activities.

Most of our students have continued to learn online for the fall semester, and our faculty and staff have continued to make teleworking arrangements. In addition to teaching online classes, our instructors have used other formats in order to enhance the learning experiences of our students. These include teaching small in-person classes, interactive video classes, and a hybrid of the two approaches. We expect to use a similar approach for our spring semester classes.



Davar Khoshnevisan

Despite these challenges, I am pleased to say that the fall semester has been a success, thanks to the many efforts of our faculty, students, and staff.

Our faculty and graduate students have received awards in recognition for their outstanding research and teaching accomplishments, and I encourage you to read about their successes in the magazine.

This year marks the 50th anniversary of the College of Science. In recognition of this, we have included information about the College as well as milestones for the Math Department during the past 50 years.

While the challenges of the coronavirus remain and may continue for many more months, I am optimistic that the University and the Department will continue to navigate these challenges successfully, producing a first-rate research and teaching environment. As part of this effort, I would like to direct your attention to a new Student Emergency Fund (giving.utah.edu/math) and solicit your donation to support our students through this particularly difficult period (see article on page 19).

As always, thank you for your support. The generosity of our friends and donors has been a powerful force advancing our mission of excellence, teaching, mentoring, and research.

Thank you for all you do. We are one Utah!

Sincerely,

Davar Khoshnevisan
Professor and Chair
Department of Mathematics

1970 - 2020

July 1, 2020, marked the 50-year anniversary of the College of Science, comprised of the School of Biological Sciences and the Departments of Chemistry, Mathematics, and Physics & Astronomy.

By James DeGooyer, Major Gifts Officer, Dean's Office, College of Science

A brief history

When the University of Deseret was founded in 1850 in the Territory of Utah, it was primarily a training school for teachers. The newly formed university taught only a handful of topics, including algebra, astronomy, botany, chemistry, geometry, and zoology. Indeed, mathematics and physical sciences were well represented from the earliest days of the university.

By the 1920s, only six organized schools existed at the U: Arts and Sciences, Business, Education, Engineering and Mines, Law, and a two-year Medical School.

Between 1948 and 1958, through two reorganizations, the School of Arts and Sciences expanded to become the College of Letters and Science. However, the composition was enormous, including departments of air science, anthropology, botany, chemistry, English, experimental biology, genetics and cytology, history, journalism, languages, mathematics, military science and tactics, naval science and tactics, philosophy, physics, political science, psychology, sociology, speech and theater arts, and zoology.

Construction to connect the Widtsoe and Cowles Buildings

Tunnel showing the foundations of the Cowles Building

By the late 1960s, Pete D. Gardner, a prominent organic chemist at the U, had convinced the central administration that the areas of mathematics and physical sciences would be most effective if separated from the large, somewhat amorphous College of Letters and Science.

Therefore, on July 1, 1970, the College of Letters and Science was replaced by three new colleges: Humanities, Social and Behavioral Science, and the College of Science.

The disciplines of biology, chemistry, mathematics, and physics and astronomy were consolidated in one cohesive academic unit. Gardner was appointed the first dean of the College and served from 1970 to 1973.

The College of Science utilized seven buildings in 1970, including Chemistry (the north wing was finished in 1968), South Biology (completed in 1969), North Biology (the James Talmage Building), Life Sciences (built in 1920 and the former home of the School of Medicine), the John Widtsoe Building (which housed both the chemistry and the physics departments), the James Fletcher Building, and South Physics.

The total faculty consisted of about 80 tenured or tenure-track professors across all four departments.

The Cowles Building today

Completed structure connecting Cowles and Widtsoe Buildings

The T. Benny Rushing Mathematics Student Center

Modern-day powerhouse

Today the College of Science is one of the largest colleges within the University of Utah, offering undergraduate and graduate degrees in biology, chemistry, mathematics, and physics and astronomy, plus specialized degrees such as a doctorate in chemical physics.

The College supports nearly 2,000 undergraduate science majors, 475 graduate students, and employs 143 full-time tenured or tenure-track faculty. The College also employs hundreds of adjunct and auxiliary faculty, postdoctoral fellows, research assistants, lab technicians, and support staff.

Last year, the College received about $36 million in external research funding, which is nearly seven percent of the University's total external research revenue.

"The exceptional caliber of the College's faculty has been a driving force behind the University's ascension as a world-class research university," says Peter Trapa, dean of the College of Science.

The College has constructed new educational and research facilities in recent years, including the Thatcher Building for Biological and Biophysical Chemistry and the Crocker Science Center on Presidents Circle. The two buildings combined serve thousands of students each year with professional academic advising, expanded classrooms, and cutting-edge labs and instrumentation.

This year, a new project—the Stewart Building for Applied Sciences—was approved by the Utah legislature. The project involves the renovation of the historic William Stewart building and will construct a 100,000-square-foot addition to house the Department of Physics & Astronomy and the Department of Atmospheric Sciences.

The proposed Applied Sciences Center will be 140,729 square feet in size, consisting of 40,729 square feet of renovated space and 100,000 square feet of new construction. Undergraduate teaching labs, research labs, and classrooms will constitute 90% of the footprint, and faculty offices will use 10% of the space. The new facility will support more than 40 faculty members, 200 undergraduate majors, 115 graduate students, and nearly 5,000 students taking STEM courses each year at the U.

Crocker Science Center

Building the future

As the 21st century unfolds amidst a global pandemic, the importance of science and mathematics will only continue to increase. Our quality of life and economic future depend on the next generation of scientists.

The College of Science is refreshing its strategic plan to further strengthen and enhance its academic and educational programs and its scientific leadership in the nation. Emerging priorities include:

- Fully implement the Science Research Initiative (SRI) in the Crocker Science Center to serve 500 undergraduates per year with specialized research opportunities.
- Establish new endowed faculty chair positions in each department, and increase the number of endowed professorships and graduate fellowships.
- Continue to increase the amount of external research funding received in the College per year.
- Invest in new and existing research directions to strengthen the College's faculty.
- Continue to advance our commitment to diversity and foster inclusive communities of faculty, staff, and students.
- Increase the six-year graduation rate of declared Science majors, and increase the total number of STEM graduates at the University.

Pearl Sandick, Associate Dean for Faculty Affairs, has led an effort that has distilled the input of faculty, staff, and students into a coherent plan for the future.

"The College will be prepared to meet the demands of the next 50 years in science education and research," says Sandick. "We will see our way through the current public health crisis, with an enhanced focus and commitment to student success, providing the facilities and rigorous training needed to boost the number of STEM graduates in Utah."

The College is sincerely grateful for its numerous friends and supporters over the last 50 years. Each gift, large and small, propels the College forward. Please join us to write the next chapter, and the following 50 chapters, in the College of Science.

If you graduated from the College of Science with a degree in Biology, Chemistry, Mathematics, or Physics and Astronomy, we want to hear from you. The College is publishing select alumni profiles on science.utah.edu/alumni, and in the college and department magazines. To share your story please contact James "Jim" DeGooyer at (801) 581-3124 or jdegooyer@science.utah.edu.

Milestones for the Math Department from 1970-2020

C. Edmund Burgess

1967-1977

C. Edmund Burgess served as chair of the department from 1967-77. He relocated the math faculty offices to the John A. Widtsoe Building. These changes were a result of sharp increases in enrollment and were important to ensuring a well-organized and fully functioning faculty and staff. Burgess fought long and hard to obtain funds to enable growth in faculty and facilities. He built significantly on the foundation laid by the previous chair (Clarence Wylie) and helped develop the U's worldwide reputation as a first-class mathematics department.

Hugo Rossi

1977-1979

After Burgess retired, **Hugo Rossi** stepped in as chair. Rossi wanted to encourage more women to pursue science and mathematics degrees. Influenced by such women as Lenore Blum (mathematician and co-founder of the Association for Women in Mathematics [AWM] and Michèle Vergne (French mathematician, specializing in analysis and representation theory), Rossi developed the ACCESS Program for Women in Science & Mathematics. Rossi also served as dean of the College of Science from 1987-1993.

Joseph L. Taylor

1979-1982

As chair of the department, **Joseph L. Taylor** recruited top mathematicians, helping lead the department to national prominence. Dr. Taylor also served as the U's Dean of the College of Science from 1985 to 1987 and as Vice President for Academic Affairs from 1987 to 1990. Taylor was known for his willingness to tackle some of the most significant mathematical problems of his era, bringing new ideas and tools to the task and enhancing the reputation of the department.

Frank C. Hoppensteadt

1982-1986

Recruited from New York University's prestigious Courant Institute, **Frank C. Hoppensteadt** joined the department and became chair in 1982. He helped develop a strong mathematical biology team, the roots of which still exist today. Under his leadership, James Keener and Hans Othmer joined the faculty. During his tenure, the field of computer science evolved as a separate area from mathematics.

T. Benny Rushing

1986-1988

During **T. Benny Rushing**'s time as chair, the department continued to grow and was ranked as the most improved mathematics department in the United States. The computing facilities moved from a ranking of poor to one of the best of any mathematics department in the country, with a VAX 8600 supermini, 13 Sun workstations (with fileserver, etc.), a graphics lab (with a mini computer), and an instructional computing lab (which included 20 Macintosh Pluses networked to a DEC 20).

1988-1991


Klaus Schmitt

As chair, **Klaus Schmitt** saw many changes within the department. While the 1980s were a decade of declining enrollments in mathematics, science, and engineering degree programs, the trend appeared to reverse during the 1990s. There was a 6.7% increase in student credit hours just within a year. Advancements made in technology ushered in changes within the department. Computing was incorporated into much of the curriculum, which began a degree emphasis in scientific computing. The computing facilities also saw changes. Graduate students' offices were filled with MACs and PCs, while the DEC 20 and VAX 8600 had become obsolete.

1991-1993


T. Benny Rushing

When **T. Benny Rushing** began his second stint as chair of the department, one of his goals was to get rid of the barracks that had been used for tutoring and build a more attractive and permanent space to serve the needs of math students. Ultimately, his vision was realized under the leadership of James Carlson. Rushing was known for his ability to get things done and to use diplomacy to diffuse tensions among faculty, especially between the areas of pure and applied mathematics. He was considered a tireless champion for the department. Rushing was appointed dean of the College of Science from 1993-1997.

1993-1995


Paul Fife

Paul C. Fife had originally been tapped to teach at Brigham Young University but chose instead to join the U's math department. Fife worked on building and expanding the area of applied mathematics and was responsible for hiring Calvin Wilcox and Graeme Milton.

1995-2002


James Carlson

During the 1960s the University had enjoyed a period of legislative funding and expansion, which resulted in new buildings for biology, chemistry, and physics. Math was also promised a new building, but by 1970, the funds had been exhausted. The department was asked to settle for a remodeled Widtsoe building. The department agreed but asked the administration to adopt a plan to meet the needs of math into the 21st century. The long-range plan called for the construction of a new structure that would connect the Cowles and Widtsoe buildings. At this time, **James Carlson** was chair and oversaw the LeRoy E. Cowles Building (LCB) renovations and construction of the T. Benny Rushing Mathematics Student Center in April 2000. In December 2001 everything was completed, and after nearly 30 years of building and classroom maneuvering, the Department of Mathematics was finally housed in a single complex, made possible by the generosity of the George S. and Dolores Doré Eccles Foundation. The department was awarded the National Science Foundation's Vertical Integration of Research and Education (VIGRE) in Mathematical Sciences grant. The C. Bryant and Clara C. Copley Scholarship Fund was established to benefit students in mathematics at the university.

Graeme Milton

2002-2005

Following James Carlson, **Graeme Milton** became chair in June of 2002 and Nathan Smale was named associate chair. Graeme was chair for only two weeks when the president of the U called to say there had been a major flood in the LeRoy E. Cowles Building (LCB). The entire computer system (and internet) was out, as was heating/air-conditioning, and the elevator shaft was warped. A major pipe into the building had broken. Fortunately, everyone rallied to help keep things flowing, but it was a challenging introduction to serving as chair. During his tenure, the department received an Integrative Graduate Education and Research Traineeship (IGERT) grant for the Mathematics Biology Research Program to train a new generation of mathematical biologists The loft on the top floor of LCB was redesigned to incorporate a space for graduate students. The Dumke Family donated a total of $125,000 to make the project a reality. On February 23, 2004, the loft was dedicated and given a new name as the Dumke Loft.

Aaron Bertram

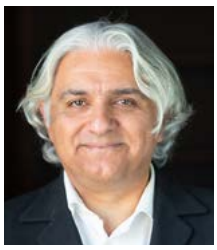
2005-2011

Aaron Bertram became chair in 2005. During his time, the department received a continuation of the VIGRE grant, extending its support until 2013. One of Bertram's most notable achievements was holding the department together during the Great Recession and during the budgetary cuts that followed. During this time the department did not scale back its graduate or postdoc programs and was able to continue hiring at the tenure-track level.

Peter Trapa

2011-2017

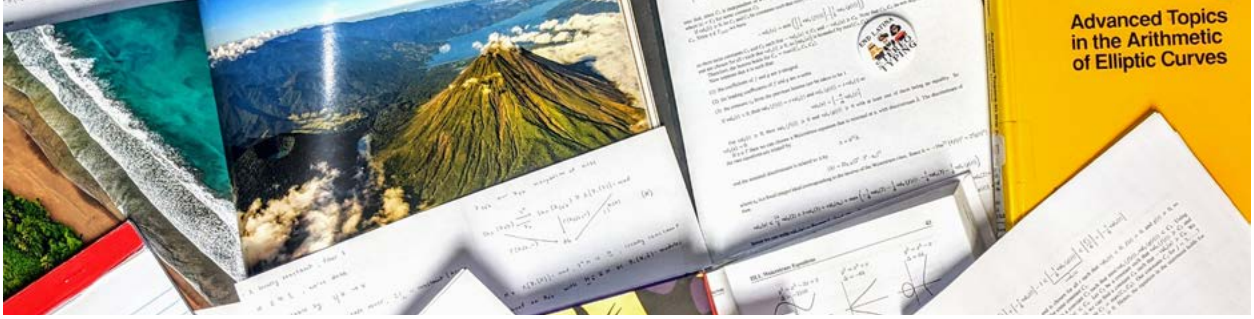
During **Peter E. Trapa**'s term as chair, the department hired ten outstanding faculty members in a wide spectrum of pure and applied mathematics; grew annual research expenditures to about $4M; secured new departmental endowments of about $1.8M; and implemented a number of student-centered initiatives (like enhanced advising and extra lab sections for many lower-division classes) aimed at improving student success in critical gateway courses. Trapa now serves as dean of the College of Science.



Davar Khoshnevisan

2017-Present

Davar Khoshnevisan became chair in 2017. During the early part of his tenure, Distinguished Professor Christopher Hacon was named the first McMinn Presidential Endowed Chair in Mathematics at the U. In addition, Hacon was also awarded the prestigious 2018 Breakthrough Prize in Mathematics.



The image above illustrates Serrano López's research

Allechar Serrano López receives U Teaching Assistant Award for second consecutive year

For the second consecutive year, Allechar Serrano López, a fifth-year math graduate student, has received the university's highly competitive Teaching Assistant Award (UTA). The UTA program is designed to assist departments in trying out new ideas in undergraduate teaching.

As a teaching assistant, Serrano López has challenged cultural norms about mathematics by working to create a more inclusive and diverse classroom. Ethnomathematics is the study of the relationship between mathematics and culture; the goal of ethnomathematics is to recognize the contributions of other cultures, with the understanding that math can be taught in different ways to different groups of people.

"Mathematics is traditionally presented as a European creation—with mathematics seen as a superior intellectual activity reserved for a few," said Serrano López. "Unfortunately, this can lead to a bias where certain cultures are favored over others. With mathematics, this bias often inadvertently restricts who gets to do and study math. Mathematical traditions outside of Europe don't fit this mold and are often largely dismissed from the history of mathematics. Our students go through a history of math class and are unaware of the contributions of indigenous people to the field. My goal is to change that."

Growing up in Costa Rica, Serrano López never thought about what mathematics meant for the natives of her country. She had learned about the Incas and Mayans, of course, but hadn't realized the indigenous people in her country had built stone spheres (legend says they were cannonballs shot by the god of thunder to drive away the god of wind). These spheres are gathered around former settlements, and archaeologists are still researching the significance and position of them. "In my mind, stone spheres were not mathematical objects," she said. "The spheres belong to the non-mathematical domain of a UNESCO World Heritage Site. Yet, they represent a complex mathematical and engineering project—my people had always been mathematicians, but I never knew it."

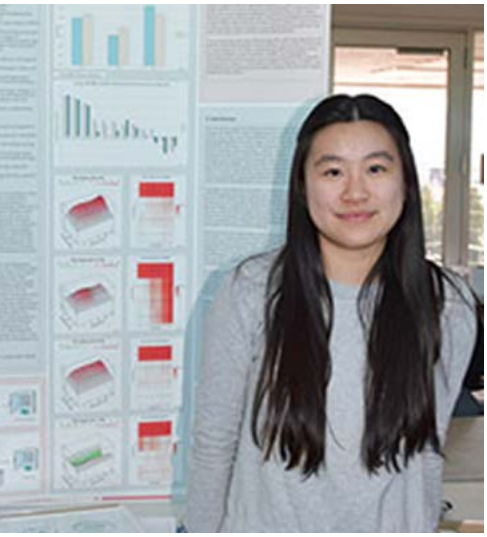
Serrano López has taught several courses at the University of Utah and participated in multiple outreach projects. She is committed to promoting under-represented groups in mathematics and STEM. As an officer for the student chapter of the Association for Women in Mathematics (AWM), she served last year as outreach chair, speaker series co-chair, and conference co-organizer. During the academic year 2020-21, she will serve as president of the chapter. The AWM Speaker Series brings mathematicians from under-represented groups to the university to share their research and their path through mathematics, with an emphasis on women and people of color. As a SACNAS (Society for Advancement of Chicanos/Hispanics and Native Americans in Science) Scholar, Serrano López participated in a national conference and graduate school fair to recruit future graduate students.

Since 1995, University Teaching Assistantships (UTA) have been available to departments on a competitive basis. The purpose of the University Teaching Assistantship program is to improve graduate education programs and training at the University of Utah in the service of undergraduate education through the creative use of graduate teaching assistants. Mentoring of graduate students to assist them in preparing for teaching careers is an integral part of the program.

U science fair finalists win

2 of 20 spots in international program

by Lisa Potter, science writer, University of Utah



Clara Tandar
PHOTO CREDIT: University of Utah Science & Engineering Fair

Tarun Martheswaran
PHOTO CREDIT: University of Utah Science & Engineering Fair

Two Utah high school students who were finalists in the University of Utah Science & Engineering Fair (USEF) will attend the prestigious WebValley online summer school. WebValley admitted 20 students total, only five of whom live in the United States. WebValley is a data science and artificial intelligence program run by the Fondazione Bruno Kessler, a top research institute based in Italy. This year the students will attend virtually.

Clara Tandar, a senior at West High School, and **Tarun Martheswaran**, a senior at The Waterford School, were invited to apply to the competitive program because their USEF projects had qualified for the International Science & Engineering Fair (ISEF), although ISEF was canceled due to COVID-19. Tandar's project was titled *Aurora Kinase Inhibitor Synergy Screen to Enhance Chemotherapeutic Sensitivity*. Martheswaran's project was *An Enhanced Early Detection Model of Dengue Fever Outbreaks Using SEIR Infectious Disease Epidemiological Compartments, Generalized Linear Regression Relationships, and Statistical Computing*.

"These students are doing graduate-level research for their projects. They're incredibly motivated and have taken their own initiative to become scientists," said Jody Oostema, program manager for USEF at the U's Center for Science & Mathematics Education since 2005. Oostema coordinates the annual spring event at The Tower in Rice-Eccles Stadium, finds the 250 qualified judges—half of whom are U faculty—and acts as a mentor to the USEF Student Advisory Board.

When USEF started in 2003, there were 186 science fair projects. This year there were 507 projects submitted by 647 students. The U oversees the state's science fair, a competition made up of students who have won their regional school district's fairs. There are three age divisions of USEF: the elementary division for 5th and 6th graders, the junior division for 7th and 8th graders, and the senior division for high schoolers. Only the senior division was able to compete this year, as the others were scheduled after the state implemented COVID-19 restrictions.

"USEF is an incredible environment. Everyone is so supportive of all of the work that we do," said Tandar. "It inspires me to push myself, and I learn so many important skills in the process."

"Growing up, I saw my sister participate in the U of U's science fair and knew that I wanted to do a project about what I was interested in," said Martheswaran. "The feedback I receive from the judges has made my project better every year."

Meet the students

Clara Tandar

Senior, West High School; secretary, USEF Student Advisory Board

Tandar has competed in the Utah fair since 2017. In May of her sophomore year, she connected with Trudy Oliver, Ph.D., associate professor and HCI Endowed Chair in cancer research, whose lab focuses on drug response and drug resistance in lung cancer, one of the leading causes of cancer-related deaths in America.

Tandar's project dealt with small-cell lung cancer (SCLC), a highly aggressive form of lung cancer. People with SCLC have lower survival rates due to a lack of effective therapies. For her science fair project, Tandar investigated various drug combinations to determine the most cytotoxic treatments through a primary and secondary drug screen.

"Dr. Oliver is amazing, Every time I'm in the lab, I learn so much from everyone," Tandar said. "She gave me a lot of independence with this project, while still being so generous with her skill and guidance. It's an amazing experience that I am lucky to have."

Tandar is thrilled to be participating in WebValley to improve her computational biology skills, including coding and single-cell sequencing.

"It's a tremendous opportunity," Tandar said. "There are few experiences like it available to kids my age. Especially from an interdisciplinary approach to computational biological research."

Tarun Martheswaran

Senior, The Waterford School; vice president, USEF Student Advisory Board

Martheswaran has participated in USEF for three years. He's always loved math and wanted to learn how to apply his passion for the subject to solve real world problems. In 9th grade, he reached out to Frederick Adler, a professor in both the Department of Mathematics and the School of Biological Sciences, who introduced Martheswaran to mathematical biology.

Adler paired Martheswaran with a graduate student who worked on modeling infectious diseases. Martheswaran chose to base his science project on dengue fever, one of the fastest spreading mosquito-borne diseases that impacts Malaysia, where his entire family lives. There's currently ongoing research into a vaccine for the disease, but it has been quite challenging due to the presence of four different serotypes in the environment. Thus, the best way to combat dengue fever is to find strategies for detecting outbreaks early and reducing transmission.

Martheswaran developed simulations based on mathematical models that established transmission and relationships between climate conditions and infectious mosquito populations in Singapore, and how it correlates to dengue fever virus outbreaks. Based on statistical testing, he found a significant lag time of four weeks for optimal mosquito temperatures and 12 weeks for optimal precipitation in a linear regression model. Testing his strategy with the 2013, 2014, 2015, and 2019 Singapore dengue fever outbreaks showed high measured correlation. He also accurately applied the model to 2019 dengue fever outbreaks in Honduras and Cambodia, suggesting that his model could be used to predict outbreaks around the world. Even with the prevalence of COVID-19, Martheswaran emphasizes the importance of paying attention to dengue fever. There have been over one million confirmed cases in the Americas alone in 2020. He hopes to reduce this number in the future.

"I'm very excited to get into a program that's so tailored to my interests. I'm excited to meet the other teenagers from around the world interested in AI and computational biology," said Martheswaran.

German research icebreaker Polarstern

U professors' research on modeling sea ice featured in AMS publication

Over the past two decades, Arctic sea ice has experienced precipitous declines in extent and thickness, with significant implications for the Arctic region and beyond. This loss of sea ice is perhaps one of the most visible large-scale changes on Earth's surface connected to planetary warming. Significantly advancing our ability to understand, model, and predict the behavior of sea ice is a central challenge to improving projections of climate change and the response of polar ecosystems. The opening of the Arctic Ocean is accompanied by expanding navigational, economic, and scientific opportunities in the region, although the sea ice pack and its future trajectory still dominate any discussions of the polar marine environment. Improving our capability to model sea ice over a range of length and time scales will help provide policy makers with vital information and a framework for navigating the new Arctic, as well as meeting the demands of increased human activities in the region.

Ken Golden

The research of two Department of Mathematics professors on sea ice is featured in the November 2020 issue of the *Notices of the American Mathematical Society*. Kenneth M. Golden, Distinguished Professor of Mathematics, and Elena Cherkaev, Professor of Mathematics, have contributed (along with 11 other authors) to an article that reviews significant recent advances in sea ice modeling, which includes a broad range of ideas and methods from many areas of applied and computational mathematics. While developed for sea ice, the mathematics in the article typically has broader applications and provides insights into the analysis and modeling of other multiscale materials and systems. The publication date of the article coincided with the official end of the largest Arctic expedition ever mounted, where the German research icebreaker *Polarstern* was frozen into the ice pack to drift for a year. A photo of the *Polarstern* steaming northward through sea ice is featured on the cover of the November issue of the *Notices*.

"The dramatic loss of Arctic sea ice has been pivotal in illustrating the serious implications of a warming climate," said Golden. "It was a real pleasure to have the opportunity to work with experts from around the world to tell the story of how mathematics is having a significant impact on advancing our ability to model and predict the behavior of sea ice. Moreover, most of these advances are mathematical in nature, and as such the results can be applied to other complex multiscale systems. We'd like to thank the editors of the *Notices* for being so helpful and accommodating in bringing this work to light."

"For an applied mathematician, sea ice offers a great variety of exciting mathematical problems," said Cherkaev. "Sea ice is a natural composite material with a very complex porous structure filled with brine, and its microgeometry changes significantly when the temperature changes. Mathematical modeling of the state of sea ice and predicting its influence on large-scale climate changes generates many challenging questions in homogenization theory, stochastic processes, random matrix theory, the theory of composite materials, and fluid dynamics. In this article, we touched on a number of these questions."

To read the article, visit "Modeling Sea Ice" at https://www.ams.org/notices.

Elena Cherkaev

Professor Karl Schwede Named Fellow of AMS

Professor Karl Schwede in the U's Department of Mathematics has been named a member of the 2021 Class of Fellows of the American Mathematical Society (AMS). The Society recognizes members who have made outstanding contributions to the creation, exposition, advancement, communication, and utilization of mathematics. Schwede joins 14 other professors in the department who were previously named fellows by the AMS.

"It's an honor to be named a fellow of the American Mathematical Society, and I'm grateful for the recognition of my peers in the profession," said Schwede.

Schwede received his undergraduate degree in mathematics from Whitman College and a Ph.D. in mathematics from the University of Washington. Math was originally third on his list of interests in college, but as he took more advanced math courses, his focus changed to mathematics.

Schwede does basic research in mathematics, studying algebra, geometry, and particularly singularities. Much of his work is in the setting of modular arithmetic (also known as clock arithmetic), the same setting as much of our modern communication systems. For example, 5 hours after 10 is 3 or 5+10 = 3. "In this area, I have primarily studied singularities of geometric shapes by algebraic means," said Schwede. Recently, he has begun working in mixed characteristic, which connects the positive characteristic of clock arithmetic with classical (5+10 = 15) geometric worlds.

He joined the U's Math Department in 2014 as associate professor and became a professor in 2018. Last spring, Schwede received a Simons Fellows Award in Mathematics from the Simons Foundation.

Karl Schwede

The U's AWM student chapter conducts a meeting on Zoom

AWM student chapter receives Scientific Excellence award

Last spring, the Math Department's student chapter of the Association for Women in Mathematics (AWM) planned a conference, with speakers, mini courses, breakout sessions, and professional development panels. About 60 participants were expected. Unfortunately, when the pandemic hit in March, everything changed, and the conference was canceled.

Despite the setback, the chapter still moved forward and will host a series of online activities and communications for attendees. In recognition of these remarkable efforts, the chapter was recently selected as the winner of the 2020 AWM Student Chapter Award for Scientific Excellence. Christel Hohenegger, associate professor of mathematics, serves as faculty advisor for the chapter.

"We are very thankful and excited to have won this award and receive national recognition," said Claire Plunkett, vice president of the chapter for 2020-2021. "This is a national award from the AWM, and we are one of more than a hundred student chapters, so it's a great honor to be chosen. We feel the award reflects how our chapter's activities have continued to grow and gain momentum over the past several years, and we're excited to continue to sponsor events and expand our activities."

For the academic year, the chapter has invited four speakers and all talks will be held on Zoom. Confirmed speakers include Nilima Nigam, professor of mathematics at Simon Fraser University; Kristin Lauter, principal researcher and partner research manager for the Cryptography and Privacy Research group at Microsoft Research; and Christine Berkesch, associate professor of mathematics at the University of Minnesota. The annual conference has been rescheduled for June 2021.

In addition, the chapter will continue to host joint monthly lunch discussions with the SIAM (Society for Industrial and Applied Mathematics) student chapter; a professor panel in which faculty research is shared with students; joint LaTeX (a software system for document preparation) workshops held with the SIAM student chapter; a screening of a documentary called *Picture a Scientist*, a discussion co-hosted with other women in STEM groups; and bi-weekly informal social meetings. For more information about the U's AWM chapter, visit http://www.math.utah.edu/awmchapter/.

FACULTY PROFILE

Will Feldman

Will Feldman

Will Feldman, assistant professor of mathematics, joined the department in July. He studies mathematical models of physics and thinks about the things most of us take for granted, for example, fluid flow, water droplets, and flame propagation. These models are often developed by engineers or physicists using basic assumptions, but the equations they use can be difficult or impossible to solve exactly, so they often use computations or special approaches to assist them.

"I'm interested in proving mathematically rigorous results for these models," said Feldman. In his research, the results sometimes show the limitations of the modeling assumptions used to derive the equations. Other times, they explain the behavior of all the solutions of the equation without relying on special formulae. "And sometimes, the results are used to justify numerical computations, which are meant to approximate solutions of these equations," he said.

One particular type of problem Feldman has studied is called "homogenization" – the study of the physical properties of complicated heterogeneous materials. The idea is to "average" or "homogenize" the complicated small-scale inhomogeneities in the material to derive simpler effective equations to describe properties at larger scales. For example, the ideas of homogenization theory can be used to study the shapes of water droplets on surfaces that have microscopic roughness, such as a plant leaf, a piece of glass, or a table top. "I like to work out these kinds of questions because I get to use both physical intuition and theoretical mathematical tools," he said.

Feldman wasn't always interested in mathematics. As an undergraduate, he thought he wanted to study physics or history. He started taking math classes because math was useful in studying advanced physics. "I had a lot of amazing math professors, and I started to like math a lot," he said. "Eventually, I realized I could maybe study math and also bring in my interest in applications (especially physics). Basically, that's how I ended up studying partial differential equations."

Like many undergrads who study math, Feldman was worried he would need a special talent to succeed at math, but he had supportive and encouraging mentors, so he never got too discouraged. "I hope the experience of having good mentors has taught me to be a good mentor, too, and show my students I believe in them and the many interesting possibilities available in a career in or related to mathematics," he said.

Before joining the U, Feldman received his Ph.D. from UCLA in 2015 and was an L.E. Dickson Instructor at the University of Chicago from 2015-2019. He was also a member of the Friends of the Institute for Advanced Study (IAS) from 2019-2020. The IAS is one of the world's leading centers for curiosity-driven basic research, based in Princeton, NJ.

Warnock Presidential Endowed Chair for Mathematics

In 2019, Feldman was awarded the John E. and Marva M. Warnock Presidential Endowed Chair for Mathematics by the University of Utah. He will hold the chair for five years and anticipates the funding will provide new and interesting directions for his research. He hopes to have a positive impact by training, mentoring, and supporting a next generation of mathematicians. ,"It was a great honor to be offered the Warnock Chair," said Feldman. "I am obviously very proud to receive the award and grateful to the Warnock family and the university."

Mentors

Feldman is grateful for the support and friendship of mentors throughout his career. As an undergraduate, he worked with a number of mentors at Claremont McKenna College. These mentors sparked his interest

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in mathematics, including Asuman Aksoy, a Crown Professor of Mathematics and Roberts Fellow; Mike O'Neill, professor of mathematics; Professor of Mathematics Emeritus Ellis Cumberbatch; and Adam Landsberg, professor of physics. Professor Jim Higdon, also at Claremont McKenna, was his undergraduate advisor in physics. Professor Inwon Kim at UCLA was Feldman's graduate advisor, and she has had the most impact on his career—they still collaborate on projects. His postdoctoral mentors and collaborators at the University of Chicago were Takis Souganidis, a Charles H. Swift Distinguished Service Professor, and Professor Charlie Smart. Both had a big influence on Feldman's mathematical writing and speaking, pushing him to see clear communication as a central and important part of being a mathematician.

Future research

As he moves forward in his research, he's been thinking about problems involving interfaces in heterogeneous media. He's also been wondering about transport equations and models of grain boundary motion in polycrystalline materials. He's looking forward to discussions and collaborations with his colleagues in the Math Department, especially in the applied and probability groups.

Feldman and his wife are in the midst of raising two young children. He enjoys the great hiking in Utah and is looking forward to relearning how to ski and maybe starting new outdoor activities, such as climbing and biking. He enjoys cooking and has become obsessed (during the pandemic) with making a great cup of coffee.

FACULTY PROFILE

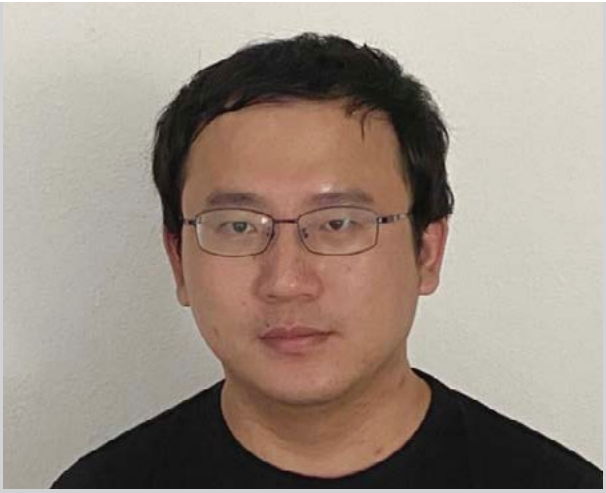
Bao Wang

Bao Wang, assistant professor of mathematics, recently joined the Department of Mathematics. Wang was raised in the modern and populous city of Nanjing, the capital of China's Jiangsu province, about 185 miles up the Yangtze River from the city of Shanghai. "I'm grateful because my parents always gave me the freedom to choose what I was interested in, and I was also able to participate in lots of math and physics contests when I was in middle and high school," he said.

After receiving a bachelor's degree in mathematics from Suzhou University, he was accepted at Michigan State and received a Ph.D. in applied mathematics in 2016. Before coming to the U, he was an assistant adjunct professor at the Department of Mathematics at UCLA.

Deep learning

Wang is interested in deep learning and scientific computing—he specializes in studying recurrent neural nets, graph neural nets, data privacy, stochastic optimization, and computational chemistry.



Bao Wang

"During my postdoc research at UCLA, I became quite excited about deep learning and its ability to revolutionize science and technology, so I started working on developing mathematical algorithms to improve deep learning," he said. He borrows ideas from differential equations and random matrix theory to develop new data privacy algorithms that use better and more efficient models. He also uses deep learning to predict such things in biomathematics as protein structure and computational imaging.

Wang and his wife first visited Utah at the end of 2018 and have moved here during the pandemic. "We haven't been able to see much due to COVID, but we're looking forward to exploring this gorgeous state," he said.

ALUMNA PROFILE

Lora Newman

After Lora (Ballinger) Newman graduated from the U in 1999 with a master's degree in applied math, she left Utah, traveled across the country, got married, and began a new life with her husband, Eric. "I planned to stay home when we had children, so it didn't make sense then for me to spend years working on a Ph.D. that I wouldn't use," she said. "But now that our kids are older and Eric is semi-retired, he can take over homeschooling the younger ones. All of this means that I 'can' go back to graduate school now, and I still want to!" Newman is a first-year graduate student in a Ph.D. program at the University of Cincinnati, where she lives.

Newman is also involved in the Math Haiku Project, a website that welcomes submissions from individuals to write haiku that is intended to help teachers and students teach and understand mathematical concepts. Here is a haiku written by Newman that will likely be included in a book called *Calculus Haiku*:

> Riemann integrals
> pixelate nature's smooth curves—
> mathematical Minecraft

Her first job after graduating from the U was as a substitute teacher at a public high school. She taught algebra and geometry and found it eye-opening. She didn't enjoy teaching and lasted a semester. "I enjoyed teaching the math and my students, but I was not at all prepared for classroom management and all the paperwork," she said. "At the time, it felt as though these other responsibilities took away so much time that could have been better spent teaching. It was a very stressful semester, but it did help me learn to prioritize tasks and to deal with people and bureaucracies."

Lora Newman

Research at the U

For her master's thesis, Newman created a mathematical model to predict winter migration paths for elk that live in Yellowstone National Park, taking into account factors such as elevation, snow depth, available forage, and elk weight. The paths themselves—not just their start and end points—are important to conservationists because certain migration paths take the elk through private lands instead of remaining entirely within Yellowstone. While hunting is not allowed inside the park, hunting is permitted outside the park, so the extent to which elk herds travel outside the park is directly relevant to the management of the size of the herds.

"My work was computer-based, working with datasets and simulations, so I only made one trip to Yellowstone to work with a biologist," said Newman. "It was memorable, though. When I was there, the biologist needed to tag a litter of coyote pups, and my advisor and I were able to go along and help. Corralling the coyote pups was a bit of an adventure!"

Her thesis advisor was Mark Lewis, a professor in the Math Department, who is now a professor and Canada Research Chair of mathematical biology in

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the University of Alberta Department of Mathematical and Statistical Sciences and Department of Biological Sciences. As Newman's advisor, he suggested the problem for her thesis and guided her through the research process. In addition, he connected her with the biologist at Yellowstone. Newman's other advisor was Fred Adler, professor of mathematics and biology at the U. Newman remembers that Adler held really interesting lab meetings, with both math and biology graduate students meeting to discuss interdisciplinary projects.

Lora Newman and most of her family (one child not shown)

Homeschooling kids

After they began having children, Newman and Eric decided to homeschool their children, now ages 18, 17, 15, 11, and 4. Their oldest was highly sensitive to loud noises and had a hard time dealing with the noise level in a typical classroom, so they decided to homeschool her for a while. They began to observe how much more freedom and flexibility homeschooling gave them as a family, so they decided to make it work for the rest of their kids. "Some of my favorite memories are of the projects we did when the kids were small—making vegetable people, creating a giant ear, making ink from pokeberries, and performing Rumpelstiltskin," she said.

As their kids got older they were able to take more responsibility for their own education by taking outside classes. "My kids have been able find tutors or take classes in stage combat, Sanskrit, ornamental horticulture, and ornithology, among other things—all subjects that I wouldn't have been equipped to teach them and they wouldn't have been able to study at any high school near us," said Newman.

Currently, Newman and her husband have a junior at Oberlin College, a sophomore at Mary Baldwin University, and three still at home. Their high school senior is taking classes at the University of Cincinnati this year, so only two are actually being homeschooled.

"My education at the U was really valuable because it helped me understand that with enough effort, I could learn whatever I wanted to learn," she said. "This is a skill that has been very useful both in homeschooling my kids and in going back to school after a (very) long break."

Please contribute to our Student Emergency Fund

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The emergence of the coronavirus has changed our lives. Unfortunately, the pandemic has created serious economic disruptions worldwide. These changes have been especially hard on some of our students. For many of them, family support has dwindled, and many of the sectors that traditionally hired working students have been severely hit. Recognizing the need, the College of Science launched a Student Emergency Fund to help our math students.

As we close 2020, we're inviting alumni and friends of the Department of Mathematics to assist our students facing difficulties. Thanks to generous math supporters, the first $10,000 in gifts to the Student Emergency Fund will be matched. Please help us support students who have lost jobs, are struggling to pay tuition, or who need extra monetary support during this difficult time. To make a donation, visit giving.utah.edu/math.

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Professor and Chair, Department of Mathematics

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We encourage all alumni and friends of the department to join the Crimson Laureate Society today.

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