

DEPARTMENT OF MATHEMATICS • UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

# MATH TIMES

SUMMER 2025

**‘Proud and**

**Grateful’**

Faculty, staff, and students from throughout the Department of Mathematics have come together to overcome the disruptions caused by the first major renovation of the department’s facilities in nearly 70 years.





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# Message from the Chair

We are in an era of change here at the Department of Mathematics at University of Illinois Urbana-Champaign. It may be a challenging road ahead but as we prepare to undergo phases three and four of the Altgeld & Illini Hall project, I am confident that we will continue to persevere as we head into a brighter, freshly-renovated future due to the strong community here at the department.

Community is the thread that ties this issue together. Our cover story, “Proud and Grateful,” is dedicated to the hard-working staff, faculty, and students that have been keeping our department alive and vibrant during this liminal phase. We may be dispersed across campus and Altgeld, our home, may be closed for a while, but the mathematics community remains strong. Our feature articles with Alumna and Convocation Speaker **Peggy Ruff** and Professor Emeritus **George Francis** further highlight the importance of community, a community that does not end upon graduation but will be carried with all alumni as they venture off into industry or pursue graduate study.

As a testament to our commitment to community, the Department of Mathematics has awarded the first George Francis Student Engagement award to Professor **Alexander Yong** which will support his Illinois Combinatorics Lab for Undergraduate Experiences. Other funding highlights include the \$1 million GAANN grant supporting graduate research, **Felix Ledistky**’s five-year NSF CAREER grant towards quantum studies, and a generous alum donation towards restoring Altgeld’s iconic glass dome.

In this issue, we are also excited to share projects that have been under work for quite some time. The MATH Talks video series, an initiative led by the Mathematics Development Advisory Board, premiered its first episode this Spring, and our mathematical models collection gets some time in the spotlight as **Karen Mortensen** and **Sarah Park** lead the model restoration project with help from a team of graduate students.

I hope that the importance of our mathematics community resonates throughout this issue as we celebrate the faculty, staff, students, and alumni who are the beating heart of this department. I would like to call upon our alumni to get involved with the Mathematics at Illinois community, to share your wisdom and experience with the new generation of mathematicians, and even to foster communities of your own. We hope you enjoy this issue of Math Times!



**Vera Mikyong Hur**  
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# CONVOCATION 2025



On May 18th, 2025 the Department of Mathematics held its convocation ceremony at the historic Virginia Theater in downtown Champaign, Illinois.

After an introduction from Department Chair, **Vera Mikyoung Hur**, Associate Dean for Technology & Online Learning **Robert Michael Morrissey**, gave his opening remarks where he thanked the friends and families for all of their help towards the

graduating class's success and congratulated the graduates on their achievements stating, "You are ready to seize opportunities and create a bright future."

**Peggy Ruff**—alumna, Mathematics Development Advisory Board member, and this year's guest speaker—shared advice with the graduating class through her five key concepts towards navigating the real world: communicate with peers, focus on continuous improvement, don't be afraid to take risks, solve problems, and give thanks and give back.

The 2025 convocation saw 214 undergraduate degrees, 10 master's degrees, and 12 doctoral degrees conferred.







“There are so many problems in the world that need a viable solution. You have been educated to know how to approach a problem and find a solution.”

Peggy Ruff

“You are ready to seize opportunities and create a bright future.”

Robert Michael Morrissey



### Watch the Ceremony

Weren't able to make it to the 2025 convocation ceremony? Scan the QR code to view the convocation live stream or visit <https://go.math.illinois.edu/Convocation2025>



# Peggy Ruff Shares Five Key Concepts to Navigating the Real World

Peggy Ruff, Department of Mathematics alumna and guest speaker for the 2025 mathematics convocation, first entered the mathematics program with the intent to become a math teacher. She quickly discovered, however, that the classroom was not the right fit for her career goals and aspirations. Her passions lied more with problem solving than education. While there were many career paths available, choosing one proved to be difficult. Upon graduating in 1975, Ruff recalls, “I didn’t know what I wanted to do.”

Ruff pushed through this uncertainty and began her search for the right career. After a quick stint working in retail, she soon found a part-time position as a clerk and began her steady rise up the corporate ladder. Ruff was initially labeled as a “temporary employee” and would mostly fill in for other colleagues during their vacation or maternity leave. This allowed her to gain experience in several roles within the company and work on a variety of assignments. Eventually she worked her way into the Refined Oil Division and secured a full-time clerical position.

During her time in this clerical position, the company went through a number of changes, selling their soybean business and shifting their focus entirely towards corn products. From there, Ruff steadily became more involved in high-level logistics. She went from being the clerk, to a merchandiser in oil, to a marketing assistant, to a director, and then ultimately to being the Vice President of Logistics for Tate & Lyle Ingredients America, a role where she was able to utilize the skills she learned at Illinois.

Ruff credits much of her success to the mathematics and liberal arts education she received while pursuing her bachelor’s. “I don’t have a master’s. I don’t have a PhD, but Illinois taught me how to think.” Coming from a working-class family in Decatur, Ruff never thought she’d have a career as a corporate executive, but her math education gave her the confidence to dive headfirst into challenges stating, “I absolutely felt



like I could do any assignment or job they would ask me to do.”

Growing up in the 60’s and 70’s, Ruff fully expected that being a woman would limit her professional career, but she never let that stop her from pursuing her goals. In Ruff’s words “To become the vice president of the Tate & Lyle company, as the first female vice president of that company, I never thought I would be able to have that. I always aspired to that, but I never thought that opportunity would be given to me.” Once the opportunity was in front of her, however, she took full advantage and ultimately thrived in the logistics-based environment.

After a successful career in logistics, Ruff has had the opportunity to serve on several advisory boards for both commercial businesses and non-profits including our Mathematics Development Advisory Board, and received the LAS Constituent Leadership Award in 2013. Still, when asked to speak at the 2025 mathematics commencement, Ruff was unsure if she was the right person for the job.

Ruff was delighted to be asked, but didn’t know if she would be a good choice since she didn’t have a higher degree. After consulting with other alumni and our department, she realized that she did have an important message. Having been in the same



position as the graduating class, she knew she wanted to offer some words of guidance stating, “Many of you receiving advanced degrees today know exactly what you want to do and what your next step will be after graduation. For me, that was not the case. I found my way towards my future career by trial and error.” Ruff had reflected on the career she had built and developed five key concepts to navigate the “real world” which she then shared with the graduating class: communicate with peers, focus on continuous improvement, don’t be afraid to take risks, solve problems, and give thanks and give back.

## **Communicate with Peers**

Communications and interactions with peers are key to being successful. With the rise of technology and social media, Ruff has witnessed the younger generations attempt to use these advancements to replace the value of human interaction, an issue that was only exacerbated by the COVID pandemic. Ruff, however, holds firm that trustworthy “in-person” relationships with your colleagues are vital for success. “At some point in your career, you will need help,” she states, “Being able to tap into personal relationships and ask for help, advice, and suggestions is irreplaceable.” Your community and network are there to help you when you need it. Sometimes, a fresh set of eyes is the missing piece to solving your problem or bringing a project to fruition.

## **Focus on Continuous Improvement**

Your personal development does not end at graduation. Each new position is an opportunity to learn and to continue to improve. This focus on continuous improvement, however, extends beyond the self. Ruff states, “All organizations can become stagnant from being burdened with attitudes and traditions that may inhibit growth. At times, it is just easier to keep on doing what you have always done rather than suggest a change. But allowing these things to fester and prevail only makes life more difficult for employees to achieve the desired results.” She further emphasizes the need to ask the difficult questions. Does this add value? Why is this information of value? Who is the audience for this information? Is there a better way to get this information? These questions will

ultimately lead to building a more sustainable culture.

## **Don’t be Afraid to Take Risks**

Throughout your professional career, you will often be asked to do something outside of your comfort zone. Ruff repeatedly encountered this during her ascent up the corporate ladder, but she never let the fear of the unknown keep her from tackling these challenges head on. She states, “You will not always know where the job or task you are asked to do will take you. When this occurs, although it may be easier to say no, I encourage you to look at these challenges as opportunities. Take advantage of the opportunity to expand your horizons and your experience. Delve into the assignment, study the conditions, and look for successful outcomes.”

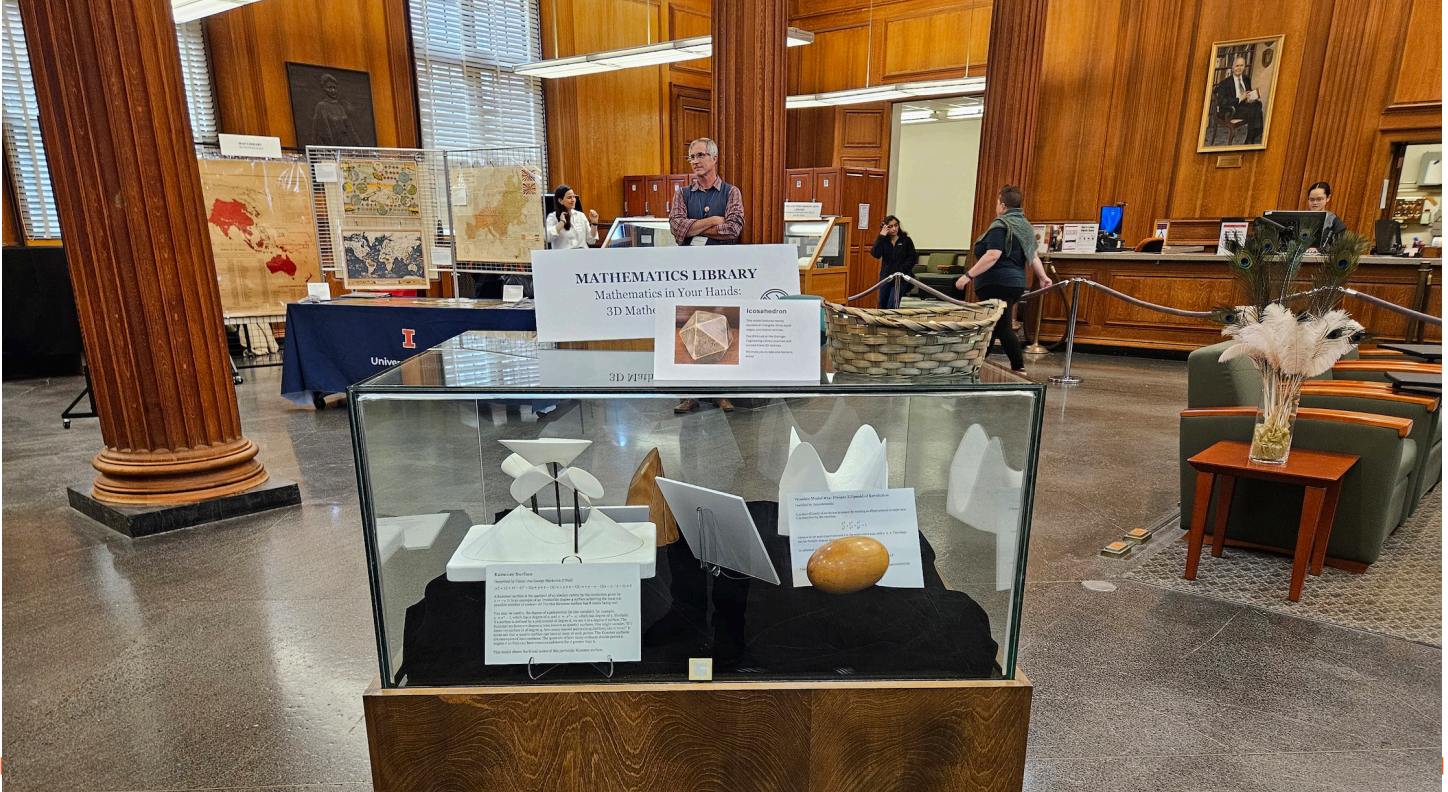
## **Solve Problems**

Graduates of mathematics are in a unique position with their degree, having gained a thorough foundation of logical reasoning and a full set of problem-solving skills. Ruff states, “There are so many problems in the world that need a viable solution. You have been educated to know how to approach a problem and find a solution. You define the problem, analyze the root cause, identify known and unknown variables and apply logical reasoning to develop solutions.” Our math alumni are problem solvers. Part of being a mathematician is taking joy in finding solutions to difficult problems, and this is a strength that can be used in any career you choose to pursue.

## **Give Thanks and Give Back**

Ruff closes out her key concepts with a reminder to be humble and show appreciation, “Always be grateful for the opportunities that you will have and utilize those opportunities for your benefit and the benefit of others. As you achieve success in your chosen field, you need to give back by taking time to share your knowledge and talents with other people and non-profit organizations in your community.” She also encourages alumni to continue to engage with Illinois and the Department of Mathematics, “You may not realize it now, but this University has had a profound impact on you, and keeping in touch as an alumni will help you, the University, and future generations of mathematicians.”





## Mathematics in Your Hands: Mathematics Library joins 100th Anniversary of the Main Library building

On November 15, 2024, the Mathematics Library participated in a celebration for the 100th Anniversary of the Main Library building and the dedication of the Shebik Family Reading Room, hosted by the University Library and the University of Illinois Foundation hosted for Library Friends and Foundation Weekend.

For the event, the Mathematics Library held a display titled Mathematics in Your Hands: 3D Mathematical Models, where visitors could view two plaster models (a Kummer surface and a model for Clairaut's Theorem) as well as two wooden models (a Right Cone with Conic Section and a Prolate Ellipsoid of Revolution).

In addition to the historical models, **Sarah Park**, the Head of the Mathematics Library, collaborated with the IDEA Lab within the Grainger Engineering Library Information Center to experiment with scanning wooden models to be used in 3D printing.

One of these models was of an icosahedron, a 3D shape which consists of twenty equilateral triangles, thirty equal edges, and twelve vertices, resembling the D-20 dice used in board games. Visitors to the display were given mini 3D-printed icosahedrons. Over 200 of these miniaturized models were handed out to guests in a variety of colors including gold, luminous white, dark blue, dark green, and luminous green.





## Six Faculty Members Added

The Department of Mathematics welcomed six new faculty members for the 2024-2025 school year:

- **Ben Castle**, assistant professor, is a mathematical logician specializing in model theory and its interactions with algebra, geometry, and combinatorics. Before coming to Illinois, Castle held postdoctoral positions at the Fields Institute, Notre Dame University, Ben-Gurion University of the Negev, and the University of Maryland; during this time, his work focused on studying reconstruction theorems in geometry from a model-theoretic lens. He holds a PhD in mathematics from UC Berkeley.
- **William Chen**, assistant professor, studies the arithmetic and geometry of noncongruence subgroups of  $SL(2, \mathbb{Z})$ , and its relation to Hurwitz stacks, Teichmüller dynamics, and combinatorial group theory. Before coming to Illinois, Chen has been a member at the Institute for Advanced Study, and an NSF Postdoctoral Fellow at Columbia University. He holds a PhD in mathematics from the Pennsylvania State University.
- **Lena Ji**, assistant professor, is an algebraic geometer who studies problems related to Fano varieties, rationality, and connections to arithmetic geometry. Most recently, Ji was an NSF postdoctoral fellow at the University of Michigan. She holds a PhD in mathematics from Princeton University.
- **Abhishek Methuku**, assistant professor, works on solving problems in Combinatorics using probabilistic methods and tools from other areas. His work involves developing semi-random methods and new tools for applying expanders to solve graph embedding problems for sparse graphs. His research includes the resolution of several longstanding problems of Erdős such as the celebrated Erdős-Faber-Lovász conjecture for which he received the 2024 Frontiers of Science Award in Mathematics awarded by the International Congress of Basic Sciences. Before coming to UIUC, he was a research fellow at ETH Zürich. He received his PhD from Central European University in Budapest.
- **Polly Yu**, assistant professor, is an applied mathematician who looks for generalizable principles to chemistry and biology. To study the dynamics arising from chemical/biological systems, she uses tools from graph theory and algebra in addition to numerical and symbolic computations. Before coming to Illinois, Yu was an independent postdoctoral fellow at the NSF-Simons Center for Mathematical & Statistical Analysis of Biology at Harvard University. She holds a PhD in mathematics from the University of Wisconsin-Madison.
- **Eric Chen**, assistant professor, works in geometric analysis on geometric flows such as the Ricci flow as well as conformal geometry. Most recently, Chen was an NSF postdoctoral fellow at the University of California, Berkeley. Chen was also the Ky Fan visiting assistant professor at the University of California, Santa Barbara. He holds a PhD in mathematics from Princeton University.



### New Graduate Leadership

**Jared Bronski** (Left) is our new Director of Graduate Studies and **Richard Sowers** (Right) is our new Director of Graduate Admissions. Traditionally, the graduate program has only had one leadership position, the Director of Graduate Studies (DGS). As we continue to grow our department, this year we have implemented a new position, Director of Graduate Admissions (DGA) which will work closely with the DGS, overseeing the application process and new student outreach.



## Department News

# New Cohort of GAANN Fellows Now at Work

*The Department of Education's Graduate Assistance in Areas of National Need supports PhD students at Illinois and a set of national research priorities.*

The Department of Mathematics recently earned a Graduate Assistance in Areas of National Need (GAANN) grant. The three-year, \$1 million grant will provide fellowships to several PhD students every year. The first cohort of GAANN Fellows includes: **Derya Asaner**, **Connor Grady**, **Doron Grossman-Naples**, **Ryan McConnell**, **Alex Taylor**, and **Ken Willyard**.

The U.S. Department of Education supports GAANN Fellows in a variety of priority research areas like math, computer science, life sciences, engineering, physical sciences, education, and psychology. Fewer than 60 institutions across the country received GAANN funding in 2024's grant cycle.

Typically, doctoral students in mathematics work as teaching assistants to support themselves, but the GAANNs Fellowships offer a different opportunity.

"Fellowship funding is so valuable in freeing students from teaching duties, especially early in their graduate studies and near the end when they are finishing a thesis," said **Karen Mortensen**, Associate Director of Graduate Studies. Mortensen leads the grant with **Jared Bronski**, Director of Graduate Studies.

The Department of Mathematics intends to use the GAANN Fellowships as a recruitment incentive for incoming PhD students and to help students shorten the time it takes to complete their degrees, according to Mortensen.

"Producing high-quality research requires regular and sustained periods of focused work on the problem, as well as time

spent reading relevant papers, speaking to colleagues, and attending seminars in order to maintain a solid understanding of related work in the field. This opportunity to focus entirely on my research is tremendously beneficial at this time in particular, as I head into the second half of my sixth and penultimate year of grad school," Doron Grossman-Naples, a new GAANN Fellow whose advisor is Professor **Charles Rezk**, said.

Grossman-Naples studies elliptic cohomology with level structure. The state of the art in elliptic cohomology with level structure "is a rather unsatisfactory state of affairs," Grossman-Naples said. It only includes "level  $N$  structure when  $N$  has a multiplicative inverse. In particular, if you want all possible level structures, you have to invert everything and work over the rational numbers [and] rational homotopy theory misses a lot of information."

The Department of Mathematics also won a GAANN grant in 2015. Twenty-one students received GAANN Fellowships during that grant cycle

### Freeing Students to Focus

The GAANN Fellowships are a boon to the department – freeing students to focus deeply on their research – and to the field more broadly. Fellows who were a part of the Department of Mathematics' 2015-2018 GAANN award are now having terrific impact in a variety of areas.

- William Balderrama is a postdoc at the University of Bonn. He is the author or co-author of 13 research papers in homotopy theory.
- Cara Monical studied combinatorics and earned recognition for her teaching while at Illinois. She is now at Sandia National Laboratories, where she was awarded her first patent in 2023.
- Dana Neidmann received an MS in the Teaching of Mathematics along with his PhD at Illinois. He is now a professor at Centre College, where he explores the interplay between graph theory and number theory.
- Colleen Robichaux is a Hedrick Adjunct Assistant Professor and NSF Postdoctoral Fellow at the University of California Los Angeles, focusing on algebraic combinatorics and Schubert calculus.





## Two mathematics PhD alumni named Sloan Research Fellows

The Mathematics Department at the University of Illinois Urbana-Champaign would like to congratulate two of our alumni, **Michelle Delcourt** (left) and **Anton Bernshteyn** (right), for being two of 126 scholars who received the 2025 Sloan Fellowships. This prestigious award is granted to the most promising early-career researchers in fields of Mathematics, Chemistry, Computer Science, Earth System Science, Economics, Neuroscience, and Physics.

## Mathematics Development Advisory Board holds 15th annual meeting

On October 4th, 2024, the Mathematics Development Advisory Board convened at Alice Campbell Alumni Center in Urbana, IL for its 15th annual meeting. The board advises math leadership on important areas of growth and development such as student success, alumni engagement, and fundraising. The MDAB has also been fundamental in developing our MATH Talks video series.

At this year's annual meeting, mathematics department leadership shared the most recent data on enrollment trends, post-graduation outcomes, and admissions. They also discussed the progress for the ongoing Altgeld & Illini Hall project and future possibilities for the Illinois Mathematics Lab (IML). Members **George Akst**, **Jerome Casey**, and **Bill Perry** ended their term with MDAB, and the board welcomed three new inductees: **Scott Fisher**, **Elaine McGrath**, and **Kelley Yancy**.



## Share Your Story

Are you an alum who has recently landed a new job, published an article, won an award, or made a breakthrough in research? We want to hear all about it. Scan the QR code or visit <https://go.math.illinois.edu/ShareYourNews>

## Spring 2025 New Staff

The Department of Mathematics had three new staff members joining us this Spring 2025 semester. **Victoria Prince** is our new Associate Director of NetMath, a newly created position that will be assisting **Partha Dey**, our current Director of NetMath, in expanding the program. Our Undergraduate office also welcomes two new academic advisors, **Stacey Albers** and **David Hovorka**.



# ILLINI HALL GROUNDBREAKING

A ground-breaking ceremony was held near the construction site at the corner of John St. and Wright St., the soon-to-be home of the next Illini Hall. The previous building there was demolished in 2023, the former home of the University YMCA, Daily Illini, and memories of thousands of alumni.

More than 100 attendees came to the event, including University of Illinois System President **Tim Killeen**, Chancellor **Robert Jones**, and members of the Board of Trustees. **Venetria Patton**, Dean of the College of LAS, Jones, and Capital Development Board Construction Administrator **Tim Patrick** spoke to the crowd.

“Today’s groundbreaking is the result of vision, dedication, and hard work of many people, some of whom have been engaged in thinking about, planning, and shepherding this project for years,” said Patton. “To everyone who has contributed to making this dream a reality, including our generous donors, I want to offer my heartfelt gratitude. The new facility that will soon begin to rise just across the street will benefit thousands of Illinois faculty and students, and will empower them to make an amazing impact on our campus, our communities, our state, and our world.”

The replacement of Illini Hall will provide a new world-class facility for mathematics and statistics departments. The building program will include

an innovative data science center to connect the university’s data scientists with business, industry, and the community. This building will also provide administrative office and support spaces, multi-purpose gathering areas, and classrooms.

Said Jones: “When this building is complete, it will stand as a tangible example of what’s possible when we stand true to our mission, and we stay committed to our goals and objectives, and when we continue the process of working seamlessly together, as members of this vital community. It is at the center of our land grant mission to provide very real, very impactful public benefits here for the citizens of the state of Illinois and beyond.”

This new building shall be minimum LEED Silver certified. The commissioning and removal of Illini Hall was completed in 2023.





“...it will stand as a tangible example of what’s possible when we stand true to our mission, and we stay committed to our goals and objectives, and when we continue the process of working seamlessly together, as members of this vital *community.*”

### Altgeld Live Stream



Tune in and watch the Altgeld & Illini Hall Renovation project live!

Scan the QR code to view the live stream, learn more, and get involved with the project or visit <https://go.illinois.edu/AltgeldLive>





# 'Proud and Grateful'

by BILL BELL

*Faculty, staff, and students from throughout the Department of Mathematics have come together to overcome the disruptions caused by the first major renovation of the department's facilities in nearly 70 years.*



“It surprises some people, but mathematics is a social activity,” according to **Rui Loja Fernandes**, the Lois M. Lackner Professor of Mathematics at the University of Illinois. “Between teachers and students, yes, but also between all kinds of faculty. Researchers need to interact with one another, too.”

Though faculty in the Department of Mathematics have been split by Wright Street for years – with some having offices in Altgeld Hall and others in Illini Hall – the gaps have been exacerbated by the construction of a replacement for Illini Hall. Since the demolition of Illini Hall, faculty have been dispersed across three buildings on campus, and further relocations are expected when extensive interior renovations to Altgeld Hall begin in the coming years. Students face a similar situation. More than 175 graduate students and postdocs have moved to temporary digs, and the Undergraduate Advising Office is currently in a building on Green Street.

“It is a very real disruption. A \$200 million-plus project is going to be. Knocking down and rebuilding a building is going to be,” said Department Chair **Vera Mikyoung Hur**. “It’s important to acknowledge the inconveniences. I am proud and grateful for the way in which the entire department has come together. Their flexibility, problem-solving, dedication, and professionalism don’t surprise me. But they do make me very happy.”

People across the department agree that the work is a must. Faculty, staff, and students have all made an intentional effort to work through and mitigate the disruptions.

The last significant renovation for Altgeld Hall was in 1956, and the future upside is huge. “You come into a state-of-the-art building. It’s welcoming. It looks great,” Loja Fernandes said. “You want to be a part of it, and interactions will increase dramatically. New spaces will make a big impact.”

## ‘Close and Relevant’

The Mathematics Library was among the first departmental units to move. In the summer of 2023, the team meticulously kept their collection of 112,000 books and other materials in order as they were shifted to the campus’ Main Library, where

they are being housed during the renovations. Items were frequently hand-carried down the stairs. Moving crews were in daily, loading cart after cart onto a truck, driving them to the new location, and offloading them. That process alone took about six weeks.

Moving the collection to another central location just off the Quad “helps us remain closely connected and relevant to the Departments of Mathematics and Statistics while also providing access to the broader campus community,” according to **Sarah Park**, head of the Mathematics Library and a professor in the University Library. Library staff, unbound journals, and course reserve materials are in Grainger Engineering Library, about a block from Altgeld. Staff are offering research and consultation services virtually, reminding faculty of those services on an ongoing basis. Appointments for in-person services and use of the collection have also helped.

“We’ve done quite a lot,” Park said.

Colleagues and members of the preservation, cataloging, and central access services departments within the University Library have been attentive and pitching in. “We’re grateful for the support we’ve received. We wouldn’t be in this position without that support. Despite the disruption, they’re helping us and keeping us in the loop,” Park said.

“The Mathematics Department has always loved our library because of the collection, and it’s been a selling point to attract top faculty and researchers from around the world. It is good to see that it remains that important,” **Becky Burner**, a senior library specialist.

## ***Become a Partner***

Gifts to the Mathematics Partnership Fund have the widest impact on the



work we do. Scan the QR code to learn more or visit <https://go.math.illinois.edu/Giving>



## ‘People Care’

With construction following so closely on the heels of the COVID pandemic, many opportunities for members of the department to meet one another, spend time together, and simply socialize dried up. The weekly tea and cookies get-together, which has been a part of the Department of Mathematics for so many years, goes on. (Rather than taking place in the basement of Altgeld it now floats among different locations.) And graduate student seminars are back up to speed.

“We’re recovering, and colloquium [which brings in distinguished faculty from other institutions] is back to pre-pandemic levels of attendance and has high faculty participation,” Loja Fernandes said.

But other events, both formal and informal, did not continue. Perhaps no one has sought to remedy that situation more than PhD student **Maddy Ritter**.

She said she is “pretty involved in the department,” and she understated things. Ritter is a member of the department’s Climate, Equity, and Inclusion Committee, president of the Graduate Student Chapter of the Association for Women in Math-

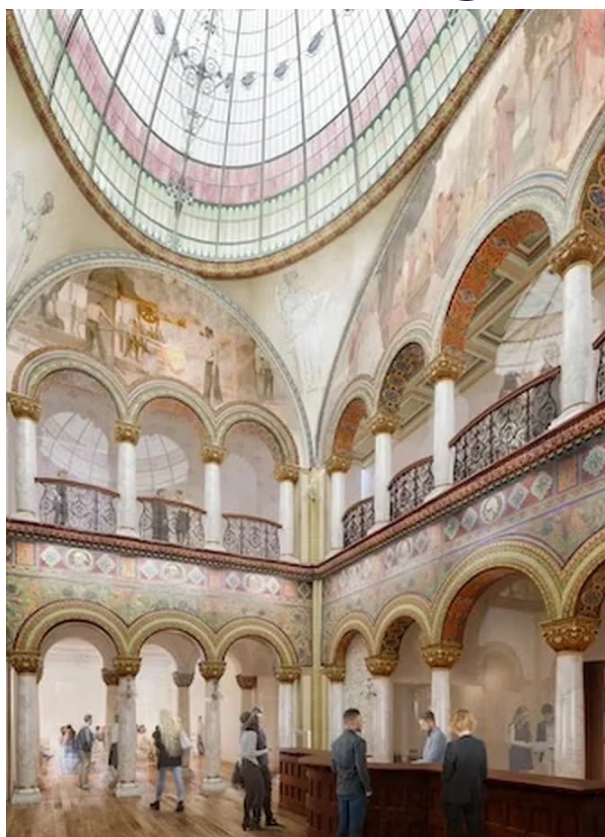
ematics (AWM), and outreach manager for the Illinois Mathematics Lab – all while winning awards for teaching excellence as a calculus TA in the Merit Program.

With Ritter’s leadership, the AWM chapter hosts several events throughout each semester, with about 15 to 20 students attending any given event. These include movie nights, an annual celebration of International Women’s Day, casual coffees, and panels of female faculty members. They also put on the welcome picnic for graduate students every fall. The AWM’s activities are not limited to social gatherings. They host a book club and support a math circle for middle to high school students on the weekends.

“People feel stuck sometimes, but people care. And we have a big presence,” Ritter said. So big and successful that the department is now helping students start an American Mathematical Society (AMS) chapter as well. “The director of graduate studies asked, ‘What can we do to help?’ They were very interested and open to making the student experience better,” she said.

The new AMS chapter has supported board game

## A fond memory of Altgeld Hall leads to a brighter future for the building



### *Mathematics alumnus supports the revival of an iconic space*

**Greg Dobbins** (MA, '73, mathematics) fondly recalls his time studying at the University of Illinois. His memories have led him to support the future of mathematics and other disciplines on campus.

Dobbins has pledged \$1 million to the Altgeld and Illini Hall Project. His gift is intended to help restore the Altgeld library lobby and former glass dome, a stunning feature which was removed in the early 1940s for safety reasons.

Originally from Cleveland, Ohio, Dobbins attended the University of Notre Dame to earn an undergraduate degree in mathematics. While he was there, the math department head recommended that he apply to the University of Illinois for graduate studies. Dobbins was accepted at Illinois in 1971 and received a teaching assistantship.

“I fell in love with the Illinois campus almost immediately,” Dobbins recalled. “I had a room in Sherman Hall, which was just a short walk to my office in Illini Hall. I attended classes in Altgeld Hall, just across Wright Street. I also took many meals in the Illini Union.”



nights for graduate students and postdocs. On their own, graduate students also organize board game and hot pot nights, watching March Madness together, and other regular activities to build community.

“AWM, under Maddy’s leadership, has been vital to community-building among the graduate students. None of these would be possible without the amazing committees that make up the AWM board,” said **Polly Yu**, who joined the department as a professor this year and is faculty advisor to AWM.

### ‘Very Exciting’

In addition to co-locating all students and faculty in the newly built Illini Hall, major improvements to Altgeld will make shared student experiences, faculty-student interaction, and student services much easier.

“[Illini Hall] has been intentionally designed to really reimagine the building and construct it to enhance the student experience. It’s very rare for a math department to be able to design a building for what we do. It’s very exciting,” said **Sheldon Katz**, a professor of mathematics and Arthur Coble Scholar, in a previous interview.

Altgeld currently includes three floors with additional odd levels reached by stairs or ramps – so addressing accessibility is a key part of the work, providing access to all areas and minimizing the number of separate levels. Other features include:

- A new lounge for undergraduate students and new rooms for undergraduate student organizations.
- New research space for the Illinois Mathematics Lab.
- New tutoring rooms.
- Several new classrooms in Altgeld and nearly a dozen new classrooms in Illini Hall.

The Mathematics Library will also return to its rightful – and beautiful – place. A new reading room will be added, and the rotunda will be specially lighted to make its stained glass all the more impressive. The bookstacks will keep their glass floors, while adding seating and an elevator.

The library team has worked closely with students who are part of the Illinois Mathematics Lab to catalog and care for more than 400 physical models that make their home in Altgeld. Made of string, wood, glass, plaster, paper, and metal – as well as the plastic and other materials used in 3D printing – these models illustrate mathematical concepts and systems. Many date back to 19th Century Germany.

With new climate-controlled gallery space in the library, this effort is “the perfect project to preserve this beauty,” according to Park. “It’s an enormous amount of work to catalog these, but they are a way to appreciate the past and connect to all the effort that previous faculty and students put in.”

**“This will be where ideas form, where friendships and mentorships form. Our people are so very creative, and the outcomes of that creativity can change how we understand the world.”**

*- Vera Mikyoung Hur*

Which is an apt description of the Altgeld Hall and Illini Hall projects as a whole – an enormous amount of work and an indelible connection to the past and future of the Department of Mathematics.

“The spaces we inhabit are crucial to our work and our relationships and all the time we spend in our studies and our research,” Department Chair Vera Mikyoung Hur said. “This will be where ideas form, where friendships and mentorships form. Our people are so very creative, and the outcomes of that creativity can change how we understand the world. Altgeld Hall and Illini Hall will anchor that for the next century of our work.”



# Mathematics Advancing Technical Horizons

## *The long road to developing MATH Talks*

by JADEN MEADOWS

In Spring 2025, the Department of Mathematics released the first episode of MATH Talks, an initiative of the UIUC Mathematics Development Advisory Board (MDAB) designed to engage Illinois Math alumni, current students, faculty, and anyone with a love of mathematics. Having been in development for several years, this project has grown in scope from its initial conception. The series is now produced through a collaboration between the Department of Mathematics and the Department of Media & Cinema Studies in the College of Media with funding coming from both departments, an anonymous donor, and the college of Liberal Arts & Sciences. In the beginning, however, it was just one man recording on his phone in the middle of the COVID pandemic.

After the murder of George Floyd in 2020, a math alumnus and former MDAB member, **Dr. Bill Taber**, began to reflect upon common diversity, equity, and inclusion practices and how best to evaluate whether said practices actually lead to an equitable workplace. Diversifying employer demographics is a complex issue that takes time to resolve and is difficult to determine if an employer is on track to an equitable workplace. With his strong background in mathematics, Taber decided he needed to model it mathematically stating, “Math can help us see our unconscious bias.”

In an ideal workplace, the employee demographics should be equal to the population’s demographics. In practice, most industries are far from the ideal and realistically, disparities in hiring cannot be fixed overnight. Employers are limited by employee turnover rate and other factors. How then, can an employer determine if they are on track to reach their diversity goals when only incremental changes occur each year?

To answer this difficult question requires a thorough examination of the hiring process and an understanding of the underlying mathematics. Employers first need a solid foundation to their hiring practices. To hire diversely, they need to be sure to recruit diversely and to seek a wide range of applicants. Furthermore, they need to have strong anti-bias training within their hiring process to ensure these applicants have a fair chance. Once these practices are in place, the population of workers will gradually shift to reflect the wider population demographics.

To visualize how this process works overtime, Taber treated the problem like a fluid of solutions. He modeled how long it would take the fluid to reach an equilibrium (i.e. a place where the demographics of the workplace match the demographics of the wider population). This enabled him to calculate how long it would take to reach diversity goals.



Tracking changes in employee demographics allowed him to provide the employer the opportunity to adjust their hiring practices to reach equilibrium at a faster rate.

Taber presented his model and mathematical explanation to colleagues at JPL to positive reception. Not long after, he joined the MDAB, and the committee began discussing ways to get people engaged in mathematics. They felt that the value of mathematics was not well understood by society and wanted to steward a project that would showcase practical applications of mathematics and how mathematics research impacts the real world.

In searching for a way to promote interest and teach these real-world applications of mathematics, the MDAB eventually settled on creating a Ted-talk like series of educational videos. The series would provide a platform for sharing insights and ideas from working mathematicians in academia and industry with the broader Illinois Math community as well as the general public. They decided on the name “MATH Talks” with MATH standing for Mathematics Advancing Technical Horizons, a backronym that suited their goal of promoting the real-world value of mathematical theory and research.

As this conversation was happening in the middle of the COVID pandemic, members of the committee were still working remotely, and campus was under lockdown. It didn’t look like there would be any development towards this project for some time, but Taber took it upon himself to create his own video. Adapting his presentation, he wrote the script, made the slides, and filmed the entire video on his phone from his son’s old bedroom which he was using as an impromptu office. There was still a long road ahead, but now there was a proof-of-concept.

From there, the MATH Talks project continued to evolve. Once in-person activity resumed on campus, the MDAB ramped up the scale of production. For the second episode, they recorded live in front of an audience with filming and post-production led by **Victor Font** who would incorporate the production into the curriculum of one of his courses.

Once the production was approved, MDAB needed to select a speaker for the second episode. The committee felt it was important to continue to show that mathematics can be used to solve real-world problems and wanted to select a topic that felt both relevant and accessible. **Rui Fernandes**, MDAB Faculty Liaison, suggested Professor **Zoi Rapti** as her work in pandemic modeling would make for a timely and interesting topic. Once she was on board, they began to develop the script with help from Professor **Thom Miller** from the Department of Theatre, College of Fine and Applied Arts.

After filming the second episode, the MDAB was able to secure funding to continue the series. Now fully funded, they were able to begin formalizing the production process. MATH Talks episodes would be recorded in the fall during Font’s class MACS 370: Cinematography and Sound Design, offered through the College of Media, and would then be edited by students under Font’s guidance. In Fall 2024, the third episode of MATH Talks was recorded with Professors **Felix Ledinsky** and **Amanda Young** on the topic of Mathematics in Quantum Science and Technology, set to be released in Fall 2025. The video was once again filmed in front of a live audience. Ledinsky and Young went through the script twice to ensure the best quality of video and afterwards, the guests were treated to a reception with snacks and refreshments.

The fourth video in the MATH Talks series is currently under production and slated for release in Spring 2026, continuing what will become a yearly tradition. This project has been in the works since 2020 and has finally come to fruition with the release of Episode 1: The Mathematics of Diversity in Spring 2025, and Episode 2: Modeling of the Covid Epidemic in Summer 2025. The Department of Mathematics at Illinois is excited to see how mathematics continues to advance technical horizons, and we hope you will tune in for the upcoming episodes of MATH Talks.



**Watch MATH Talks Now!**

Scan QR Code or Visit <https://go.illinois.edu/MATHTALKS>



# Awards & Grants

## Leditzky awarded 5-year NSF CAREER Grant

Assistant Professor **Felix Leditzky** has been awarded a 5-year Grant from the National Science Foundation (NSF) through their Faculty Early Career Development (CAREER) Program. Through this award, NSF has recognized Leditzky as an early-career faculty member with a strong potential to be a role model and leader within mathematics research and education.

This grant will fund Leditzky's project, "Symmetries in noisy multipartite quantum systems". Quantum communication and computing rely on understanding the mechanics of multipartite entanglement. Due to the presence of environmental noise and the complexity of large quantum systems, it is difficult to construct a precise mathematical characterization of this phenomenon. Leditzky aims to utilize symmetries to reduce the complexity of describing these quantum systems, and to understand how they behave under the influence of environmental noise.

Environmental noise has been a present issue with existing technology such as radio waves and satellite communication. Leditzky is utilizing techniques based on similar error-correcting methods to develop tools to protect quantum information from decoherence and to discover the limits of such tools.

Beginning in October 2025, this grant will fund research assistant positions for graduate students, work-related travel, and a broader impact initiative with local community colleges. Research in this field requires advanced linear algebra which is often not taught in standard linear algebra courses. As part



of this project, Leditzky will work with graduate students to provide a crash course in linear algebra with the intention of working in quantum theory. This crash course will be recorded and publicly available for free, helping to lower barriers for students wishing to participate in quantum studies.

The University of Illinois at Urbana-Champaign has been an active proponent of quantum research with the interdisciplinary Illinois Quantum Information Science and Technology Center (IQUIST) which brings together faculty from several departments including mathematics, physics, engineering, computer science, and material science. This grant will provide opportunities for students interested in quantum theory and help ensure the university's continued progress in the field.



## Bateman Prize in Number Theory

Debmalya Basak was named recipient of the Bateman Prize, awarded to a graduate student in recognition of outstanding research in number theory. Debmalya Basak works in Number Theory at the University of Illinois Urbana-Champaign, co-advised by Prof. Alexandru Zaharescu and Prof. Jesse Thorner. His research focuses on analytic number theory, particularly the distribution of prime numbers, L-functions, exponential sums, sieve methods, and partitions. He thanks his advisors and the vibrant Number Theory group at UIUC for creating an inspiring academic environment that played a key role in earning him both the Bateman Prize and the Philippe Tondeur Dissertation Prize.

Prof. Zaharescu describes Debmalya as a remarkably dedicated and intellectually gifted student, who stands out for his creativity and collaborative spirit. Prof. Thorner adds that Debmalya combines his technical strength with a rare ability

to identify and pursue bold, original ideas, qualities that distinguish him as a scholar with extraordinary promise.

Debmalya's research has already been published in multiple journals, including Transactions of the American Mathematical Society, International Mathematics Research Notices, and Algebra & Number Theory. After completing his Ph.D., he will continue his mathematical journey as a postdoctoral fellow at the Max Planck Institute for Mathematics in Bonn, Germany.



## Irving Reiner Memorial Award

Ada Stelzer was named recipient of the Irving Reiner Memorial Award and Fellowship. The Reiner Prize is awarded each spring to one or more graduate students in recognition of outstanding scholastic achievement in the field of algebra. Ada Stelzer is a 4th year PhD student in algebraic combinatorics, advised by Prof. Alexander Yong. Her research is centered on the homological invariants of determinantal varieties, which she and her collaborators study via a blend of techniques from representation theory, commutative algebra, and combinatorics. Stelzer is a recipient of an NSF graduate fellowship and frequently presents her work at other institutions, such as the Université du Québec à Montréal and University of California, Los Angeles. Outside of math, she enjoys making music and spending time outdoors.



## Kuo-Tsai Chen Prize

Wilmer Smilde was named recipient of the Kuo-Tsai Chen Prize, given in recognition of outstanding scholastic achievement by a graduate student whose research examines relationships between analysis and either geometry or algebra. Smilde received his bachelor's and master's at Utrecht University and currently works on the geometry of solutions to partial differential equations with large symmetry, bridging Lie theory with classification problems for geometric structures.



## Awards & Grants

### Maddy Ritter and Nathan Dunfield recognized by campus and LAS teaching awards

The Department of Mathematics is excited to announce that two of our members have each received two teaching awards. Both PhD Student Maddy Ritter (left) and Professor Nathan Dunfield (right) have received the Campus Award for Excellence in Undergraduate Teaching. Additionally, from the College of Liberal Arts and Sciences, Ritter has received the Excellence in Undergraduate Teaching Assistants, and Dunfield has received the Dean's Award for Excellence in Undergraduate Teaching.

**Maddy Ritter** has been an active member of the department since 2021. With Bruce Reznick as her adviser, she has been researching exact m-covers and works on graph reconstruction with Professors Alexandr Kostochka and Doug West. Ritter has also served as the outreach manager for the Illinois Mathematics Lab and president of the Graduate Student Chapter of the Association for Women in Mathematics.

Ritter is thankful for her students and for the formative experience of teaching stating, "I love teaching because I don't see the point in pursuing higher education if you are not helping someone. If you want to teach, it's really important to have a motivation. The fulfillment you get from it is priceless."



**Nathan Dunfield** has been with the mathematics department since 2007. His research interests include topology and geometry, specifically knots and 3D-manifolds in computations. Dunfield teaches both undergraduate and graduate courses and has received several awards, previously earning the Distinguished Teaching Award in Mathematics for Tenured Faculty in 2012, the same LAS Dean's Awards for Excellence in Undergraduate Teaching in 2014, and a campus-wide Caltech teaching award in 2006.

Dunfield describes his approach to teaching mathematics, "For me, the key to teaching mathematics is to remember how difficult it was to learn the material in the first place. Things that I now understand from a multitude of angles, I initially perceived only dimly from a single viewpoint. Thus, it is imperative to have a mental model of what the students already know so they can bridge the gap of understanding."

### 2025 Exceptional Merit Award for Non-Instructional Staff

The Exceptional Merit Award for Non-instructional Staff has been presented to **Jen Sans**, Event Administrative Associate, and **Laura Herrera Munoz**, Office Support Specialist in the Undergraduate Studies Office. Each will receive a \$1000 prize in celebration of their outstanding contributions to our department. From the nominations:

"Jen has consistently gone above and beyond in her role, particularly in organizing a wide range of departmental events....Each time we've sought

her assistance, she has responded promptly and enthusiastically, often offering creative ideas and thoughtful suggestions that have significantly enhanced the success of our activities. Whenever we've faced uncertainty or indecision in planning, Jen has provided multiple well-considered alternatives—many of which we hadn't even considered. Her initiative, creativity, and collaborative spirit have been invaluable."

"Laura is always willing to go above and beyond to assist with daily tasks. She has a wonderful understanding of the office processes and is willing to not only contribute to the work outcomes but adapt to any changes that may be necessary in order to best help serve our students."

# Alexander Yong named as first recipient of George Francis Student Engagement Award

## ICLUE set to receive \$12,500 in funding

The Department of Mathematics is pleased to announce that Professor **Alexander Yong** will be the first recipient of the George Francis Student Engagement Award. This grant will provide \$12,500 in funding to Yong's Illinois Combinatorics Lab for Undergraduate Experiences (ICLUE).

Yong has been with the department since 2008, and his research focuses on combinatorics and algebra. Having overlapped with **George Francis's** time as a professor, Yong is especially honored to receive an award bearing Francis' name. In Yong's words, "George was well-liked by students. He dedicated his career to education, mentoring, and engagement. The name of the award is well-suited." On a personal note, Yong and his family would attend George and Bettina Francis's annual Kinderfasching event, which included a puppet show for kids.

Yong initiated ICLUE in Spring of 2017 after reflecting on his experience with students seeking letters of recommendation for graduate programs. Yong recognized the need for extended, individualized mentorship of these talented young people. Thus, he started the ICLUE program to offer trainees a system to work with faculty mentors, as well as those mentors' postdoctoral scholars and graduate students.

ICLUE is designed to give students a sense of graduate school and extends through the student's entire undergraduate career. The program is tailored to students' interests and career goals. This "grad-lite" experience includes seminars and discussions, invitations to talks, meetings with visitors, and funding for conference travel. An NSF grant awarded in 2020 provided funding for domestic students. However, the George Francis Student Engagement Award will allow ICLUE to support additional students regardless of nationality.

Beyond academic opportunities, Yong highlights one of ICLUE's greatest benefits: the community it fosters.

Yong encourages alumni of the program to keep in contact, and over the years, a growing network of students, faculty, and alumni has developed. Participation in the program allows mentors to share rich stories of their students' success when it comes time to write letters of recommendation, while providing students with a community of peers that are interested in pursuing advanced mathematics. Indeed, Yong happily relates how two alumni who met through the program went on to get married while each completing their doctorates in mathematics.

Most of ICLUE's members are recommended for the program after excelling in coursework under a potential mentor. However, Yong encourages any interested student to reach out to him. Although ICLUE prepares students for grad school, the ultimate goal is to help them discover the path best suited to them. As Yong puts it, "When you're starting out, you might like math but aren't sure if you want to pursue it as a career. It's also a success when a mentee discovers through ICLUE that they don't want to pursue graduate studies. We help people figure out what they truly want to do with math."





# Emeritus Spotlight

## George Francis: Building Community Beyond the Lecture Hall

Professor Emeritus **George Francis** has had a long and impactful career here at Illinois, a legacy that was recently celebrated with the George Francis Student Engagement Award named in his honor by an anonymous donor. The intention behind the award was to incite faculty to engage with their students in a meaningful way beyond a lecture or seminar much in the same vein as Francis.

Roger Wolfson, Mathematics Development Advisory Board President and former student of Francis, has fond memories of his particular brand of pedagogy: “George (always on a first name basis, even with undergrads) brought such a unique educational style to his teaching environment. Not just a class, it felt more like an extracurricular, in that his students would happily spend extra time working together and with alumni of his class on our projects. George had the habit of getting to know each student’s strengths and working with them to choose an appropriate area of research—even for a 100-level freshman course. I was amazed at the end of the year when we even got an invitation to his house for dinner and found that George and his wife, Bettina, routinely had his course alumni over to mingle with one another and make new friends over shared interests. So routine, in fact, that they eventually built an addition to their house, a large dining area, for these gatherings.”

Anecdotes like these are abundant. It seems like everyone who had the opportunity to work with Francis had stories like this to share. From dinners at his home, to speakers for undergraduate classes, to department-wide picnics, to puppet shows put on during his annual Kinderfasching event, Francis was always busy educating his students and fostering a community within the Department of Mathematics.

When I finally had the chance to ask Francis himself about his philosophy behind teaching, he was quick to emphasize that he has “always taken teaching very, very seriously and that never stopped as [he] grew older.” Francis

taught his first class when he was only 18 at Notre Dame summer school in 1957. Back when they “still smoked in the classrooms,” he was teaching adults, some of them old enough to be his parents, but he wasn’t alone. He had an appointed guardian who would query the students and ask them to evaluate Francis’s teaching. The consensus was, “Francis is pretty good, unless he’s not prepared.” Francis took this feedback to heart and began to ensure that he was well prepared for each class that he taught.

As Francis continued his mathematics career, teaching only became more and more of a focus. It quickly became clear that if you wanted to be a research mathematician, you’d better be a teacher. In Francis’s words, “Even writing a paper in mathematics is a teaching event.” This philosophy extended into the classroom where Francis preferred to assign final projects that resembled mathematic research papers as opposed to a traditional final exam stating, “I like to say I’ve spent half of my career teaching future teachers.”



Mid-career, in the late 80's to 90's, Francis began to move away from teaching graduate-level geometry and shifted focus towards undergraduate teaching. During this time he was the Founding Director of the UIMATH Applelab (1983-1994) and the grafiXlab (1995-2006), precursors to what would eventually become the Illinois Mathematics Lab; he taught Math 198 "Hypergraphics" freshman honors seminar in geometrical computation for the Campus Honors Program (1990-2006); and developed many undergraduate and graduate courses, chiefly for teachers training which was recognized by the 1994 Campus AMOCO award for excellence in undergraduate teaching.

This era also solidified Francis's love of visualization, stating in the 1998 PBS documentary *Life by the Numbers*, "These are pictures of abstract ideas. I started drawing lots of pictures to prove my theorems and as time went by, I found the pictures were more interesting than the theorems themselves. And so, I left the theorem proving to people who could do it better and I do illustration." In 2006, many of his mathematical illustrations and visualizations were featured in a five-month CALCUL\*RT exhibit at the Krannert Art Museum.

Always on the cutting edge of visualization technology, Francis encouraged his students to lead with curiosity and creativity. Wolfson testifies how Francis challenged each student to test their own limits, "I recall with amusement late one Sunday evening my junior year, two years after I was actually enrolled in his class, when I ran into George as I was leaving and he was entering his computer lab at Beckman, he inquired what I'd been working on at that hour, and I replied with perhaps a self-congratulatory tone that I'd just programmed a 3D version of the game Asteroids. George replied, in his very own acerbic way, '3D? Why not do it in 4D?' I was startled and asked with some exasperation, 'But... How would I do it in 4D?'" His reply: 'I don't know. Generalize!'"

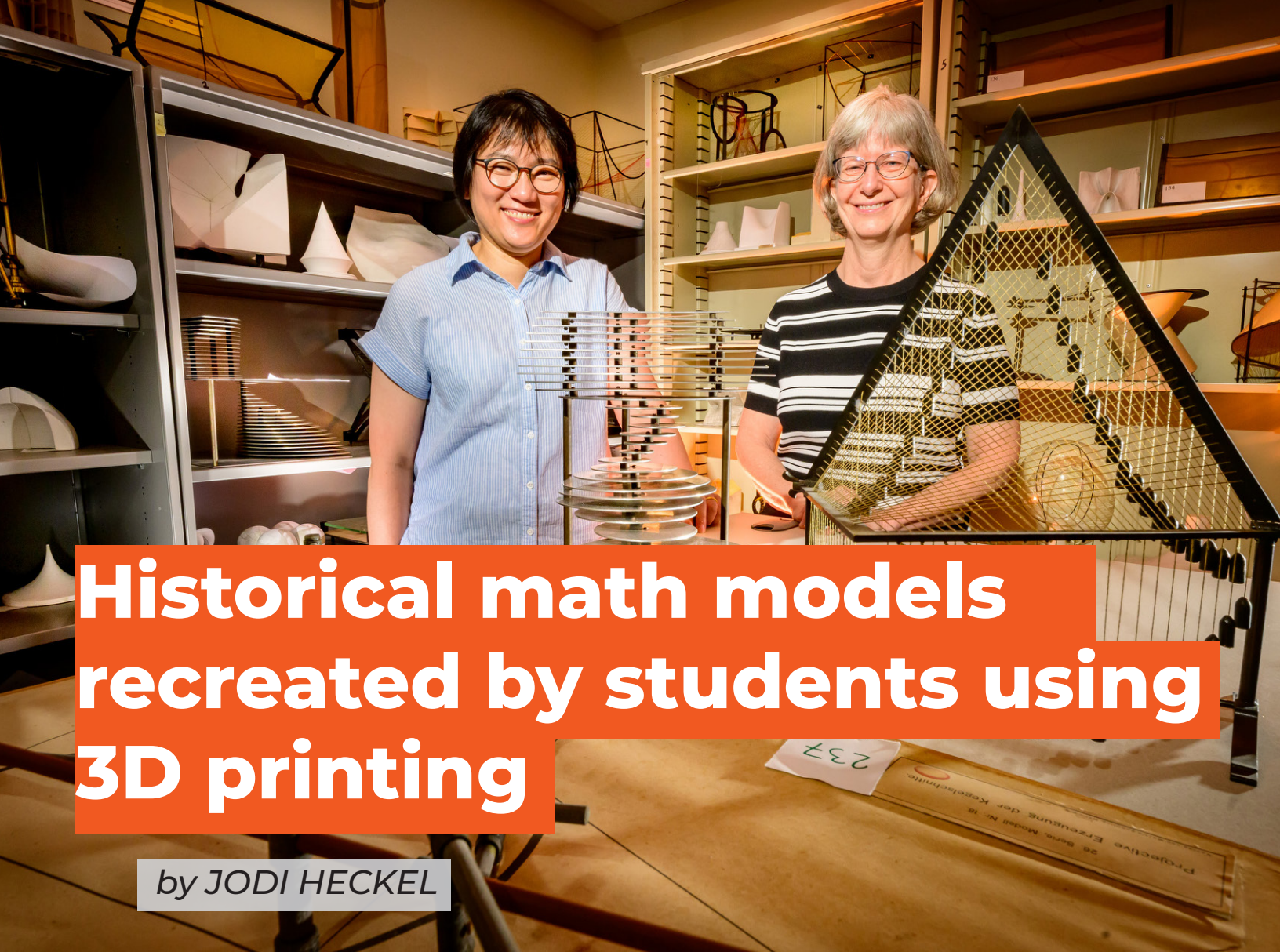
It is clear that Francis is an instructor who has thought carefully about how he teaches and intentionally conducts his classroom in a way to promote collaboration between peers and creative

problem solving. With his reputation amongst his peers and former students for engaging the Illinois Math community socially, I expected to see some of this come through in his teaching philosophy but when asked, he seemed to think of them as two separate but important functions, stating "My philosophy of teaching is a serious take on research and transmission of knowledge. I do not include service as one of the things. That is simply something that you have to do like brushing your teeth in the morning."

Francis viewed his outreach and student engagement as an inherent part of the job. He was a teacher, but he was also a community member. He did not construct a plan to become a pillar of the community but instead, took each opportunity he had to make connections and bring people together, something he feels needs to happen organically: "There's no schema. No, it's spontaneous. It has to be driven by people." Building community is about showing up and taking the initiative to connect with others, something that Francis feels is something that comes to him naturally, which he credits at least in part to his father who was a sociologist. Beyond mathematics, Francis's career is defined by community and coalition building, a process he is proud to see that his sons have carried on in their careers.

George Francis's legacy continues to have tremendous impact on the Department of Mathematics at Illinois which can be seen in the work of Alexander Yong, the first recipient of the George Francis Student Engagement Award, whose Illinois Combinatorics Lab for Undergraduate Experiences (ICLUE) has been pairing the new generation of mathematicians with experienced mentors. Wolfson hopes this award will encourage more faculty to follow in Francis's footsteps stating, "I am excited that this teaching award will highlight some of these habits for today's professors and put a spotlight on those who are doing great work in this vein, of going beyond the core lecture format to get to know their students and encourage them to form connections with one another, across years even, and to drive creativity and collaboration."



A photograph of two women standing in a museum filled with mathematical models. The woman on the left is wearing a blue button-down shirt and glasses, and the woman on the right is wearing a black and white striped shirt and glasses. They are surrounded by shelves of various mathematical models, including a large wireframe pyramid and a stack of metal disks.

# Historical math models recreated by students using 3D printing

by JODI HECKEL

University of Illinois Urbana-Champaign students recreated some of the historical mathematical models owned by the U. of I. math department using a 3D printer.

The Illinois math department has nearly 400 mathematical models — one of the world's largest collections — from the late 19th and early 20th centuries. The models demonstrate abstract mathematical principles in a three-dimensional way. Many of them were purchased around the turn of the century from the German company Martin Schilling, and others were designed and built by Illinois math professors.

“They are a department treasure,” said mathematics librarian **Sarah Park**. “We have the largest collection of these objects, and they offer a unique value to mathematics scholars on campus as well as around the world.”



*This moveable model offers a dynamic proof that the cross-section of a cone (at a suitable angle) is an ellipse. The spheres are called “Dandelin spheres.” Students 3D-printed a re-creation of the model, which the Illinois Mathematics Lab can use for its outreach activities to area schools. Photo by Fred Zwicky*



*This model illustrates a Kummer surface. Among its admirers was the artist Man Ray, who photographed an identical model in Paris in 1934 and made a painting of it in 1948. Photo by Fred Zwicky*

The models were displayed throughout Altgeld Hall, which houses the math department. Moving them to storage during the ongoing renovations of Altgeld Hall offered an opportunity to catalogue and recreate the models. Students worked on the project through the Illinois Mathematics Lab, which offers undergraduate opportunities for mathematical research, experimentation and visualization. They used the Champaign Urbana Community Fab Lab to make the new models.

“These originally were made because mathematics at the time was rapidly becoming more abstract,” said **Karen Mortensen**, the director of the Illinois Mathematics Lab. “Mathematicians wanted to make something more concrete for students to look at, to enhance their understanding of abstract concepts.”

The models were intended to be handled by students, who could study them from different angles. At one time, some of the models could be checked out from the math library, but many of them have become fragile. Their condition varies, Mortensen said. Those made of plaster are mostly in good condition, although some have stains or minor damage. The wooden models made of beech are sturdy. But many of the models use string to represent ruled surfaces, and some of the strings are detached, or the fiber has deteriorated.

Mortensen took the students to see the historical models in storage and was surprised to see how engaged they were with the models.



*This plaster model shows the superposition of an ellipsoid and two hyperboloids. The etched lines show the grid of lines of curvature that result from the intersection of confocal quadric surfaces such as these. Students 3D-printed a small version of the model at the CU Community Fab Lab. Photo by Fred Zwicky*



*This plaster model represents Boy's surface, which is an immersion of the real projective plane in three-dimensional space. The colors and etched lines indicate various geometric properties. Photo by Fred Zwicky*

“You can study the equations and look at recreations moving on the screen, but it’s different when you see it like this. Even though they’d seen pictures, the students suddenly got a lot more interested and were making conjectures about what a model shows. I didn’t know it would make that much of a difference to see them in person and touch them, rather than seeing a high-quality picture,” Mortensen said.





*This plaster model depicts a Kuen surface, which is an example of a surface of constant negative curvature. It attracted the attention of artist Man Ray, who photographed an identical model in Paris in 1934. Photo by Fred Zwicky*

Making re-creations of the models brings another level of learning for them, Park said. She said it was important for the students to have a hands-on experience and be able to do the work themselves, which the CU Community Fab Lab offered.

The students wrote mathematical descriptions of the models and the concepts they demonstrated, which required them to have an in-depth understanding of the equations that the models represent, Mortensen said. To find the equations for some of the models, the students had to find and read mathematical papers from the turn of the century, some of which had to be translated from German.

**Michael Dalton**, the Fab Lab manager, taught the students how to take the 3D models they created in Mathematica and get them prepared for 3D printing using MeshMixer. They optimized the models by simplifying overly complex geometry that the 3D printer's slicing software would have difficulty processing.

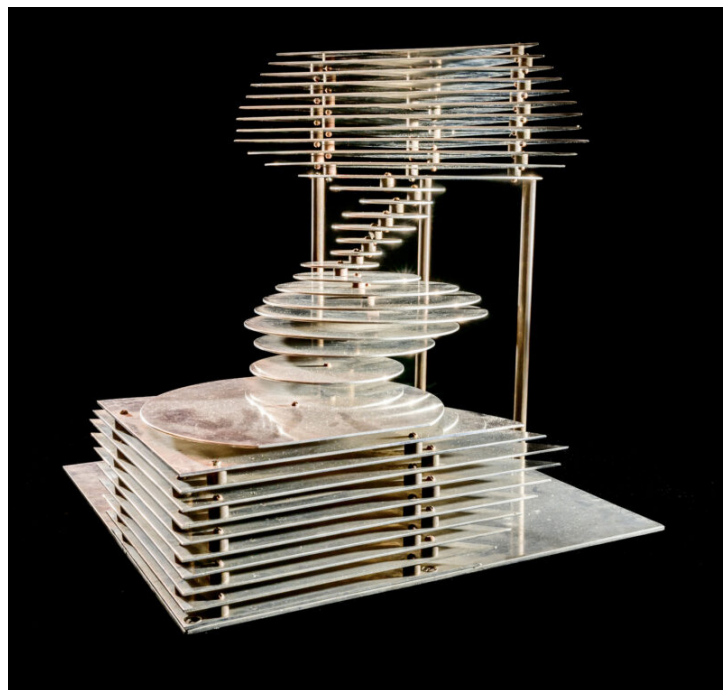
Then the students used a slicing software with a graphical interface that provides a visualized preview of the 3D printed model, allowing the user to view each layer of the 3D print. It also issues warnings if there are any areas that the printer cannot produce, so the user can adjust the parameters. Then the slicing software produces code that the printer reads to print the object in very thin layers.

"There are a number of things they have to know for the 3D prints to succeed," Dalton said.

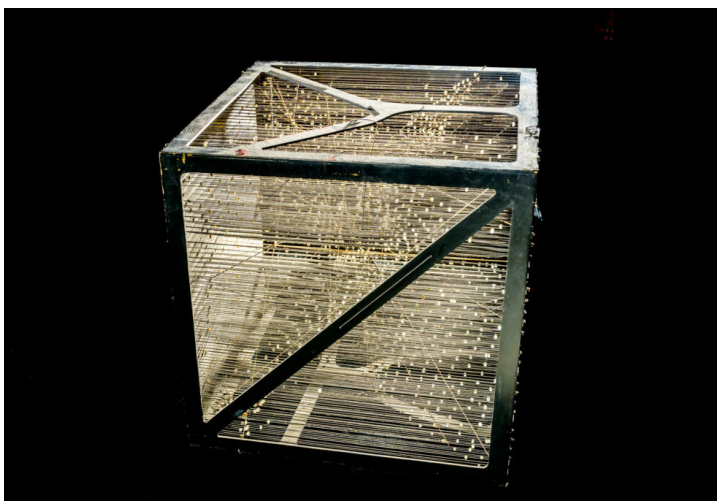
For example, structures with curved or overhanging surfaces must have supporting material so they won't collapse while they are being printed.

**Dashiell Cloud**, a rising senior studying physics, said the project required understanding the software and its constraints to get the results he wanted. One challenge for him was creating an ellipsoid that featured lines of curvature along its surface. He said recreating the model helped him better understand the concept in its 3D representation.

**Wentao Qi**, a rising senior majoring in math, said he enjoyed learning how to create the code in Mathematica, and he learned a lot of mathematical proofs and theories through the project.



*This aluminum model, created by Illinois math professor Arnold Emch, represents a quartic surface, whose horizontal cross sections are circles. It illustrates a theorem that Emch published in the American Journal of Mathematics in 1922. Photo by Fred Zwicky*



*This elaborate string model represents an algebraic surface called the Weddle surface. It was made by Illinois graduate student Walter Lee Moore, who in 1928 wrote his Ph.D. thesis on the Weddle surface under the direction of professor Arnold Emch. Photo by Fred Zwicky*

“To plot the mathematical models and print them, we had to fully understand the important mathematical theories behind them and try to figure out why such models even exist and what are they representing,” he said.

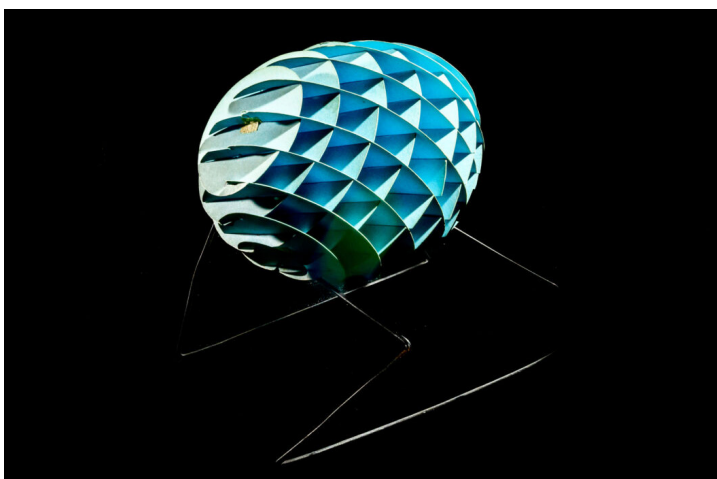
There were instances when he was trying to use a function of the modeling software in a unique way that posed challenging coding problems for him. Working as a group helped in finding solutions to the project’s challenges, and he learned from talking with the other students, he said.

Dalton said that 3D printing is a valuable skill to learn because the principles used in that process are at the core of Computer Numerical Control machines, which are used in all kinds of labs.

“A lot of the fundamentals can be incredibly valuable and give a frame of reference when exploring different machine operations. It’s pretty useful knowledge to be able to communicate with other people, understand what these processes cost, the time it takes, and whether for a particular model it’s better to 3D print or use some other manufacturing process,” he said. “It gets people thinking in a very different way when they’re in here instead of a traditional classroom.”



*The curve marked on this glass sphere is an algebraic curve of degree six and is the intersection of the sphere with a cone. This model was made by Illinois math professor Arnold Emch in 1923. Photo by Fred Zwicky*



*This ellipsoid, made of cardboard in the late 19th century, was one of the earliest mathematical models acquired by the math department. It is constructed of 30 circular sections and is deformable under light pressure, remaining an ellipsoid. Photo by Fred Zwicky*

The math department and the University Library plan to have a digital collection of the historical models that includes information about the models, photographs, the mathematical descriptions and the digital files created by the students. The files will be publicly available so anyone can use them to print a model, Mortensen said.

The Illinois Mathematics Lab has outreach programs in local schools, and the 3D-printed models can be used in those programs. The department also is working with the University Library’s Preservation Services on the restoration of the original models.





## Wearable technology continuously monitors heart-rate recovery to predict risk

by DIANA YATES

*Graduate student Jonathan Cerna monitors heart data from a “smart shirt” that tracks electrical activity as graduate student Laila Shaaban exercises and rests. Researchers are working to develop the technology to make heart-related predictions more widely accessible through the use of wearables. Photo by Fred Zwicky*

CHAMPAIGN, Ill. — The time it takes the heart to return to its baseline rhythm after exercise can predict a host of cardiovascular or metabolic disorders. In a new study, scientists at the University of Illinois Urbana-Champaign used a “smart shirt” equipped with an electrocardiogram to track participants’ heart-rate recovery after exercise and developed a tool for analyzing the data to predict those at higher or lower risk of heart-related ailments.

They report their findings in the *IEEE Journal of Health Informatics*.

“The heart’s response to exercise provides us with an early indicator of changes in health, in particular cardiovascular function and mortality,” said **Manuel Hernandez**, a professor of biomedical and translational sciences at the Carle Illinois College of Medicine who led the research with industrial and enterprise systems engineering professor **Richard Sowers** and graduate student **Ayşe Dogan**.

“Extensive research has shown [an] association between abnormal heart-rate recovery and various cardiovascular diseases, including heart failure, coronary artery disease, diabetes mellitus, hypertension and sudden cardiac death,” the researchers wrote. But measuring HRR has traditionally been an involved process requiring a cardiologist, a treadmill and other costly equipment and personnel.

The team wanted to develop a more accessible approach to assessing and predicting cardiovascular risk. If a wearable device could capture relevant data as a person goes through their daily routines, shipping off that data to a laboratory or doctor’s office for analysis, it could make early diagnosis of potential problems available to many more people.

To achieve this, the researchers made use of a smart shirt developed by the Quebec-based company Carre Technologies. The shirt provides sensors to capture continuous measures of heart



performance, including tracking electrical activity and heart-rate variability. In total, 38 participants ranging in age from 20 to 76 walked on a treadmill at varying speeds and inclines while wearing the device. The study was conducted in 2021 in Illinois during the COVID-19 lockdown.

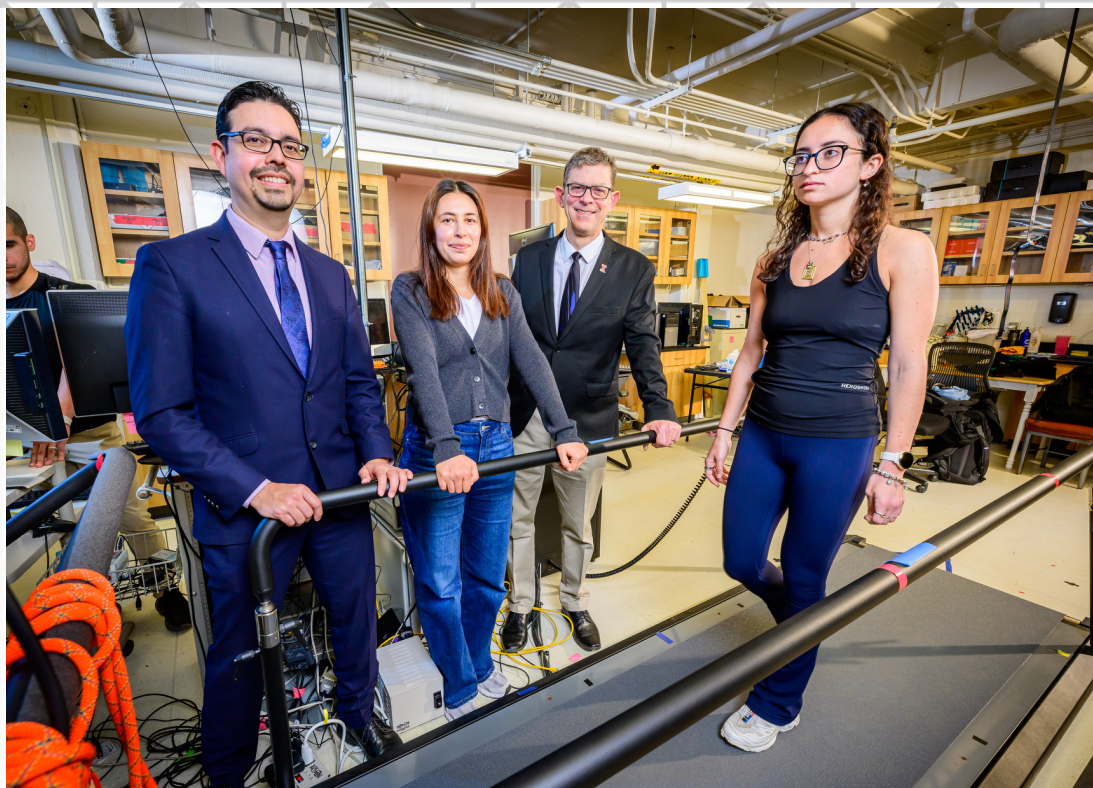
The team used machine-learning and other techniques to extract the most meaningful signals of cardiac health from the data, designing a system for predicting those at highest risk of cardiovascular maladies.

“We chose the median heart rate recovery value of 28 beats per minute as the threshold to separate participants into high-risk and low-risk groups,” the researchers wrote. They used other statistical measures to cross-check the findings.

“We are finding consistent values with the different traditional classifiers and cross-validation approaches,” Dogan said. That means that the algorithm developed for the study yielded reasonably accurate results despite the small sample size, she said.

The study is a first step toward using wearables to help people more readily assess their risk of heart-related problems, perhaps catching worrisome trends before they develop into full-fledged disorders or cause sudden death, Hernandez said.

“We want to use it to provide us with some greater insight in terms of our underlying cardiovascular function,” he said. “And we want to make something that’s clinically actionable.”



*From left, Manuel Hernandez, Ayse Dogan and Richard Sowers watch as graduate student Laila Shaaban walks on a treadmill while a “smart shirt” tracks electrical activity in her heart. In the background, graduate student Jonathan Cerna monitors sensor data. Photo by Fred Zwicky*

“One would like to have a whole bunch of data from wearables, and then that data is transmitted to a doctor’s office, and the doctor can interpret it,” Sowers said. This would be especially useful for those living in rural communities or other areas with poor access to advanced medical facilities.

Future studies of the use of wearable technology to predict cardiovascular risk should increase the number of people studied, follow participants over time and compare their heart activity during exercise and at rest, the researchers said. Further studies should also focus on integrating the technology into standard healthcare practices.

Hernandez also is an affiliate of the Beckman Institute for Advanced Science and Technology, the departments of bioengineering and health and kinesiology, and of the Center for Social and Behavioral Science at the U. of I. Sowers also is a professor of mathematics and in the National Center for Supercomputing Applications at Illinois.

The paper “Continuous heart rate recovery monitoring with ECG signals from wearables: identifying risk groups in the general population” is available online. | DOI: 10.1109/JBHI.2025.3550092





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